



## The associations between state veteran population rates, handgun legislation, and statewide suicide rates



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### ABSTRACT

**Background:** Within the US, veterans exhibit an elevated suicide rate, with firearms serving as the most common method. Research has demonstrated that several state laws regulating handgun ownership are associated with lower suicide rates.

**Method:** Publically available databases were utilized to extract relevant data.

**Results:** Statewide veteran population rates (per 100,000) predicted overall suicide rates, firearm suicide rates, and the proportion of suicides by firearms. Furthermore, the association between veteran population and overall suicide rate was largely explained by the elevated proportion of suicides by firearms in states with higher veteran populations. Lastly, results demonstrated states without handgun legislation in place exhibited higher veteran populations.

**Conclusions:** Findings indicate veterans may impact statewide suicide rates through their propensity to use firearms as their method and that the tendency for veterans to live in states without handgun legislation may exacerbate this phenomenon.

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Suicide is a substantial public health concern within the US, serving as the 10th leading cause of death (Centers for Disease Control and Prevention [CDC], 2015). Within veteran populations, this concern is amplified (Hoffmire et al., 2015), with recent research indicating that, in the general population, veterans are twice as likely as non-veterans to die by suicide (Hoffmire and Bossarte, 2014; McCarten et al., 2015). A commonality across both military and civilian populations, however, is that the vast majority of suicide attempts do not result in death (CDC, 2015). This is a crucial point because, for a variety of reasons (e.g. ephemeral crises, psychological/medical interventions), only a minority of suicide attempters eventually die by suicide (Anestis and Bryan, 2013).

An extreme exception to this rule is suicide attempts utilizing firearms. Firearms account for more than half of the suicide deaths within the US each year (CDC, 2015), largely due to their elevated likelihood of causing death. Indeed, research has demonstrated that the vast majority (80–95%) of suicide attempts involving firearms are fatal (Card, 1974; Chapdelaine et al., 1991). Similarly, it has been reported that suicide is approximately five times as likely in the homes of gun owners (Simon, 2007).

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The salience of this point is highlighted by the fact that at least some subpopulations of veterans appear more likely than non-veterans to own guns (Lambert and Fowler, 1997). Furthermore, in a sample of combat veterans, Freeman et al. (1994) reported that the majority of veterans kept a loaded firearm by their bed and that more than half of those individuals had considered attempting suicide with the weapon. This aligns with findings that the rate of suicide deaths per suicide attempt is substantially higher in military populations relative to the general population (Anestis and Bryan, 2013). The authors of that work proposed that this was indicative of elevated capability for suicide (diminished fear of death/bodily harm, heightened pain tolerance; Joiner, 2005) in military samples and, indeed, prior work examining US Air Force personnel who had recently completed basic training demonstrated that soldiers exhibit higher mean levels of the capability for suicide than even civilians with multiple prior suicide attempts (Bryan et al., 2010). Predominant theoretical models of suicide propose that access to and experience with lethal means is an essential component that moves a person from desiring death (a relatively common phenomenon) to attempting suicide (a much less common event; Joiner, 2005; Klonsky & May, 2014). The above findings, along with such theoretical work, present a picture of elevated military suicide risk driven largely by ready access to and comfort with firearms and a propensity to use firearms in suicide

attempts, ultimately resulting in a heightened suicide rate and a higher percentage of lethal attempts within military samples.

A robust research base has demonstrated that means restriction – an approach aimed at limiting access to highly lethal methods for suicidal behavior – is a highly effective tool in suicide prevention efforts (Boor and Bair, 1990; Carrington, 1999; Fleegler et al., 2013; Lester and Murrell, 1982; Loftin et al., 1991; Ludwig and Cook, 2000; Miller et al., 2002; Sarchiapone et al., 2011; Yang and Lester, 1991). A potential concern with respect to means restriction is the possibility that individuals thwarted in an effort to die by suicide using one particular method will simply find another way. In this sense, means restriction would result in individuals who want to die finding a different method for doing so rather than decreasing the frequency of suicide overall. This notion of means substitution, however, lacks any consistent empirical support (Daigle, 2005). As such, it appears that preventing an individual from utilizing a highly lethal means on a particular occasion may – although certainly not universally – often result in keeping that individual from ever dying by suicide.

