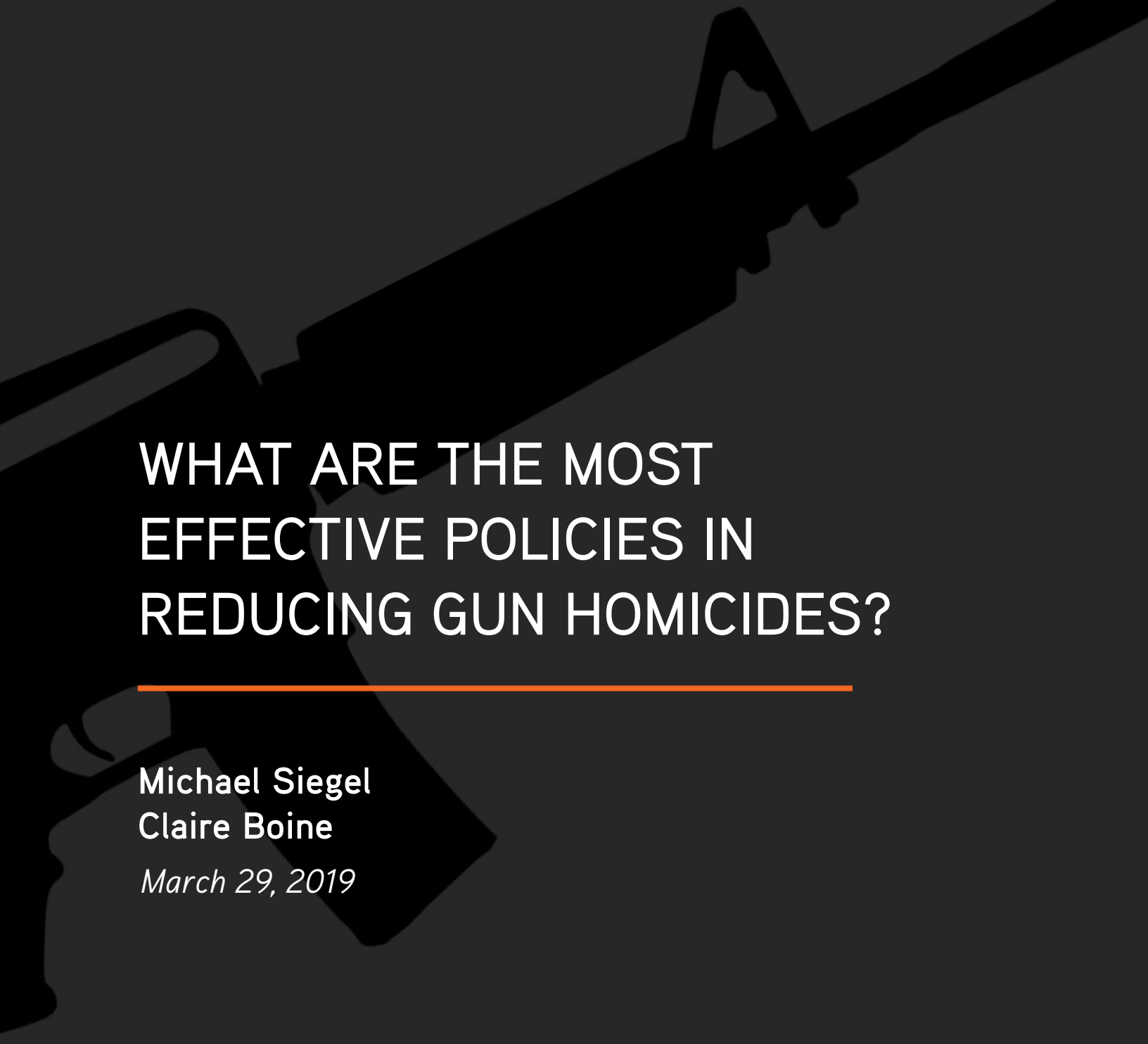
POLICY BRIEF



WHAT ARE THE MOST EFFECTIVE POLICIES IN REDUCING GUN HOMICIDES?

Michael Siegel
Claire Boine

March 29, 2019

Rockefeller SUNY Institute of Government

Regional Gun Violence Research Consortium

State policymakers are grappling to identify solutions by considering multiple legislative proposals, from red flag laws to universal background checks to bans on assault weapons to stricter regulation of semiautomatic weapons. With a myriad of often conflicting ideas and proposals, where does a state policymaker begin?

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The public mass shootings in Newtown, Charleston, Orlando, Las Vegas, Sutherland Springs, Pittsburgh, and, especially, Parkland have brought the issue of firearm violence to the forefront. These tragedies have sparked a national debate about federal and state policies to reduce firearm violence. State policymakers are grappling to identify solutions by considering multiple legislative proposals, from red flag laws to universal background checks to bans on assault weapons to stricter regulation of semiautomatic weapons. Some states are considering laws that make it easier to carry and use firearms in public. Still others are debating laws aimed at eradicating gun culture, by — for example — banning all gun-related activities (such as shooting clubs or trainings) at public high schools. With a myriad of often conflicting ideas and proposals, where does a state policymaker begin?

This policy brief will help state policymakers navigate the scientific evidence regarding the impact of state firearm laws on gun-related homicide. Taking advantage of new data resulting from a research project at the Boston University School of Public Health and with funding from the Robert Wood Johnson Foundation's Evidence for Action Program,[1] we developed a comprehensive database of state firearm laws spanning the period 1991-2016. We then examined the impact of a range of state firearm laws on total, firearm-related, and nonfirearm-related homicide rates at the state level during this time period. The State Firearm Laws Database is publicly available at www.statefirearmlaws.org.

Our analysis found three priority pieces of legislation that would have the greatest impact in reducing overall firearm homicide rates:

1. Universal background checks.
2. Prohibition of gun possession by people with a history of any violent misdemeanor, threatened violence, serious alcohol-related crime, or subject to a domestic violence restraining order. This must be accompanied by: (1) a requirement that firearms already in their possession be surrendered; (2) a procedure for confiscating guns if they are not relinquished voluntarily; and (3) procedures for confiscating guns in situations where a person becomes prohibited from owning firearms after having passed an earlier background check.
3. Laws that give discretion to law enforcement officials ("may issue" laws) in denying concealed carry permits to those who are at high risk for violence, especially those who have a criminal history of violence.

The purpose of this research was not simply to identify a list of laws that "work" and laws that "do not work." The advantage of this research is that it allowed us to compare the impact of multiple laws at the same time, enabling us to obtain a sense of what laws appear to be *most strongly* associated with lower rates of firearm homicide. Ultimately, our goal was to identify the **types** of laws that appear to have the greatest impact and which should therefore be a *priority* for policymakers.

Understanding the Problem

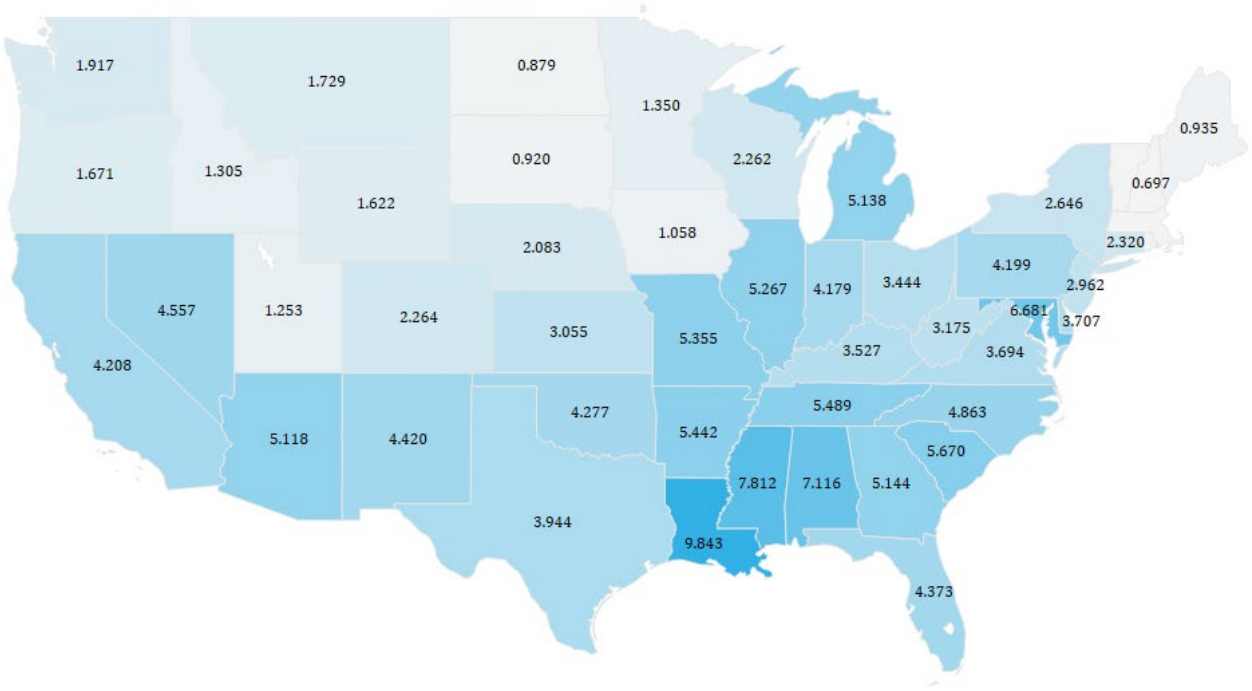
In order to develop policies to reduce firearm death, we must first understand the nature of the problem. There are three main categories of firearm violence:

1. homicide (including intimate partner homicide, acquaintance homicide, stranger homicide, and mass shootings);
2. suicide; and
3. unintentional firearm deaths.

