

Physical Harm Reduction in Domestic Violence: Does Marijuana Make Assaults Safer?

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Abstract

Studies on the effect of marijuana on domestic violence often suffer from endogeneity issues. To examine the effect of marijuana decriminalization and medical marijuana legalization on serious domestic assaults, we conducted a difference-in-differences analysis on a panel dataset on NIBRS-reported assaults in 24 states over the twelve years between 2005 and 2016. Assaults disaggregated according to situation and extent of injury were employed as dependent variables. We found that while the total number of assaults did not change, decriminalization reduced domestic assaults involving serious injuries by 18%. From a harm reduction perspective, these results suggest that while the extensive margin of violence did not change, the intensive margin measured by the seriousness of assaults were substantially affected by decriminalization. This result may be partially explained by reductions in offender alcohol intoxication and weapon-involved assault.

Keywords: Marijuana, Domestic Violence, Harm Reduction

Introduction

Domestic violence can result in lasting physical, mental, and financial consequences for victims, and has been identified as a pressing public health issue (Saltzman et al., 2000; Chrisler & Ferguson, 2006; Modi et al., 2014). However, assaults that result in serious physical injury merit particular attention as they increase victims' risk of suffering health problems in the long-term (World Health Organization 2002; Vos et al., 2006; Romito et al., 2005). Such health consequences include gastrointestinal symptoms, gynecological issues, traumatic brain injury, neurological symptoms, chronic pain, disability, and even death (Campbell 2002; Plichta 2004). They may also presage the murder of the victim in a later abusive event (Mueller et al., 2016). However, to date much of the existing literature has not differentiated between crime incidents involving serious injury and non-serious injury, only evaluating total assaults. This is understandable, given both the tendency for abuse to escalate in severity (Choi et al., 2019), and the long-lasting emotional trauma even minor physical and non-physical abuse can cause for the victim (Yoshihama et al., 2009). However, given evidence that abuse victims often return to abusive relationships for reasons varying from limited economic resources (Horton & Johnson, 1993; Strube & Barbour, 1983), fear of further violence (Pagelow, 1984; Walker & Meloy, 1998), or emotional attachments to their abusers (Griffing et al., 2002), harm reduction can be a productive supplementary strategy for supporting victims even while perpetrators of domestic abuse continue to maintain access to their victims. Harm reduction has been described as an approach that mitigates the 'harmful consequences of [high-risk] behaviors rather than eliminating the behaviors themselves' (Shannon, 2017). A harm reduction strategy with respect to domestic violence

therefore necessitates a more meaningful measure of violence for domestic assault than the predominant approach, which evaluates the extensive margin or total number of assaults, while an alternative approach would consider the intensive margin of harm, by asking how much injury results from the given number of assaults.

This study uses incident-level crime data to create a unique measure of assaults involving serious injury. We leverage a policy intervention of considerable external validity to address the link between marijuana laws and domestic assaults involving serious physical injury. While previous studies have examined the link between marijuana and domestic violence (Smith et al., 2013; Fals-Stewart et al., 2003; Boles & Miotto, 2003), seriousness of injury has not been evaluated. Measuring severity reveals a new aspect of the oft-contested link between marijuana use and violence.

A Poisson analysis of state panel data suggests that marijuana decriminalization had no effect on the number of assaults that took place. However, this masked more striking and significant results concerning the most serious types of violence. Decriminalization of marijuana reduced domestic assaults involving serious injury by 18%. Within incidents with a serious injury, the number of incidents where the offender was under the influence of alcohol or used a weapon also declined significantly. These findings contrast with previous literature showing null effects of marijuana usage on violence or aggression. We show that measuring purely on the extensive margin the number of crimes inadequately measures both the effect of a policy and the seriousness of harm caused by crime.

Literature Review

The literature on the relationship between substance use and violence remain dissatisfying for a number of reasons. First, the vast majority of studies are cross-sectional in nature, leading to endogeneity due to omitted variable bias. Often, these studies examine more generally the link between all forms of substance use, such as alcohol and cocaine usage, and violence. Such studies generally find a statistically significant result for the overall relationship between substance use and assault (Moore et al., 2008; Boles & Miotto, 2003). While the effect of marijuana specifically is mixed and potentially mediated by mechanisms such as withdrawal (Moore et al., 2008), the emergent causal link between alcohol and violence is much stronger. The past decade of research has seen ‘increasingly sophisticated studies’ (Leonard & Quigley, 2017) supporting alcohol consumption as a contributory cause of violence across countries (Abramsky et al., 2011; Kishor & Johnson, 2004), and over diverse research settings (Leonard & Senchak, 1996; O’Farrell et al., 2004; Stuart et al., 2006; Hellmuth et al., 2013; Snowden & Pridemore, 2013; Woodin et al., 2014; MacDonald, 2015). A 2008 meta-analysis suggested that a small to moderate association between alcohol use and male-to-female partner violence was amplified when measures assessed more severe alcohol problems (Foran & O’Leary, 2008). Additionally, a meta-analytic review of specifically experimental studies conducted between 1981 and 2014 indicated that alcohol use resulted in intimate partner aggression (Crane et al., 2016).

