

# Firearm Death Rates and Association with Level of Firearm Purchase Background Check

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**Background:** Past ecologic analyses of firearm deaths have studied the effects of various gun-control laws; however, no study has analyzed the effects of the differences among states in the background checks required for firearm purchase. Some states utilize a federal agency to conduct the background checks; others use a state agency; still others use a local agency. The information potentially available to checking agencies at different levels of government varies; the consequence of this variation is not known.

**Methods:** In 2007, negative binomial regression models were used to assess the association between the Department of Justice classification of agencies conducting firearm background checks for each state in 2002–2004 and firearm suicide and homicide rates for the same years from the National Center for Injury Prevention and Control while controlling for age, race, unemployment, crime, income inequality, poverty, alcohol consumption, urbanization, and divorce rate.

**Results:** Performing local-level background checks was associated with a 27%-lower firearm suicide rate (incidence rate ratio [IRR]=0.73, 95% CI=0.60, 0.89) and a 22%-lower homicide rate (IRR=0.78, 95% CI=0.61, 1.01) in adults  $\geq 21$  years.

**Conclusions:** Using local-level agencies to perform firearm background checks is associated with reduced rates of firearm suicide and homicide. Methods to increase local-level agency background checks, such as authorizing local police or sheriff's departments to conduct them, or developing the capability to share local-level records with federal databases, should be evaluated as a means of reducing firearm deaths.

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## Background

The Brady Handgun Violence Prevention Act mandates background checks on individuals who purchase firearms from federally licensed firearm dealers. Under the Brady Act, which establishes the federal minimum for gun-control laws, a person is disqualified from purchasing a firearm if he or she is under indictment or convicted of a crime punishable by more than 1 year in prison, is a fugitive from justice, is unlawfully a user of a controlled substance, has been adjudicated as a mental defective or committed to a mental institution, was dishonorably discharged from the armed services, has renounced U.S. citizenship, is subject to a restraining order, or has been convicted of domestic violence.<sup>1</sup> Any of the above criteria is manda-

tory grounds for rejection of a firearm purchase; however, the agencies that conduct background checks often lack the data necessary to conduct a complete search.<sup>2</sup> The digitization of state records may be partial, and information may not be made available to federal databases because of either budgetary constraints on the state level or legal restrictions that prevent the sharing of local data.<sup>2,3</sup>

The effect of the Brady Act on suicide and homicide rates has been analyzed and found to have limited impact except for certain subpopulations.<sup>4</sup> Several additional state regulations, including age-specific restrictions, one-gun-a-month laws, junk-gun laws, and concealed-weapon laws do not appear to confer a significant benefit.<sup>5–7</sup> Nonetheless, differences in interstate firearm mortality exist that have not been fully explained by previously studied factors.

To the best of our knowledge, no study has evaluated the effect of the quality of a state's firearm background check on firearm death rates. State-by-state differences in the level of background checks, and hence the detail and availability of the data that a check accesses, may determine whether the check is fully effective at preventing firearm sales to individuals who are prohibited by law from purchasing a gun.

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When an individual desires to purchase a gun from a federally licensed dealer, the dealer uses telephone, mail, or electronic communication to contact the agency that the state has designated as being responsible for conducting firearm background checks. The agency that is contacted will be one of three possibilities: the FBI, a single state agency, or a local law enforcement department such as a municipal police or sheriff's office. The designated agency then conducts the background check and informs the dealer if the sale can proceed. Each state, whether it utilizes a federal, state, or local checking agency, accesses the National Instant Criminal Background Check System (NICS), a system that scans federal databases and is the minimum check that must be performed. However, states that utilize a state or local office for background checks "have access to all of the information available to the FBI through NICS, plus some . . . have additional information available only to their respective state."<sup>2</sup> Therefore, depending on which agency is conducting the background check, additional records may be accessed,<sup>1</sup> resulting in a more detailed and effective check.

In 2004, approximately 8,084,000 applications were received for firearm transfers nationwide and 126,000, or 1.6%, were rejected.<sup>8</sup> Also in that year, firearms were involved in 29,036 deaths.<sup>9</sup> Suicides and homicides constituted 57.2% and 38.7% of the firearm deaths, respectively.