Examining 345,882 firearm homicides during the period 1997-2016, the average age-adjusted *homicide* rate across all 50 states during this period was 5.2 per 100,000, but it ranged from a low of 1.4 per 100,000 in New Hampshire to a high of 12.7 per 100,000 in Louisiana. The average age-adjusted *firearm homicide* rate across all 50 states during this period was 3.5 per 100,000, but it ranged from a low of 0.7 per 100,000 in New Hampshire to a high of 9.8 per 100,000 in Louisiana (see Figure 1).

As Figure 2 illustrates, most firearm deaths are caused by an intimate partner, family member, or acquaintance. Likewise, more than 60 percent of all firearm deaths are a result of suicide. A much smaller proportion of deaths are caused by a perpetrator who is unknown to the victim, and only a tiny fraction of homicides are the result of a mass public shooting.[2]

FIGURE 1. Average Firearm Homicide Rates by State, 1997-2016 (per 100,000)

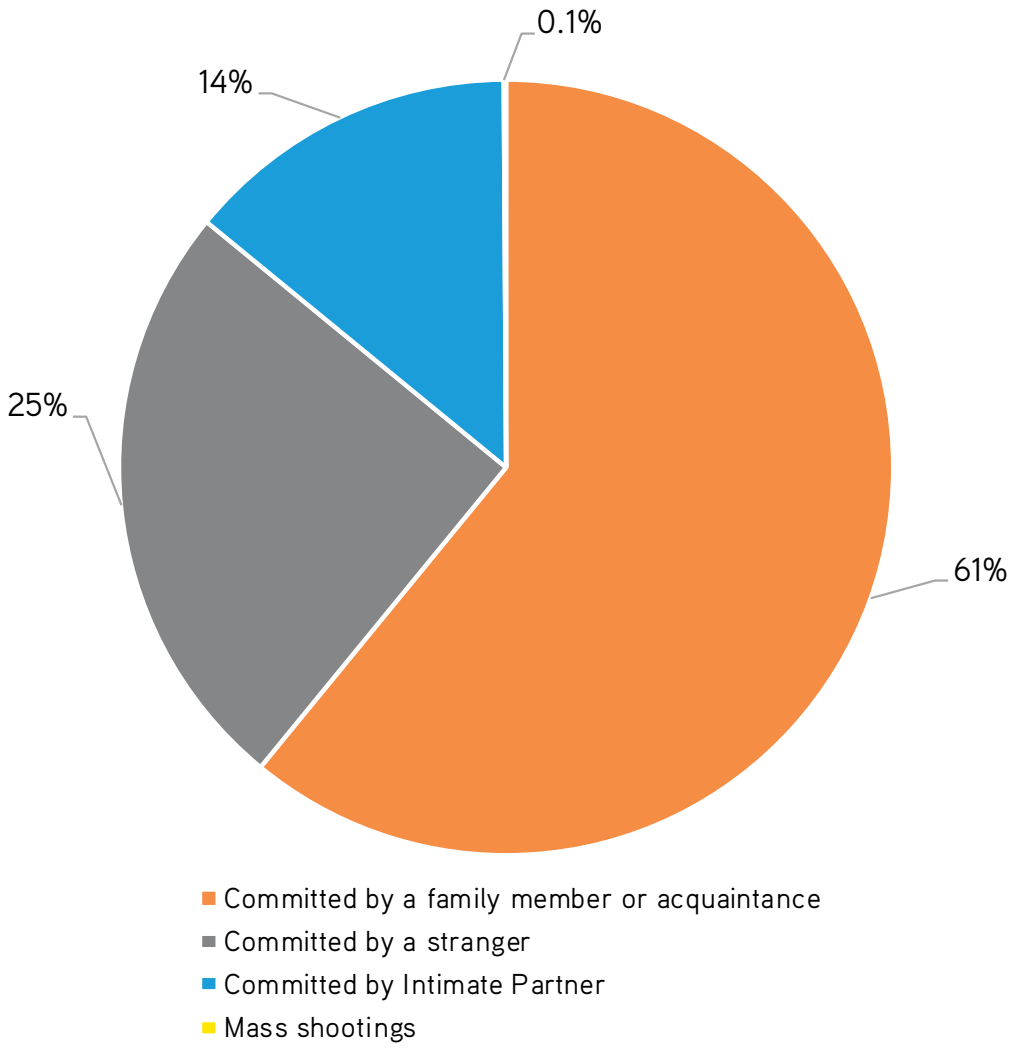


SOURCE: "Web-based Injury Statistics Query and Reporting System (WISQARS)," Centers for Disease Control and Prevention, 1997-2016, https://www.cdc.gov/injury/wisqars/index.html.

Although mass shootings account for only 0.1 percent of the total firearm-related mortality between 2000 and 2014, they are what tend to bring national attention to the issue of firearm violence, followed by a discussion about how that particular event could have been prevented.[3] While mass shootings have increased steadily over time, the more important question is what set of policies would have the greatest impact in reducing firearm homicide across the board.

To prevent firearm violence, policymakers must consider not only laws intended to reduce firearm homicide, but those to reduce firearm suicide and unintentional firearm deaths as well. These laws may not be the same. In this brief, we only examine the relationship between state firearm laws and homicide. However, there is an emerging body of evidence to which policymakers should look in developing policies to reduce rates of firearm-related suicide (see Appendix 1 for a summary).

FIGURE 2. Firearm Homicides



SOURCE: Federal Bureau of Investigation, "Uniform Crime Reporting Program Data: Supplementary Homicide Reports, 1997-2016." Jaclyn Schildkraut and H. Jaymi Elsass, *Mass Shootings: Media, Myths, and Realities* (Santa Barbara: Praeger, 2016). See also: Jaclyn Schildkraut, Margaret K. Formica, and Jim Malatras. *Can Mass Shootings be Stopped? To Address the Problem, We Must Better Understand the Phenomenon* (New York: Rockefeller Institute of Government, Regional Gun Violence Research Consortium, May 22, 2018), https://rockinst.org/wp-content/uploads/2018/05/5-22-18-Mass-Shootings-Brief.pdf.

Analysis: Policies with the Greatest Impact on Reducing Homicides

Our research examines the effect of eight major types of state firearm laws on firearm-related homicide rates. Each law was divided into one of four categories:

- Laws regulating who may purchase or possess a firearm: universal background checks; prohibition of gun possession by people convicted of a violent crime; and "may issue" laws, which give police discretion in issuing concealed carry permits (as opposed to "shall issue" laws, which require police to approve concealed carry permits unless the applicant meets explicitly stated exclusion criteria);
- Laws regulating what types of firearms and ammunition are allowed and how many guns may be purchased (assault weapon bans, bans on large capacity ammunition magazines, and bans on the purchase of more than one gun per month);
- Laws regulating when firearms may be used (stand your ground laws); and
- Laws regulating why firearms may be purchased (bans on gun trafficking).

Many previous studies have examined the relationship between state gun laws and firearm-related homicide rates (see Appendix 2 for a summary). Several national studies, for example, found a negative association between universal background checks, conducted either at point-of-sale or through permit requirements, and homicide rates.[4] However, studies conducted at the level of the individual state have been conflicting.[5] The evidence is also mixed regarding the impact of "may issue" laws,[6] assault weapon bans,[7] large capacity ammunition bans,[8] and one gun per month laws.[9] However, evidence suggests that keeping firearms out of the hands of people at high risk for violence is associated with reduced homicide rates.[10]

Although previous studies have examined the relationship between state gun laws and firearm-related homicide rates, the vast majority examined the impact of just one or two types of laws. What is unique about our work is that we used a single statistical model to evaluate the impact of a wide range of laws (see Appendix 3 for a discussion of our methodology).

We analyzed a total of eight laws within four categories, as shown in the table on the next page.