Second, although they can provide useful contextual clues about the causal mechanisms linking substance use and abuse, longitudinal studies are often limited by a small sample size and reliance on self-reported measures (Fals-Stewart et al., 2003; Reingle et al., 2012).

However, potential causal and mediating mechanisms unearthed by these longitudinal studies included the consistency of usage (Reingle et al., 2012), victims' substance use (Cunradi et al., 2015), withdrawal (Reingle et al., 2012; Smith et al., 2013), and the extent to which alcohol and marijuana are used as complementary or substitutory substances (O'Hara et al., 2016).

There are several panel data studies that do address the issue of omitted variable bias, using medical marijuana legalization as their treatment variable. However, none of the studies have addressed the effect of marijuana liberalization on domestic violence specifically. Rather, studies have addressed marijuana liberalization's effect on crime generally (Morris et al., 2014), drug trafficking-related violent crime (Gavrilova et al., 2019), rape (Dragone et al., 2016), or driving under the influence (Anderson et al., 2013).

Lastly, Anderson et al.'s (2013) study found that alcohol consumption fell following medical marijuana legalization suggesting that marijuana and alcohol are substitutes. This emergent link suggests that marijuana liberalization will have the unintended effect of reducing domestic violence, which the current study seeks to verify.

Contributions

This study therefore makes a number of contributions to the literature. First, it utilizes a unique harm reduction approach by measuring victim injury seriousness rather than the number of domestic violence incidents in the wake of marijuana legalization. This approach disambiguates 'assault' by considering the intensive margin of a subset of assaults which result in serious injury rather than the extensive margin of the number of assaults,

regardless of the seriousness of injury. Second, by relying on an analysis of state-level panel data, it minimizes the previously identified problems of endogeneity and omitted variable bias, and avoids the underreporting problems associated with self-reported measures. While a similar econometric approach has been used in other studies relating to marijuana legalization, this is the first study that uses the approach with respect to domestic violence. Third, this study assesses the effects of a large-scale policy intervention on domestic violence, a research area where innovative large-scale solutions are rare.

Data

This study uses a state-by-year panel dataset of 24 states over 12 years, beginning in 2005 and ending in 2016, a time period which saw substantial changes to state laws regulating marijuana in the United States. Although states continued to liberalize marijuana laws after 2016, all crime data used in this study is drawn from the National Archive of Criminal Justice Data (NACJD), for which 2016 is the most recent year of data available.¹

Dependent variable

This study uses twelve dependent variables in total. First, it considers total assaults, domestic assaults, and non-domestic assaults at all levels of injury. For assaults involving serious injury, total assaults, domestic assaults, and non-domestic assaults are also considered. Finally, after decriminalization was found to significantly affect serious domestic

¹ <https://www.icpsr.umich.edu/web/NACJD/series/128>

assaults only, this measure was further disaggregated into race/ethnicity and situational subgroups: serious domestic assaults involving White victims, Black victims, Hispanic victims, that involved a weapon, that involved an alcohol-intoxicated offender, and the proportion that took place at home,

Assault data was drawn from the FBI's National Incident-Based Reporting System (NIBRS) Extract Files provided by the National Archive of Criminal Justice Data (NACJD). NIBRS is an incident-based crime data collection that provides detailed information on each crime reported to the law enforcement agency. The data contains information on the type of crime committed, where it occurred, the relationship between the victim and offender, the victim's demographics, whether the offender was intoxicated, which weapons - if any - were used by the offender, and what injuries the victim sustained.

NIBRS data contains two crucial components for this analysis: which crime happened and, through information about the victim and offender's relationship, if that crime constitutes domestic violence. First, we subset the NIBRS data to keep only incidents where a simple or aggravated assault occurred. This definition excludes sexual assault, which is listed under the category of 'Sex Offenses' by NIBRS; however, as NIBRS data makes it possible to list up to ten offenses committed within the same incident, some of the incidents listed in the dataset may include sexual assault. To define domestic versus non-domestic assaults, we used the victim-offender relationship information and classified the assault as domestic if the victim and offender were dating, married, or are family members. In addition to the offender's relationship to the victim, NIBRS specifies whether the offender is suspected of being under the influence of alcohol and what weapon, if any, they used during the assault.

We consider an assault to involve a weapon if the offender used any weapon other than their body. As NIBRS does not indicate if the weapon was used to directly harm the victim or merely to threaten or intimidate them, this may overcount the number of assaults where the victim was injured by a weapon.