One potentially potent – albeit controversial – method for implementing means restriction on a broader scale with public health implications could be legislation. Indeed, recent work examining a series of state laws tracked by the National Rifle Association and aimed towards regulating handgun ownership has indicated that such laws are associated with decreased statewide overall suicide rates, firearm suicide rates, and proportion of suicides due to firearms (Anestis et al., 2015). In a follow-up to that work, another recent study (Anestis and Anestis, 2015) reported that state laws involving mandatory background checks, waiting periods, and the use of gun locks, as well as laws regulating the open carrying of handguns, were associated with lower rates in each of those same three suicide-rate categories with large effect sizes, controlling for a broad range of suicide-related factors. The authors noted that the association between laws and overall suicide rates was driven by the proportion of suicides resulting from firearms and demonstrated that the effects of the laws held longitudinally, with decreased suicide rates following implementation and increased suicide rates following repeal. Such work points towards the potential for state governments to impact suicide rates overall – not simply firearm suicides – by enacting laws that decrease access and exposure to handguns, a point consistent with previously noted theory citing such factors as pivotal in enabling the transition from suicidal ideation to attempt (Klonsky & May, 2014).

This project aimed to clarify the association between veteran status and suicide while examining the potentially vital role of firearms and handgun legislation in that relationship (Hoffmire and Bossarte, 2014; McCarten et al., 2015). To do this, we examined the extent to which statewide veteran population rate (per 100,000) predicted the statewide overall suicide rate, firearms suicide rate, and proportion of suicides resulting from firearms beyond the effects of suicide-relevant demographic covariates. We next examined whether the effect of veteran population rate on the overall suicide rate was indirect through the proportion of suicides resulting from firearms. Lastly, in an effort to expand upon recent findings (Anestis and Anestis, 2015), we examined whether states without laws requiring mandatory background checks, a waiting period for the purchase and acquisition of a handgun, the use of gun locks for handguns in certain circumstances, and regulations on the open carrying of handguns exhibited higher veteran population rates.

## 1. Method

Data were collected through the use of publically available databases based upon figures from 2013, the most recent year for

which official suicide numbers were available at the time of data extraction.

*Statewide Suicide Rates.* Information on state overall population, statewide overall suicide rate, statewide firearm suicide rate, and statewide proportion of suicides resulting from firearms were extracted from the Web-based Injury Statistics Query and Reporting System (WISQARS), which is maintained by the Centers for Disease Control and Prevention (CDC, 2015).

*Demographic Variables.* Data reflecting poverty rates were extracted from the website for the Congressional Research Service (2015). Data for population density (number of individuals living per square mile within state), education, age, and race were extracted from the website for the United States Census Bureau (2015).

*Firearms Legislation.* Data regarding states that did and did not have legislation in place regarding (1) waiting periods for the purchase of a handgun (2) mandatory background checks (3) handgun lock requirements and (4) regulation of open carrying of handguns were extracted from the website of the Law Center to Prevent Gun Violence (2015). A list of which states did and did not have specific forms of legislation in place in 2013 is available (Anestis and Anestis, 2015).

*Veteran Population Rates.* Data regarding the number of veterans per 100,000 residents in each state (plus the District of Columbia) were extracted from the website for the Department of Veterans Affairs (2015). Veteran population rates were computed utilizing the veteran population number obtained from the Department of Veteran Affairs and the total population number obtained from the CDC. The Department of Veteran Affairs derived their population estimates from multiple sources, including the US Census Bureau, the Department of Defense, Veteran Affairs hospitals, and the Internal Revenue Service and, as such, the figures represent estimates of the total veteran population rather than only those veterans who registered with the VA for services.

### 1.1. Data analytic plan

To test our hypothesis that veteran population rate would be associated with statewide overall suicide rate, firearm suicide rate, and proportion of suicides resulting from firearms, we first examined Pearson correlation coefficients. To test whether any such associations remained significant after controlling for relevant covariates, we then ran a series of three linear regressions. In each case, the covariates were entered in Step 1 and veteran population rate was entered in Step 2. Statewide overall suicide rate, firearm suicide rate, and proportion of suicides resulting from firearms each served as the dependent variable in one of the three regressions. To test for a significant indirect effect of veteran population rate on statewide overall suicide rate through the proportion of suicides resulting from firearms, we ran a test of indirect effects using 10,000 bootstrapped resamples through the PROCESS macro for SPSS (Hayes, 2013). Lastly, to test whether veteran population rates differ by the presence (versus absence) of specific forms of handgun legislation, we conducted four analyses of covariance (ANCOVAs), with law status as the independent variable and veteran population rate as the dependent variable.

