

# Handgun Legislation and Changes in Statewide Overall Suicide Rates

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**Objectives.** To examine the extent to which 4 laws regulating handgun ownership were associated with statewide suicide rate changes.

**Methods.** To test between-group differences in statewide suicide rate changes between 2013 and 2014 in all 50 states and the District of Columbia with and without specific laws, we ran analyses of covariance.

**Results.** We found significant differences in suicide rate changes from 2013 to 2014 in states with mandatory waiting periods and universal background checks relative to states without such laws. States with both laws differed significantly from those with neither. No significant differences in rate changes were noted for open carry restrictions or gun lock requirements.

**Conclusions.** Some state laws regulating aspects of handgun acquisition may be associated with lower statewide suicide rates. Laws regulating handgun storage and carrying practices may have a smaller effect, highlighting that legislation is likely most useful when its focus is on preventing gun ownership rather than regulating use and storage of guns already acquired.

**Public Health Implications.** The findings add to the increasing evidence in support of a public health approach to the prevention of suicide via firearms, focusing on waiting periods and background checks. (*Am J Public Health.* 2017;107:579–581. doi:10.2105/AJPH.2016.303650)

**F**irearms account for approximately half of all suicide deaths in the United States.<sup>1</sup> A strong literature base has indicated an association between firearm ownership and suicide, even after accounting for a wide range of clinically relevant variables.<sup>2–6</sup> Studies also have identified safe firearm storage as an important consideration.<sup>7,8</sup>

Recently, Anestis and Anestis<sup>9</sup> identified a significant association between statewide overall suicide rates and several state laws regulating handgun ownership and exposure. These laws—mandatory waiting periods, universal background checks, gun lock requirements, and limitations on open carry—were associated with lower suicide rates, with each law having a significant indirect effect through the proportion of suicides resulting from firearms. The authors theorized that the laws might exert their effect through a decrease in suicide attempts, a decreased lethality in suicide attempt methods, or lower gun ownership.

Although promising, this study did not account for several potential risk factors, including gun ownership, depression, and suicidal ideation. Furthermore, the authors considered data from only 1 year. To address this, we reanalyzed the data from Anestis and Anestis,<sup>9</sup> considering a broader range of potential confounds, while examining whether the presence of these laws predicted changes in suicide rates from 2013 to 2014. We anticipated that, for each of the 4 laws, states without the law would have a significantly steeper increase in statewide suicide rates relative to states with the law. We also examined whether the joint presence of laws predicted a steeper decrease in suicide rates

than did the presence of only 1 law. Results consistent with our hypotheses would indicate that certain legislation may play a role in lowering state-level suicide rates, thereby highlighting their potential as prevention tools.

## METHODS

We derived statewide suicide data from the Centers for Disease Control and Prevention's Web-Based Injury Statistics Query and Reporting System. We obtained the status of specific state laws (mandatory waiting periods, universal background checks, gun lock requirements, open carry limitations) from the Law Center to Prevent Gun Violence. We coded laws dichotomously as present or absent. We included gun ownership rates, education levels, race/ethnicity, median age, state population and population density, poverty levels, elevation above sea level, and past-year rates of severe suicidal ideation and depression as covariates. Gun ownership rates were derived from Kalesan et al.<sup>10</sup> We derived our demographic data from the same sources as in the study by Anestis and Anestis.<sup>9</sup> We obtained rates of suicidal ideation and depression experienced in the past year from the National Surveys on Drug Use and Health.<sup>11</sup>

To test between-group differences in statewide suicide rate changes between 2013 and 2014 in all 50 states and the District of Columbia with and without specific laws, we ran a series of analyses of covariance. In each analysis, partial  $\eta^2$  was used as the index of effect size ( $\eta_p^2$ ; small = 0.01; medium = 0.06; large = 0.14). To our knowledge, no states changed their status on any of these laws during

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**TABLE 1—Analyses of Covariance Examining Between-Group Differences in Changes in State Overall Suicide Rates in States With and Without Specific Laws Regulating Handgun Ownership and Exposure: United States, 2013–2014**