This study analyzed the effect of conducting federal-, state-, or local-level background checks on firearm death rates. It was hypothesized that states that conduct background checks on a more local level would be associated with lower suicide and homicide rates because local agencies, with access to more-detailed criminal reports and records that are not readily available to the federal government, would be able to perform more thorough background checks.

## Methods

### State Classifications

The level of the background checks performed by each of the 50 states was classified using the annual Bureau of Justice Statistics published table of agencies conducting firearm background checks.<sup>10</sup> This table, and the publication containing it, detail the level of government involved in conducting either the entire background check or a significant portion (i.e., handgun checks or checks separate from the NICS)<sup>11</sup> as determined by state law. For the analysis, states were classified according to the background check agency reported in the Bureau of Justice Statistics publication: federal level if the background check agency was the FBI, state level if the agency was a centralized state agency, or local level if the background check agency was a municipal police or sheriff's office.

The data analysis was performed in 2007; the time period analyzed was 2002–2004. This time period was chosen because the level of the background checks performed by each

state remained unaltered with the exception of only two states. Vermont switched from using a state-level to a federal-level check on February 2, 2002, and Arizona switched on August 22, 2002. These states were included in the analysis at the federal-level category because they switched background-check levels very early in the study period and their inclusion would only support the null hypothesis that there exists no benefit to performing more local background checks. Furthermore, analyses were performed excluding these states; overall trends remained unaltered (results not shown).

The time period of the study could not be expanded past 2004 because federal statistics on firearm death rates were not available beyond that year. Because only three states have changed background-check levels since 1999, the first full year in which the permanent Brady Act and NICS were in place, it was not possible to create a longitudinal analysis comparing the states pre- and post-changes in background-check levels. Therefore, the study design compared states to one another.

### Outcome Variables

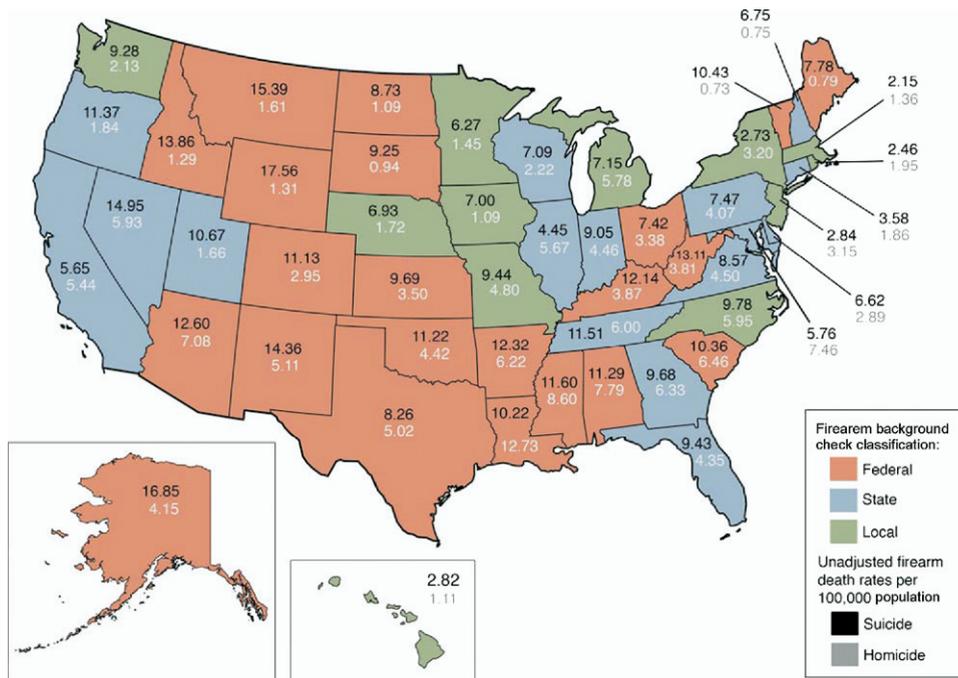
Aggregated rates of firearm suicide and homicide mortality per 100,000 population for 2002 to 2004 were calculated for each state from the National Center for Injury Prevention and Control's Web-based Injury Statistics Query and Reporting System (WISQARS).<sup>12</sup> Rates were calculated for individuals aged 21 or older because federal law prohibits a federally licensed firearm dealer from selling a handgun to anyone under age 21.<sup>1</sup> Studying the firearm suicide rates for individuals aged 21 or older allows a more precise analysis of the effectiveness of the Brady Act because it excludes younger individuals who may have committed suicide with a gun that they did not purchase. Additionally, looking at firearm homicide deaths in individuals aged  $\geq 21$  also provides a more refined analysis because the ages of homicide victims and perpetrators are correlated.<sup>4,13</sup> Homicide deaths due to legal intervention were excluded from the analysis.

