



Firearm assaults against US law enforcement officers in the line-of-duty: Associations with firearm ownership and state firearm laws

Ariana N. Gobaud^{a,*}, Christina A. Mehranbod^a, Paul M. Reeping^a, Brady R. Bushover^a, Christopher N. Morrison^{a,b}

^a Department of Epidemiology, Columbia University Mailman School of Public Health, NY, NY, United States

^b Department of Epidemiology and Preventive Medicine, Monash University School of Public Health and Preventive Medicine, Melbourne, Australia

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ABSTRACT

Law enforcement officers are disproportionately affected by occupational injury. Firearm violence is the second leading cause of occupational mortality for this group behind motor vehicle crashes. In the general population, greater firearm ownership and weaker firearm laws are associated with increased firearm violence incidence. It is plausible that a high prevalence of firearms could also be associated with a greater incidence of LEO assault with a firearm. Using data from the Federal Bureau of Investigation's, Uniform Crime Reporting, Police Employee Data for 2006–2016, we conducted a panel analysis to estimate the association between state-level estimates of household firearm ownership and LEO assault with a firearm. We additionally examined if effect modification by universal background check law status was present. Higher state-level firearm ownership was associated with an increased odds of LEO assault with a firearm in multi-level models. This association was modified by universal background check law status. In states without a universal background check law, for every 1% increase in state-level firearm ownership per agency-year, there was a 12.4% increase in the odds of an LEO assault with a firearm when adjusting for confounders (OR:1.124; 95% CI:1.018,1.240). In states with a universal background check law, there was no association. Findings, though small in magnitude, suggest aggregate firearm ownership may contribute to LEO assault with a firearm in states without a universal background check law. Future research to prevent LEO assault with a firearm should combine measures to address high rates of firearm ownership with other evidence-based prevention strategies.

1. Introduction

Occupational injury among law enforcement officers (LEOs) remains high compared to the average worker in the United States (US). LEOs have three times greater risk of firearm homicide compared to the general US population. Firearm violence is the second leading cause of occupational mortality for this group behind motor vehicle crashes (Tiesman et al., 2010; Tiesman et al., 2013). Although LEOs are at higher risk for assault with a firearm, LEOs are recruited, equipped, and trained to encounter dangerous situations (Pinizzotto et al., 2007). Despite their specialized training and equipment, the higher risk of assault persists (Swedler et al., 2014).

Previous research that examined occupational hazards among LEOs have focused on describing situational contexts in which LEOs are assaulted (Crifasi et al., 2016; Blair et al., 2016). The two most commonly cited data sources in these studies are the Federal Bureau of

Investigation's (FBI) Uniform Crime Reporting (UCR) Law Enforcement Officers Killed or Assaulted (LEOKA) data and the Center for Disease Control and Prevention's (CDC) National Violent Death Reporting System (NVDRS) data. However, both of these data sources have limitations. All reports to the UCR are voluntary; therefore, the number of agencies with reported annual data is subject to change. Studies have largely ignored the potential yearly change in data and instead conduct analyses using annual count of events at the state-level over some time period (Crifasi et al., 2016; Swedler et al., 2015). This introduces a selection bias that results in over or underestimation of study results depending on the number of agencies reporting data for a given year. Alternatively, studies using NVDRS data are restricted by the number of states that provide data (Blair et al., 2016; Sivaraman et al., 2020). The NVDRS began collecting data in 2002 from six states and only expanded to all 50 states in 2018 (CDC, 2019). Thus, the generalizability and statistical power of these results is limited.

* Corresponding author at: 722 West 168th St, Room R516, New York, NY 10032, United States.

E-mail address: ang2167@cumc.columbia.edu (A.N. Gobaud).

