

# Effects of state-level policy changes on homicide and nonfatal shootings of law enforcement officers

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## ABSTRACT

**Objective** To evaluate the impact of state-level policy changes on assaults on law enforcement officers (LEOs) in the USA.

**Methods** Pooled time series and cross-sections with negative binomial regression were used to estimate the impact of state-level changes of right-to-carry (RTC), three-strikes and permit-to-purchase (PTP) handgun laws on fatal and non-fatal assaults of LEOs. LEO assaults were stratified by weapon type (all methods, handgun and non-handgun) and whether or not the assault was fatal. Data were collected from the Federal Bureau of Investigation's Law Enforcement Officers Killed and Assaulted database and analysed for the period 1984–2013 for fatal assaults and 1998–2013 for non-fatal assaults.

**Results** RTC laws showed no association with fatal ( $p>0.4$ ) or non-fatal ( $p>0.15$ ) assaults on LEOs. Three-strikes laws were associated with a 33% increase in the risk of fatal assaults on LEOs. Connecticut's PTP law was not associated with fatal ( $p>0.16$ ) or non-fatal ( $p>0.13$ ) assaults. Missouri's repeal of its PTP legislation was marginally associated with a twofold increased risk of non-fatal handgun assaults ( $p=0.089$ ).

**Conclusions** This research indicates that three-strikes laws increase the risk of fatal assaults. RTC laws are not associated with increased risk of assault. Missouri's PTP repeal may increase the risk of non-fatal handgun assaults.

## INTRODUCTION

Law enforcement is an occupation with inherent risk to officers. Law enforcement officers (LEOs) respond to crimes in progress, handle dangerous suspects and investigate crimes, among other duties.<sup>1–2</sup> LEOs have an increased risk of assault, compared with other public service occupations, owing to their interactions with criminals and response to volatile situations; LEOs often work alone or in small numbers, in high-crime areas and late at night or during the early morning.<sup>3</sup> Although the rates of fatal LEO assaults have declined over the past several decades, their homicide rates are consistently higher than that for the general population—in 2011 the LEO homicide rate was 8 per 100 000,<sup>4</sup> while for the general population the rate was 4.7 per 100 000.<sup>5</sup>

Several factors influence the risk of a homicide of a LEO, including state laws and policies. Policy can influence the ways in which criminals and the public as a whole interact with law enforcement. Policies such as concealed carry weapons laws could increase the number of guns being carried on the street by people encountered by LEOs.

Permit-to-purchase (PTP) handgun laws generally make it more difficult for prohibited people to obtain handguns through background checks for all sales, which might create barriers to gun access for criminals. Laws that impose strict or mandatory sentencing for repeat offenders could increase the wish to evade capture, which might increase violence against LEOs during encounters with criminals.

Many studies have examined the effect of concealed carry weapons laws, commonly referred to as right-to-carry (RTC) laws, on homicide and other violent crimes in the general population.<sup>6–8</sup> Only a few studies have explored the possible effect of these RTC laws on LEO assault and have yielded inconsistent findings.<sup>7–9–10</sup> RTC laws could be relevant to LEO safety as these laws may increase the number of handguns carried in public. Many of those most likely to commit firearm violence are prohibited from possessing firearms (eg, criminals, anyone subject to a court-issued restraining order for domestic violence, juveniles) and therefore cannot obtain a permit to carry a concealed handgun. However, individuals with extensive histories of arrest for crimes and convictions for crimes involving violence, drug, or alcohol abuse may both legally possess firearms and carry concealed handguns in many states.

Three-strikes laws (ie, criminals receive mandatory harsher sentences for committing a third crime) became popular among states during the mid-1990s in an effort to deter chronic offenders from repeating crimes. Early evaluations of the law's impact in California (which had the broadest application) indicated increases in violent crime, including homicide, in the years following passage of the law.<sup>11–12</sup> These laws were implemented to deter violent crime, but data suggest that they have a negative impact on public safety. One analysis of the laws' effects in cities found a positive association between three-strikes laws and homicide and no significant reductions in crime.<sup>13</sup> Moody and colleagues found that three-strikes laws were associated with a 44% increase in the expected numbers of fatal LEO assaults.<sup>10</sup> The reasons for these increased assaults are unclear, but it seems that chronic offenders may be killing LEOs to evade capture and potential life imprisonment.

