# Evaluating the Effect of State Regulation of Federally Licensed Firearm Dealers on Firearm Homicide

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Effective federal regulation of firearm dealers has proven difficult. Consequently, many states choose to implement their own regulations. We examined the impact of state-required licensing, record keeping of sales, allowable inspections, and mandatory theft reporting on firearm homicide from 1995 to 2010. We found that lower homicide rates were associated with states that required licensing and inspections. We concluded that firearm dealer regulations might be an effective harm reduction strategy for firearm homicide. (*Am J Public Health.* 2014;104:1384–1386. doi: 10.2105/AJPH.2014.301999)

Current federal regulations and enforcement practices limit the federal government's ability to effectively deter illegal firearm sales by federally licensed firearm dealers.[1–4] Several states have enacted their own firearm laws or require an additional layer of oversight, but evidence in support of these laws as injury reduction strategies vary.[5–7] Firearm dealer regulations aimed at decreasing trafficking have been successful, yet little data exist regarding the effect of these regulations on firearm homicides.[8] In this study, we examined state licensing and other lawful sales promoting dealer regulations, and hypothesized that they decrease firearm homicide.

## METHODS

We conducted a state-level panel study to examine how regulation of federally licensed firearm dealers related to firearm homicide during 1995 to 2010.

We used data from the Centers for Disease Control and Prevention's Web-based Injury Statistics Query and Reporting Systems and Multiple Cause of Death files to identify state-level firearm homicide totals from 1995 to 2010. Homicide rates were subsequently calculated for each state. We used published peer-reviewed research that cited the laws regulating firearm dealers, and characterized the regulatory status of each state during the study.[9] LexisNexis was used for confirmation.

We performed multivariable Poisson regression analyses controlling for sociodemographic characteristics from the US Census, burglary and drug arrest rates from the FBI's Uniform Crime Report, state firearm regulation scores from the *Traveler's Guide to Firearm Laws of the Fifty States*, and a validated firearm ownership proxy measure.[10–12]

Models were analyzed using state licensing, theft reporting, allowable inspections, and mandatory record keeping as categorical independent variables and homicide rates as the dependent variable. We also constructed models evaluating interactions between key variables.

In addition, a model using an overall strength variable, which equaled the sum of the 4 regulations, was constructed and analyzed. All analyses controlled for clustering at the state level.

## RESULTS

The characterization of each state's dealer regulations are listed in Table 1. Over the years examined, 195 932 people died by firearm homicide. The median annual homicide rate per 100 000 people was 3.66 (interquartile range = 1.80–5.39).

Lower homicide rates were associated with states that required licensing and allowed inspections (Table 2). Theft reporting was not associated with lower homicide rates (incidence rate ratio [IRR] = 1.04; 99% confidence interval [CI] = 0.95, 1.14), and record maintenance was associated with higher homicide rates (Table 2). The protective effect was stronger in states that required both licensing and inspections (IRR = 0.49; 99% CI = 0.42, 0.58).

Lower homicide rates were associated with states that had 3 or more laws regulating

firearm dealers (IRR = 0.76; 99% CI = 0.67, 0.86 [3 laws] and IRR = 0.75; 99% CI = 0.65, 0.86 [4 laws]).

## DISCUSSION

Our national study adds to the literature through a rigorous examination of the effect of state regulation of firearm dealers on firearm homicide. Our findings suggest that firearm dealer licensing and allowable inspections might save lives. Although limited to association by the observational design and absence of policy change during the study period, these findings are promising and warrant further investigation.

Similar to previous studies, our results varied based on the type of regulation. State licensing and authorized inspections were associated with lower homicide rates, whereas record keeping was associated with increased homicides. Furthermore, having both licensing and inspections appeared to be more strongly protective against homicide than either alone. It makes intuitive sense for the effect to be stronger for having both mandatory licensing and allowable inspections because it is important to have a mechanism by which to evaluate and enforce compliance with the licensing. The association between record keeping and increased homicides is less clear. Perhaps this finding exists because states that have problems with firearm diversion, and consequently, increased access to guns that might be used in homicides, have chosen to enact these laws to attempt to address these problems. These findings highlight the complex nature of these associations and suggest that the findings might also be influenced by other unmeasured covariates, such as enforcement of the law or other unmeasured laws or variables not included within our models.[13]

Our findings are compelling, but have limitations. In addition to the study design caveats mentioned previously, it is important to acknowledge that, as evidenced by the nonlinear association between increasing laws and decreased firearm injury, all laws are not equivalent, and further research is necessary to identify the combination of laws that might best prevent homicide. Furthermore, we were unable to quantify enforcement in our models, which evidence suggested is an important factor in determining the effect of laws.[8,14,15]

