

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

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Abstract

Objective: To examine the effect of medical marijuana legalization and marijuana decriminalization on serious domestic assaults.

Methods: NIBRS data on assaults in 25 states for the years 2005 to 2016 was examined using a Poisson analysis. Assaults were disaggregated according to the situation and extent of injury: total assaults, domestic assaults, non-domestic assaults at all levels of seriousness, as well as serious assaults, serious domestic assaults, and serious non-domestic assaults, were employed as dependent variables.

Results: Results show that decriminalization reduced domestic assaults involving serious injuries by 18%. 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 31.6% and the number of serious domestic assaults involving weapons also went down by 18.4%.

Conclusions: This study provides evidence that decriminalization of marijuana leads to substantial declines in victim injury.

Keywords: Marijuana, Domestic Violence, Interpersonal Violence, Harm Reduction

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Introduction

A New Approach to Measuring Violence

The implicit premise of most criminological research is that no one policy serves as a panacea. Crime and its attendant social harms cannot be entirely eliminated, only reduced. Therefore, the extensive literature on crime prevention often encompasses harm reduction, defined as 'an approach to high-risk behaviors that focuses on mitigating the harmful consequences of such behaviors rather than eliminating the behaviors themselves' (Shannon, 2017). Though the approach was first developed to address substance use (Connock et al., 2007; Kleber, 2008; Sporer & Kral, 2007; Wilson et al., 2015; Marotta & McCullagh, 2016; Prangnell et al., 2017; Pates & Riley, 2012; Marlatt & Witkiewitz, 2002; Witkiewitz & Marlatt, 2006; Muckle et al., 2012; Crippa et al., 2012; Hall & Weier, 2015), such interventions have been applied with respect to juvenile delinquency (Heller et al., 2017), sex and sex work (Andrasik & Lostutter, 2012; Cusick, 2006; Rekart, 2005), gambling (Broda et al., 2008; Nelson et al., 2008), and policing (Ratcliffe et al., 2011; Beckett, 2016).

If harm reduction is a useful principle of crime prevention, that necessitates a more meaningful measure of violence, specifically for domestic assault. While all forms of violence may traumatize victims of domestic abuse, those incidents that result in serious injury can lead to consequences not seen in incidents of lesser severity. While all forms of domestic violence can result in lasting physical, mental, and financial consequences for the victim, assaults that result in serious 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, trau-

matic brain injury, neurological symptoms, chronic pain, disability, and even death (J. Campbell, 2002; Plichta, 2004). They may also presage the murder of the victim in a later abusive event (Mueller et al., 2016). In short, there is a world of difference between a punch and a gunshot wound. 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. While this predominant approach evaluates the extensive margin or total number of assaults, an alternative approach would consider the intensive margin of harm, by asking how much injury results from the given number of assaults.

In addition to prevalence, the severity of domestic violence can vary considerably between sites (Garcia-Moreno et al., 2006). Therefore any policy change that has the unintended consequence of changing the severity, if not prevalence, of domestic violence, should be seriously evaluated. We leverage a policy intervention of considerable external validity to address the link between marijuana laws and domestic violence incidents involving serious injury, with results showing that one positive externality of decriminalization was its effect on domestic assault. When we considered assaults at all levels of seriousness, the results showed that the policy intervention had no effect on violence. 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 some 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. Not only did these findings ostensibly contradict the earlier result, they also 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 that

crime caused.

Literature Review

The literature on the relationship between marijuana and violence remains 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; Snowden & Pridemore, 2013; MacDonald, 2015), with alcohol having a pronounced effect and the effect for marijuana being more mixed, and potentially mediated by mechanisms such as withdrawal (Moore et al., 2008).

Second, although they can provide useful contextual clues about the causal mechanisms linking substance use and abuse, those studies that are longitudinal 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 legalization on domestic violence specifically. Rather, studies have addressed marijuana legalization effect on crime generally (Morris et al., 2014), drug

trafficking-related violent crime (Gavrilova et al., 2014), rape (Dragone et al., 2016), or driving under the influence (Anderson et al., 2013).