### Statistical Analyses

Negative binomial regression was used to evaluate the association between a state's firearm suicide and homicide rates and its level of background checks while controlling for potential confounders. Negative binomial regression is useful when rates are skewed and variances are greater than the mean, as is typical of death rates.<sup>14</sup> Likelihood ratio tests were performed, revealing that the distribution was not Poisson. Regression analyses were performed in Stata 9.2.

The multivariate analyses controlled for potentially confounding factors commonly identified in the literature as being associated with a state's homicide or suicide rate: percentage of the population unemployed<sup>15</sup>; robbery rate<sup>16</sup>; income inequality level (as measured by the Gini coefficient)<sup>17</sup>; percentage of individuals living in poverty<sup>18</sup>; per capita alcohol consumption<sup>19,20</sup>; percentage of the population living in metropolitan areas<sup>21,22</sup>; divorce rate<sup>23,24</sup>; age (percentage aged  $\geq 65$  for suicide and percentage aged 15–29 for homicide)<sup>25,26</sup>; and race (percentage white for suicide and percentage black for homicide).<sup>26,27</sup>

All data for potential confounders were obtained from the U.S. Census Bureau's Statistical Abstract<sup>28</sup> except for alcohol consumption data, which were taken from the National



**Figure 1.** Level of agency involved in conducting state background checks and unadjusted firearm suicide and homicide rates, 2002–2004.

Institute on Alcohol Abuse and Alcoholism,<sup>29</sup> and the robbery rate, which was taken from the FBI’s Uniform Crime Reports.<sup>30</sup> Most data used in the regression models were measured annually. The percentage of the population living in metropolitan areas and the income-inequality level were available only for the 2000 Census data. Divorce rates were available only for 2003 and 2004. In two states, California and Hawaii, divorce rate data were not reported in 2003 or 2004, so rates from the most recently available year were used—the 1990 and 2000 censuses, respectively. The state of Indiana does not report divorce rate data, and was therefore dropped from the analysis, with 49 states remaining in the final model. The divorce rate was included as a potential confounder because it is highly associated with rates of both firearm suicide and homicide.

For more targeted investigation, the effect of the level of background checks on firearm suicide and homicide rates in age groups (0–14, 15–24, 25–34, 35–44, 45–54, 55–64, and ≥65) was examined by plotting rates over the age groups for each level of background check.

## Results

Figure 1 shows the level of each state’s firearm background check (federal, state, or local) and presents each state’s crude firearm suicide and homicide rate. Background checks were classified as federal level for 21 states, as state level for 17 states, and as local level for 12 states. **The crude rates of firearm suicide showed a distinct reduction as background checks were performed on a more local level** (Table 1); the rates for federal, state, and local classifications were 11.64, 8.45, and 5.74 per 100,000 population, respectively. Firearm

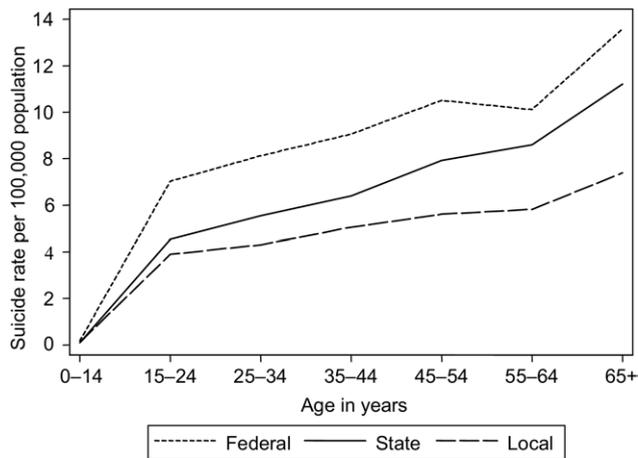
**homicide rates also showed a trend of reduced rates as background checks were performed at a more local level;** for federal, state, and local classifications, the rates were 4.28, 4.02, and 2.81 per 100,000 population, respectively.