NIBRS provides eight categories for victim injury: (1) no injury, (2) minor injury, (3) apparent broken bones, (4) unconsciousness, (5) possible internal injury, (6) loss of teeth, (7) severe laceration, (8) and other major injury. If a victim suffered any of the injury categories other than (1) or (2), they are considered to have suffered a serious injury. Victim injury information comes from two sources: police observation at the scene and information reported to the officer by the victim.²

As submitting data to NIBRS is voluntary, not all agencies do so. Only states which consistently reported NIBRS data were included in the study. During the time period studied, over 2,000 agencies from the 24 states reported data to NIBRS every month of the year for all 12 years, and data from these agencies were included in the study. Three other states - Arizona, Kentucky, and South Dakota - and Washington, D.C. also reported data. However, Arizona, Kentucky, and Washington D.C. were dropped from the dataset because their reporting agencies covered fewer than 100,000 people in the state.³ South Dakota reported zero serious domestic and non-domestic assaults in the year 2006 and was dropped for all

² Personal communication with Criminal Justice Information Services' NIBRS coordinator Drema Fouch on April 5th, 2018.

³ Within the Washington, D.C. metropolitan area, only the Metro Transit Police Department, the police agency of the Washington Metropolitan Area Transit Authority, reports to NIBRS.

years so that the panel dataset would remain balanced. Included states are listed in Appendix Table A1.

There may be a few concerns with the NIBRS data employed in this study. First, there may be discrepancies in reporting rates and practices between agencies; more specifically, agencies may not accurately report victim injuries. It should be noted that NIBRS offers the advantage of standardization in that the data makes the comparison of victim injury possible, a prospect not available with Uniform Crime Reporting (UCR) Program data. However, given possible inconsistencies in how agencies report victim injuries, state fixed effects which adequately address between-agency discrepancies as data for each state consists of the same number of consistently-reporting agencies every year of the study period are employed to address this issue.

A second concern with the measure of serious injury is that while marijuana liberalization may be unlikely to be related to police data practices, it may influence whether victims report an injury to police. Marijuana has been associated with increased pain tolerance among users, possibly reducing the chance that users who suffer an injury realize the full extent of that injury (Campbell et al. 2001; Milstein et al. 1975; Cooper, Comer, and Haney 2013; Kramer 2015). If marijuana liberalization increases victim usage, they may be less likely to report or may downplay a serious injury to the reporting officer.⁴ However, as the injuries

⁴ NIBRS does not include information on whether the victim was under the influence of drugs or alcohol during the incident.

studied are both serious and frequently visible to the reporting officer, we find it unlikely that marijuana use by the victim will cause a significant decline in serious injury reporting.

Independent variable

The independent variables were decriminalization and medical legalization of marijuana, effective the date the policy was enacted. For both measures, we constructed a continuous variable between the values of 0 and 1 indicating the proportion of the year with the law in effect. For example, if a law was implemented on August 1st (the 213th day of a non-leap year), the variable would have a value of 0.58 (213/365) for that year. As laws within states are not necessarily homogeneous, any effect we see on marijuana liberalization is likely to be conservative. Notably, states with conservative marijuana laws may be home to cities with more relaxed city ordinances.

Another concern that the study has grappled with is heterogeneity between medical marijuana laws. Differences, such as the scale of the medical marijuana program, and how tightly dispensaries are regulated, can affect levels of marijuana use (Pacula et al. 2015; Powell, Pacula, and Jacobson 2018). This suggests then that restraint should be employed in interpreting the medical marijuana legalization covariates.

States which have decriminalized marijuana or legalized medical marijuana are generally in either coastal regions or in the North-West. No state in the Southern United States decriminalized or legalized medical marijuana during the study period. However, if more recent data or a wider number of states were available, southern states with law changes would be included. Both Louisiana and Arkansas, for example, legalized medical marijuana in 2017.

Control variables

Marijuana laws are not randomly assigned; they are the product of conditions within the state that lead to legal changes. In order to control for these conditions, we use a number of demographic and economic variables at the state level. The bulk of these variables come from the U.S. Census' annual American Community Survey. We consider six demographic variables: the state population, percent of the population that is male, is Black, is Hispanic, is aged 15-24 years, and the percent that is foreign-born.⁵

As a measure of the state's social and economic well-being, we consider the percentage of the population that is married, is in the labor force, that do not have a high school degree or equivalent (of those aged 25 or older), is living in poverty, is working in manual trades, the percentage of households headed by women, and the median household income.

