

State Gun Regulations and Reduced Gun Ownership are Associated with Fewer Firearm-Related Suicides Among both US Juveniles and Adults

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Abstract

Background: Few studies have investigated the relationship between specific gun regulations and gun ownership with the number of firearm-related suicides among juveniles across U.S. states. Therefore, this study seeks to determine if measures of state gun ownership and gun restrictions are related to the rate of firearm-related suicide in both the pediatric and adult populations.

Methods: Sixteen measures of state gun law restrictions, gun ownership and firearm-related statistics by the ATF were collected. These measures included ATF registered weapons, ATF federal firearm licensees, Giffords Center rankings, gun ownership percentages, and 12 specific firearm laws. Bivariate linear regression was used to model the relationship between each individual variable and the rate of firearm-related suicides for adults and children in each state. This was repeated using a multivariate linear regression adjusting for poverty, poor mental health, race, educational attainment, and divorce rate by state.

Results: In the bivariate linear regression, 11 of 16 of the firearm-related measures were statistically associated with fewer firearm-related suicides in the adult population. Similarly, 11 of 16 measures were also found to be associated with fewer firearm-related suicides in the pediatric population. In the multivariate regression, 6 of 16 measures were still statistically associated with fewer firearm-related suicides in the adult population vs. 5 of 16 measures in the pediatric population, even after controlling for all five potentially confounding variables. No restrictions were associated with higher levels of suicides for either analysis.

Conclusions: Ultimately, this is one of the first studies linking state gun restrictions and gun ownership with fewer firearm-related suicides among juveniles in the United States at the state level. This data suggests that US lawmakers should focus on strengthening gun restrictions and reducing gun ownership rates to potentially reduce the rate of firearm-related suicide among children and adults.

Introduction

Among economically-wealthy countries, the effects of gun violence are significantly more pervasive in the United States than in other peer nations. For example, there were over 38,000 gun-related deaths in the US in 2019 alone.¹ Conversely, the rates of firearm-related deaths in most other economically-developed nations remain strikingly lower.²⁻⁴ Over 200 Americans are killed or injured by firearms daily, with over 300,000 firearm-related deaths in the past decade.⁵ In the US, school-aged children are currently experiencing an alarming increase in firearm-related mortality. Numerous factors have been postulated as reasons for this increase including worsening rates of domestic violence, income inequality, and more relaxed state-level firearm laws.⁶⁻⁸

Currently, a variety of firearm laws have been enacted, including those mandating background checks, limiting access to assault weapons, and regulations regarding gun purchases.⁹ However, while these laws

have been associated with reduced gun deaths, their existence varies significantly between US states.^{10,11} To that end, Lee and colleagues found that stronger gun policies were associated with decreased rates of firearm homicide, even after adjusting for social and demographic information.⁹

Unfortunately, the US suicide rate has increased dramatically by 33% over the past two decades. In 2019, there were over 47,000 suicides in the US, of which nearly 24,000 were carried out by firearms.^{1,12} Among US adolescents, suicide now represents the second leading cause of death and rates have continued to increase over the last decade.^{1,13} Some have suggested that relaxation of gun-ownership restrictions have contributed to this increase. In fact, one recent study showed that repeal of Missouri's "Permit to Purchase" law was associated with a 21.8% increase in firearm-related suicide rates in young adults.¹⁴

Analysis of discrepancies between state-level firearm-associated suicide rates could potentially lead to identification of policies and regulations that correlate with reduced rates of mortality. Therefore, the aim of this study was to determine whether rates of gun ownership, ATF-tracked firearm statistics and the relative strictness of state-level gun laws were associated with differing levels of firearm-related suicides in both pediatric and adult populations in the United States.