TABLE 1. Type of State Firearm by Category

Law	Detailed Description of Provision	States with Law in Effect in 2016
Laws regulating WHO may purchase or possess a firearm		
Universal background checks	Individuals must undergo a background check to purchase any type of firearm, either at the point of purchase or through a license/permit application. This may or may not include exemptions for buyers who have already undergone a background check for a concealed carry permit or other licensing requirements.	CA, CO, CT, DE, HI, IL, MA, NJ, NY, OR, RI, WA
"May issue" laws	Law provides authorities with discretion in deciding whether to grant a concealed carry permit, or the law bans all concealed weapons. This provision refers to a "may issue" system, in which the state grants the issuing authority wide discretion to deny a concealed carry permit, for reasons such as a person lacking good character or failing to demonstrate a sufficient need to carry a concealed weapon. Allowing limited discretion is not sufficient. States that do not allow concealed carry at all are coded as "may issue."	CA, CT, DE, HI, MD, MA, NJ, NY, RI
Violent misdemeanor laws	Law prohibits gun possession by people who have committed violent misdemeanors punishable by less than one year of imprisonment. Must cover possession of guns, not just purchase. Must cover assault, not just aggravated assault. Must extend beyond domestic violence-related misdemeanors, restraining orders, and stalking. Must not require that misdemeanor involve use of a firearm or result in injury. Must not explicitly exempt crimes punishable by less than one year of imprisonment.	CA, CT, HI, MD
Laws regulating WHAT types of firearms and ammunition are allowed and HOW MANY guns may be purchased		
Assault weapons bans	Law bans the sale of both assault pistols and other assault weapons.	CA, CT, MA, NJ, NY
Large capacity ammunition magazine bans	Law bans the sale of both assault pistol ammunition and other large capacity magazines.	CA, CO, CT, MD, MA, NJ, NY
One gun per month laws	Buyers can purchase no more than one handgun per month, even if they have a concealed carry permit. In order to bypass this restriction, the buyer must be able to demonstrate an extraordinary need for the additional handgun. This may or may not apply to purchases from private sellers.	CA, MD, NJ
Laws regulating WHEN firearms may be used		
No stand your ground law	Use of deadly force is not allowed to be a first resort in public. There is a duty to retreat. Does not count as stand your ground law if it only applies when person is in a vehicle.	AR, CA, CO, CT, DE, HI, ID, IL, IA, ME, MD, MA, MN, NE, NJ, NM, NY, ND, OH, OR, RI, VT, VA, WA, WI, WY
Laws regulating WHY firearms may be purchased		
Ban on gun trafficking	The law prohibits the trafficking of firearms; that is, the purchase of a firearm with the intent to resell the firearm, but without going through a background check process (or without the buyer already having gone through a background check to obtain a firearm license). An exception for transfer to relatives is acceptable.	CA, CO, CT, DE, FL, IL, MA, MN, NY, ND, OH, UT, VA

The relationships between the eight laws examined and total homicide rates are shown in Table 2 (full regression results are shown in Appendix 4). Universal background checks were significantly associated with 9.6 percent lower homicide rates. May issue laws were significantly associated with 11.1 percent lower homicide rates. Violent misdemeanor laws were significantly associated with 19.3 percent lower homicide rates. We did not find any significant association between homicide rates and assault weapons bans, large capacity ammunition magazine bans, one gun per month laws, stand your ground laws, or prohibitions on gun trafficking.

Our findings suggest a general conclusion about the impact of state firearm laws. It appears that laws which regulate the "what" (i.e., what guns/products are allowed) do not have much of an impact on overall population homicide. In contrast, laws that regulate the "who" (i.e., who has legal access to firearms) may have an appreciable impact on firearm homicide, especially if access is restricted specifically to those people who are at the greatest risk of violence: namely, people who have a history of violence or are determined to represent an imminent threat of violence.

TABLE 2. **Difference in Total Homicide Rate Associated with State Firearm Laws**

Law	Percentage Difference	95% Confidence Interval
Universal background checks	**-9.6%***	**-0.1% to -18.2%**
May issue laws	**-11.1%***	**-5.4% to -15.9%**
Violent misdemeanor laws	**-19.3%***	**-12.4% to -25.6%**
One gun per month laws	-0.70%	-9.2% to +8.6%
Assault weapons bans	3.20%	-11.1% to +19.9%
Large capacity ammunition magazine bans	3.70%	-5.0% to +13.3%
Absence of a stand your ground law	-2.30%	-7.2% to +2.9%
Trafficking prohibition	-3.80%	-11.4% to +4.5%

* Estimate is statistically significant (also shown in **bold** type).

Other factors found to be significantly associated with the total homicide rate were overall population (negatively associated), population density (positively associated), percent young males (positively associated), property crime rate (positively associated), per capita alcohol consumption (positively associated), and per capita federally licensed firearm dealers (FFLs) (positively associated). Each of these associations has been observed in previous studies. For example, homicide rates are higher in places that are densely populated,[11] are disproportionately high among young males,[12] are highly correlated with rates of other types of crime,[13] are positively associated with alcohol consumption,[14] and are positively associated with the density of gun dealers.[15]

For the three laws that we found to be associated with lower homicide rates, we compared their association with firearm versus nonfirearm homicide (see Table 3). For each of these three laws, their association with homicide was specific to firearm

homicide. They were significantly associated only with firearm homicide rates, not nonfirearm homicide rates. Moreover, the magnitude of their association with firearm homicide rates was higher than with total homicide rates.

We explored the additive effect of these laws by examining the relationship between

TABLE 3. **Association between State Firearm Laws and Firearms vs. Nonfirearm Homicide Rates**

	Firearm Homicide		Nonfirearm Homicide	
Law	Percentage Difference	95% Confidence Interval	Percentage Difference	95% Confidence Interval
Universal background checks	**-12.9%***	**-1.6% to -22.9%**	-4.9%	-14.7% to +6.1%
May issue laws	**-15.0%***	**-8.2% to -21.3%**	-0.0%	-8.3% to +9.0%
Violent misdemeanor laws	**-26.7%***	**-17.7% to -34.7%**	-4.3%	-11.5% to +3.5%

* Estimate is statistically significant (also shown in **bold** type).

the **number** of these laws present in a state and its overall homicide rate. Compared to states with none of these laws in effect, states with one of these laws experienced 10.1 percent lower homicide rates, states with two of the laws experienced 22.3 percent lower homicide rates, and states with all three of the laws in effect experienced homicide rates that were 34.6 percent lower (see Table 4).

TABLE 4. **Relationship between Number of Laws in Effect and Total Homicide Rates**

Number of Laws in Effect	Percentage Difference	95% Confidence Interval
No laws	Reference Group	
One law	**-10.1%***	**-5.1% to -14.8%**
Two laws	**-22.3%***	**-15.6% to -28.6%**
All three laws	**-34.6%***	**-27.9% to -40.7%**

Laws are (1) universal background checks; (2) may issue laws; and (3) violent misdemeanor laws.

* Estimate is statistically significant (also shown in **bold** type).

Discussion

There are several possible reasons why regulating access to guns is probably more important than regulating the types of guns that are available. For starters, defining assault weapons is exceedingly difficult, often resulting in ways to get around the law. Indeed, many states use cosmetic elements of a firearm (i.e., its appearance) in what classifies it as an "assault" weapon, rather than characteristics that are directly related to its lethality. For example, in Massachusetts, a rifle with a folding stock is a banned assault rifle; however, if you drive a nail through the stock so that it is fixed, then it is no longer an assault rifle. Other features that typically define an assault weapon are also not directly related to lethality: flash suppressors, bayonet lugs, pistol grips, and grenade launchers. However, there is no evidence that any of these features make a gun more lethal.[16]

Rather than regulating what types of firearms are allowed, regulating who may have access to those firearms appears to have a greater impact in reducing overall population homicide rates. Our findings are consistent with evidence that suggests a history of violence is strongly associated with an increase in risk for future violence. Generally, these studies show that a history of a violent crime, an alcohol-related crime, or a threat of violence may all be sensitive and specific predictors of people for whom firearm possession puts the public at a heightened risk.[17]

In contrast to policies that prevent the sale of certain types of guns, efforts to keep guns out of the hands of people at the greatest risk for violence should result in minimal interference with the right of law-abiding citizens to own and carry firearms. In this light, the underlying goal of firearm policy should be to find the most effective ways of limiting access to firearms among individuals who are shown to be potentially dangerous based on their criminal history without casting the net so wide as to prevent law-abiding citizens from purchasing or possessing guns. This is precisely what our research suggests would be most effective: identifying people who are at the highest risk for violence based on a past history of violence or the presence of a restraining order and stringently enforcing that gun possession prohibition. It is important not to cast too wide a net by including overly broad categories of people. As Keene and Mason explain: "When law enforcement begins looking at groups, rather than individuals, for likely criminals, and particularly when a decision is made to target groups because of characteristics that supposedly 'make' individual members of a group a potential danger, the innocent suffer."[18]

What our research suggests is that a specific criterion to identify people at the highest risk of committing firearm violence is *having a history of violence*. If there were stringently enforced laws ensuring that these individuals could not possess a firearm, then it is possible that we could even make it easier for low-risk individuals without any criminal history to exercise their constitutional rights to purchase and possess firearms. We believe that adopting effective measures to prevent firearm violence is not at odds with the Second Amendment, but could in some cases actually *ease the burden* for law-abiding citizens to exercise their Second Amendment rights.

An additional advantage of prioritizing laws that seek to keep firearms out of the hands of people at high risk for violence, rather than seeking to control the type of firearms that anyone can purchase, is that by targeting at-risk individuals, rather than particular types of guns, we avoid alienating gun owners who perceive that they are being blamed or targeted when firearms that they own and use are treated as the reason for high rates of firearm violence. For instance, what defines an assault weapon is often arbitrary and based on cosmetic features that are not directly tied to lethality. As a result, many gun owners are frustrated because they view their weapons as being taken away without a public health justification.