Current federal firearm policy requires a background check and record keeping only for purchases made from federal licence dealers. Some states have taken steps to deal with this gap through PTP handgun licensing laws. PTP laws require all prospective handgun purchasers to pass a background check and both licensed and private sellers may sell a handgun only to valid permit

holders. Nine of 12 states with PTP laws require potential handgun purchasers to apply in person at a law enforcement agency where they are also photographed and sometimes fingerprinted.<sup>14</sup> States with PTP laws also often have stricter standards for legal gun ownership, and expansive background checks that access local, state and federal records. In-person applications at law enforcement agencies could increase the integrity of the background check and, potentially, deter purchases of an illegal firearm made by others on behalf of prohibited people.

PTP laws have been associated with decreased diversion of guns to criminals<sup>15</sup> and lower rates of firearm homicide.<sup>16</sup> Missouri repealed its PTP law in August of 2007. This policy change was associated with significant increases in both the diversion of guns to criminals<sup>15</sup> and age-adjusted firearm homicide rates.<sup>17</sup> If the repeal of Missouri's PTP law increased the availability of firearms to prohibited persons, in addition to leading to more homicides, it is plausible that it would also increase firearm-related assaults on LEOs.

These previously mentioned policies—RTC, three-strikes and PTP laws—all are important for LEO safety. In this study, each of these policies is evaluated because of their potential to influence the ways in which suspects, criminals and citizens interact with law enforcement. Moreover, the impact of PTP laws and, specifically, Missouri's repeal, have yet to be evaluated for associations with LEO homicide. Furthermore, none of the policies discussed has been studied for their effect on non-fatal assaults (those committed with a firearm or knife that result in an injury). Non-fatal assaults share similar characteristics to those of fatal assaults and are key to understanding the context in which assaults occur so that the true magnitude of a policy's effect on LEO safety can be elucidated. To deal with these gaps in knowledge and inform the current policy debates about these policies generally and specifically on LEO safety, this study evaluated changes to state-level crime and gun policies to determine their association with the risk of fatal or non-fatal LEO assault.

## METHODS

### Design

This study used pooled time series and cross-sectional data from 1984 through 2013 to evaluate the associations between state policy changes and LEO assaults. The policy changes studied were RTC, three-strikes and PTP handgun licensing laws. Annual, state-level counts of LEO assaults were stratified by outcome (fatal or non-fatal) and weapon type (all methods, handgun, non-handgun). This approach created six dependent variables to estimate associations with policy changes. Because both RTC and PTP laws are specific to handguns, separating handgun and non-handgun assaults, this allowed for increased specificity when testing for policy effects.

### Data measures and sources

Counts of LEO assaults were generated from the FBI's Law Enforcement Officers Killed and Assaulted database.<sup>18</sup> The FBI compiles this database from reports of every line-of-duty fatal assault and non-fatal assaults committed with a firearm or knife that result in an injury as part of the Uniform Crime Reporting programme.<sup>19</sup> The database includes a number of variables, including the type of weapon used by the suspect, which was used to stratify the dependent variables.

For the policies of interest, indicator variables were created and coded as 0 for the years before the law, a proportion for the fraction of days in the year the law was in effect and 1 for each subsequent year with the law, which is a method that has been used in previous research investigating policy impacts.<sup>10 17</sup>

For example, if a state enacted a three-strikes law on 1 July 1995 the three-strikes indicator would be coded as 0 for years 1984–1994, 0.5 for 1995 and 1 for years 1996–2013. For RTC and PTP laws, state legislation was first identified using Ludwig and Cook's book, *Evaluating Gun Policy*,<sup>20</sup> which provided data up to the year 2000. For policy changes after 2000, the Law Center to Prevent Gun Violence policy summaries for RTC<sup>21</sup> and PTP<sup>14</sup> were used to identify state legislation. Moody *et al*<sup>10</sup> provided the state legislation for three-strikes laws.

Once the appropriate legislation was identified from these sources and verified, the laws were reviewed for each state to determine a law's effective date and if any changes to the legislation had occurred during the study period. For RTC laws, states were considered to have 'permissive' laws if state authorities had no discretion in issuing permits or the state did not require a permit to carry a concealed handgun. For three-strikes and PTP laws, the indicator variable represented the presence or absence of said law.