**TABLE 1—Mean Annual Homicide Rates by State and State Laws Regulating Federally Licensed Firearm Dealers: United States, 1995–2010**

| State | Mean Homicide Rate | License | Records | Inspections | Thefts |
|---|---|---|---|---|---|
| Alabama | 7.27 | Yes | Yes | No | No |
| Alaska | 4.46 | No | Yes | No | No |
| Arizona | 6.18 | No | No | No | No |
| Arkansas | 5.82 | No | No | No | No |
| California | 5.06 | Yes | Yes | Yes | Yes |
| Colorado | 2.84 | No | Yes | Yes | No |
| Connecticut | 2.4 | Yes | Yes | Yes | No |
| Delaware | 3.49 | Yes | Yes | Yes | No |
| District of Columbia | 29.01 | Yes | Yes | No | No |
| Florida | 4.44 | No | No | No | No |
| Georgia | 5.62 | Yes | Yes | Yes | No |
| Hawaii | 1.09 | Yes | No | Yes | No |
| Idaho | 1.98 | No | No | No | No |
| Illinois | 5.37 | No | Yes | Yes | No |
| Indiana | 4.41 | Yes | No | No | No |
| Iowa | 1.25 | No | No | No | No |
| Kansas | 3.36 | No | No | No | No |
| Kentucky | 3.78 | No | No | No | No |
| Louisiana | 10.5 | No | No | No | No |
| Maine | 1.31 | No | Yes | Yes | No |
| Maryland | 6.79 | Yes | Yes | Yes | No |
| Massachusetts | 1.49 | Yes | Yes | Yes | Yes |
| Michigan | 5.22 | No | Yes | Yes | Yes |
| Minnesota | 1.72 | No | No | Yes | No |
| Mississippi | 7.76 | No | Yes | Yes | No |
| Missouri | 5.3 | No | No | No | No |
| Montana | 2.64 | No | No | No | No |
| Nebraska | 2.29 | No | No | No | No |
| Nevada | 5.7 | No | No | No | No |
| New Hampshire | 0.99 | Yes | No | No | No |
| New Jersey | 2.6 | Yes | Yes | Yes | Yes |
| New Mexico | 5.07 | No | No | No | No |
| New York | 3.09 | Yes | Yes | Yes | Yes |
| North Carolina | 5.43 | No | Yes | Yes | No |
| North Dakota | 1.07 | No | No | No | No |
| Ohio | 3.21 | No | No | No | Yes |
| Oklahoma | 4.4 | No | No | No | No |
| Oregon | 2.23 | No | Yes | Yes | No |
| Pennsylvania | 4.2 | Yes | Yes | No | No |
| Rhode Island | 1.89 | Yes | Yes | Yes | No |
| South Carolina | 5.58 | Yes | Yes | Yes | No |
| South Dakota | 1.03 | No | No | No | No |
| Tennessee | 6.07 | No | Yes | Yes | No |
| Texas | 4.53 | No | No | No | No |

Firearm homicide is a persistent threat to societal well-being. Our study highlights regulatory approaches states could take to potentially decrease firearm homicide. Through tougher regulation of firearm dealers, it might be possible to prevent firearm-related deaths. ∎

## About the Authors

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## References

1. USDOJ, Office of the Inspector General. Review of ATF's Federal Firearms Licensee inspection program. April 2013. Available at: http://www.justice.gov/oig/reports/atf.htm. Accessed January 10, 2014.

2. Wintemute G. Firearm retailers' willingness to participate in an illegal gun purchase. *J Urban Health*. 2010;87(5):865–878.

3. Wintemute GJ. Frequency of and responses to illegal activity related to commerce in firearms: findings from the Firearms Licensee Survey. *Inj Prev*. 2013;19(6):412–420.

4. Sorenson SB, Vittes KA. Buying a handgun for someone else: firearm dealer willingness to sell. *Inj Prev*. 2003;9(2):147–150.

5. Rosengart M, Cummings P, Nathens A, et al. An evaluation of state firearm regulations and homicide and suicide death rates. *Inj Prev*. 2005;11(2):77–83.