Marijuana use may be co-morbid with other drug usage as well as alcohol use. We use the drug death rate per 100,000 population data from the Center for Disease Control as a measure of drug usage in the state, with a fair amount of confidence that marijuana use does not result in drug-related death. This variable is lagged by a year. As a measure of alcohol use, we use National Institute on Alcohol Abuse and Alcoholism (NIAAA) data that estimates per capita ethanol consumption for each state.⁶ This variable is converted into per capita "drinks" consumed based on the conversion equation included in the NIAAA's report.

⁵ As in some states not all agencies report to NIBRS, we use the average of the population covered by NIBRS agencies and the total state population.

⁶ For population aged 14 and older.

Finally, police responses to domestic violence are affected by manpower constraints. To measure police manpower capacity, we turn to the Uniform Crime Reporting (UCR) Program's Law Enforcement Officers Killed and Assaulted data which reports the number of sworn officers employed in an agency. We aggregate these agencies into a total number of sworn police officers in the state.

Method

Poisson Analysis

To estimate the effect of marijuana decriminalization and medical legalization on assault, we use a Poisson regression. The general equation for analysis is:

$$\log(E|Y_{it}) = \beta_0 + \beta_1 Policy_{it} + X_{it} + \phi_i + \gamma_t + \varepsilon_{it}$$

Where $\log(E|Y_{it})$ is the number of incidents for each category of assaults measured in state i during the year (or, if the state-by-month panel is analyzed, month) t . $\beta_1 Policy_{it}$ estimates a continuous variable of the proportion of the year that the state had either marijuana decriminalization or medical marijuana legalization in effect. X_{it} is a vector of state-level control variables. ϕ_i and γ_t are state and year (or month) fixed effects. Standard errors are clustered at the state level to account for serial correlation (Bertrand, Duflo, and Mullainathan 2004). Models are weighted by the average of the state's population according to the Census and the population covered by NIBRS agencies in that state.

Using this general equation, we test the effect of marijuana liberalization on 12 total dependent variables. The first set of three tests use the number of domestic assaults, the

number of non-domestic assaults, and the number of total assaults as dependent variables. The second set of three tests subsets the previous dependent variables to those where the victim suffered a serious injury.

To examine the heterogeneity of effects that decriminalization had on serious injury domestic assaults, the final set of six tests looked at whether effects changed based on victim or situational characteristics. First, we disaggregated serious domestic assaults by victims' race and ethnicity: assaults involving White victims, Black victims, and Hispanic victims. The three situational characteristics we examined were incidents where the offender was suspected of being under the influence of alcohol, where the offender used a weapon, and the proportion of incidents that occurred in the victim's home.

As the probability of identifying at least one significant result due to chance increases as more hypotheses are tested, therefore increasing the chances of incorrectly rejecting a null hypothesis, we use the Bonferroni correction to adjust the relevant p-value. The Bonferroni correction counteracts the problem of multiple comparisons through multiplying the p-value of each coefficient by the number of tests. Since there are 12 tests, the threshold for significance is $.05 / 12 = .0041666$ (repeating).

As an alternate specification to the state-by-year panel dataset, a state-by-month level dataset was also analyzed, resulting in 24 states with 144 months over the same time period. This was less preferable compared to the main analysis on the state-by-year dataset for two reasons: first, clustering of standard errors does not work as well when the number of observations (months) per cluster are much larger than the number of clusters (Bertrand et al., 2004). Secondly, a state-by-month analysis may be too granular to reflect longer-term

transitions in patterns of behavior around marijuana use, a hypothesis supported by Hunt and Pacula (2017)'s study on early impacts of marijuana legalization on prices in Colorado and Washington.

Event Study

Considering that changes in state laws may take time to affect social and behavioral patterns, we ran an event study on domestic assaults involving serious injury to track changes from year to year. An event study analyses the impact of an event on the outcome by tracking how the outcome changes within a defined period before and after the initial implementation of the treatment. In other words, a state which decriminalized marijuana in 2004 is, in the year 2005, treated as equivalent to a state which decriminalized marijuana in 2012, is in the year 2013.

$$\log(Y_{it}) = \alpha + \sum_{j=-5}^5 \beta_j [D_{st}^j = 1] + X_{it} + \phi_i + \gamma_t + \varepsilon_{it}$$

The variables D^j are dummy variables equal to 1 when marijuana was decriminalized j years ago in state s , as of year t . As in Equation (1), Y_{it} is the number of incidents for each category of assaults measured in state i during year t , X_{it} is a vector of state-level control variables, ϕ_i and γ_t are state and year fixed effects, and ε_{it} is an error term.

For this event study, we considered the period beginning five years prior to marijuana decriminalization and ending five years after marijuana decriminalization, with the year just before marijuana decriminalization used as the reference year.