## 2. Results

Our results indicated that the number of veterans per 100,000 members of a state's population was significantly correlated with the statewide overall suicide rate, firearms suicide rate, and proportion of suicides resulting from firearms ( $r$ 's > .61;  $p$ 's < .001; see Table 1).

Additionally, controlling for statewide education levels, race,

**Table 1**  
Correlations amongst variables of interest.

	1	2	3	4
1 Veterans Per 100,000	–			
2 Total Suicide Rate	.68**	–		
3 Firearm Suicide Rate	.70**	.92**	–	
4% Suicides by Firearms	.61**	.64**	.86**	–

Note: \* = significant at the  $p < .05$  level; \*\* = significant at the  $p < .01$  level. All data represent statistics from 2013.

age, population density, and poverty rates, our results indicated that the veteran population rate significantly predicted the statewide overall suicide rate ( $R^2 = .66$ ;  $\Delta R^2 = .27$ ;  $\beta = .64$ ;  $p < .001$ ;  $f^2 = .79$ ), firearms suicide rate ( $R^2 = .79$ ;  $\Delta R^2 = .24$ ;  $\beta = .60$ ;  $p < .001$ ;  $f^2 = 1.14$ ), and proportion of suicides resulting from firearms ( $R^2 = .81$ ;  $\Delta R^2 = .10$ ;  $\beta = .39$ ;  $p < .001$ ;  $f^2 = .53$ ; Table 2). In each case, a large proportion of the variance was accounted for in the model and the effect size for the primary predictor was extremely large.

Results further indicated that the veteran population rate had a significant total ( $b = .002$ ;  $p < .001$ ) and direct ( $b = .001$ ;  $p < .001$ ) effect on the statewide overall suicide rate. In addition, the indirect effect through the proportion of suicides resulting from firearms was significant ( $b = .001$ ; 95% confidence interval = .0003–.0013;  $\kappa^2 = .23$ ; Table 3). Here again, the effect size was large.

Lastly, results indicated that states without (vs. with) laws requiring a waiting period ( $R^2 = .44$ ;  $F = 7.56$ ;  $p = .009$ ;  $p\eta^2 = .15$ ), background checks ( $R^2 = .50$ ;  $F = 13.98$ ;  $p = .001$ ;  $p\eta^2 = .24$ ), restriction of open carry ( $R^2 = .52$ ;  $F = 16.34$ ;  $p < .001$ ;  $p\eta^2 = .27$ ), and gun lock requirements ( $R^2 = .51$ ;  $F = 15.40$ ;  $p < .001$ ;  $p\eta^2 = .26$ ) for handguns exhibited higher veteran population rates, controlling for the same list of demographic variables (see Tables 4 and 5). In the case of the latter three laws, the effect sizes were large and, in the case of waiting periods, the effect size fell just below the traditional cutoff for large effects (Ellis, 2011).

**3. Discussion**

The primary objectives of this study were to examine the extent to which states with populations more heavily saturated with veterans exhibit higher overall suicide rates, whether that relationship is largely explained by the tendency of veterans to utilize firearms as their suicide means, and whether veterans tend to make up a higher proportion of the population in states without specific handgun legislation in place, thereby facilitating the use of firearms in suicide attempts. In each of our analyses, the results were

consistent with our hypotheses and, taken together, they speak to the importance of considering veteran population rates in understanding statewide suicide rates. These findings also point towards a potential mechanism of action as well as one potential avenue for robustly impacting this outcome. Our initial analyses indicated that, even after considering other suicide-related demographic variables, states with a greater veteran population rate exhibited highly elevated overall suicide rates, firearm suicide rates, and proportions of suicides resulting from firearms.