The criminological literature on domestic violence frequently employs harm reduction approaches, the most well-known amongst them being the Minneapolis Domestic Violence Experiment (Sherman & Berk, 1984), in which nearly 1,200 suspects of domestic violence incidents that came to the attention of police were randomly assigned to either arrest or a warning. The experiment showed that arrestees were much less likely to engage in violence subsequently, and was hugely influential, prompting police departments across the United States to implement mandatory arrest policies in cases of domestic violence. Replication at six further sites showed similar results, although results were not as striking as in the original experiment. A follow-up study conducted 23 years after the original experiment, however, showed that victims were 64% more likely to have died if their partners were arrested and jailed than if warned and allowed to remain at home (L. Sherman & Harris, 2015). Subsequent domestic violence studies employing harm reduction approaches have tended to be randomized controlled trials within unique settings that pose challenges about applicability to larger-scale interventions (Parcesepe et al., 2016).

Despite the innovations that have taken place in domestic violence intervention, domestic violence remains unacceptably high for a specific subset of abusive relationships—in which the perpetrator uses alcohol. Overall, the balance of evidence suggests a strong and pervasive causal link between alcohol and violence. The past decade of research—in which ‘increasingly sophisticated studies’ (Leonard & Quigley, 2017) have been conducted—support drinking as a contributing cause of violence on every continent (Abramsky et al., 2011; Kishor & Johnson, 2004), and over diverse research settings (Hellmuth et al., 2013; O’Farrell et al., 2004; Stuart

et al., 2006; Leonard & Senchak, 1996; Woodin et al., 2014). 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 resulted in intimate partner aggression (Crane et al., 2016).

Given that causality has been established, it follows that reducing alcohol consumption should reduce the incidence of domestic or intimate partner violence. Anderson et al. (2013)'s study indicating alcohol consumption fell following medical marijuana legalisation suggests marijuana and alcohol are substitutes. Therefore, one might hypothesize that marijuana liberalisation will have the unintended effect of reducing domestic violence.

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 - a subset of assaults which result in serious injury - rather than the extensive margin - 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. Finally, the study provides supplementary information which is used to analyze the heterogeneous effects of marijuana legalization, such as incidents broken down by victims' race, incidents where the perpetrator was suspected of alcohol intoxication at the time of the incident, whether the offender used a weapon, and whether the offense took place at in the victim's home.

The remainder of the paper is organized as follows. Section 2 describes our empirical strategy while Section 3 describes the data used. Section 4 presents results and Section 5 discusses robustness checks employed. Section 6 discusses those findings and concludes.

Empirical Strategy

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

$$\log E(Y_{it}) = \beta_0 + \beta_1 Policy_{it} + X_{it} + \phi_i + \gamma_t + \varepsilon_{it} \quad (1)$$

Where $\log E(Y_{it})$ is the number of incidents for each category of assaults measured in state i during year t . $\beta_1 Policy_{it}$ estimates a continuous variable of the proportion of the year 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 fixed effects. Standard errors are clustered at the state level to account for serial correlation (Bertrand et al., 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.¹

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 whether effects changed based on victim or case characteristics. First, we disaggregated serious domestic assaults by victims' race and ethnicity: assaults involving white victims, assaults involving black victims, and assaults involving Hispanic victims. The three case characteristics we examined were incidents where the offender was suspected of being under the influence of alcohol, where the offender used a weapon, and incidents that occurred in the victim's home².

As the probability of identifying at least one significant result due to chance increases as more hypotheses are tested, therefore increasing 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). (Note that while we also run separate analyses on state-by-year and state-by-month panel datasets, these analyses are done for the purpose of cross-checking the results provided by either dataset and so we count 12 tests and not 24.) The Bonferroni correction is a conservative method—other methods, such as the Holm-Bonferroni and Šidák corrections are less stringent. We opted to use the Bonferroni correction to avoid making Type I errors, even at the expense of committing Type II errors.