Moreover, policies that regulate who can access firearms have much greater public support than those which ban firearms that are commonly possessed by many gun owners and therefore may be easier to enact. For example, 97 percent of the public and 97 percent of people in gun-owning households support universal background checks, while 67 percent of the public and just 53 percent of people in gun-owning households support assault weapons bans.[19]

Arguably, the three prongs of instituting such an approach would be: (1) policies that prohibit firearm possession by people at high risk for violence, such as those with a history of a violent misdemeanor or subject to a restraining order, people who have threatened violence, or people with a conviction for an alcohol-related crime; (2) universal background checks so that a gun cannot be purchased without a check of whether that individual has a history of a violent crime, threatened violence, a domestic violence restraining order, or an alcohol-related crime; and (3) laws that give discretion to law enforcement officials ("may issue" laws) in denying concealed carry permits to those who are at high risk for violence, especially those who have a criminal history of violence. The advantage of approach #1 is that even if states have "shall issue" laws governing concealed carry, if the proper prohibitors are in place, then risk will still be minimized even if law enforcement officials do not have additional discretion beyond the explicitly stated prohibitors. In other words, violent misdemeanor laws can theoretically be effective as long as universal background checks are in place, even if the state is "shall issue."

It is important to note that our research did not evaluate the potential impact of gun violence restraining order laws (also called "extreme risk protection order" or "red flag" laws) because there were not enough of these laws and not enough changes over time to generate stable effect estimates. However, in 2018, eight states passed "red flag" laws which may allow the impact of these policies to be examined within a few years. The value of adding these laws to policies outlined above is that they may be effective in identifying individuals who, despite passing a background check, later become high-risk gun owners because of behavior that indicates a threat to themselves or others. Although the effect of gun violence restraining order laws on homicide rates has not been studied, two published articles — studying "red flag" laws in Connecticut and Indiana — have concluded that these laws are effective in reducing suicide rates.[20]

Readers should bear in mind the following important limitations of our analysis:

1. It only considers policies to reduce overall firearm homicide. It does not address policies intended to reduce firearm suicides, police shootings, or unintentional firearm injuries. It also does not consider policies intended to reduce firearm homicide among specific subpopulations.
2. Because it is possible that states with lower homicide rates may have been more likely to adopt certain gun laws, it is possible that we are observing a "reverse association" rather than a causal effect of state firearm laws. Policy decisions should be made based on the totality of the evidence at a given time and research into each of the laws discussed in this brief should be continued.
3. It should not be assumed that laws which have not been shown to have a significant effect on firearm homicide rates are ineffective. The existing studies may not have had adequate power to detect an effect or the law may be narrow enough so that a measurable effect on the overall population rate of homicide would not be expected. Our analyses are looking at broad, population-based outcomes and some firearm laws are narrowly crafted and would only be expected to affect certain subpopulations. For example, a law banning the sale of handguns to 18-20-year-olds would not be expected to affect overall homicide rates in the population. It would only be expected to affect homicide rates among young people. Thus, a failure to find an association between this law and overall population rates of homicide would not necessarily mean that the law is ineffective for its intended purpose.
4. In addition, laws may be found not to be associated with declines in homicide, not because they are ineffective, but because they are not adequately enforced. The research reviewed in this brief generally did not take enforcement into account.
5. The conclusions of this policy brief are based on the existing evidence, which is limited. Further research is necessary to corroborate (or challenge) our findings. Policymakers must make decisions based on the existing scientific evidence, so our attempt was to synthesize the current evidence to the best of our ability. Our findings should be used as a springboard for further research, not as a definitive conclusion about the effect of state firearm laws.

In summary, these data should not be used to argue that a particular law "works" or "does not work." Instead, the general findings of the brief should be used to generate working hypotheses as to the types of legislation that appear to be most effective in reducing the overall population burden of firearm-related homicide and which therefore might be suitably identified as priority areas for state legislative efforts. Viewed in light of previous research, our findings suggest that universal background checks, "may issue" laws, and violent misdemeanor laws are associated with significant declines in overall homicide rates, driven by their strong association with firearm homicide rates.

Appendix 1. Previous Studies of the Effect of State-Level Firearm Legislation on Firearm Suicide

Study and years covered	Measure of state firearms laws	Outcome
Castillo-Carniglia et al., 2018 (1991-2000)	Implementation of universal background checks for all firearm sales in 1991; implementation of violent misdemeanor law in 1991.	No association with firearm homicide rates in California.
Kivisto and Phalen, 2018 (1981-2015)	Risk-based firearm seizure laws (also called "red flag" laws, gun violence restraining order laws, or extreme risk protection order laws) in Indiana and Connecticut.	Indiana's law was associated with a 7.5 percent reduction in firearm suicides; Connecticut's law was associated with a 1.6 percent immediate reduction in firearm suicide and a 13.7 percent reduction after increased enforcement.
Kaufman et al., 2018 (2010-14)	State firearm policy scores from 0-12.	County-level: High policy scores were associated with lower firearm suicide rates.
Alban et al., 2018 (1998-2011)	State firearm policy grades on a scale of A to F.	States with lower firearm policy grades had higher firearm suicide rates.
Kagawa et al., 2018 (1981-2008)	Repeal of laws requiring universal background checks for handgun purchases in Indiana and Tennessee.	No association with firearm suicide rates in either state.
Luca et al., 2017 (1970-2014)	Required waiting periods for firearm purchase.	Associated with significantly lower firearm suicide rates.
Swanson et al., 2017 (1999-2013)	Gun violence restraining order law in Connecticut.	Associated with significantly lower incidence of firearm suicide.
Anestis et al., 2017 (2013-14)	Mandatory waiting periods and universal background checks.	States with both laws had significantly greater declines in suicide rates from 2013 to 2014.
Humphreys et al., 2017 (1999-2014)	Florida's stand your ground law	No association with firearm suicide rates.
Kposowa et al., 2016 (2011-13 average)	Index of state firearm laws on scale of 0-100.	Stronger laws were associated with lower firearm suicide rates.
Anestis and Anestis, 2015 (2013)	Mandatory waiting period for handgun purchase, universal background checks, requirement for gun locks, restriction of open carrying of handguns.	Each law was associated with lower firearm suicide rates.
Lemieux, 2014 (2010)	Legislative score from 0-25, with points awarded for specific provisions within five categories: gun dealer regulations, background checks, child safety, assault weapons ban, and restricting guns in public places. Score was then dichotomized by separating states with the "most restrictive" laws.	Most restrictive laws were significantly associated with lower percentage of deaths by firearm, suggesting an effect on firearm suicides since there was no effect on firearm homicide rates.
Fleegler et al., 2013 (2007-10)	Legislative score from 0-28, with points awarded for specific provisions within five categories: gun dealer regulations, background checks, child safety, assault weapons ban, and restricting guns in public places.	Independently, each category except background checks was associated with significantly decreased firearm suicide rates; together, legislative strength scores in the fourth quartile (9-24 points) significantly reduced firearm suicide rates.

Study and years covered	Measure of state firearms laws	Outcome
Rodríguez-Andrés and Hempstead, 2011 (1995-2004)	(1) Regulation of firearm sales to minors; (2) Bans on sales to persons with history of mental health, alcohol, or drug problems, prior convictions for misdemeanors, and domestic violence offenses; (3) Prohibition of sales to aliens, convicted felons, fugitives, and persons with history of serious criminal offenses as juvenile.	Significant reduction in suicide rates associated with #1 and #2, but not #3.
Gius, 2011 (1995-2004)	Required permits for handgun purchase, required registration for handguns, and required waiting period for handgun purchases.	Required permits for handgun purchase were associated with significantly lower firearm suicide rates; registration requirement was associated with significant increase in nongun-related suicides.
Rosengart et al., 2005 (1979-1998)	Separately examined effects of five types of state laws: "shall issue" laws, minimum age of 21 for private purchase, minimum age of 21 for private possession, one gun purchase per month, and ban on junk guns.	No significant association with firearm suicide rates for any of the five laws.
Price et al., 2004 (1999)	Legislative score from 0-22 based on the presence of 22 specific provisions in the categories of background checks, government control laws, possession laws, safety laws, and sales restrictions.	No relationship between individual scores or combination of laws on firearm suicide rates.
Conner and Zhong, 2003 (1999-2000)	Used Open Society Institute index of state laws, divided into three levels of stringency.	The most stringent level was associated with significant reduction in suicide rates.
Lott and Whitley, 2001 (1977-96)	Safe storage gun laws, one gun a month purchase rules, and a required waiting period law.	No significant effect on suicide rates for any of these laws.
Ludwig and Cook, 2000[2] (1985-97)	Presence or absence of state requirements for waiting periods and background checks equivalent to Brady Act requirements prior to implementation of Brady Act.	No overall effect on suicide rates, but decrease in firearm suicide rate among those 55 and older (no change in total suicide rate in this group).
Cummings et al., 1997 (1979-94)	Safe storage gun laws.	No significant effect on firearm suicides.
Kwon et al., 1997 (1990)	Presence or absence of any state requirement for a waiting period or licensing.	No significant effect on firearm suicide rates.
Yang and Lester, 1991 (1970, 1980)	Dealer licensing law, license to carry law, license to purchase law, and waiting period to purchase law.	Restrictive laws were associated with significantly lower firearm and total suicide rates.
Boor and Bair, 1990 (1985)	Defined "strict" gun control laws as those which place restrictions on both buyers and sellers (index of 0-3 for purchase restrictions [waiting period, forwarding of records of sales to government, license to carry requirement] and for sales restrictions [required license to buy, registration of all handguns, ownership ID cards]).	Strict laws were associated with significantly lower overall suicide rates.
Lester, 1988 (1970)	Strength of handgun control statutes, averaged by region.	No significant effect on overall suicide rates.