The control variables evaluated for inclusion in the models were state-level rates of violent crime and arrest per 100 000 population;<sup>18</sup> percentage poverty;<sup>22</sup> percentage unemployment (among those aged  $\geq 16$ );<sup>23</sup> incarceration rates per 100 000 population;<sup>24</sup> proportion of state population black, Hispanic and age 18–34 interpolated between census years;<sup>25</sup> percentage of the population living in Metropolitan statistical areas;<sup>18</sup> gun availability (calculated as the ratio of firearm suicide to all suicide);<sup>26 27</sup> population;<sup>27</sup> and state-aggregated law enforcement expenditures per 100 000 population.<sup>28</sup>

### Analytical methods

All the covariates outlined above were tested for inclusion in the model based on previous research indicating possible associations with assault. In addition to the policy indicators, state-aggregated law enforcement expenditures, arrest rates for violent crime and the number of LEOs were included as theoretically mandatory independent variables. Collinearity between variables and large variance inflation factors were used to identify covariates that it was not appropriate to include in the models. The final model included the following covariates: state-aggregated law enforcement expenditures, arrest rates for violent crime and the number of LEOs, as well as percentage poverty, percentage of Metropolitan statistical areas and gun availability.

To estimate the association between RTC, three-strikes, PTP handgun laws and LEO assaults, negative binomial regression models were estimated using state and year as fixed effects. State fixed-effects models were used to control for time-invariant factors and omitted variables associated with LEO assault risks in order to estimate the policies' effects. The use of Poisson regression models was evaluated, but there was a high degree of overdispersion in the data (likelihood ratio test of  $\alpha=0$ ,  $p<0.001$ ). The utility of a random-effects model was evaluated using the Hausman test;<sup>29</sup> however, it was determined that fixed effects were most appropriate to estimate these policy effects. Analyses were restricted to the state level owing to small sample sizes and inconsistencies in reporting county-level crime data.<sup>30 31</sup> SEs were adjusted to account for clustering by state. The number of LEOs in each state<sup>32</sup> was used as an offset variable and the policy effect estimates are presented as incident rate ratios.

The estimated policy effects are presented in tables within the text. Full-model results for each dependent variable with covariates are available in online supplementary tables S1 and for fatal and non-fatal assaults, respectively. Analyses were conducted

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using Stata IC V.13.1.<sup>33</sup> This study was deemed to be ‘not human subjects’ research by the Johns Hopkins Bloomberg School of Public Health institutional review board.

## RESULTS

During the study, 22 states had permissive RTC laws (17 law changes during the study), 24 states had three-strikes laws (24 law changes during the study) and 12 states had PTP laws (3 law changes during the study) (table 1).

## Fatal and non-fatal assaults of law enforcement officers

From 1998 to 2013 there were 2884 assaults of LEOs, of which 862 were fatal and 2022 non-fatal. Fatally assaulted LEOs were on average 1.3 years older with 12.3 months more experience than LEOs in non-fatal assaults. Proportions of LEOs in the two groups were similar for gender and race. More LEOs who were killed were assaulted with a firearm, but the breakdown of firearm type used by the suspect between fatal and non-fatal assaults was similar (table 2).

## Estimates of policies’ effects on fatal assaults

Across the dependent variables, RTC laws showed no association with fatal assaults of LEOs (table 3). Three-strikes laws were associated with a 33% increase in fatal LEO assaults committed overall ( $p=0.016$ , 95% CI 1.05 to 1.67) and a 62% increase in fatal non-handgun assaults ( $p=0.02$ , 95% CI 1.08 to 2.44). Three-strikes laws were marginally associated with a 27% increase in fatal assaults committed with a handgun ( $p=0.076$ ,

**Table 2** Descriptive statistics for law enforcement officer assaults 1998–2013 and dependent variables

Variable	Fatal (n=862)	Non-fatal (n=2022)
Mean age (years)*	36.9	35.6
Mean experience (months)*	130.6	118.3
Male (%)	94	95
White (%)	85	88
Firearm (%)*	84	66
Handgun	71	72
Rifle	21	15
Shotgun	8	13
Dependent variable	Mean	Variance
Fatal assaults—all methods	1.12	2.76
Fatal handgun assaults	0.76	1.52
Fatal non-handgun assaults	0.36	0.60
Non-fatal assaults—all methods	2.52	16.73
Non-fatal handgun assaults	1.20	4.48
Non-fatal non-handgun assaults	1.32	5.58

\* $p<0.05$ .