Lastly, 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.

$$\log(Y_{it}) = \alpha + \sum_{j=-5}^5 \beta_j [D_{st}^j = 1] + X_{it} + \phi_i + \gamma_t + \varepsilon_{it} \quad (2)$$

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 as the reference year.

Data

This study seeks to measure the effect of marijuana liberalization on domestic violence generally, and domestic violence that causes serious victim injuries specifically. For this, we require data that provides information on how many domestic violence incidents occur as well as characteristics of each incident such as injuries sustained by the victim. The Federal Bureau of In-

investigation's National Incident-Based Report System (NIBRS) is a crime dataset whose wealth of information for each crime, victim, and offender meets these criteria and makes it uniquely suited to this task.

This study uses a state-by-year panel dataset of 25 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.

Measuring Violence

The FBI's National Incident-Based Reporting System (NIBRS) is used to measure the number of domestic violence incidents reported to the police, as well as the small subset of incidents that leads to a serious injury for the victim. Approximately 5% of domestic violence incidents leave the victim with a serious injury.³ 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, which weapons if any were used by the offender, and what injuries the victim sustained.⁴

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, 2,644 agencies from the 25 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 state⁵. South Dakota reported zero serious domestic and non-domestic assaults in the year 2006 and was dropped for all years so that the panel dataset would remain balanced.

Though NIBRS is a national crime dataset that satisfies our criteria, two other commonly used datasets merit discussion. The Uniform Crime Reports' Summary Reporting System (UCR-SRS) data provides monthly counts for a number of crimes. However, while it succeeds in breadth of coverage —nearly all agencies in the United States report—it is limited by the fact that it lacks detail and contextual richness. UCR data contains only the number of crimes committed in a given month, providing no information about the victim's injuries or their relationship to the offender. In addition to the detail and context provided by NIBRS, another advantage that NIBRS data provides over that of the UCR-SRS is that of quality, which is achieved by 'build[ing] in a series of edit checks that review the completeness and accuracy of the data reported' (Strom & Smith, 2017).

The second dataset to discuss is the National Crime Victimization Survey (NCVS), a nationally representative survey of households in the United States that measures victimization. Its major benefit is that it is based on victim reports, it is able to better measure the "dark figure" of crime that goes unreported. In crimes such as domestic violence, surveys are likely to be more accurate in measuring the true number of crimes that occurred than official police records as victims may not report to the police. The NCVS also contains information about victim injuries and victim's relationship to the offender, meeting both of our criteria for choosing a crime dataset for this study. However, as the NCVS interviews all members of a surveyed household, there is concern that victim's will not report domestic violence for fear that their abusive partner finds out (Tjaden & Thoennes, 1998). A second issue with the NCVS is that while rep-

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). Recent changes to the NCVS have been made to improve state-level data but occurred beginning in 2013, leaving too few years to study.⁶

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 simple or aggravated assault.⁷ Using the victim-offender relationship information, the assault is classified as domestic violence if the victim and offender are dating, married, or are family members.⁸

In addition to the offender’s relationship to the victim, NIBRS says whether the offender is suspected of being under the influence of alcohol and what weapon they used during the assault.⁹ We consider an assault to include weapon use if the offender used any weapon other than their body. As NIBRS does not indicate if the weapon was used to directly harm to 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) other major injury. If a victim suffered any of the injury categories other than "no injury" or "minor injury", 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.¹⁰

There may be a few concerns with how NIBRS data is employed in this study, which are briefly addressed here. First, there may be discrepancies in reporting rates and practices be-

tween agencies; more specifically, a substantial number of 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 under UCR-SRS. 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 (F. A. Campbell et al., 2001; Milstein et al., 1975; Cooper et al., 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.¹¹ However, as the injuries 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.