Results

Descriptive Results

Table 1 provides summary statistics for the study. Overall, 26.1% of the state-years had decriminalized marijuana, and 26.0% of state-years legalized medical marijuana. At all levels of seriousness, domestic assaults, non-domestic assaults and total assaults per 100,000 people ranged between hundreds to thousands. Assaults involving serious injury only were considerably rarer. In one year, one state reported only .36 domestic assaults involving serious injury per 100,000 people covered by NIBRS reporting in that state. A number of states reported zero serious domestic assaults involving Black victims in a year, which was not surprising as they were states with a high percentage of the population that was White (at least 86%). Similarly, the states which reported zero serious domestic assaults involving Hispanic victims in a year were states such as West Virginia and Louisiana with a low percentage of the population that was Hispanic (less than 5%). Most serious domestic assaults occurred at home (81.5%), with nearly all involving an offender that was under the influence of alcohol, and half involving a weapon.

The mean number of total assaults in each state per year was 1,161. However, the variance (the square of the standard deviation) was much greater. Therefore, the count data is overdispersed as standard Poisson distributions usually have an equal mean and variance. However, each state is weighted by population, which addresses the overdispersion issue.

Main Results

Table 2 reports the incident rate ratio (IRR) of the effect of decriminalization on various dependent variables. Panel A reports the analysis on the yearly data, while Panel B reports the analysis on the monthly data. Columns (1) – (3) provide the coefficients for decriminalization's effect on total assault, domestic assault, and non-domestic assault. None of these results are significant. Columns (4) – (6) of Panel A report the results for decriminalization on serious total assault, serious domestic assault, and serious non-domestic assault. Decriminalization significantly reduces domestic assaults involving serious injuries by 18% (IRR .820). Panel B provides similar results, with only serious domestic assault being significantly affected by decriminalization, with a reduction of 21.1% (IRR .789).

Table 3 reports the incident rate ratio of the effect of medical legalization of marijuana on various categories of assault. As with Table 2, Panel A provides the results of the analysis on the yearly data, while Panel B reports the results of the analysis on the monthly data. In both Panel A and B, medical legalization was shown to have no significant effect on any category of assault.

Given that the most significant result thus far was that for the effect of marijuana decriminalization on serious domestic assault, we decided to analyze this effect by sub-group. This was done considering both demographic sub-groups and situational sub-groups. As reported in Table 4, we first considered the effect of marijuana decriminalization on serious domestic assault incidents affecting White victims, Black victims, and Hispanic victims separately (Columns (1) – (3)). While serious domestic assaults involving White and

Hispanic victims decreased sharply (by 16.2% and 31.3%, or IRR .838 and .687, respectively) following marijuana decriminalization, there was not a significant effect for Black victims (12.1% decrease, p-value = 0.198).

We next considered whether marijuana decriminalization might also result in changes to the situational variables in serious domestic assaults. Analysis on the annual data (Panel A) suggested that while the proportion of serious domestic assaults that took place at home did not change, serious domestic assaults involving offender alcohol intoxication were reduced by 37.6% (IRR .624), and the number of serious domestic assaults involving weapons also went down (IRR .816).⁷ These results were supported by the monthly analysis (Panel B).

Event Study

The graph of the event study is presented in Figure 1. The horizontal axis represents the number of years since decriminalization, while the vertical axis represents the incidence rate ratio of serious domestic assaults compared to the reference year, -1 (the year prior to decriminalization). The dots represent the point estimates, while the bars represent the 95 percent confidence intervals. Prior to $T=0$, most of the confidence estimates cross the IRR = 1 (no change) boundary, suggesting that there are no pre-trends on the whole. There is one exception: $T = -2$ presents an estimate within a 95 percent confidence interval, suggesting that there was an increase in serious domestic assaults two years prior to marijuana decriminalization. So, if anything, the event study suggests that serious domestic assaults

⁷ For assaults involving only guns and not other kinds of weapons, decriminalization is related to negative but not statistically significant results.

were increasing prior to marijuana decriminalization. The post-period of $T = 1$ to $T = 5$ suggests that the decline in serious domestic assaults kicks in within five years after post-decriminalization, with $T = 3$ and $T = 4$ showing an IRR less than 1 within a 95 percent confidence interval. $T = 5$ shows a non-significant effect, indicating that the reduction in serious domestic assaults is not a permanent change, ceasing five years after the law is enacted.

Conclusion

The key finding in this study was that decriminalization led to a reduction of serious injury in domestic assaults. This finding was surprising, for a number of reasons. First, despite the fact that marijuana decriminalization had no effect on the total number of domestic assaults - or indeed any other type of assault - suggesting that following decriminalization, the same number of domestic assaults occurred but led to fewer serious injuries. This shows an important effect of marijuana decriminalization on the intensive margin of injury, suggesting that the relationship between marijuana use and domestic violence is more nuanced than previous measures suggest. Second, the effect of decriminalization was contrasted with the finding that medical legalization of marijuana had seemingly no effect on total assaults or serious injury assaults.