Methods

The presence or absence of 12 different firearm-control laws were noted for each state.¹⁵⁻¹⁷ These specific laws were assessed as they are all tracked by the National Rifle Association (NRA), Giffords Center, and Kaiser Family Foundation, with corresponding data publicly available on the organization's website. In addition, rankings of the relative strictness of each state's gun-related laws were taken from the Giffords Law Center to Prevent Gun Violence, a national organization committed to promoting gun control efforts.¹⁸ For the Giffords Center rankings, lower numbers indicate more restrictive firearm laws, while higher numbers denote states with more lenient gun laws. For instance, the Giffords Center currently ranks California as number one, suggesting that it has the nation's strictest gun laws, while Mississippi is ranked number 50, indicating that it has the country's most lenient gun laws.¹⁸ (Fig. 1)

We attempted to use data from the Bureau of Alcohol, Tobacco, Firearms, and Explosives (ATF) as surrogate markers for the number of guns in circulation. The number of ATF federal firearm licensees and ATF registered weapons in each state for 1999 through 2019 was recorded.¹⁹ ATF registered weapons data includes registration of all weapons covered by the National Firearms Act. Specifically, the Act covers shotguns and rifles having barrels less than 18 inches in length, certain firearms described as "any other weapons," machine guns, and firearm mufflers and silencers.²⁰ A federal firearm license allows individuals to engage in business related to the manufacture of ammunition or firearms or the interstate or intrastate sale of firearms.²¹ Once the data was extracted, values were averaged for each state across the 21-year time span. For the identical time period, state-level gun ownership rates were taken from the RAND corporation.^{22,23} The variables of interest, the rate of firearm-related suicides in each state among both the juvenile (less than 18 years-old) and adult statewide populations (18 years-old and older), were

obtained from the Web-based Injury Statistics Query and Reporting System of the Centers for Disease Control and Prevention (CDC) from 1999 to 2019.²⁴

Poverty and population statistics were harvested from the US Census Bureau and from the US Department of Labor, also from the same time period of 1999 to 2019.^{25,26} State-level divorce rates and racial data, specifically the percentage of non-white citizens, were obtained from the US Census Bureau while educational attainment data was obtained from the Kids Count data center.²⁷⁻²⁹ Rates of poor mental health, defined as in previous studies as the percentage of citizens having at least 14 days of poor mental health each month were procured from the CDC's Behavioral Risk Factor Surveillance System for each state.³⁰⁻³² Finally, each of these variables was averaged into one flat value for each individual state across the 21-year time span.

First, bivariate linear regressions were used to compare each measure related to firearm ownership and the rate of firearm-related suicide in the pediatric population. For example, the number of ATF federal firearm licensees was used as the independent variable while the number of firearm-related suicides in children under 18 years-old was the dependent variable. The p and associated Beta values were determined for each regression to determine the strength of association. The same analysis was then repeated for the firearm-related suicide rate of the adult population.

Finally, the same linear regression analyses were repeated for the pediatric and adult state-level populations while adjusting for the prevalence of poverty, educational attainment, percentage of non-white citizens, divorce rate, and poor mental health in each state. Again, the p and beta values for each multivariate regression were determined. An a priori analysis determined that all p values less than 0.05 were statistically significant. All statistical analyses were conducted in R Studio software, version 1.4.1717.

Results

In total, 16 measures of either state-level firearm-control laws (Fig. 2), ATF-tracked firearm statistics, or gun ownership rates were collected for each state. In the unadjusted bivariate linear regression comparing these measures and firearm-related suicides for adults aged 18 years or older, 11 of 16 measures were significantly associated with fewer firearm-related suicides (Table 1). These included reduced gun ownership rates, lower Giffords Center ranking, handgun permit requirements, handgun magazine size restrictions, open carry restrictions, background check requirements for private gun sales, long gun magazine size restrictions, long gun registration requirements, child access prevention laws, safe storage requirements, and assault weapon bans (Table 1). In the same unadjusted bivariate analysis for children under 18 years of age, 11 of 16 measures were also associated with significantly fewer firearm-related suicides. These included fewer federal firearm licensees by state, lower gun ownership rates, lower Giffords Center ranking, handgun magazine size restrictions, handgun open carry restrictions, background check requirements on private gun sales, long gun magazine size restrictions, long gun registration requirements, child access prevention laws, safe storage requirements, and assault weapon

bans (Fig. 3). The Beta value represents the slope of the relationship while the p value represents the strength of the statistical relationship between the two variables. For example, for gun ownership percentage in the adult population, the beta value of 0.22 notes that as the gun ownership percentage in a given state increases by 1 unit, there is 0.22 unit increase in the rate of firearm-related suicides in the adult population. This is significant at a p value of < 0.001 . Therefore, states with higher gun ownership percentages are statistically associated with higher rates of adult firearm-related suicides, but no causal inference can be concluded.