The mean and variance of the dependent variables are presented to illustrate the overdispersion present in the data necessitating the use of negative binomial regression.

95% CI 0.98 to 1.67). Neither the passage of Connecticut’s PTP law ( $p>0.159$ ) nor the repeal of Missouri’s PTP law ( $p>0.451$ ) were significantly associated with any of the dependent variables for fatal LEO assaults.

## Estimates of policy effects on non-fatal assaults

The analysis of non-fatal assaults did not include three-strikes laws, because during the study period (1998–2013) there were

**Table 1** States with right-to-carry (RTC), three-strikes and permit-to-purchase (PTP) laws with year of implementation†

Permissive RTC 17 law changes	Three-strikes 24 law changes	PTP 3 law changes
Alaska <sup>i</sup>	Arkansas <sup>vi</sup>	Connecticut <sup>vi</sup>
Arizona <sup>i</sup>	California <sup>i</sup>	Hawaii
Florida <sup>ii</sup>	Colorado <sup>i</sup>	Illinois
Idaho <sup>iii</sup>	Connecticut <sup>i</sup>	Iowa
Kentucky <sup>iv</sup>	Florida <sup>vi</sup>	Maryland <sup>xi</sup>
Louisiana <sup>iv</sup>	Georgia <sup>vi</sup>	Massachusetts
Mississippi <sup>iii</sup>	Indiana <sup>i</sup>	Michigan
Missouri <sup>v</sup>	Kansas <sup>i</sup>	Minnesota
Nebraska	Louisiana <sup>i</sup>	Missouri*
Nevada <sup>vi</sup>	Maryland <sup>i</sup>	
New Mexico	Montana <sup>vi</sup>	New Jersey
North Carolina <sup>vi</sup>	Nevada <sup>vi</sup>	New York
Ohio <sup>vii</sup>	New Jersey <sup>vi</sup>	North Carolina
Oklahoma <sup>vi</sup>	New Mexico <sup>i</sup>	
South Carolina <sup>iv</sup>	North Carolina <sup>i</sup>	
Tennessee <sup>i</sup>	North Dakota <sup>vi</sup>	
Texas	Pennsylvania <sup>vi</sup>	
Vermont	South Carolina <sup>iv</sup>	
Washington	Tennessee <sup>i</sup>	
West Virginia <sup>viii</sup>	Utah <sup>vi</sup>	
Wisconsin <sup>x</sup>	Vermont <sup>vi</sup>	
Wyoming <sup>x</sup>	Virginia <sup>i</sup>	
	Washington <sup>ix</sup>	
	Wisconsin <sup>i</sup>	

†Unless otherwise noted, the laws were in effect across the entire study period. Law was passed: <sup>i</sup>1994; <sup>ii</sup>1987; <sup>iii</sup>1990; <sup>iv</sup>1996; <sup>v</sup>2003; <sup>vi</sup>1995; <sup>vii</sup>2004; <sup>viii</sup>1989; <sup>ix</sup>1993; <sup>x</sup>2011; <sup>xi</sup>2013.

Law was repealed: \*2007.

**Table 3** Impact of state policies on fatal law enforcement officer assaults, 1984–2013

Dependent variable	IRR*	95% CI†	p Value
<i>Permissive RTC</i>			
Total	1.02	0.81 to 1.29	0.873
Handgun	0.92	0.70 to 1.21	0.569
Non-handgun	1.27	0.85 to 1.88	0.241
<i>Three strikes</i>			
Total	<b>1.33</b>	<b>1.05 to 1.67</b>	<b>0.016</b>
Handgun	1.27	0.98 to 1.67	0.076
Non-handgun	<b>1.62</b>	<b>1.08 to 2.44</b>	<b>0.020</b>
<i>Missouri’s PTP repeal</i>			
Total	1.23	0.48 to 3.14	0.669
Handgun	1.52	0.51 to 4.46	0.451
Non-handgun	0.92	0.19 to 4.52	0.917
<i>Connecticut’s PTP law</i>			
Total	0.45	0.10 to 2.08	0.307
Handgun	0.20	0.02 to 1.90	0.159
Non-handgun	1.67	0.18 to 15.18	0.650

Italic used for  $p<0.1$ .