Study and years covered	Measure of state firearms laws	Outcome
Sommers, 1984 (1970)	Dealer licensing law, license to carry law, license to purchase law, and waiting period to purchase law.	Found relationship between several gun control measures and lower overall suicide rates, but only controlled for two state-level variables.
Medoff and Magaddino, 1983 (1970)	Created index based on requirements for license to purchase and waiting period.	Six states with the highest index had significantly lower overall suicide rates compared to all other states.
DeZee, 1983 (1978)	Waiting period laws, license requirements for owners and dealers, and laws restricting ownership to certain individuals.	No significant effect on overall suicide rates.
Lester and Murrell, 1982[3] (1960, 1970)	Restrictions on purchase of handguns (0-7 scale).	Found significant association with lower firearm suicide rates; however, there was an increase in suicides by means other than firearms.
Murray, 1975 (1970)	Requirement for license or permit to purchase a handgun, waiting period, report of handgun sales to police, license required to sell, and minimum purchase age.	No significant effect on total suicide rates.
Geisel et al., 1969 (1960, 1965)	Restrictions on sales to minors and persons with a history of crime, drug addiction, alcohol abuse, and mental illness, dealer licensing, recordkeeping, waiting period, and license required to purchase. Used a combination of weights of each provision to create an index with the highest R-squared value.	Significant decline in firearm suicide rates, but not total suicide rates.

Adapted from: Michael Siegel, et al., "The Impact of State Firearm Laws on Homicide and Suicide Deaths in the US, 1991-2016: A Panel Study," *Journal of General Internal Medicine*, published online March 29, 2019, https://link.springer.com/article/10.1007/s11606-019-04922-x.

Appendix 2. Previous Studies of the Effect of State-Level Firearm Legislation on Firearm Homicide

Universal background checks: Several national studies have found a negative association between universal background checks, conducted either at point-of-sale or through permit requirements, and homicide rates. Crifasi et al., in a study of the effects of state firearm laws on firearm homicide rates in urban counties throughout the US during the period 1984-2015, reported that laws requiring permits to obtain a firearm were associated with an 11 percent reduction in firearm homicide rates.[21] Fleegler et al., in a study of all 50 states during the period 2007-10, reported a 9 percent reduction in firearm homicide rates associated with universal background checks conducted either at point-of-sale or through permit requirements.[22] Ruddell and Mays, in a national study using aggregated data for the period 1999-2001, reported significantly lower firearm homicide rates in states with stronger background check laws, but the results are difficult to quantify because they used a 0-100 scale in classifying the strength of the laws, rather than a dichotomous variable.[23] Sen and Panjamapirom, analyzing state-specific homicide data for the period 1996-2005, found that the greater the extent of background checks conducted prior to firearm purchase, the lower the firearm homicide rate (the overall decrease was 7 percent).[24] For states that require a background check to determine whether a prospective purchaser is under a domestic violence restraining order, the rate of firearm homicide was 13 percent lower.

Studies conducted at the level of the individual state have been conflicting. Rudolph et al.[25] and Webster et al.[26] found declines in the firearm homicide rate of 40 percent and 23 percent, respectively, associated with the presence of firearm permit laws in Connecticut and Missouri. However, two recent papers reported no association between universal background checks and firearm homicide rates in three specific states studied (California, Indiana, and Tennessee).[27]

There is a second line of evidence that supports the effectiveness of universal background checks. Several studies have shown that universal background checks, either implemented at the point-of-sale or through a permit requirement, significantly reduce access to guns in a state, as measured by the percentage of guns recovered from crimes that were traced to an in-state source.[28] Each of these studies found that states with either universal background check or permit-to-purchase laws had a lower percentage of crime guns traced to an in-state source, indicating a higher level of legal access to crime guns in that state.

"May issue" laws: Historically, the literature on the impact of concealed carry permit laws has been inconsistent. Several studies found a negative association between "shall issue" laws and homicide rates. However, three recent studies to examine these laws found a positive association.[29] The most recent study to examine these laws did not find a statistically significant effect of "shall issue" and "permitless carry" laws on firearm homicide rates.[30] However, the point estimate (an increase of 6.3 percent in the firearm homicide rate) is consistent with the results of the three other recent studies.

Violent misdemeanor laws: A recent study reported a 24 percent reduction in intimate partner homicide rates in states with laws that prohibit firearm possession by people with a history of a violence misdemeanor crime.[31] In contrast, Crifasi et al. reported an increase in homicide rates associated with violent misdemeanor laws. However, that study included only urban counties.

There is an additional body of evidence that keeping firearms out of the hands of people at high risk for violence is associated with reduced homicide rates. Five different studies found that laws prohibiting firearm possession by people subject to a domestic violence restraining order were associated with lower rates of intimate partner homicide.[32]

A third line of evidence supporting the effectiveness of violent misdemeanor laws in reducing access to guns ultimately used in crimes is a study which showed that states with these laws in place had a lower percentage of crime guns traced to an in-state source.[33]

Assault weapon bans: Two studies have specifically examined the impact of state assault weapon bans. Lott, examining the impact of state-level assault weapons bans during the period 1997-2005, found a small positive relationship between these laws and rates of homicide.[34] Gius found no association between state assault weapons bans and homicide rates in a study covering the period 1980-2009.[35]

One gun per month laws: One previous study, examining state-level data from 1980 to 2005, found a relationship between one gun per month laws and lower homicide rates.[36] However, two other studies found no association between one gun per month laws and homicide rates.[37]

The evidence on whether one gun per month laws are associated with fewer crime guns traced to an in-state source is mixed, with one study finding an association[38] and one study failing to find an association.[39]

Stand your ground laws: Two previous studies reported a positive relationship between stand your ground laws and homicide rates.[40] Both of these studies examined laws enacted during the decade of 2000-10.

Large capacity ammunition magazine bans: We are not aware of any specific studies of the impact of large capacity ammunition magazine bans at the state level. However, Koper et al. provided a detailed assessment of the impact of the federal ban on assault weapons and large capacity ammunition magazines that was in effect from 1994-2003 and concluded that there was no clear evidence that the ban resulted in a reduction in firearm homicide.[41]

Bans on gun trafficking: We are not aware of any previous studies on state laws that prohibit gun trafficking.

Previous Studies of the Effect of State-Level Firearm Legislation on Firearm Homicide

Study and years covered	Measure of state firearms laws	Outcome
Type of Firearm Laws: Multiple Policies		
Crifasi et al., 2018 (1984-2015)	Right-to-carry laws, stand your ground laws, permit-to-purchase laws, universal background checks, and laws prohibiting firearm possession by people convicted of violent misdemeanors.	Urban counties: Permit-to-purchase laws were associated with a 14 percent reduction in firearm homicide rates; right to carry laws, stand your ground laws, background check laws, and violent misdemeanor laws were significantly associated with a 4 percent, 7 percent, 16 percent, and 14 percent increase in firearm homicide rates, respectively.
Kaufman et al., 2018 (2010-14)	State firearm policy scores from 0-12.	County-level: High policy scores were associated with lower firearm homicide rates.
Kivisto et al., 2017 (2015-16)	State firearm policy scores obtained from the Brady Center.	Higher scores were associated with lower rates of fatal police shootings.
Kalesan et al., 2016 (2010)	Twenty-nine state gun law provisions among six categories: dealer regulations, purchase regulations, background checks, child access prevention, assault weapons and large capacity magazine bans, public place restrictions.	Nine specific policies were associated with significantly lower firearm homicide rates; strongest effects for firearm identification, universal background checks, and ammunition background checks.
Crifasi et al., 2016 (1984-2015)	State right-to-carry laws, permit to purchase laws, and three strikes laws.	No significant effect of right-to-carry or three strikes laws on homicide of law enforcement officers; positive effect of three strikes laws.
Simonetti et al., 2015 (2010)	Legislative score from 0-28, with points awarded for specific provisions within five categories: gun dealer regulations, background checks, child safety, assault weapons ban, and restricting guns in public places.	States in highest tertile of state legislation strength had significantly lower rates of nonfatal firearm injuries.
Towers et al., 2015 (1999-2010)	State Brady Campaign legislative scores.	No effect on mass killings.
Lemieux, 2014 (2010)	State legislative score from 0-25, with points awarded for specific provisions within five categories: gun dealer regulations, background checks, child safety, assault weapons ban, and restricting guns in public places. Score was then dichotomized by separating states with the "most restrictive" laws.	States with the most restrictive laws did not have significantly different firearm homicide rates.
Gray, 2014 (2001 and 2011)	Overall state legislative score based on 29 different provisions.	Stronger scores were not significantly associated with changes in overall homicide rates.
Fleegler et al., 2013 (2007-10)	State legislative score from 0-28, with points awarded for specific provisions within five categories: gun dealer regulations, background checks, child safety, assault weapons ban, and restricting guns in public places.	Independently, only background checks significantly decreased rates; together, legislative strength scores in the fourth quartile (9-24 points) significantly reduced rates.