Other Data

A state is considered to have a marijuana policy on the date that policy is enacted. For both decriminalization and medical legalization we construct a continuous variable between the values of 0 to 1 indicating the proportion of the year with the law in effect.¹² As laws within states are not necessarily homogeneous, any effect we see on marijuana liberalization is likely to be con-

servative. Notably, states with conservative marijuana laws may be home to cities with more relaxed city ordinances.¹³

Another concern that the study has grappled with is heterogeneity between medical marijuana laws. Despite the use of a continuous variable between 0 and 1 indicating the proportion of the year with the medical marijuana law in effect, the variable is binary in the sense that the value assigned is 0 if there is no medical marijuana law and greater than 0 if there is one, regardless of specific provisions, the scale of the medical marijuana program, and how tightly dispensaries are regulated, all of which affect levels of marijuana use (Pacula et al., 2015; Powell et al., 2018). This suggests then that restraint should be employed in interpreting the medical marijuana legalization covariate.

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.

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, the percent that is Black, the percent that is Hispanic, the percent that is aged 15-24 years, and the percent that is foreign-born.¹⁴

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, does not have a high school degree or equiv-

alent, is living in poverty, is working in manual trades, the percentage of households headed by a woman, and the median household income.¹⁵

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 users in the state, with a fair amount of confidence that drug deaths are not caused by marijuana use. 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.¹⁶ This variable is converted into per capita "drinks" consumed based on the conversion equation included in the NIAAA's report.

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 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.

Results

Main analysis

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. Considering assaults involving serious injury only, these were

considerably more rare. In one year, one state reported only .36 domestic assaults involving serious injury per 100,000 people covered by NIBRS reporting in that state. As for the race and ethnicity subgroups, 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.

Table 2 presents the first half of our results from our main analysis, reporting the incident rate ratio of the effect of decriminalization on various dependent variables. Panel A reports the analysis on the yearly data, while Panel B reports the results of 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 non-domestic assault. Strikingly, decriminalization returns a significant effect for domestic assaults involving serious injuries, with an IRR of .820 or a reduction of 18%. Panel B provides similar results, with only serious domestic assault being significantly affected with an IRR of .789.

Table 3 presents the second half of the results, reporting the incident rate ratio of the effect of medical legalization of marijuana on various categories of assault. As with Table 2, Panel A provided the results of the analysis on the yearly data, while Panel B reported the results of the analysis on the monthly data. In Panel A, medical legalization was shown to have no significant

effect on any category of assault. In Panel B, showing the analysis on monthly data, medical legalization was shown to significantly affect domestic, non-domestic, and total assaults at all levels of seriousness (but not assaults leading to serious injuries). These findings, however, disappeared when the yearly data was used.

The finding that decriminalization reduces serious domestic assaults¹⁷ was a surprising result, for a number of reasons. First, there were no changes in levels of assault involving all levels of injury. This suggests that while the same number of assaults were happening following decriminalization, fewer of them involved serious injuries. Second, this was contrasted with the finding that medical legalization of marijuana had seemingly no effect on assaults, whether one considered assaults at all levels of injury or only those involving serious injury.

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)). 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, a

definite conclusion would be precipitate. We caution against drawing conclusions on disparate racial effects of decriminalization based solely on this study.

However, further analysis by situational sub-groups provided a more convincing explanation. We considered if marijuana decriminalization might also result in changes to the situational variables in serious domestic assaults —the proportion of incidents that took place at home, the number of incidents that where the perpetrator was suspected of alcohol intoxication, and the number of incidents involving a weapon. 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).¹⁸ These results were supported by the analysis done on the monthly data (Panel B).

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 dot represents 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: $T = -1$ presents an estimate within a 95 percent confidence interval, suggesting that compared to the reference year, or year prior to prior to decriminalization, there was an increase in serious domestic assaults. So, if anything, the event study suggests that serious domestic assaults 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.

Robustness Checks

Before further discussion of our results, we specify several robustness checks in order to confirm the validity of our overall identification strategy, as well as several decisions made during the research process.