Noting a series of significant between group differences, while important, provides little information regarding mechanisms of action. To address this point, we then examined the indirect effect of veteran population rate on statewide overall suicide rates through the proportion of suicides resulting from firearms. The significant indirect effect – again with a large effect size – indicates that the association between veteran population rates and statewide overall suicide rates is largely accounted for by the fact that, in states with higher veteran population rates, a substantially higher proportion of deaths by suicide result from self-inflicted gunshot wounds. Consistent with prior literature indicating that veterans are more likely than same-aged non-veteran peers to use a firearm in a suicide attempt (Hoffmire and Bossarte, 2014; McCarten et al., 2015), this indicates that in states with higher veteran populations, there is a greater propensity to utilize highly lethal means, which in turn may lead to an elevated overall suicide rate, potentially through a higher percentage of lethal attempts (Joiner, 2005). Future longitudinal work demonstrating that shifts in the proportion of suicides resulting from firearms accounts for the association between shifts in veteran population rate and shifts in statewide suicide rates would provide more certainty in our interpretation of the current results.

Our final set of analyses considered whether states without laws previously shown to be associated with lower overall suicide rates (Anestis and Anestis, 2015) exhibited higher veteran population rates. As expected, the results indicated that this was the case, again with predominantly large effect sizes. Given prior research demonstrating that such laws are associated – both cross-sectionally and longitudinally – with lower overall suicide rates (versus simply firearm suicide rates; Anestis et al., 2015; Anestis and Anestis, 2015) – such results thus indicate that veterans tend to cluster in locations in which access and exposure to handguns are greater and the use of firearms in suicide attempts is higher. Such results certainly do not imply that veterans move to such states in response to gun laws or that specific gun laws impact the willingness of individuals to choose military service. Instead, the

**Table 2**  
Linear regressions examining the association between state veteran population rate and statewide suicide outcomes.

	Total suicide rate					Firearm suicide rate					% Suicide by Firearm				
	$R^2$	$\Delta R^2$	$\beta$	$p$	$f^2$	$R^2$	$\Delta R^2$	$\beta$	$p$	$f^2$	$R^2$	$\Delta R^2$	$\beta$	$p$	$f^2$
Step 1	.39					.55					.71				
Education			-.42	.071				-.59	.004				-.51	.002	
Race			.35	.016				.38	.003				.31	.002	
Age			-.25	.057				-.27	.018				-.21	.018	
Pop.Density			-.08	.700				.02	.912				-.20	.142	
Poverty			-.08	.641				.01	.960				.19	.115	
Step 2	.66	.27				.79	.24				.81	.10			
Education			-.01	.971				-.20	.182				-.26	.062	
Race			.33	.003				.36	.000				.30	.000	
Age			-.39	.000				-.40	.000				-.30	.000	
Pop. Density			-.14	.356				-.04	.737				-.24	.035	
Poverty			.11	.436				.18	.093				.31	.004	
Veterans			.64	.000	.79			.60	.000	1.14			.39	.000	.53

Note: Education = Percentage of state above age 25 with a college degree; Race = Percentage of state identified as White; Age = Statewide median age; Pop. Density = Statewide population density; Poverty = Percentage of state below the poverty line; Veterans = Veterans per 100,000 of statewide population.

**Table 3**

Test of indirect effect of state veteran population rate on statewide total suicide rate through the percentage of suicide deaths resulting from firearms.

Independent Variable	Dependent Variable	R <sup>2</sup>	Path	Coefficient	SE	95% CI lower	95% CI upper	Ratio I:T	κ <sup>2</sup>
Veterans per 100,000	State Suicide Rate	.54	Total	.002	.00	.0014	.0027		
			Direct	.001	.00	.0007	.0022		
			Indirect	.001	.00	.0002	.0013	.31	.23

Note: Tests of indirect effects computed using PROCESS (Hayes, 2013) macro for SPSS. This approach utilizes a regression framework. SE = Standard error; 95% CI = Bias-corrected 95% confidence interval; Ratio I:T = ratio of the indirect effect to the total effect.

**Table 4**

Veteran population rates (per 100,000) in states with versus without specific forms of handgun legislation.