Previous Studies of the Effect of State-Level Firearm Legislation on Firearm Homicide, continued

Study and years covered	Measure of state firearms laws	Outcome
Moody and Marvell, 2010 (1980-2005)	Assault weapons bans, one gun per month law, waiting periods, permit requirements, "shall issue" laws.	One gun per month laws were associated with lower homicide rates; no other laws were significantly associated with homicide rates.
Lott, 2010 (1997-2005)	Two categories of state laws: (1) Assault weapons ban; and (2) Required background checks.	Assault weapons bans were associated with significant increase in homicide rates; background checks had no significant effect.
Moorhouse and Wanner, 2006 (1999 and 2001)	State gun control index based on 30 criteria, each with a score from 0-7.	No significant effect on homicide rates.
Rosengart et al., 2005 (1979-1998)	Separately examined effects of five types of state laws: "shall issue" laws, minimum age of 21 for private purchase, minimum age of 21 for private possession, one gun purchase per month, and ban on junk guns.	No significant association with firearm homicide rates for any of the five laws.
Kwon and Baack, 2005 (2000)	State gun policy legislative strength score, based on six policy categories: firearm registration, safety training, firearm sales regulation, safe storage laws, owner licensing, and litigation and preemption.	States in the top quartile of legislative strength score had significantly lower firearm homicide rates than states in the bottom quartile.
Price et al., 2004 (1999)	State legislative score from 0-22 based on the presence of 22 specific provisions in the categories of background checks, government control laws, possession laws, safety laws, and sales restrictions.	Higher scores were significantly associated with higher firearm homicide rates.
Phillips, 2002 (1990)	State legislative score from 0-5 based on provisions of state law regarding: (1) required application and waiting period; (2) license or permit required to purchase; (3) required registration of firearms; (4) purchase records sent to state; and (5) prohibition of carrying a concealed weapon.	Analysis at level of metropolitan standard area: Higher scores were associated with lower homicide rates among whites, but not blacks or Hispanics.
Cheng, 2002 (1995-99)	Six state policies: (1) waiting periods for handgun purchase; (2) permit to purchase handguns; (3) handgun licensing; (4) records of sales to police; (5) identification cards; and (6) ban on certain types of weapons.	Only handgun licensing was associated with significantly lower levels of firearm homicide.
Lott and Whitley, 2001 (1977-96)	State safe storage gun laws, one gun a month purchase rules, and a required waiting period law.	No significant effect on unintentional firearm deaths or overall homicide rates.
Ludwig and Cook, 2000 (1985-97)	Presence or absence of state requirements for waiting periods and background checks equivalent to Brady Act requirements prior to implementation of Brady Act.	No effect of Brady Act implementation on homicide rates.

Previous Studies of the Effect of State-Level Firearm Legislation on Firearm Homicide, continued

Study and years covered	Measure of state firearms laws	Outcome
Kwon et al., 1997 (1990)	Presence or absence of any state requirement for a waiting period or firearm licensing requirements.	Nonsignificant decrease in firearm mortality rates in states with a law.
Kleck and Patterson, 1993 (1979-81) (aggregated)	State and local laws in 19 categories, including licensing and permit requirements, waiting periods, and regulation of gun sales and possession.	One hundred and seventy largest US cities: Only restrictions on gun sales to persons with a history of mental illness and additional penalties for gun crimes were significantly associated with lower firearm homicide rates; overall index of all 19 laws was associated with a significant increase in firearm homicide rates.
Magaddino and Medoff, 1984 (1979)	Background checks, handgun sales reporting, and waiting periods.	No significant effect on homicide rates.
DeZee, 1983 (1978)	State waiting period laws, license requirements for owners and dealers, and laws restricting ownership to certain individuals.	No significant effect on overall homicide rates.
Murray, 1975 (1970)	State requirement for license or permit to purchase a handgun, waiting period, report of handgun sales to police, license required to sell, and minimum purchase age.	No significant effect on total homicide rates.
Geisel et al., 1969 (1960, 1965)	State restrictions on sales to minors and persons with a history of crime, drug addiction, alcohol abuse, and mental illness, dealer licensing, recordkeeping, waiting period, and license required to purchase. Used a combination of weights of each provision to create an index with the highest R-squared value.	No significant effect on firearm or total homicides; significant negative effect on accidental firearm deaths.
Type of Firearm Policies: Access to Firearms among Domestic Violence Offenders		
Zeoli et al., 2017 (1980-2013)	Restraining order firearm prohibition laws; violent misdemeanor and domestic violence misdemeanor firearm prohibition laws.	Domestic violence restraining order firearm prohibition laws were associated with reduction in intimate partner violence, as were nonspecific violent misdemeanor prohibitions. There was no effect of domestic violence-related misdemeanor prohibitors.
Díez et al., 2017 (1991-2015)	State domestic violence-related gun laws: (1) regulating gun possession by domestic violence misdemeanants; (2) restraining order laws; (3) removal of guns from scenes of a domestic violence incidence; (4) stalking prohibition for gun possession.	Laws requiring the surrender of firearms by people subject to domestic violence-related restraining orders were associated with 14 percent lower firearm-related intimate partner homicide rates. No effect of other laws.

Previous Studies of the Effect of State-Level Firearm Legislation on Firearm Homicide, continued

Study and years covered	Measure of state firearms laws	Outcome
Zeoli and Webster, 2010 (1979-2003)	State domestic violence-related gun laws: (1) regulating gun possession by domestic violence misdemeanants; (2) regulating gun possession by persons under domestic violence restraining orders; (3) allowing confiscation of firearms from scene of a domestic violence incident.	Among 46 US cities: State laws restricting gun possession by persons under restraining orders were associated with significantly lower firearm-related intimate partner homicide rates.
Bridges et al., 2008 (1995-99, averaged)	Prohibition of firearm possession by domestic violence misdemeanants and by persons with a domestic violence restraining order.	No significant effect of either type of law on intimate partner or family homicide rates.
Vigdor and Mercy, 2006 (1982-2002)	State domestic violence-related gun policies: (1) ban on gun sales and/or possession for persons with domestic violence-related restraining order; (2) ban on gun sales and/or possession for persons with prior domestic violence conviction; (3) allowing confiscation of firearms from scene of domestic violence incident; and (4) background check requirements.	Restraining order laws significantly reduced intimate partner homicide and firearm homicide rates, but only in the presence of background check requirements; no significant effect of ban on sales to persons with prior convictions.
Vigdor and Mercy, 2003 (1982-98)	State domestic violence-related gun policies: (1) ban on gun sales and/or possession for persons with domestic violence-related restraining order; (2) ban on gun sales and/or possession for persons with prior domestic violence conviction.	Laws restricting access to persons with restraining orders associated with significantly lower intimate partner homicide rates; no effect of restriction for domestic violence misdemeanants.
Type of Firearm Policies: Youth Access Policies		
Lott and Whitley, 2001 (1979-96)	State child access prevention laws.	No impact on unintentional gun deaths among youth.
Marvell, 2001 (1979-98)	State laws banning possession of firearms by minors.	No significant association with firearm or total homicide rates among minors or all persons.
Webster and Starnes, 2000 (1979-97)	State child access prevention laws.	Significant association between Florida's child access prevention law and reduced unintentional death among children, but no effect in other 14 states.
Cummings et al., 1997 (1979-94)	State safe storage gun laws.	Significant reduction in unintentional firearm deaths among children under age 15; no significant effect on firearm homicides.
Type of Firearm Policies: Sales and Possession Regulations		
Luca et al., 2017 (1970-2014)	Required waiting periods for firearm purchase.	Associated with significantly lower firearm homicide rates.
Rudolph et al., 2015 (1984-2005)	Enactment of permit to purchase law in Connecticut (compared before and after trends with those in 39 control states).	Implementation of law was associated with a 40 percent reduction in firearm homicide rate.