First, we ran an analysis on a state-by-month level dataset, resulting in 25 states with 144 months over the same time period. The reason for this check was that many states introduced changes in the law in the middle of the year. In the state-by-year analysis, this was resolved by giving the dependent variable the value of the proportion of the year when the law is in place during the year of the law's passage. In the state-by-month analysis, the treatment variable is a binary. If the law was enacted during the middle of the month, we considered that month treated.

Tables 4 and 5 report the findings for this analysis, with Table 4 reporting the impact of decriminalization and medical legalization on all assaults and assaults involving serious injury. As with the main results, Panel A reports the coefficients from marijuana decriminalization and Panel B reports the coefficients for medical marijuana decriminalization. Most of the analyses conducted on a state-by-month basis, similarly to the main state-by-year data, return non-significant results. The state-by-month analysis confirmed that decriminalization led to a drop in domestic assaults involving serious injury, with similar estimates to the yearly results. Interestingly, the state-by-month analysis suggests that legalizing medical marijuana leads to an increase in total, domestic, and non-domestic assaults at all levels of seriousness, though the

yearly analysis returned nulls.

Table 5 reports the effects of decriminalization on serious domestic assaults, divided into race and ethnicity-based or situational sub-groups. As with the yearly results, the monthly results showed that domestic assaults involving White victims and Hispanic victims went down following decriminalization. The monthly results also confirmed that decriminalization led to a significant reduction in serious domestic assaults involving alcohol or weapons, by 39.4% (IRR .616) and 22.4% (.786) respectively.

The second robustness check involved a randomization inference to confirm that our results were more reliable than placebo treatment effects, by randomly assigning the treatment vector—the date of a law change—to each state in our data. The treatment vector was assigned 1000 times, and in every case had a smaller treatment effect than the actual result.

Discussion and Limitations

The key finding in this study was that decriminalization led to a decrease in the number of domestic assaults where the victim was seriously injured, by about 18%. Otherwise, the decriminalization of marijuana or its medical legalization had non-significant effects on assault, contrary to fears that legalizing marijuana would result in increased violence. This was 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 a stunning effect of marijuana decriminalization on what we term the intensive margin of injury.

Further analyses offered a compelling explanation for this dynamic: that decriminalization

reduced serious domestic assaults involving alcohol by nearly approximately 40%, as well as serious domestic assaults involving weapons by nearly a quarter (23.1%). Given the evidence that alcohol is a substance which aggravates violence (Leonard, 2005; Stith et al., 2004; Foran & O’Leary, 2008), the alcohol finding suggests both that (a) marijuana and alcohol are substitutes rather than complements, and (b) the substitutionary use of marijuana 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 the data quality flaws in NIBRS’ indicator for drug usage and the fact that NIBRS does not differentiate marijuana 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 have remained the same while serious domestic assaults have decreased. Domestic assaults are less likely to inflict serious injury on the victim if a weapon is not used (Sorenson, 2017). That being said, Sorenson’s study shows 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, IPV 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 & 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 if the perpetrator had a weapon during the incident and does not require that a firearm be discharged, 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 has 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.

Further research may clarify the relationship between (a) alcohol and marijuana use, (b) the relationship between marijuana use and weapon use, and (c) the effect of marijuana use on violence. 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. Marijuana laws are changing with increasing regularity; it is important that research continue in this field and assess what impact these changes have on crime.

Notes

¹Models weighed with Census population only provide similar results.

²For assaults that occurred at the victim's home, we consider the proportion of assaults occurring at home rather than the number of assaults.

³This figure differs considerably from that provided by the NCVS, where nonfatal serious violence comprised more than a third of intimate partner violence (Catalano, 2013). However, while the NCVS collects information on nonfatal victimizations reported and not reported to the police against persons age 12 or older from a nationally representative sample of U.S. households, NIBRS only provides data on those incidents reported to the police.