	N	Veteran population rate (per 100,000)	
		M	SD
<b>Waiting Period</b>			
Yes	11	6693.86	1384.76
No	40	7942.45	1139.62
<b>Background Check</b>			
Yes	17	6718.26	1355.62
No	34	8150.94	963.21
<b>Open Carry Restricted</b>			
Yes	20	6741.09	1393.96
No	31	8274.86	769.52
<b>Gun Lock Required</b>			
Yes	4	5407.99	692.39
No	47	7866.18	1137.98

Note: The District of Columbia is included in these analyses, thereby resulting in a total of 51 states/territories in these analyses.

results simply reflect a tendency for states without specific gun laws to exhibit higher veteran population rates. Past theoretical and empirical work has noted that military personnel are less fearful about death and more likely to utilize lethal means when making a suicide attempt (Anestis and Bryan, 2013; Bryan et al., 2010; Joiner, 2005). As such, a propensity for veterans to cluster in areas in which handgun ownership is not regulated may represent a particularly dangerous situation that facilitates the highly elevated suicide rate within this population.

Taken together, this series of analyses thus indicates that veterans represent a higher proportion of the population in states without legislation in place that regulates access and exposure to handguns and that the veteran population rate is associated with a higher overall suicide rate, largely due to the propensity of veterans to use firearms in their attempts. Although such findings do not conclusively indicate that implementing specific laws regulating access and exposure to handguns would robustly impact statewide overall suicide rates, previous longitudinal work examining the impact of these laws on suicide rates in the general population (Anestis and Anestis, 2015) provide a strong rationale for considering this possibility. This point is also consistent with a robust research base supporting the risk associated with easy access to firearms (Miller and Hemenway, 1999, 2008) and the importance of means restriction in suicide prevention (Boor and Bair, 1990; Carrington, 1999; Fleegler et al., 2013; Lester and Murrell, 1982; Loftin et al., 1991; Ludwig and Cook, 2000; Miller et al., 2002; Sarchiapone et al., 2011; Yang and Lester, 1991). We would also note that the term means restriction is in many ways misleading and has largely been replaced in use by the phrase “means safety” in an effort to emphasize that safety approaches are not intended to infringe upon rights. This approach, moves beyond only limiting access, with health care providers encouraged to promote safe use and storage of potentially lethal means. Given political and cultural obstacles to the implementation of means safety based legislative

**Table 5**

Association between legislation regulating handgun ownership and statewide veteran population rate (per 100,000).

	Veterans per 100,000			
	R <sup>2</sup>	F	P	pμ <sup>2</sup>
<b>Waiting period status</b>	.44			
% over 25 with College Degree		9.96	.003	.19
% White		.79	.378	.02
Median Age		5.69	.021	.12
Population Density		1.48	.231	.03
% of State Below Poverty Line		6.30	.016	.13
Waiting Period		7.56	.009	.15
<b>Background check status</b>	50			
% over 25 with College Degree		4.61	.037	.10
% White		1.25	.270	.03
Median Age		7.62	.008	.15
Population Density		.31	.584	.01
% of State Below Poverty Line		5.72	.021	.12
Background Check		13.98	.001	.24
<b>Open carry restriction status</b>	.52			
% over 25 with College Degree		6.78	.013	.13
% White		1.04	.313	.02
Median Age		3.44	.070	.07
Population Density		.34	.564	.01
% of State Below Poverty Line		4.64	.037	.10
Open Carry Restricted		16.34	.000	.27
<b>Gun lock requirement status</b>	.51			
% over 25 with College Degree		2.14	.151	.05
% White		.08	.778	.00
Median Age		5.35	.025	.11
Population Density		.43	.517	.01
% of State Below Poverty Line		1.46	.234	.03
Gun Lock Required		15.40	.000	.26

Note: Analyses of covariance utilized to test for between group differences on state veteran population rate based upon presence and absence of specific state laws regulating handgun ownership. Population density = number of individuals living per square mile within state.

efforts in certain portions of the country, such broader approaches may ultimately prove vital in translating these results into practical suicide prevention strategies. Importantly, we do not propose that handgun legislation would be sufficient to eliminate suicide or represent an adequate overall approach towards suicide prevention. Rather, we note that such laws have the potential to be one meaningful arm of a broader approach towards suicide prevention and that this particular approach has the potential to save thousands of lives.

**Authors contribution**

Author M.A. developed the hypotheses, ran the analyses, and drafted the initial draft of the document. Author D.C., contributed to the theoretical framework of the document as well as the revision process.

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## Conflicts of interest

The authors have no conflicts of interest, financial or otherwise.

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