Law	b	SE	95% CI	$\eta_p^2$
<b>Universal background checks, <math>R^2 = 0.28</math></b>				
% gun ownership in state	-0.01	0.02	-0.06, 0.03	0.01
% citizens $\geq 25$ y with college degree	0.08	0.06	-0.05, 0.20	0.04
% White	-0.03	0.01	-0.06, 0.00	0.08
Median age	0.10	0.09	-0.08, 0.29	0.03
2013 population	0.00	0.00	0.00, 0.00	0.04
% 2013 population below federal poverty line	0.04	0.08	-0.12, 0.20	0.01
2013 population density	0.00	0.00	0.00, 0.00	0.01
2013 suicide rate	-0.10	0.10	-0.31, 0.11	0.02
2013 statewide rate of serious suicidal ideation	0.00	0.00	0.00, 0.01	0.08
2013 depression rate	0.00	0.00	0.00, 0.00	0.08
Mean statewide elevation above sea level	0.00	0.00	0.00, 0.00	0.02
Universal background checks	1.15	0.55	0.04, 2.26	0.10
<b>Mandatory waiting periods, <math>R^2 = 0.29</math></b>				
% gun ownership in state	0.01	0.02	-0.04, 0.05	0.00
% citizens $\geq 25$ y with college degree	0.06	0.06	-0.07, 0.18	0.02
% White	-0.02	0.01	-0.05, 0.00	0.07
Median age	0.13	0.09	-0.06, 0.31	0.05
2013 population	0.00	0.00	0.00, 0.00	0.01
% 2013 population below federal poverty line	0.00	0.08	-0.17, 0.17	0.00
2013 population density	0.00	0.00	0.00, 0.00	0.00
2013 suicide rate	-0.07	0.10	-0.27, 0.13	0.01
2013 statewide rate of serious suicidal ideation	0.00	0.00	0.00, 0.00	0.02
2013 depression rate	0.00	0.00	0.00, 0.00	0.03
Mean statewide elevation above sea level	0.00	0.00	0.00, 0.00	0.01
Mandatory waiting periods	1.09	0.50	0.07, 2.10	0.11
<b>Universal background checks + mandatory waiting periods, <math>R^2 = 0.36</math></b>				
% gun ownership in state	-0.01	0.02	-0.05, 0.04	0.00
% citizens $\geq 25$ y with college degree	0.06	0.06	-0.06, 0.19	0.03
% White	-0.03	0.01	-0.06, 0.00	0.09
Median age	0.14	0.09	-0.04, 0.33	0.07
2013 population	0.00	0.00	0.00, 0.00	0.01
% 2013 population below federal poverty line	-0.01	0.08	-0.18, 0.15	0.00
2013 population density	0.00	0.00	0.00, 0.00	0.00
2013 suicide rate	-0.13	0.10	-0.33, 0.08	0.04
2013 statewide rate of serious suicidal ideation	0.00	0.00	0.00, 0.00	0.06
2013 depression rate	0.00	0.00	0.00, 0.00	0.07
Mean statewide elevation above sea level	0.00	0.00	0.00, 0.00	0.03
Universal background checks + mandatory waiting periods	2.29	0.68	0.93, 3.65	0.20
<b>Gun lock requirements in at least some circumstances, <math>R^2 = 0.21</math></b>				
% gun ownership in state	0.00	0.02	-0.05, 0.05	0.00
% citizens $\geq 25$ y with college degree	0.09	0.07	-0.05, 0.22	0.05
% White	-0.02	0.02	-0.05, 0.01	0.03
Median age	0.09	0.10	-0.10, 0.29	0.03
2013 population	0.00	0.00	0.00, 0.00	0.02
% 2013 population below federal poverty line	0.08	0.08	-0.09, 0.24	0.02
2013 population density	0.00	0.00	0.00, 0.00	0.02

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2013 to 2014, thereby precluding analyses examining the effect of shifts in law status.

## RESULTS

Information on law statuses, population, gun ownership, and suicide rates is available as a supplement to the online version of this article at <http://www.ajph.org>.

Results indicated that, whereas states with universal background checks had a decrease of 0.29 suicides per 100 000 population from 2013 to 2014, those without such laws had an increase of 0.85 per 100 000 ( $\eta_p^2 = 0.10$ ). Similarly, whereas states with mandatory waiting periods had a decrease of 0.38 suicides per 100 000 population, those without such laws had an increase of 0.71 per 100 000 ( $\eta_p^2 = 0.11$ ). In each case, effect sizes were medium to large. When considered in combination, states with both universal background checks and mandatory waiting periods differed from states with neither law, with the former reporting a decrease of 0.76 suicides per 100 000 population and the latter reporting an increase of 1.04 per 100 000. States with only background checks (decrease of 0.12 per 100 000) or waiting periods (decrease of 0.33 per 100 000) did not differ from any other group. The overall effect size for states with both universal background checks and mandatory waiting periods ( $\eta_p^2 = 0.20$ ) and the effect sizes for the significant contrast ( $\eta_p^2 = 0.16$ ) were large. States with and without laws regulating gun lock use or restricting open carry of handguns did not differ on changes in suicide rates from 2013 to 2014. These results are presented in Table 1.