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Studies of the general population consistently identify that greater firearm ownership is associated with an increased incidence of firearm violence (Cook and Ludwig, 2006; Miller et al., 2002). It is plausible that LEOs—who have increased occupational risk for assault with a firearm—will have even greater risk in states with higher rates of household firearm ownership. Prior research has shown states with higher rates of firearm ownership see higher rates of LEO homicide (Swedler et al., 2015). It is possible that a higher rate of firearm ownership increases the likelihood that people will have weapons during police encounters or have a firearm in the car during a traffic stop. Alternatively, law enforcement officers may perceive greater danger from the public when more firearms are available, resulting in higher rates of use of force against civilians.

To reduce firearm violence in the US, numerous state and federal laws have been implemented that limit citizen access to firearms. Several of these laws have been shown to be associated with lower rates of homicide and nonfatal firearm injuries (Fleegler et al., 2013; Simonetti et al., 2015). Universal background check laws, which require both licensed dealers and private sellers to conduct background checks at point of purchase for all firearms, are unique among firearm policies in that the passage of such laws has been shown to be moderately effective in reducing firearm homicide in states that have adopted them. For example, they have been shown to be associated with a 19 % decrease in African American homicide (Kaufman et al., 2020). Evidence remains limited for most other firearm policies having a clear benefit in the prevention of firearm assault and homicide. However, research has shown when background check requirements are removed there is an increase in firearm homicide (Webster et al., 2014).

The aim of this study was to estimate the association between state-level estimates of household firearm ownership and LEO assault with a firearm in the US and to determine whether effect modification by universal background check law status was present.

2. Material and methods

2.1. Study design

We conducted an ecological panel analysis to estimate the association between the estimated household firearm ownership in each state and LEO assault with a firearm. The units of analysis were law enforcement agency-years. Law enforcement agencies eligible for inclusion were located in 46 states that contributed annual data to LEOKA from 2006 to 2016 (Webster et al., 2014). Four states (WA, WV, WI and WY) were not included in these analyses because none of the police departments in these jurisdictions reported data to the FBI's UCR LEOKA database.

A total of 11,346 law enforcement agencies reported full data over the 11 years, thus the analytic dataset was a balanced panel of 124,806 agency-years. The analysis was performed at the agency level to minimize measurement error since not all law enforcement agencies in each state reported annual data to LEOKA.

2.2. Variables

The dependent variable quantified the incidence of LEOs assault with a firearm for each agency-year. Since the overall count of assault events for each agency per year was low, we dichotomized the outcome to indicate whether there were any LEO assaults with a firearm.

The main independent variable was a state-level estimate of household firearm ownership. We obtained firearm ownership data from the RAND Corporation's public database of state-level estimates of household firearm ownership from 1980 to 2016 (Kaufman et al., 2020; Siegel, 2020).

Other independent measures included the rate of LEOs per 1,000 persons in the agency jurisdiction for each agency-year and other time-varying state-level characteristics that could confound associations

between firearm laws and officer assaults. Time-varying state-level characteristics included the total population, the percent of the population that is male and white, median age, median household income, and the total number of firearm laws. We used the American Community Survey 5-year estimates for 2011–2016 and 2010 decennial Census data for 2006–2010 to obtain all state-level demographic confounders [17,18]. We did not include other agency, city-, or county-level variables because law enforcement agencies are not neatly geographically nested. For example, the University of California Berkeley (UCB) police department is located in Berkeley, CA in Alameda County. The UCB police department has primary law enforcement jurisdiction on the UCB campus and associated properties. It does not have primary responsibility for responding to incidents in the city or county at large. To minimize measurement error, we did not to include measures at geographic levels lower than states. We obtained firearm law data from the State Firearm Law Database [19], a publicly available catalogue of state-level firearm provisions. To calculate the total number of firearm laws, we summed the number of laws per year for a given state.