⁴The crime location is a broad category representing types of locations such as a bar, victim residence, or a school, rather than the specific place in the city where the crime happened.

⁵Within 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.

⁶One method in the NCVS design to develop state-level data is to estimate a state's crime based on that of "like place[s]" (Langton et al., 2017). As this means a state's crime data is from people who may not live in that state, its use in measuring state-level policy effects is improper.

⁷NIBRS data provide detailed information for each crime victim, with each entry recording up to ten crimes. A victim is considered an assault victim if any of these ten crimes are simple or aggravated assault. In the vast majority of cases, only one crime is reported. In 2016, 9% of all victims and 6% of assault victims reported two crimes in the incident. Fewer than 1% of all victims or assault victims reported more than two crimes in the incident.

⁸As NIBRS includes up to ten offenders, this introduces the possibility that an assault can include multiple offenders whose relationship to the victim can be classified as both a domestic violence and non-domestic violence assault. To avoid this double-counting, we consider a domestic violence relationship to supersede other relationships such that a victim who has both kinds of relationships with their offenders will be considered the victim of a domestic assault only. A non-domestic violence assault, therefore, requires that the offender-victim relationships only consist of only known relationships that are not family or dating.

⁹NIBRS provides data on whether the victim or the reporting police officer believe that the offender used drugs or alcohol in relation to the crime. However, the indicator for drug usage does not differentiate being under the

influence of marijuana with using other drugs. This variable is also largely unreported by police. For example, several states in the sample reported around 15 drug-related assaults in a calendar year. As this variable has significant flaws in data quality we do not analyze it separately.

¹⁰Personal communication with Criminal Justice Information Services' NIBRS coordinator Drema Fouch on April 5th, 2018.

¹¹NIBRS does not include information on whether the victim was under the influence of drugs or alcohol during the incident.

¹²For 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.

¹³For example, in 2017 the city of Atlanta decriminalized marijuana despite being in a state (Georgia) where the possession of marijuana is still a crime.

¹⁴As 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.

¹⁵The education variable is of those aged 25 or older.

¹⁶For population aged 14 and older.

¹⁷For assaults involving the three most serious categories of injury —unconsciousness, possible internal injury, and severe laceration —decriminalization is related to negative but not statistically significant results.

¹⁸For assaults involving only guns and not other kinds of weapons, decriminalization is related to negative but not statistically significant results.

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
<i>Socio-economic variables</i>				
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
<i>Other</i>				

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	300	300	300	300	300	300

(a) Panel A: Annual Data

	All Assaults			Serious Injuries		
	Domestic Assault	Non-domestic Assault	Total Assault	Domestic Assault	Non-domestic Assault	Total Assault
$exp(\hat{\beta})$	1.016	1.061	1.072	.789*	.854	.913
p	.448	.132	.014	.000	.004	.037
[CI]	[.976, 1.057]	[.982, 1.147]	[1.014, 1.134]	[.705, .882]	[.767, .951]	[.838, .994]
N	3600	3600	3600	3600	3600	3600

(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	300	300	300	300	300	300

(a) Panel A: Annual Data

	All Assaults			Serious Injuries		
	Domestic Assault	Non-domestic Assault	Total Assault	Domestic Assault	Non-domestic Assault	Total Assault
$exp(\hat{\beta})$	1.094*	1.156*	1.117*	1.020	1.069	1.060
p	.001	.001	.001	.494	.114	.017
[CI]	[1.036, 1.156]	[1.063, 1.258]	[1.044, 1.196]	[.964, 1.080]	[.984, 1.161]	[1.011, 1.112]
N	3600	3600	3600	3600	3600	3600

(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	300	300	300	300	300	300

(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
$exp(\hat{\beta})$	.821*	.820	.692*	.951	.618*	.789*
p	.000	.067	.002	.017	.000	.000
[CI]	[.736, .916]	[.663, 1.014]	[.550, .872]	[.913, .991]	[.559, .684]	[.698, .892]
N	3600	3600	3600	3600	3600	3600