Bold used for  $p<0.05$ .

\*IRR estimated from negative binomial regression.

†CI of the estimated IRR.

This model controlled for state-aggregated law enforcement expenditures, arrest rates for violent crime and the number of law enforcement officers, as well as percentage poverty, percentage Metropolitan statistical areas and gun availability. IRR, incident rate ratio; PTP, permit-to-purchase; RTC, right-to-carry.

no changes to these policies. Across the dependent variables, there were no statistically significant associations between RTC laws and non-fatal LEO assaults (table 4). Missouri's PTP repeal was marginally associated with an 83% increase in the risk of overall non-fatal assault ( $p=0.073$ , 95% CI 0.94 to 3.54). The repeal was also marginally associated with a twofold increased risk of non-fatal handgun assaults ( $p=0.089$ , 95% CI 0.89 to 5.14), with no corresponding change in non-fatal non-handgun assaults ( $p=0.416$ ).

## DISCUSSION

RTC, three-strikes and PTP handgun laws are particularly important when considering factors that influence LEO safety. These laws have the potential to change the ways in which suspects interact with LEOs. RTC laws are a commonly debated policy, in which risk to LEOs is often raised. This debate centres on the legal carrying of concealed weapons that could be used either in the assault or aid of a LEO responding to a call for service. Previous studies have produced mixed findings for the effect of RTC laws on LEO safety.<sup>7 9 10</sup> Our study fills an important knowledge gap by estimating impacts on both fatal and non-fatal assaults to illustrate the most complete picture of the relationship between RTC laws and LEO safety. Findings from this study indicate no significant effects of RTC laws on the risk of fatal or non-fatal assaults of LEOs.

Three-strikes laws were popular in the mid-1990s as a way to crack down on chronic offenders. However, previous research on the effects of three-strikes laws by Moody and colleagues<sup>10</sup> indicates a serious unintended consequence of these laws—the homicide of LEOs. The results of our study are consistent with those of Moody *et al* showing that these laws increase fatal assaults to LEOs. There was no association between three-strikes laws and fatal handgun assaults, but this is not surprising since there is nothing inherent in three-strikes laws that would lead to them having a greater or lesser impact on fatalities committed with a handgun. Additionally, chronic offenders in states with three-strikes laws may be more likely to have prohibiting conditions that would limit their ability to purchase or possess handguns.

Research by Margarita<sup>34</sup> found that fatal assaults of LEOs were situational and contextual, often occurring during the suspects' attempts to evade capture after committing a crime. These findings, together with those of Moody *et al*, suggest that

while three-strikes laws were designed to deter crime, they increase the risk of fatal assault—presumably because criminals want to avoid long sentences or potential life imprisonment. It is important that future research on the association of three-strikes laws and fatal LEO assault should include a re-examination of Margarita's work by interviewing suspects who killed LEOs. However, as is indicated in recent research by Stone, about 50% of individuals who kill LEOs are either killed or commit suicide so their reasons for killing LEOs may remain theoretical.<sup>35</sup>

Before Missouri's repeal of its PTP law in 2007, anyone wanting to purchase a handgun in Missouri had to apply in-person at a law enforcement agency and be photographed. Sellers, both licensed and unlicensed, were only allowed to sell to a purchaser with a valid permit. After Missouri's repeal, background checks were no longer required for private gun sales, making it easier for prohibited people to obtain guns. Findings by Webster *et al*<sup>15</sup> demonstrated a sharp increase in both the number of crime guns recovered in Missouri that were originally sold within the state (an indicator of diversion of guns to criminals) and firearm homicide rates<sup>17</sup> after the repeal. Both these studies point to a changing illegal gun market in Missouri, in which it became easier for criminals to obtain guns and use those guns to commit violent crime. This change could also have led to an increased risk of firearm assaults against LEOs who were responding to these crime scenes. The findings of our study of an increased risk of non-fatal handgun assaults following Missouri's repeal of the PTP law support this theory. Since the PTP law was specific to the sale of handguns, it is likely that the greatest effect would be seen among handgun assaults. Adding to the specificity of the findings, no corresponding change in non-fatal non-handgun assaults occurred in Missouri after the repeal.