We then conducted further analyses in order to explain this dynamic. The results suggested that while White and Hispanic victims suffered from fewer serious domestic assaults following decriminalization, the same could not be said for Black victims. The reason for this is unclear. Given that most assaults, as is the case for most crimes, are intra-racial in

nature with the perpetrator and the victim being of the same race, it is possible that marijuana decriminalization did not affect Black perpetrators similarly in causing them to inflict less serious injuries on their victims. Speculatively, one could attribute this to unchanged patterns of behavior around marijuana consumption for Black victims or differential enforcement of decriminalization among different races, but in the absence of further verification, such explanations are speculative. We caution against drawing conclusions on disparate racial effects of decriminalization based solely on this study.

Disaggregating the data by situational characteristics, however, offered a more compelling explanation for the main finding that decriminalization resulted in less serious injury. Decriminalization reduced serious domestic assaults involving alcohol by nearly 40%. Given the evidence that alcohol is a substance which aggravates violence (Leonard 2005; Stith et al. 2004; Foran and O'Leary 2008), the alcohol finding suggests both that (a) marijuana and alcohol are substitutes rather than complements, and (b) substituting marijuana for alcohol use likely mitigates the severity of assaults. Despite the longstanding debate over whether marijuana contributes to violence, the medical literature suggests that marijuana is effective as a short-term sleep aid (Nuutinen, 2018) and may contribute to excessive daytime sleepiness (Babson et al., 2017). By making would-be assailants sleepier, marijuana consumption may make the nature of assaults less serious and injuries less severe. This is likely the simplest explanation and is certainly incomplete. This substance-based mechanism is behavioral in nature, and is premised on marijuana decriminalization increasing consumption to the extent that assailants are more likely to be under the influence of marijuana at the time of assault. Unfortunately, this assumption could not be tested, given that NIBRS does not differentiate marijuana intoxication from other drugs.

Decriminalization also resulted in serious domestic assaults involving weapon use decreasing by nearly a quarter (23.1%); likely also a contributory factor as to why the number of domestic assaults remained the same while serious domestic assaults decreased. Domestic assaults are less likely to inflict serious injury on the victim if a weapon is not used (Sorenson, 2017). However, Sorenson's study showed that guns were used most often to intimidate or threaten a partner; therefore, when a gun - as opposed to a non-gun external weapon or bodily force - was used, victims were less likely to have visible injuries but were more likely to be frightened. Displaying or using a gun to threaten can facilitate coercive control, a condition in intimate partner violence whereby an abuser intimidates their victim. Sullivan and Weiss (2017) suggest that such threats are significant and unique predictors for the severity of victims' experience of post-traumatic stress disorder symptoms. Given that the NIBRS data similarly indicates weapon use even if the perpetrator had a weapon but did not use it during the assault, it is possible that marijuana decriminalization has led a decrease in serious domestic assault because it has also increased perpetrators' propensity to use weapons as a form of coercive control, thus causing such incidents to be classified as entailing non-serious injury. However, given that weapon use also declined among serious domestic assaults, it may be more likely that perpetrators are less likely to pick up a weapon in the first place.

The event study suggested that the reduction in serious domestic assaults faded out within five years after decriminalization. While precise causes require further research, this may be due to any substitution between alcohol and marijuana dissipating in the long term. As more years of NIBRS data becomes available, future research should examine precisely how long

of an effect marijuana decriminalization has on serious domestic assault, and under which circumstances it persists.

There are a number of limitations to this study. First, NIBRS only provides data on crime incidents reported to the police. As such, there is almost certainly underreporting. While approximately 5% of domestic assaults reported to NIBRS involved serious injury, this figure differs considerably from that provided by the National Crime Victimization Survey (the NCVS), where non-fatal serious violence comprised more than a third of intimate partner violence (Catalano 2013). The NCVS was not an appropriate source of data for this study, as it interviews all members of a surveyed household, giving rise to concerns that victims will not report domestic violence (Tjaden & Thoennes, 1998). Moreover, while the NCVS is representative at a national level, it is unlikely to be representative at the state level, and in some cases does not survey anyone from certain states (Langton et al., 2017). Second, NIBRS provides data on whether the victim or reporting police officer believed that the offender used drugs or alcohol in relation to the crime. However, the indicator for drug usage did not differentiate marijuana from other drugs. Furthermore, that variable was largely unreported by police with several states in the sample reporting around 15 drug-related assaults in a single calendar year, suggesting significant flaws in data quality. Third, other sub-group data such as income, education, and ideology that could have provided useful contextual information about the contours of the effect was not available. More detailed data would provide context to the link between decriminalization and the reduction of harm suggested by this study; as such, this research provides only initial clues.