## DISCUSSION

The current study expands on previous work in 2 ways: (1) considering a broader range of covariates and (2) examining changes in suicide rates between 2 years. Analyses indicated statistically significant changes in suicide rates from 2013 to 2014 for states with waiting periods and background checks, such that states with relevant legislation saw a decrease in suicide rates and states without relevant legislation saw an increase. Additionally, states with both of these laws in place differed significantly from those with neither, whereas states with only 1 law in place did not

TABLE 1—Continued

Law	b	SE	95% CI	$\eta_p^2$
2013 suicide rate	-0.05	0.11	-0.27, 0.17	0.01
2013 statewide rate of serious suicidal ideation	0.00	0.00	0.00, 0.00	0.03
2013 depression rate	0.00	0.00	0.00, 0.00	0.04
Mean statewide elevation above sea level	0.00	0.00	0.00, 0.00	0.01
Gun lock requirements in at least some circumstances	0.62	0.81	-1.02, 2.25	0.02
Restriction of open carry privileges, $R^2 = 0.24$				
% gun ownership in state	0.01	0.02	-0.04, 0.05	0.00
% citizens $\geq 25$ y with college degree	0.08	0.06	-0.05, 0.21	0.04
% White	-0.02	0.01	-0.05, 0.01	0.05
Median age	0.08	0.09	-0.11, 0.27	0.02
2013 population	0.00	0.00	0.00, 0.00	0.02
% 2013 population below federal poverty line	0.05	0.08	-0.11, 0.21	0.01
2013 population density	0.00	0.00	0.00, 0.00	0.01
2013 suicide rate	-0.07	0.11	-0.28, 0.14	0.01
2013 statewide rate of serious suicidal ideation	0.00	0.00	0.00, 0.00	0.02
2013 depression rate	0.00	0.00	0.00, 0.00	0.02
Mean statewide elevation above sea level	0.00	0.00	0.00, 0.00	0.00
Restriction of open carry privileges	0.61	0.45	-0.30, 1.52	0.05

Note. CI = confidence interval; background checks + waiting periods = comparison of no laws, background checks only, waiting periods only, and both background checks and waiting periods. Scatterplots describing the  $R^2$  for each analysis of covariance are available as a supplement to the online version of this article at <http://www.ajph.org>.

differ from any other group (although statistical power may have influenced the latter finding). Significantly different changes in suicide rates were not seen when considering open carry and gun lock legislation.

Contrary to our expectations, not all firearm legislation appears to be equally effective as a suicide prevention tool. Waiting periods and background checks are implemented before the purchase of a handgun, whereas open carry and gun lock laws apply to gun owners after the point of purchase. These data indicate that legislative efforts may be better spent regulating who can possess a handgun, as opposed to restricting or enabling access for individuals already in possession of a handgun. After the point of purchase, nonlegislative efforts such as lethal means safety counseling should be considered. Laws that affect the acquisition of a handgun could provide more time for an individual to be identified as high risk and receive treatment, could interfere with a plan to use a gun and prevent a suicide attempt, or could prompt an individual to use a less lethal means in a suicide attempt, thereby increasing the odds of survival. Lethal means counseling, on the contrary, could decrease the odds that an individual will use a gun in a suicide attempt by decreasing access to the

weapon and rendering a firearm suicide attempt logistically more difficult.

Open carry and gun lock legislation, however, may be important in the prevention of other public health problems (e.g., homicide) or may influence a subgroup of suicide deaths not specifically examined in these analyses (e.g., adolescents).

Study limitations to consider include the limited range of years available to study (2013–2014); an inability to consider the effect of the timing of law implementation on our results, restricting our analyses to 4 handgun laws; and the examination of only handguns (not long guns).

## PUBLIC HEALTH IMPLICATIONS

The current findings add to the increasing evidence in support of a public health approach to the prevention of suicide via firearms,<sup>12</sup> particularly focusing on waiting periods and background checks. Such legislation, implemented broadly, may reduce risk by delaying or preventing access to a gun by high-risk individuals who may not otherwise be identified as experiencing suicidal ideation. Certain laws may serve a nonredundant suicide prevention

function relative to traditional treatment and prevention efforts, increasing the reach of prevention by systematically addressing gun access across the entire population. **AJPH**

## CONTRIBUTORS

M. D. Anestis developed the initial plan for the article and analyses, ran the analyses, and wrote approximately 50% of the article. J. C. Anestis consulted on the plan for the article and analyses and wrote approximately 30% of the article. S. E. Butterworth consulted on the plan for the article and analyses and wrote approximately 20% of the article.

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## HUMAN PARTICIPANT PROTECTION

No institutional review board approval was required because this project did not involve any individual participants and relied entirely on publicly available data.

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