**TABLE 1—Continued**

| | | | | | |
|---|---|---|---|---|---|
| Utah | 1.8 | No | No | No | No |
| Vermont | 1.31 | No | Yes | Yes | No |
| Virginia | 4.32 | Yes | Yes | Yes | No |
| Washington | 2.39 | Yes | Yes | No | No |
| West Virginia | 3.62 | No | No | No | No |
| Wisconsin | 2.46 | No | Yes | No | No |
| Wyoming | 2.15 | No | Yes | Yes | No |

**TABLE 2—Adjusted Effect of the State Regulations on Firearm Homicides: United States, 1995–2010**

| Outcome/Laws | IRR (95% CI) | AIC |
|---|---|---|
| Homicide rate | | 34.65 |
| Licensing | 0.74* (0.67, 0.81) | |
| Record keeping | 1.45* (1.30, 1.61) | |
| Inspections | 0.64* (0.59, 0.69) | |
| Theft reporting | 1.04 (0.95, 1.14) | |
| Licensing and inspections | 0.49* (0.42, 0.58) | |
| Strength | | 34.65 |
| 1 law | 1.10 (0.96, 1.26) | |
| 2 laws | 0.94 (0.85, 1.05) | |
| 3 laws | 0.76* (0.67, 0.86) | |
| 4 laws | 0.75* (0.65, 0.86) | |

*Note.* AIC = Akaike's information criterion; CI = confidence interval; IRR = incident rate ratio. Covariates in the model included race, percent urban, percent living in poverty, percent male, percent younger than 24 years old, percent college educated, drug arrest rate, burglary rates,[12] scores, and firearm ownership proxy.
*$P \leq .001$.

# The Impact of Data Suppression on Local Mortality Rates: The Case of CDC WONDER

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CDC WONDER (Centers for Disease Control and Prevention Wide-Ranging Online Data for Epidemiologic Research) is the nation's primary data repository for health statistics. Before WONDER data are released to the public, data cells with fewer than 10 case counts are suppressed. We showed that maps produced from suppressed data have predictable geographic biases that can be removed by applying population data in the system and an algorithm that uses regional rates to estimate missing data. By using CDC WONDER heart disease mortality data, we demonstrated that effects of suppression could be largely overcome. (*Am J Public Health.* 2014;104:1386–1388. doi: 10.2105/AJPH.2014.301900)

6. Conner KR, Zhong Y. State firearm laws and rates of suicide in men and women. *Am J Prev Med.* 2003;25 (4):320–324.

7. Webster DW, Vernick JS, Zeoli AM, Manganello JA. Association between youth-focused firearm laws and youth suicides. *JAMA.* 2004;292(5):594–601.

8. Webster DW, Vernick JS, Bulzacchelli MT. Effects of state-level firearm seller accountability policies on firearm trafficking. *J Urban Health.* 2009;86(4):525–537.

9. Vernick JS, Webster DW, Bulzacchelli MT, Mair JS. Regulation of firearm dealers in the United States: an analysis of state law and opportunities for improvement. *J Law Med Ethics.* 2006;34(4):765–775.

10. Miller M, Hemenway D, Azrael D. State-level homicide victimization rates in the US in relation to survey measures of household firearm ownership, 2001–2003. *Soc Sci Med.* 2007;64(3):656–664.

11. Wiebe DJ. Homicide and suicide risks associated with firearms in the home: a national case-control study. *Ann Emerg Med.* 2003;41(6):771–782.

12. Kappas S. *Traveler's Guide to the Firearm Laws of the Fifty States.* Covington, KY: Traveler's Guide Inc; 1997–2010.

13. Braga AA, Wintemute GJ, Pierce GL, Cook PJ, Ridgeway G. Interpreting the empirical evidence on illegal gun market dynamics. *J Urban Health.* 2012;89 (5):779–793.

14. Webster DW, Vernick JS, Bulzacchelli MT, Vittes KA. Temporal association between federal gun laws and the diversion of guns to criminals in Milwaukee. *J Urban Health.* 2012;89(1):87–97.

15. Webster DW, Bulzacchelli MT, Zeoli AM, Vernick JS. Effects of undercover police stings of gun dealers on the supply of new guns to criminals. *Inj Prev.* 2006;12 (4):225–230.

CDC WONDER (Centers for Disease Control and Prevention Wide-Ranging Online Data for Epidemiologic Research) provides county-level data on directly age-adjusted mortality rates, and age- and gender-stratified mortality and population counts.[1] To protect against the potential disclosure of personal health information, WONDER suppresses any statistic (counts or rates) calculated using fewer than 10 observations.[2] However, such suppression restricts the utility of WONDER data to compute and map reliable rates for areas with small populations, for short time periods, or for rare diseases.[3,4] Furthermore, rates that are indirectly adjusted for age, which are currently not provided by WONDER, can only be calculated for those counties where count data are not suppressed.[5,6] Using an example of heart disease mortality, we showed