However, one story can be definitively ruled out. One might suggest that marijuana liberalization leads not to increased marijuana consumption but a change in reporting due to the increased number of assaults that take place at home. In their study of medical marijuana laws and traffic fatalities, Anderson et al. (2013) could not rule out the attribution of a decrease in the number of traffic fatalities following medical marijuana legalization to the fact that marijuana consumption typically takes place at home. However, decriminalization did not change the proportion of serious domestic assaults taking place at home.

There are a number of policy implications that result from this study. First, contrary to fears that legalizing marijuana would result in increased violence (Johnson, 2019; Berenson, 2020), this study suggested that decriminalization had null effects on all assaults and reduced the severity of domestic assaults. Second, this study provides new evidence about the substitutability of alcohol and marijuana, and suggests that the latter is less dangerous despite being more commonly prohibited. Third, there may be a relationship between marijuana usage and weapon usage, with alcohol being a potential mediator.

Further research may clarify these relationships and the promise marijuana seems to hold as a harm reduction strategy in domestic violence. There are two ways in which the scope of such research could be extended: firstly, while the current study examined a number of important victim subgroups, specific forms of domestic assault such as child abuse and elder abuse fall into the purview of family violence. Future research should examine how marijuana policy changes affect these forms of domestic violence. Second, as future years of NIBRS data become available, the power of similar studies will increase as there will be more

years of data from NIBRS-participating states where medical marijuana and later recreational marijuana is legal. Given the rapidity with which marijuana laws are changing, it is important that research continue in this field and assess the impact these changes have on crime.

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Table 1: Summary statistics

Variable	Mean	S.D.	Min.	Max.
<i>Independent variables</i>				
Decriminalization	.26	.44	0	1
Medical legalization	.26	.44	0	1
<i>Total Assaults (per 100,000 population)</i>				
Total assaults	1,161.00	419.78	375.18	2,294.35
Domestic assaults	542.90	204.42	220.39	1,164.12
Non-domestic assaults	463.02	181.72	128.10	1,053.80
<i>Serious Assaults (per 100,000 population)</i>				
Total assaults	60.19	42.29	0.95	233.61
Domestic assaults	18.40	12.75	0.36	58.37
Non-domestic assaults	27.59	19.53	0.60	135.67
<i>Serious Assaults (proportion of all assaults)</i>				
Total assaults	0.05	0.03	0.00	0.14
Domestic assaults	0.03	0.02	0.00	0.10
Non-domestic assaults	0.06	0.03	0.00	0.25
<i>Serious domestic assaults by victim race (per 100,000 population)</i>				
White victims	11.81	7.09	0.24	37.49
Black victims	5.67	9.18	0.00	45.20
Hispanic victims	1.34	1.52	0.00	8.20
<i>Serious domestic assaults by situation (proportion of total)</i>				
Occurred at victim's home	0.81	0.06	0.54	1.00
Involving alcohol	0.89	0.10	0.00	1.00
Involving a weapon	0.49	0.13	0.14	0.82
<i>Demographic variables</i>				
ACS State population (in 100,000s)	47.24	50.86	6.21	278.63
NIBRS-covered population (in 100,000s)	17.79	18.27	0.77	67.12
Percent male	49.30	.66	48.13	51.54
Percent black	9.78	9.27	0.19	33.93
Percent Hispanic	8.44	7.55	0.55	39.07
Percent aged 15—24 years	14.05	0.98	11.88	18.00
Percent foreign-born	6.97	4.09	1.13	16.9
Percent married	53.58	3.62	44.8	64.0
Percent female head of household	9.49	2.03	5.39	16.00
Percent in labor force	65.36	3.87	53.09	72.36
Percent no high school degree	9.52	3.55	4.17	21.43
Median household income	52,870	8,642	37,410	75,040
Percent in poverty	13.78	2.97	7.04	20.38
Percent working in manual trades	19.80	2.88	13.47	27.40
Number of police officers (in 1000s)	10.89	11.14	1.21	56.69
Drug death rate (lagged)	13.92	5.56	2.01	40.67
Per capita alcohol consumption (in number of drinks)	529.36	134.52	270.93	1,017.60

Table 2: Main Results: Decriminalization

	All Assaults			Serious Injuries		
	Domestic Assault	Non-domestic Assault	Total Assault	Domestic Assault	Non-domestic Assault	Total Assault
$exp(\hat{\beta})$	.972	.995	1.012	.820*	.835	.906
p	.091	.881	.566	.000	.007	.043
[CI]	[.940, 1.005]	[.932, 1.063]	[.971, 1.056]	[.739, .910]	[.733, .951]	[.824, .997]
N	288	288	288	288	288	288

(a) Panel A: Annual Data

	All Assaults			Serious Injuries		
	Domestic Assault	Non-domestic Assault	Total Assault	Domestic Assault	Non-domestic Assault	Total Assault
$exp(\hat{\beta})$	0.974	0.997	1.015	.830*	.844	.907
p	.0067	.917	.433	.000	.004	.025
[CI]	[.947, 1.002]	[.943, 1.054]	[.978, 1.052]	[.755, .912]	[.752, .946]	[.832, .988]
N	3456	3456	3456	3456	3456	3456

(b) Panel B: Monthly Data

All models are estimated using population weights.