Previous Studies of the Effect of State-Level Firearm Legislation on Firearm Homicide, continued

Study and years covered	Measure of state firearms laws	Outcome
Webster et al., 2014 (1999-2012)	Repeal of purchase to permit law in Missouri (compared before and after trends with all other states).	Repeal of law was associated with a 23 percent increase in firearm homicide rate.
Lester and Murrell, 1982 (1960, 1970)	State restrictions on purchase of handguns (scale of 0-7).	No relationship with firearm homicide rates.
Sommers, 1980 (1977)	State handgun licensing requirement.	Licensing associated with a significant decrease in homicide rates.
Type of Firearm Policies: Background Checks		
Castillo-Carniglia et al., 2018 (1991-2000)	Implementation of universal background checks for all firearm sales in 1991.	No association with firearm homicide rates in California.
Kagawa et al., 2018 (1981-2008)	Repeal of laws requiring universal background checks for handgun purchases in Indiana and Tennessee.	No association with firearm homicide rates in either state.
Sen and Panjamapirom, 2012 (1996-2005)	State laws requiring additional background checks (in addition to criminal history) for restraining orders, mental illness, fugitive status, and misdemeanors	Checking for restraining orders and fugitive status: Significant decrease; Checking for mental illness: Nonsignificant decrease; Checking for misdemeanors: no effect
Sumner et al., 2008 (2002-04)	Level at which Brady Act-mandated background checks are conducted: federal, state, or local.	States with local-level checks had significantly lower firearm homicide rates.
Ruddell and Mays, 2005 (1999-2001 aggregated)	State legislative score from 0-100 based on background check provisions: automatic screening for felony, fugitive status, restraining orders, domestic violence restraining orders, and mental illness.	Higher scores were significantly associated with lower rates.
Cook and Ludwig, 2003 (1990-97)	Implementation of Brady Act background checks in states without equivalent legislation already in place in 1994.	No significant difference between states in firearm homicide rates.
Ludwig and Cook, 2000 (1985-1997)	Implementation of Brady Act background checks in states without equivalent legislation already in place in 1994.	No significant difference between states in firearm homicide rates.
Type of Firearm Policies: Dealer Regulations		
Irvin et al., 2014 (1995-2010)	State laws regulating federally licensed firearm dealers: licensing, record keeping, inspections, theft reporting, and total number of provisions (0-4).	Licensing and inspections: Significant decrease; Record keeping: Significant increase; Three or more provisions: Significant decrease.

Previous Studies of the Effect of State-Level Firearm Legislation on Firearm Homicide, continued

Study and years covered	Measure of state firearms laws	Outcome
Type of Firearm Policies: Stand Your Ground Laws		
Humphreys et al., 2017 (1999-2014)	Florida's stand your ground law.	Significantly associated with an increase in the firearm homicide rate.
Cheng and Hoekstra, 2013[4] (2000-10)	State stand your ground laws.	Stand your ground laws were associated with a significant increase in homicide rate.
McClellan and Tekin, 2012 (2000-09)	State stand your ground laws.	Stand your ground laws were associated with a significant increase in homicides among whites, but no significant effect on homicides among blacks.
Type of Firearm Policies: Assault weapons bans		
Gius, 2014 (1980-2009)	Assault weapons bans.	No significant association with homicide rates.
Ban on Junk Guns		
Webster et al., 2002 (1975-98)	Ban on sale of "Saturday night specials" in Maryland in 1990.	Associated with significantly lower firearm homicide rates.
Type of Firearm Policies: Concealed Carry Laws		
Hamill et al., 2018 (1986-2015)	No carry, "may issue," "shall issue," and permitless carry.	State-level data: No significant association of permissive concealed carry laws with firearm homicide rates.
Crifasi et al., 2018 (1984-2015)	Permissive concealed carry laws ("shall issue").	Urban county data: Right-to-carry laws were significantly associated with a 4 percent increase in firearm homicide rates.
Siegel et al., 2017 (1991-2015)	Permissive concealed carry laws ("shall issue").	State-level data: Permissive laws associated with a significant 8.6 percent increase in firearm homicide rates.
Donohue et al., 2017 1977-2014	Permissive concealed carry laws ("shall issue").	State-level data: Synthetic controls models show increase in homicide, but only significant in one model.
Barati, 2016 (1991-2008)	Permissive concealed carry laws ("shall issue").	State-level data: No association with homicide rates.
Zimmerman, 2014 (1999-2010)	Permissive concealed carry laws ("shall issue").	State-level data: Significant increase in homicide rates in one model; no significant association with homicide rates in instrumented model.
Gius, 2014 (1980-2009)	Permissive concealed carry laws ("shall issue").	State-level data: Permissive laws associated with significantly lower homicide rates.

Previous Studies of the Effect of State-Level Firearm Legislation on Firearm Homicide, continued

Study and years covered	Measure of state firearms laws	Outcome
Moody et al., 2014 (1977-2006)	Permissive concealed carry laws ("shall issue").	County-level data: Permissive concealed carry laws significantly associated with lower homicide rates.
Aneja et al., 2011 (1977-2006)	Permissive concealed carry laws ("shall issue").	State- and county-level data: No significant association with homicide rates.
Moody and Marvell, 2010 (1960-2005)	Permissive concealed carry laws ("shall issue").	State-level data: No significant association with homicide rates.
Lott, 2010 (1977-2005)	Permissive concealed carry laws ("shall issue").	State-level data: Permissive concealed carry laws associated with significant decrease in homicide rates.
Lott and Whitley, 2007 (1976-98)	Permissive concealed carry laws ("shall issue").	State-level data: Shall issue laws associated with increased rate of decline in homicide.
Rosengart et al., 2005 (1979-98)	Permissive concealed carry laws ("shall issue").	State-level data: Shall issue laws associated with a nonsignificant increase in firearm and total homicide rates.
Hepburn et al., 2004 (1979-98)	Permissive concealed carry laws ("shall issue").	State-level data: No association between concealed carry laws and homicide rates.
Rubin and Dezhbakhsh, 2003 (1977-92)	Permissive concealed carry laws ("shall issue").	County-level data: No association between concealed carry laws and homicide rates in most states.
Ayres and Donohue, 2003[63] (1977-92)	Permissive concealed carry laws ("shall issue").	County-level data: Permissive concealed carry laws associated with lower homicide rates in the 1980s, but increased homicide rates in the 1990s.
Mustard, 2001 (1984-96)	Permissive concealed carry laws ("shall issue").	State-level data: Shall issue laws associated with lower rates of police deaths.
Olson and Maltz, 2001 (1977-92)	Permissive concealed carry laws ("shall issue").	County-level data: Permissive concealed carry laws associated with significant reduction in firearm and total homicide rates.
Lott and Whitley, 2001 (1979-96)	Permissive concealed carry laws ("shall issue").	State-level data: Permissive concealed carry laws associated with significant reduction in homicide rates.
Plassmann and Tideman, 2001 (1977-92)	Permissive concealed carry laws ("shall issue").	County-level data: Relationship varies by state; no significant association or negative association in most states.
Dezhbakhsh and Rubin, 1998 (1977-92)	Permissive concealed carry laws ("shall issue").	County-level data: Permissive concealed carry laws associated with slightly lower homicide rates.

Previous Studies of the Effect of State-Level Firearm Legislation on Firearm Homicide, continued

Study and years covered	Measure of state firearms laws	Outcome
Bronars and Lott, 1998 (1977-1992)	Permissive concealed carry laws ("shall issue").	County-level data: Permissive concealed carry laws associated with lower homicide rates.
Ludwig, 1998 (1977-94)	Permissive concealed carry laws ("shall issue").	State-level data: Permissive concealed carry laws not significantly associated with adult homicide rates.
Black and Negin, 1998 (1977-92)	Permissive concealed carry laws ("shall issue").	County-level data: Permissive concealed carry laws not significantly associated with homicide rates.
Lott and Mustard, 1997 (1977-92)	Permissive concealed carry laws ("shall issue").	County-level data: Permissive concealed carry laws associated with lower firearm homicide rates.
McDowall et al., 1995 (1973-92)	Shall issue laws in Florida, Mississippi, and Oregon.	Shall issue laws were associated with an increase in the firearm homicide rate.
Sommers, 1980 (1977)	Concealed carry laws.	State-level data: No effect on homicide rates.
DeZee, 1983 (1978)	Permissive concealed carry laws ("shall issue").	State-level data: No significant effect on overall homicide rates.
Murray, 1975 (1970)	Permissive concealed carry laws ("shall issue").	State-level data: No significant effect on overall homicide rates.

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Appendix 3. Methodology

Our research on the effect of state firearm laws is not novel. There are many previous studies that have examined the relationship between state gun laws and firearm-related homicide rates (see Appendix 1 for a summary). Among these, the majority examined the impact of just one or two types of laws. What is unique about our work is that we used a single statistical model to evaluate the impact of a wide range of laws. The research evidence reported in this brief resulted from the use of a standard methodology to simultaneously evaluate a wide range of laws, allowing their impacts to be directly compared.

A second unique aspect of this research is that, unlike most previous studies, we have provided a detailed, clearly articulated definition of what constitutes each state firearm law. The primary goal of our database is to aid researchers as they evaluate the effectiveness of various firearm laws. To do this, laws must be classified in such a way that they can be compared across state lines; however, creating these criteria can often prove difficult. State statutes are not uniformly written — laws are nuanced in their language, implementation, and enforcement, making each provision unique to a particular state. Our aim was to categorize provisions using a methodology that captured important differences while maintaining a level of comparability between states. We provide a detailed codebook that articulates the specific definition of each of the law provisions we coded.