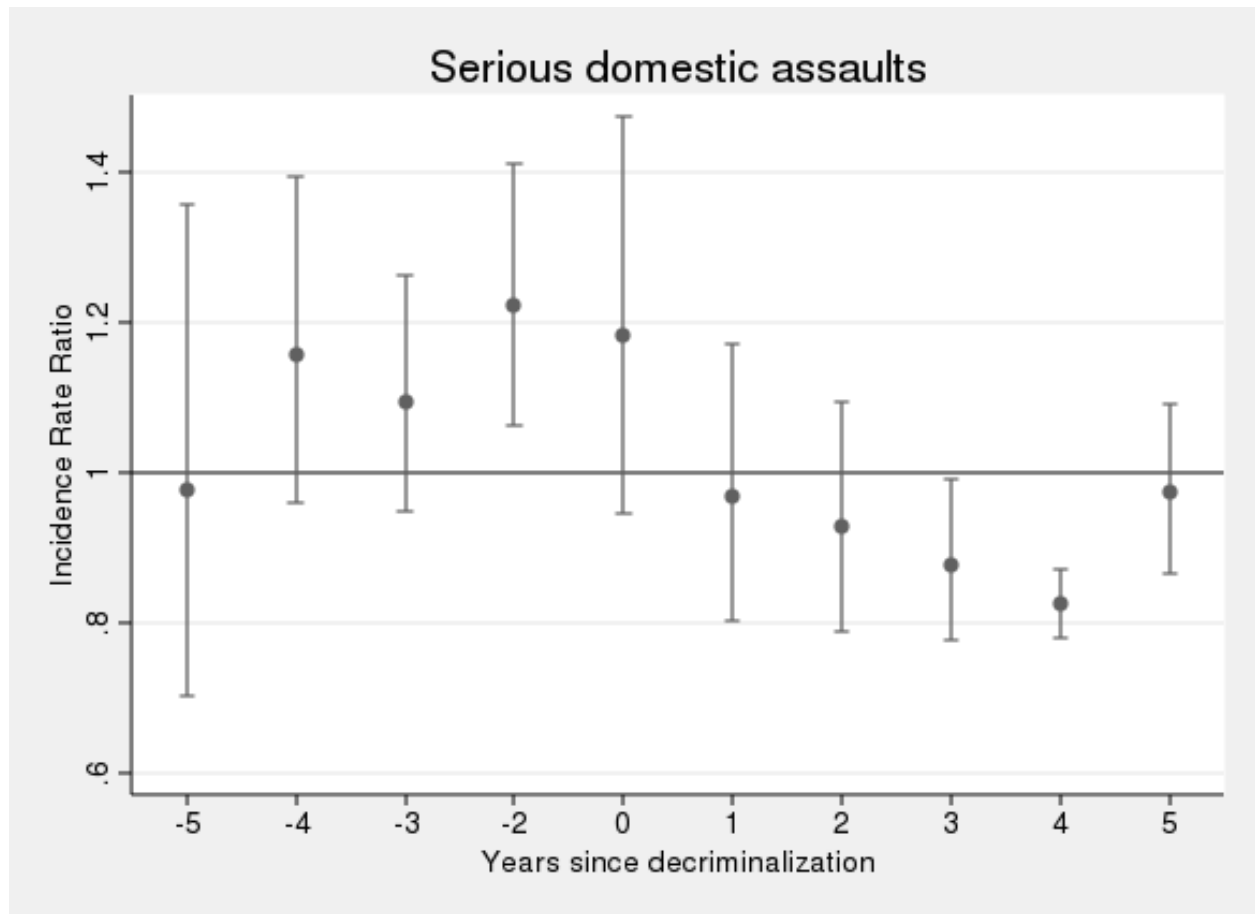
(b) Panel B: Monthly Data

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 = 300				
Note: Reference year = -1.				

Figure 1: Event Study of Effects of Decriminalization on Serious Domestic Assaults



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