Figures 2 and 3 show the association of background checks with firearm suicide and homicide rates for the various age groups analyzed. Local checks showed a lower rate for both homicide and suicide across all age groups. The difference between federal and local checks was most distinct in homicides for people aged 15–44, while firearm suicide rates were distinctly lower in states with local checks compared to those with federal checks for people aged 15–24 and older.

**Table 1.** Unadjusted firearm suicide and homicide rates and IRRs in states with federal, state, or local firearm purchase background checks, individuals aged ≥21, 2002–2004

Background-check level	Rate per 100,000 population	IRR (95% CI)
<b>Firearm suicides</b>		
Federal	11.64	1.0 (ref)
State	8.45	0.73 (0.58, 0.92)
Local	5.74	0.50 (0.38, 0.64)
<b>Firearm homicides</b>		
Federal	4.28	1.0 (ref)
State	4.02	0.93 (0.62, 1.40)
Local	2.81	0.65 (0.42, 1.02)

IRR, incidence rate ratio

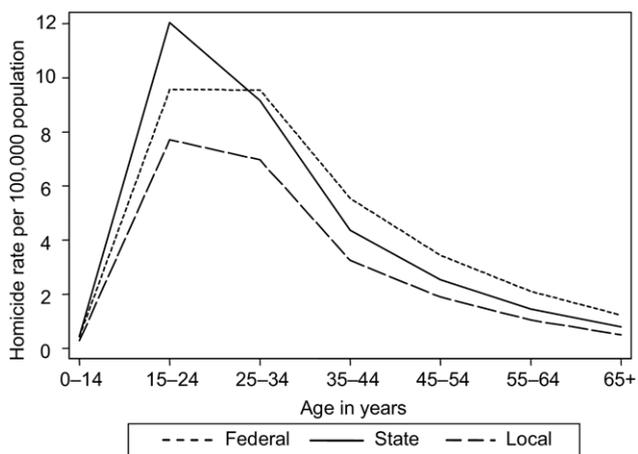


**Figure 2.** Firearm suicide rate per 100,000 population by age, within state firearm background check groups, 2002–2004.

Table 2 presents the multivariate analysis that adjusted for potentially confounding variables. These results demonstrated similar patterns with decreasing firearm suicide and homicide rates as background checks were performed by a more-local agency, but only the **incidence rate ratio (IRR)** for suicide in states conducting local checks had a CI that excluded 1.0. **Using federal-level checks as the reference group, when local agencies conducted background checks, firearm suicide rates showed an IRR of 0.73 (95% CI=0.60, 0.89), indicating that states with a local agency conducting background checks had a firearm suicide rate that was 27% lower than states with a federal agency conducting background checks.**

## Discussion

This study provided evidence that states that utilize local-level agencies to conduct firearm background



**Figure 3.** Firearm homicide rate per 100,000 population by age, within state firearm background check groups, 2002–2004.

**Table 2.** Adjusted IRRs for firearm suicide and homicide by state firearm background-check levels, individuals aged  $\geq 21$ , 2002–2004

Background-check level	Firearm suicides <sup>a</sup> IRR (95% CI)	Firearm homicides <sup>b</sup> IRR (95% CI)
Federal	1.0 (ref)	1.0 (ref)
State	0.97 (0.79–1.19)	0.84 (0.65–1.08)
Local	0.73 (0.60–0.89)	0.78 (0.61–1.01)

<sup>a</sup>Adjusted for percent unemployed, robbery rate, income inequality level, percent living in poverty, per capita alcohol consumption, percentage living in metropolitan areas, divorce rate, percent aged  $\geq 65$ , and percent white

<sup>b</sup>Adjusted for percent unemployed, robbery rate, income inequality level, percent living in poverty, per capita alcohol consumption, percentage living in metropolitan areas, divorce rate, percent aged 15–29, and percent black

IRR, incidence rate ratio

checks have reduced rates of firearm suicide and, possibly, firearm homicide.