2.3. Statistical analysis

We used two multilevel logistic regression models to conduct complete case analyses. Models were specified as:

$$\ln\left(\frac{\pi_{it}}{1-\pi_{it}}\right) = (\beta_0 + \beta_s) + \beta_1 \bullet \text{firearm_ownership}_{st} + \beta_2 \bullet \text{background_checks}_{st} + \beta_n \bullet X'_1 it$$

where π_{it} is the probability of observing an assault in agency i during year t . The constant term β_0 is an overall intercept and β_s is a state-level random intercept that accounts for the likelihood that assault risks in agencies from the same state are more likely to be similar. The coefficient β_1 is the parameter estimate for the association between the state firearm ownership rate and assault incidence, and β_2 is the parameter estimate for associations for universal background check laws. The terms β_n and X'_1 are the parameter estimates and a matrix of time-varying agency and state-level independent variables, including the number of LEOs, the size of the population served, and a count of other state firearm laws.

We conducted additional analyses to assess effect modification by universal background check law status. We sought to determine whether the association between state-level firearm ownership and assault of an LEO differed between states with and without universal background check laws in place. Using the State Firearm Law Database mentioned above, we identified the presence or absence of a universal background check law for each state for each year.

2.4. Ethics statement

This study utilizes publicly available data and was deemed not to be human subjects' research by the Columbia University Institutional Review Board.

3. Results

In total, 5,711 of the 11,346 law enforcement agencies had at least one LEO assault with a firearm from 2006 to 2016. Of the 46 states included in the study the average household firearm ownership rate was 36.3 % (SD = 0.1 %) and 20 % of included agency-years were in states with universal background check laws in effect (Table 1).

There was an association between state-level firearm ownership and LEO assault with a firearm. For every 1 % increase in state-level firearm ownership per agency-year, there was a 13.3 % increase in the odds of a LEO assault with a firearm when adjusting for confounders (OR = 1.133; 95 % CI: 1.027 – 1.250) (Table 2).

The association was modified by universal background check status.

Table 1
Descriptive Statistics for 11,371 law enforcement agencies, 2006–2016 (n = 125,081 agency years).

Variable	n	%	Mean	Standard Deviation	Minimum	Maximum
<i>Agency-Level</i>						
LEO assault with a firearm	57,111	5.0				
Rate of LEO Per 1,000 Persons in the Agency Jurisdiction			24.3	32.2	0	989.0
<i>State-Level</i>						
Household Firearm Ownership Rate			36.3	0.1	3.4	69.0
Total Number of Firearm Laws			26.7	23.0	2	104
Universal Background Check Laws	21,287	1.9				
State Population			7,275,918	6,362,552	621,254	39,250,017
% Male			50.9	0.6	47.6	51.7
% White			75.6	11.9	24.9	95.6
Median Age			60.3	2.7	51.6	68.7

Law enforcement agency data was obtained from the Federal Bureau of Investigation’s (FBI) Uniform Crime Reporting (UCR) Law Enforcement Officers Killed or Assaulted (LEOKA) database. Data was provided for 46 states (WA, WV, WI, and WY were not included).

Table 2
Odds ratios and 95 % confidence intervals for the association between LEO assault with a firearm for 11,371 law enforcement agencies, 2006–2016 (n = 125,081 agency years) with and without effect modification by universal background check (UBC) status.

<i>No Effect Modification</i>	OR	(95 % CI)	
Firearm ownership	1.133	(1.027,	1.250)
UBC	1.391	(1.317,	1.469)
Rate of LEO per 1,000 Persons in the Agency Jurisdiction	0.876	(0.831,	0.924)
Total Number of Firearm Laws	1.315	(1.179,	1.467)
State Population	0.712	(0.667,	0.759)
% Male	0.693	(0.658,	0.730)
% White	1.287	(1.207,	1.374)
Median Age	0.879	(0.832,	0.928)
Median Household Income	1.005	(0.970,	1.042)
<i>Effect Modification by UBC</i>			
Firearm ownership	1.124	(1.018,	1.240)
UBC	1.332	(1.257,	1.411)
Rate of LEO per 1,000 Persons in the Agency Jurisdiction	0.871	(0.825,	0.919)
Total Number of Firearm Laws	1.304	(1.168,	1.456)
State Population	0.724	(0.675,	0.778)
% Male	0.688	(0.652,	0.726)
% White	1.285	(1.204,	1.371)
Median Age	0.895	(0.846,	0.946)
Median Income	1.003	(0.968,	1.040)
Firearm ownership * UBC	0.887	(0.840,	0.936)