Table 1
Unadjusted Analysis of 16 Firearm-Related Measures and Firearm-Related Suicides

Unadjusted Analysis		Adults		Children	
Statistical Measure		β (Slope)	P-Value	β (Slope)	P-Value
ATF-Registered Weapons by State		-5.18E-06	0.52	-3.24E-06	0.11
Federal Firearm Licensees by State		-4.24E-04	0.13	-1.56E-04	0.03
Gun Ownership (% of adults) by State		0.22	<0.001	0.052	<0.001
Gifford Ranking by State		0.21	<0.001	0.047	0.001
Gun Law- Handgun Permit required		-2.68	0.01	-0.53	0.06
Gun Law - Handgun Magazine Size restriction		-5.46	<0.001	-1.11	0.002
Gun Law - Handgun Open Carry allowed		3.42	0.03	0.83	0.04
Gun Law - Background Check on Private Gun Sales required		-4.6	<0.001	-0.99	0.002
Gun Law - Long Gun Carry Permit required		-1.56	0.41	-0.35	0.46
Gun Law - Long Gun Magazine Size restriction		-4.98	<0.001	-1.02	0.007
Gun Law - Long Gun Open Carry allowed		2.97	0.062	0.73	0.071
Gun Law - Long Gun Purchase Permit		-5.46	0.052	-1.19	0.097
Gun Law - Long Gun Registration required		-6.14	0.007	-1.28	0.029
Gun Law - Child Access Prevention Firearm Law		-3.31	0.002	-0.93	<0.001
Gun Law - Safe Storage or Gun Lock Requirement		-6.2	<0.001	-1.22	<0.001
Gun Law - Assault Weapons Ban		-7.18	<0.001	-1.38	<0.001

In the adjusted linear regression, controlling for poor mental health, percentage of nonwhite citizens, educational attainment, divorce rates, and poverty, 6 of 16 measures were still significantly associated with fewer firearm-related suicides among adults. These measures included lower gun ownership percentages, lower Giffords ranking, handgun permit requirements, handgun magazine size restriction, background checks on private gun sales, safe storage requirements, and assault weapon bans (Table 2).

For example, in the adult population, holding divorce rates, poor mental health, the percentage of non-white citizens, educational attainment, and poverty the same across all states, for every increase in Gifford Center Ranking, there is a 0.17 unit increase in firearm-related suicides among adults for a given state. Since higher Gifford Center Ranking represent states with more relaxed gun laws, this can be interpreted as states with more relaxed gun laws are associated with increased firearm-related suicides, even after controlling for the aforementioned variables. In the adjusted multivariate analysis in the pediatric population, 5 of 16 measures were still significantly associated with fewer firearm-related suicides, including lower gun ownership rates, lower Giffords Center ranking, background checks on private gun sales, child access prevention laws, and safe storage requirements (Table 2), even after controlling for the aforementioned five potential confounding variables.

Table 2
Adjusted Analysis of 16 Firearm-Related Measures vs. Firearm-Related Suicides

Adjusted Analysis		Adults		Children	
Statistical Measure		β (Slope)	P-Value	β (Slope)	P-Value
ATF-Registered Weapons by State		4.55E-06	0.54	2.70E-07	0.9
Federal Firearm Licensees by State		-1.72E-04	0.49	-5.87E-05	0.42
Gun Ownership (% of adults) by State		0.19	< 0.001	0.053	< 0.001
Gifford Ranking by State		0.17	< 0.001	0.047	< 0.001
Gun Law- Handgun Permit required		-1.85	0.03	-0.44	0.08
Gun Law - Handgun Magazine Size restriction		-2.22	0.11	-0.67	0.1
Gun Law - Handgun Open Carry allowed		1.21	0.36	0.3	0.44
Gun Law - Background Check on Private Gun Sales required		-2.56	0.01	-0.68	0.03
Gun Law - Long Gun Carry Permit required		-0.44	0.76	-0.29	0.49
Gun Law - Long Gun Magazine Size restriction		-1.86	0.17	-0.44	0.26
Gun Law - Long Gun Open Carry allowed		0.93	0.47	0.2	0.6
Gun Law - Long Gun Purchase Permit		0.13	0.96	0.11	0.88
Gun Law - Long Gun Registration required		-0.3	0.89	-0.33	0.61
Gun Law - Child Access Prevention Firearm Law		-1.83	0.0594	-0.58	0.04
Gun Law - Safe Storage or Gun Lock Requirement		-3.82	0.001	-0.74	0.04
Gun Law - Assault Weapons Ban		-4.09	0.02	-0.85	0.11