Table 3: Main Results: Medical Legalization

	All Assaults			Serious Injuries		
	Domestic Assault	Non-domestic Assault	Total Assault	Domestic Assault	Non-domestic Assault	Total Assault
$exp(\hat{\beta})$	1.101	1.173	1.118	1.005	1.046	1.030
p	.070	.044	.073	.887	.479	.431
[CI]	[.992, 1.221]	[1.005, 1.370]	[.990, 1.264]	[.933, 1.084]	[.924, 1.184]	[.957, 1.110]
N	288	288	288	288	288	288

(a) Panel A: Annual Data

	All Assaults			Serious Injuries		
	Domestic Assault	Non-domestic Assault	Total Assault	Domestic Assault	Non-domestic Assault	Total Assault
$exp(\hat{\beta})$	1.087	1.151	1.106	.978	1.017	1.013
p	.041	.015	.031	.535	.737	.699
[CI]	[1.003, 1.177]	[1.028, 1.290]	[1.010, 1.212]	[.913, 1.048]	[.918, 1.130]	[1.949, 1.081]
N	3456	3456	3456	3456	3456	3456

(b) Panel B: Monthly Data

All models are estimated using population weights.

Table 4: Effect of Decriminalization on Serious Domestic Assaults by Sub-group

	Race and Ethnicity Sub-groups			Situational Sub-groups		
	White Victims	Black Victims	Hispanic Victims	Home (Proportion)	Offender Alcohol Involvement	Weapon Assault
$exp(\hat{\beta})$	.825*	.889	.699	.968	.624*	.816*
p	.000	.353	.007	.287	.000	.000
[CI]	[.745, .914]	[.693, 1.140]	[.539, .907]	[.911, 1.028]	[.552, .706]	[.733, .908]
N	288	288	288	288	288	288

(a) Panel A: Annual Data

	Race and Ethnicity Sub-groups			Situational Sub-groups		
	White Victims	Black Victims	Hispanic Victims	Home (Proportion)	Offender Alcohol Involvement	Weapon Assault
$exp(\hat{\beta})$	.838*	.879	.687	.954	.641*	.823*
p	.001	.198	.006	.025	.000	.000
[CI]	[.754, .931]	[.723, 1.069]	[.524, .899]	[.915, .994]	[.574, .715]	[.747, .907]
N	3456	3456	3456	3456	3456	3456

(b) Panel B: Monthly Data

All models are estimated using population weights.

Table 5: Event study for Decriminalization

Year	$exp(\hat{\beta})$	$se(\hat{\beta})$	p	[CI]
-5	.977	.164	.889	[.704, 1.356]
-4	1.157	.110	.126	[.960, 1.395]
-3	1.095	.080	.218	[.948, 1.264]
-2	1.225	.089	.005	[1.063, 1.411]
0	1.182	.1336	.139	[.947, 1.475]
1	.970	.094	.750	[.802, 1.172]
2	.930	.077	.382	[.791, 1.094]
3	.878	.054	.035	[.779, .991]
4	.826	.0233	.000	[.782, 874]
5	.974	.057	.649	[.868, 1.092]

Observations = 288

Note: Reference year = -1.

Appendix

Table A1: Dates of marijuana law changes

State	Decriminalization	Legalization of medical marijuana
Arkansas	-	Jul 1, 2017
Colorado	Jan 1, 1975	Jun 1, 2001
Connecticut	Jun 1, 2011	May 1, 2012
Delaware	Dec 1, 2015	Jul 1, 2011
Iowa	-	-
Idaho	-	-
Kansas	-	-
Louisiana	-	Aug 1, 2018
Massachusetts	Jan 1, 2009	Jan 1, 2013
Maine	May 1, 1976	Dec 1, 1999
Michigan	-	Apr 1, 2013
Montana	-	Jan 1, 2005
Nebraska	Jan 1, 1979	-
North Dakota	-	Jan 1, 2019
New Hampshire	Sep 12, 2017	Apr 1, 2016
Ohio	Jan 1, 1975	Aug 1, 2016
Oregon	Jan 1, 1973	Nov 1, 1998
Rhode Island	Apr 1, 2013	Jan 1, 2006
South Carolina	-	-
Texas	-	-
Utah	-	-
Virginia	-	-
Wisconsin	-	-
West Virginia	-	-