Law enforcement agency data was obtained from the Federal Bureau of Investigation’s (FBI) Uniform Crime Reporting (UCR) Law Enforcement Officers Killed or Assaulted (LEOKA) database. Data was provided for 46 states (WA, WV, WI, and WY were not included).

Bolded values are statistically significant at an alpha value of 0.05.

In states without a universal background check law present, for every 1 % increase in state-level firearm ownership per agency-year, there was a 12.4 % increase in the odds of a LEO assault with a firearm when adjusting for confounders (OR = 1.124; 95 % CI: 1.018, 1.240). In states with a universal background check law present, there was no association (Table 2).

4. Discussion

This ecological panel analysis identified that law enforcement agencies located in states without a universal background check law have an increased odds of LEO assault with a firearm. The statistically significant results, however, were small in magnitude. There is no effect on LEO assault with a firearm in states with a universal background check law.

Previous studies evaluating the association between firearm

ownership and firearm injuries and fatalities in the US have largely focused on the effect on the general population (Fleegler et al., 2013). Firearm legislation may act to reduce firearm assaults by reducing firearm prevalence. Specifically, laws that regulate who has access to firearms appear to be more effective than those regulating the type of firearms that can be obtained (Siegel, 2020). Our results support the findings in the general population, as firearm ownership was associated with higher levels of LEO assault with a firearm. We also found that this association was modified by the presence of a universal background check law.

This study should be interpreted with its limitations in mind. First, it included only associative analysis and cannot suggest any causative mechanisms. Second, although we adjusted for many state-based factors associated with firearm assault among LEOs, there may be additional factors not considered in our model that could confound associations between firearm laws and LEO assault incidence (e.g., policy enforcement). Third, we are inherently limited by data availability. There is no publicly available data on firearm ownership. As a result, we rely on estimates such as those provided by the RAND Corporation. However, these estimates do not reflect illegally obtained firearms. It is unclear if the rate of illegal firearm possession differs based on universal background check law status and how this might bias our results. Also, several states are not included in the UCR LEOKA data. Nonetheless, the FBI uses a strict definition of LEOs for inclusion in its UCR reports (Uniform Crime Reporting Handbook, 2004). Other data sources, including the Bureau of Labor Statistics’ Census of Fatal Occupational Injuries and the National Law Enforcement Memorial fund, use broader definitions of LEOs (Tiesman et al., 2013). The UCR LEOKA data best fits the purpose of our study which was to assess the risk of LEO assault with a firearm in the line of duty. Additionally, since occupational assaults of LEOs with a firearm are important events, it is unlikely that a local law enforcement agency would fail to report the assault of one of its own officers to the FBI.

Understanding the role of firearm prevalence and universal background check laws on LEO assault with a firearm will be key for occupational injury prevention. Attention to the observed effect specifically of increased state-level firearm ownership on LEO assault with a firearm in states without universal background check laws may provide insight for new intervention strategies to reduce occupational injury of LEOs. Future research and advocacy resources to prevent LEO assault with a firearm should combine measures to address high rates of firearm ownership with other evidence-based prevention strategies.

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CRedit authorship contribution statement

Ariana N. Gobaud: Conceptualization, Data curation, Writing – original draft, Visualization. **Christina A. Mehranbod:** Writing – review & editing. **Paul M. Reeping:** Writing – review & editing. **Brady R. Bushover:** Writing – review & editing. **Christopher N. Morrison:** Conceptualization, Supervision, Data curation, Writing – review & editing.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

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