No measures relating to fewer guns in circulation or a more restrictive regulatory firearm environment were associated with an increase in firearm-related suicide among either juveniles or adults. Rather, of the associations that were statistically significant, all firearm-related restrictions or measures denoting fewer firearms in circulation resulted in diminished rates of firearm-related suicide among both the pediatric and adult populations.

Discussion

Our research demonstrates that states with higher gun ownership rates, higher Giffords Center rankings, no background check requirements, and no safe storage requirements for firearms had increased levels of firearm-related suicides in both the pediatric and adult populations, even after controlling for poor mental health, rates of divorce, race, educational attainment and poverty. In other words, even if the prevalence of these five potentially confounding factors were equal, stronger gun regulations and fewer firearms in circulation are associated with lower rates of firearm-related suicide across all age groups. While many studies have shown a link between state-level policy and suicide rates among overall populations, far fewer studies have found similar links among pediatric populations specifically.³³⁻⁴⁰ In fact, Zeoli et. al found that only 20 articles between 1985 and 2018 related firearm laws to firearm-related outcomes in adolescents. They attribute this sparsity to a lack of a national surveillance system and data surrounding policy and gun violence.⁴¹ Some authors have cited a severe lack of funding at the federal level for the issue of gun violence despite the enormity of this problem.⁴² This paucity of funding, at least in part, can be attributed to a 1996 omnibus consolidated appropriations bill, which stated "none of the funds made available for injury prevention and control at the Centers for Disease Control and Prevention may be used to advocate or promote gun control."^{42,43} Several researchers have argued that analyzing the association between firearm legislation and firearm-related casualties would give policy makers knowledge into which interventions are more likely to reduce the rate of both injuries and mortalities.^{41,44} Therefore, this data is crucial as it can potentially lead to implementation of laws and restrictions in states with particularly high rates of firearm-related suicide.

Several studies have demonstrated that enacting gun-control policies can reduce the rates of firearm-related violence. One of the earliest such policy changes was the Brady Handgun Violence Prevention Act of 1994, which mandated background checks for those purchasing firearms from licensed gun dealers. Multiple authors have argued that this law prevented 2.1 million people from accessing handguns between 1994 and 2010 and significantly reduced the US suicide rate.^{45,46} Additionally, federal law preventing those with severe mental illness from having guns has been shown to be effective in reducing firearm-related violence.⁴⁷ More specifically, Webster et. al demonstrated that laws intended to prevent high-risk individuals from accessing firearms were effective in limiting the diversion of firearms to criminal activities.⁴⁶ These studies help to enhance the argument that policy changes are effective in reducing firearm-related violence and can provide tangible evidence to lawmakers about the efficacy of such policies.

Moreover, this study helps to support the notion that the pediatric population is significantly affected by gun violence. Most firearm-related injuries actually take place in the home or somewhere in close proximity due to easy accessibility of these parental-owned firearms.⁴⁸ However, governing bodies and even parents are often naïve about this impact of gun ownership on their children. According to one study, nearly 40% of parents incorrectly assume their children are unaware of the storage location of household guns and 22% of parents falsely believe their children have never handled household guns.⁴⁹ With increasing rates of mental illnesses among adolescents worldwide, the consequences of this

ignorance can be devastating.⁵⁰ In fact, between 2010 and 2016, of pediatric firearm-related injuries, there was an increase in the share of those that were self-inflicted from 8.7–10.1%.⁵¹