Structure of the dataset: Our dataset consisted of a *panel* of annual data for each of the 50 states covering the 20-year period 1997-2016. Thus, there were a total of 1,000 observations (50 states times 20 years). The main outcome variable was the overall homicide rate in a given state in a given year. The main predictor variable was the presence or absence of a particular state firearm law during the relevant year. We lagged the laws by one year so that the variable reflects the first full year in which a law was implemented.

Overview of methods: We used a difference-in-differences analysis. This is a panel regression method that evaluates the change in the outcome variable across states in relation to changes in the presence of a state law. For example, to evaluate the potential impact of a state firearm law implemented in California in 2001, the regression would compare the change in homicide rates from before to after 2001 in California to the change in homicide rates over the same time periods in all other states without that same law present. The regression includes fixed effects for each year and state. Including year fixed effects allows us to account for national secular changes in homicide rates that were occurring throughout the nation. Including state fixed effects allows us to account for time-constant differences between states that could otherwise explain differences in homicide rates. We controlled for a range of state-level variables that are known to be associated with homicide rates and that could confound our analyses because they may also be related to the presence or absence of certain firearm laws.

Control variables: We controlled for the annual values of the following state-level variables, whose association with homicide rates has been documented in the cited studies:

- Total population[42]
- Population density[43]
- Proportion of black residents[44]
- Proportion of Hispanic residents[45]
- Proportion of young people, ages 15-29[46]
- Proportion of males among the population ages 15-29[47]
- Per capita number of law enforcement officers[48]
- Poverty rate[49]
- Unemployment rate[50]
- Violent crime rate (assault, rape, and robbery)[51]
- Property crime rate (burglary, larceny, and motor vehicle theft)[52]
- Income inequality (Gini coefficient)[53]
- Per capita alcohol consumption[54]
- Density of gun dealers (per capita federally licensed firearm dealers (FFLs))[55]
- Gun ownership (based on a proxy: the proportion of suicides committed with a firearm)[56]

One of the chief threats to the validity of a study such as this one is the possibility that states that enact stronger gun laws are those which also have a lower percentage of household gun ownership and a lower level of gun activity to begin with. To mitigate this threat to validity, we control for two variables that pertain to gun ownership and gun activity. First, we control for the estimated household gun ownership in each state. Second, we control for the density of gun dealers, defined as the per capita number of federally licensed firearm dealers (FFLs). Weisser reported that the correlation between the densities of FFLs is more strongly correlated with homicide rates than the overall strength of gun laws.[57] We believe that this is one of the first studies of the effect of state firearm laws to control for this important variable. Because state-level data on the number of FFLs was available to us only starting in 1997, the study period for our analyses is 1997-2016.

Data sources: The annual homicide rate in each state during the period 1997-2016 was obtained from the Centers for Disease Control and Prevention's Web-based Injury Statistics Query and Report System (CDC WISQARS).[58] The homicides included in our data were all cases of murder and nonnegligent homicide. We did not include homicides that CDC classified as unintentional (e.g., "accidental" shootings) or "legal intervention" (i.e., police shootings). Since 1999, the CDC has not reported homicide rates based on counts that are less than 10. We were therefore missing observations for certain states in some years.[59] Population, demographic, and socioeconomic state-level data were obtained from the U.S. Census Bureau using American FactFinder.[60] Per capita alcohol consumption for each state was obtained from the National Institute of Alcohol Abuse and Alcoholism.[61] State-specific rates of violent crime and property

crime were obtained from the FBI Uniform Crime Reporting system.[62] The annual per capita number of federally licensed gun dealers (FFLs) was obtained from the Bureau of Alcohol, Tobacco, Firearms, & Explosives.[63] State-level household gun ownership was estimated using a well-recognized proxy: the proportion of suicides committed with a firearm. The cross-sectional validity of this proxy has been validated and it is widely used in firearm research.[64]

Statistical details: The outcome variable was the homicide rate in a given state in a given year. Because the outcome variable is not normally distributed (it is highly skewed), we used a count model, which is specifically designed to deal with count data like these. The count model we used was a negative binomial model, which was chosen over a Poisson model because there was overdispersion in the distribution of the outcome variable. Because of the clustering by states (i.e., there were multiple observations for each state), we adjusted the standard errors of the regression coefficients to account for these multiple observations. We used cluster robust standard errors.[65] Because we were interested in estimating the independent effect of the state firearm laws, we entered them together in the regression model. Thus, the resulting estimates account for the presence of other firearm laws within the same state.

Interpretation of results: The results are reported as incidence rate ratios (IRRs), which indicate the estimated percentage difference in the homicide rate in a state associated with a particular state firearm law. For example, an IRR of 0.80 for a particular law would indicate a 20 percent lower homicide rate associated with the presence of that law. We also report 95 percent confidence intervals on these estimates. Simply put, these confidence intervals indicate the precision of our estimates. They essentially indicate the range of estimates within which we can be 95 percent confident that the true population association lies based on the variability among the observations in our data. If the 95 percent confidence interval crosses 0, then we cannot be sure that the law is associated with the outcome and we conclude that the association is not *statistically significant*. If the 95 percent confidence interval does not cross 0, then we can be reasonably confident that chance alone does not explain the observed association, which we conclude is *statistically significant*.

Validity check: For any laws that we found to be associated with homicide rates, we separately examined their relationship with firearm versus nonfirearm homicides. Finding that the relationship is specific to firearm-related events would increase confidence that the association is a causal one. If a law were to be associated with both firearm and nonfirearm events, then we would be reluctant to conclude that there is a causal association because, conceptually, these laws would be hypothesized to only affect the firearm-related death rates.

Limitations of this analysis

It is important to point out two critical limitations of this analysis. First, while our research is able to establish associations between certain laws and outcomes, this does not necessarily imply that there is a causal relationship. States that enact strong firearm laws may also be more likely to experience lower firearm homicide rates, and this could be an alternative explanation for the observed study findings.

Nevertheless, we undertake several procedures to help establish evidence for a causal relationship. This includes using fixed effects models and employing a difference-in-differences approach which explores the impact of *changes* in laws on *changes* in homicide rates over time. This approach also controls for time-constant differences between states that could otherwise explain observed differences in homicide rates. In addition, we conduct falsification tests in which we examine the association between state firearm laws and **nonfirearm** homicide rates. If a state law is related only to firearm homicide rates, but not nonfirearm homicide rates, that specificity of the relationship adds evidence for the causal nature of the association.

To be conservative, we do not conclude that any state law is associated with an increase or decrease in homicide unless: (1) it is significantly associated with overall homicide rates; and (2) it is only associated with firearm-related homicide rates, not nonfirearm-related homicide rates.

A second important limitation of this analysis is that there were several laws that were not enacted in enough states by 2016 to provide adequate power for us to evaluate them. This includes extreme risk protection order (or "red flag") laws.

Appendix 4. Full Regression Results

Incidence rate ratios (IRR) for each variable in regression model: relationship between state firearm laws and total homicide rates.[a]

Variable	IRR	95% confidence interval
Total population	**0.82***	**0.68-0.99**
Population density	**2.70***	**1.37-5.35**
Proportion of black residents	1.27	0.88-1.84
Proportion of Hispanic residents	1.00	0.96-1.05
Proportion of young people ages 15-29	0.95	0.90-1.01
Proportion of males among young people	**1.08***	**1.03-1.13**
Per capita law enforcement officers	1.00	0.98-1.02
Poverty rate	0.98	0.96-1.00
Unemployment rate	0.99	0.96-1.01
Violent crime rate	1.05	0.99-1.11
Property crime rate	**1.10***	**1.06-1.15**
Income inequality (Gini coefficient)	1.00	0.93-1.08
Per capita alcohol consumption	**1.09***	**1.03-1.16**
Per capita FFLs	**1.06***	**1.01-1.11**
Household gun ownership	1.02	0.97-1.08
Universal background checks	**0.90***	**0.82-1.00**
May issue laws	**0.89***	**0.84-0.94**
Violent misdemeanor laws	**0.81***	**0.74-0.88**
One gun per month laws	0.99	0.91-1.09
Assault weapons bans	1.03	0.89-1.20
Large capacity ammunition magazine bans	1.04	0.95-1.13
Absence of a stand your ground law	0.98	0.93-1.03
Trafficking prohibition	0.96	0.89-1.05

* Coefficient is significant at $p<0.05$ (also appears in **bold** type).

a Variables are standardized so the IRR indicates the percentage change in homicide rate associated with a one standard deviation increase in the independent variable.

ENDNOTES

1 The views expressed here do not necessarily reflect those of the Robert Wood Johnson Foundation.

2 Furthermore, there are approximately 500 unintentional firearm deaths each year, mostly among children. There is a specific set of policies — including safe storage laws, child access protection laws, and minimum age for purchase and possession laws — that are intended to reduce unintentional firearm injuries. We did not analyze these issues.

3 In perhaps the most comprehensive analysis of mass shootings in the United States, Schildkraut and Elsass reported that there were 558 mass shooting deaths from 2000 to 2014. However, during the same period, there were a total of 468,753 firearm-related deaths, which include all other homicides, suicides, and unintentional firearm-related deaths. Thus, mass shootings accounted for only 0.1 percent of the total firearm-related mortality during this period.

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