This research has some limitations. The ability of the models to estimate the effects of the policies on non-fatal assaults was different from that for fatal assaults—the sample size for non-fatal assaults was larger; however, the number of years of observation was shorter. It is possible that the marginal significance of the estimates of Missouri's PTP repeal on non-fatal assaults might change with further years of observation. Any longitudinal study of crime trends in the USA has the potential for bias if the study does not control for the crack cocaine epidemic, which is thought to have played a key role in the sharp increase in homicides during the late 1980s and early 1990s.<sup>36</sup> However, the ways in which changes in the market for crack cocaine might influence risks to LEOs were probably controlled for in this study through statistical controls for changes in violent crime and arrest rates. It is possible that the passage of these laws is endogenous with LEO assaults, which would result in mis-specification and biased estimates of the policies' effects. However, as discussed by Moody *et al*,<sup>10</sup> LEO homicides are rare and unlikely to lead to passage of a law on their own. Additionally, the time it takes for legislation to be drafted, approved and implemented makes it even less likely that endogeneity exists. As with most studies of the effects of state laws, there is the potential for selection bias. This potential is increased if states that adopted the laws had different rates of LEO assaults before passing the law than states that did not enact the laws. Controlling for state-level factors across time such as changes in violent crime that might prompt the enactment of these laws probably reduced any potential influence of selection bias.

This study also has a number of strengths. While the Law Enforcement Officers Killed and Assaulted (LEOKA) report's

**Table 4** Impact of state policies on non-fatal law enforcement officer assaults, 1998–2013

Dependent variable	IRR*	95% CI†	p Value
<i>Permissive RTC</i>			
Total	0.72	0.47 to 1.10	0.132
Handgun	0.74	0.41 to 1.33	0.311
Non-handgun	0.74	0.42 to 1.3	0.296
<i>Missouri's PTP repeal</i>			
Total	1.83	0.94 to 3.54	0.073
Handgun	2.14	0.89 to 5.14	0.089
Non-handgun	1.43	0.61 to 3.37	0.416

Italic used for  $p<0.1$ .

\*IRR estimated from negative binomial regression.

†CI of the estimated IRR.

This model controlled for state-aggregated law enforcement expenditures, arrest rates for violent crime and the number of law enforcement officers, as well as percentage poverty, percentage Metropolitan statistical areas and gun availability.

IRR, incident rate ratio; PTP, permit-to-purchase; RTC, right-to-carry.



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strict definition of a 'LEO' often results in undercounting of LEO homicides compared with other data sources,<sup>37</sup> the database contains a number of important details that allow for the stratification of assaults by weapon type to better estimate the policy effects. This is the first study to estimate the impact of PTP laws on LEO assault and the first to examine the effects of state-level policies on non-fatal LEO assaults. Our study generated new findings about how state policies affect the LEO work environment; RTC, three-strikes and PTP laws are particularly relevant owing to their potential to influence the ways in which criminals interact with law enforcement.

Three-strikes laws were associated with a significantly increased risk of fatal assaults against LEOs. Missouri's PTP repeal indicates a trend toward increased risk for non-fatal handgun assaults against LEOs. This research demonstrates that state law changes related to crime or firearms can affect the environment in which LEOs operate and potentially increase their risk of injury and death. LEOs play an important role in keeping communities safe. Policies that show little crime prevention or public safety benefit while also increasing the risk of assault against LEOs need to be reconsidered.

## What is already known on this subject

- State-level crime and gun policies can affect the work environment of law enforcement officers (LEOs).
- Evidence for the association between concealed carry laws and LEO homicide is mixed.
- Three-strikes laws are associated with an increased risk of LEO homicide.

## What this study adds

- No evidence of an association between concealed carry laws and fatal or non-fatal LEO assault.
- More evidence of an increased risk of LEO homicide in states with three-strikes laws.
- Indications that Missouri's repeal of its permit-to-purchase handgun licensing law is associated with an increased risk of handgun assaults against LEOs.

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# Effects of state-level policy changes on homicide and nonfatal shootings of law enforcement officers

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