Our study does have several limitations. First, as this is an ecological study, we can only argue the association between these various measures of gun restriction, gun ownership, and firearm-related suicide. It is impossible to argue a causal relationship based on these data and linear regression alone. However, we tried to mitigate possible confounding variables by performing the adjusted regression with poor mental health, race, divorce, educational attainment and poverty. Additionally, not all firearms are subject to the National Firearms Act and thus many are not captured by the ATF-registered weapon metric. For example, most handguns, which are the most commonly used weapons in firearm-related deaths in the United States, do not meet the definition of firearms tracked by the ATF.¹⁹ Unfortunately, in the United States, there is no comprehensive, totally inclusive federally-maintained database of the number of civilian firearms in circulation. Therefore, we attempted to use ATF-registered weapons and ATF federal firearm licensees as surrogate markers for the number of guns in circulation. It is acknowledged that while these measures have strict definitions, they are by no means all encompassing. In addition, we also compensated for the limits of these measures by incorporating the Giffords Center ranking and gun ownership rates to ultimately obtain 16 different measures of gun strictness across states.^{18,23} Finally, there are many other possible confounding variables that could potentially impact the rate of firearm-related suicide among states such as education level and access to mental health services, to name a few.^{52,53} However, to avoid the principle of overfitting the adjusted model we chose five variables (poor mental health, educational attainment, percentage of non-white residents, divorce rates and poverty) that we felt were most relevant and were publicly available for each state for the time interval of interest.

Conclusion

Ultimately, this is one of the first studies to show the association of state-level gun restrictions and gun ownership to reduced levels of firearm-related suicide in juvenile populations at the state level. These relationships are maintained even after controlling for poor mental health, race, divorce, educational attainment, and poverty. Future research studies can focus on which specific policies are most effective at reducing the levels of firearm-related suicide and whether governing bodies are willing to implement such restrictions. Hopefully, evidence-based studies, such as the current one, will spur policy makers to enact more restrictive regulations on firearms to reduce self-inflicted injury among both children and adults.

Abbreviations

Bureau of Alcohol, Tobacco, Firearms, and Explosives (ATF)

Centers for Disease Control and Prevention (CDC)

Declarations

Ethics Approval and Consent to Participate: Ethics approval and consent to participate – Not Applicable. All methods were carried out in accordance with the ethical standards as laid down in the 1964 Declaration of Helsinki and its later amendments or comparable ethical standards.

Consent for Publication: Not applicable.

Availability of Data and Materials: The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Competing Interests: The authors declare that they have no competing interests.

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Authors' Contributions:

MP made substantial contributions to the conception **of the work, completed** the acquisition of data and analysis, drafted the work, and approves the submitted version (and any substantially modified version that involves the author's contribution to the study) and agrees both to be personally accountable for her own contributions and ensures that questions related to the accuracy or integrity of any part of the work, even ones in which she was not personally involved, are appropriately investigated, resolved, and the resolution documented in the literature.

BC made substantial contributions to the conception and design of the study. He revised the work, approved the submitted version, and agrees both to be personally accountable for his own contributions and ensures that questions related to the accuracy or integrity of any part of the work, even ones in which the author was not personally involved, are appropriately investigated, resolved, and the resolution documented in the literature.

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References

1. America's Gun Culture in Charts. BBC News US & Canada. 2021.
2. Naghavi M, Marczak LB, Kutz M, et al. Global Mortality From Firearms, 1990–2016. *Jama*. Aug 28 2018;320(8):792–814. doi:10.1001/jama.2018.10060.
3. Pritchard C, Parish M, Williams RJ. International comparison of civilian violent deaths: a public health approach to reduce gun-related deaths in US youth. *Public Health* Mar. 2020;180:109–13. doi:10.1016/j.puhe.2019.11.003.
4. Grinshteyn E, Hemenway D. Violent death rates in the US compared to those of the other high-income countries, 2015. *Prev Med* Jun. 2019;123:20–6. doi:10.1016/j.ypmed.2019.02.026.
5. Iroku-Malize T, Grissom M. Violence and Public and Personal Health: Gun Violence. *FP Essent* May. 2019;480:16–21.
6. Geller LB, Booty M, Crifasi CK. The role of domestic violence in fatal mass shootings in the United States, 2014–2019. *Inj Epidemiol* May. 2021;31(1):38. doi:10.1186/s40621-021-00330-0. 8) .
7. Kwon R, Cabrera JF. Income inequality and mass shootings in the United States. *BMC Public Health* Sep. 2019;20(1):1147. doi:10.1186/s12889-019-7490-x. 19) .
8. Liu Y, Siegel M, Sen B. Neighbors Do Matter: Between-State Firearm Laws and State Firearm-Related Deaths in the U.S., 2000–2017. *Am J Prev Med* Nov. 2020;59(5):648–57. doi:10.1016/j.amepre.2020.06.022.
9. Lee LK, Fleegler EW, Farrell C, et al. Firearm Laws and Firearm Homicides: A Systematic Review. *JAMA Intern Med*. Jan 1 2017;177(1):106–119. doi:10.1001/jamainternmed.2016.7051.
10. Goyal MK, Badolato GM, Patel SJ, Iqbal SF, Parikh K, McCarter R. State Gun Laws and Pediatric Firearm-Related Mortality. *Pediatrics*. 2019;144(2):e20183283. *Pediatrics*. Jan 2020;145(1)doi:10.1542/peds.2019-3232.