**A significant reduction in firearm suicide rates with local-level background checks was seen for all subgroups of age, except for the group aged 0–14.** This is consistent with the legal reality that individuals in that age group cannot purchase a firearm from a federally licensed firearm dealer, so they theoretically should not be able to commit suicide with their own weapon.<sup>1</sup> **Gun availability is highly correlated with firearm suicide rates.**<sup>31</sup>

The reduction in firearm suicide rates associated with local-level background checks could have an important public health and economic impact. Individuals who attempt suicide with a firearm are far more successful than individuals who attempt suicide by other means.<sup>32</sup> Suicide attempted by firearm is also associated with markedly increased financial burdens on patients and healthcare systems compared to suicide attempted by other means.<sup>32</sup>

Firearm homicide rates were not as strongly associated with local background checks as were suicide rates. Homicide rates were reduced in states that conduct state and, to a greater degree, local background checks, but the CIs of the IRR included 1.0, and these findings could be attributable to chance.

As with suicides, the reduction in firearm homicide rates associated with local-level background checks would also have an important impact on public health and economic outcomes. Assaults involving a firearm are more lethal and more costly for patients and hospital systems than nongun assaults.<sup>33,34</sup>

**The greater reduction observed in firearm suicide rates compared to firearm homicide rates is consistent with the belief that more people who commit homicide obtain their guns from nonfederally licensed dealers compared to those who commit suicide.**<sup>35</sup> Nonetheless, the study findings suggest that firearm homicide rates may be reduced by local background checks, which is consistent with studies showing that gun-control laws create friction in illegal markets.<sup>36</sup>

Some noteworthy limitations of this study should be addressed. **This study failed to discover any significant benefit to the performance of background checks by state-level agencies compared to federal-level checks.** It is possible that some large, centralized state-level agencies have just as little access to local-level records as federal background-check agents do because of the great variability in state procedures.<sup>1</sup> A federal-level check performed by the FBI accesses the NICS, which performs the federally required minimum-level background check using national databases. States that are mandated by state law to conduct their own background checks also have an NICS check, but may search additional state records.<sup>1</sup> Unfortunately, it is difficult to quantify what additional data are accessed, the regularity of access, and the completeness of those data. Furthermore, for the states that perform local-level background checks, it is also difficult to clarify the quality and quantity of data that these local-level agencies are accessing, because there are more than 2800 such agencies.

It would have been ideal to conduct a longitudinal analysis in which the states that experienced changes in the level of their background checks were compared to themselves, pre- and post-change. However, since 1999 (the first full year in which the permanent Brady Act and NICS were in place), only Arizona, Vermont, and South Carolina have switched background-check levels in the time periods for which data are available. Furthermore, as South Carolina's switch occurred during the first year of data availability, there would not be sufficient pre- and post- data available for analysis of this state.

Nonetheless, this study has detected a strong association between more local-level background checks and lower firearm-suicide fatality rates, and it was hypothesized that this may be due to more-thorough background checks performed by local agencies. Indeed, the existence and potential problems of state-to-state differences in background-check detail have been raised by Congress,<sup>2,37</sup> and may be a plausible explanation for some of the variability in state firearm death rates.

It should also be mentioned that local-level background checks could possibly be acting as a proxy for other unmeasured factors. For example, states that involve local-level agencies in background checks may place an added political or societal value on firearm control and be devoting more financial, police, or legal resources to the issue. Some states routinely conduct federal- or state-level background checks on firearms but conduct more local-level checks when a gun purchaser is applying to carry a concealed weapon.<sup>1</sup> In other words, many states know which purchases are especially high-risk and are willing to divert more resources into evaluating those purchases. Results from this study suggest that it may be beneficial for states to

allocate resources to permit local police or sheriff's departments to conduct all background checks, or for states to develop the legal and fiscal capabilities to share all of their local-level records with federal databases.

Studies on the implementation of the Brady Act or other gun-control laws have generated inconclusive evidence on the association between such actions and suicide and homicide rates.<sup>4,6,38</sup> This ecologic study suggests a potential explanation for some of the inconsistencies in previous studies. State-by-state differences in the level of background checks—and hence the depth and availability of the data that the checks access—may be responsible for an important portion of the de facto effectiveness of gun-control attempts; these differences merit further investigation.

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