11. Kalesan B, Mobily ME, Keiser O, Fagan JA, Galea S. Firearm legislation and firearm mortality in the USA: a cross-sectional, state-level study. *Lancet*. Apr 30 2016;387(10030):1847-55.
doi:10.1016/s0140-6736(15)01026-0.
12. Stone D, Jones C, Mack K. Changes in Suicide Rates - United States 2018–2019. Centers for Disease Control and Prevention; 2021.
13. The State of. Mental Health in America. Alexandria, VA2021.
14. Bhatt A, Wang X, Cheng AL, et al. Association of Changes in Missouri Firearm Laws With Adolescent and Young Adult Suicides by Firearms. *JAMA Netw Open* Nov. 2020;2(11):e2024303.
doi:10.1001/jamanetworkopen.2020.24303. 3) .
15. State Gun Laws. National Rifle Association of America (NRA); 2020.
16. States with Firearm Laws Designed to Protect Children. State Health Facts: Kaiser Family Foundation; 2019.
17. Large Capacity Magazines. Giffords Law Center to Prevent Gun Violence; 2019.
18. Annual Gun Law Scorecard. San Francisco, CA: Giffords Law Center; 2021.
19. Reports on Firearms Commerce in the U.S. Source: Bureau of Alcohol, Tobacco, Firearms and Explosives.
20. National Firearms. Act 26 US Code § 5849: Cornell Law School.
21. 18 U.S. Code § 921. Cornell Law School.
22. Schell T, Peterson S, Vegetable B, Scherling A, Smart R, Morral A. Data from: State-Level Estimates of Household Firearm Ownership. 2019.
23. McCracken H. Gun Ownership in America. RAND Corporation; 2021.
24. Fatal Injury Reports. National, Regional and State, 1981–2019. Centers for Disease Control and Prevention.
25. Historical Poverty Tables. People and Families – 1959–2019. US Census Bureau.
26. Population P Change. Estimated Components of Population Change. April 1, 2010 to July 1, 2020. In: Census.gov, editor. Washington, D.C.: United States Census Bureau 2020.
27. Data from. Marriage and Divorce. 2021.
28. Data from: Race. 2021.
29. Data from. Educational attainment of population age 25 and older. 2021.
30. Behavioral Risk Factor Surveillance System. Centers for Disease Control and Prevention; 2021.
31. Massetti GM, Thomas CC, King J, Ragan K, Buchanan Lunsford N. Mental Health Problems and Cancer Risk Factors Among Young Adults. *Am J Prev Med* Sep. 2017;53(3S1):30–9.
doi:10.1016/j.amepre.2017.04.023.
32. Steinberg ML, Williams JM, Li Y. Poor Mental Health and Reduced Decline in Smoking Prevalence. *Am J Prev Med*. Sep 2015;49(3):362–9. doi:10.1016/j.amepre.2015.01.016.

33. Alban RF, Nuño M, Ko A, Barmparas G, Lewis AV, Margulies DR. Weaker gun state laws are associated with higher rates of suicide secondary to firearms. *J Surg Res*. Jan. 2018;221:135–42. doi:10.1016/j.jss.2017.08.027.
34. Anestis MD, Anestis JC. Suicide Rates and State Laws Regulating Access and Exposure to Handguns. *Am J Public Health* Oct. 2015;105(10):2049–58. doi:10.2105/ajph.2015.302753.
35. Hahn RA, Bilukha O, Crosby A, et al. Firearms laws and the reduction of violence: a systematic review. *Am J Prev Med* Feb. 2005;28(2 Suppl 1):40–71. doi:10.1016/j.amepre.2004.10.005.
36. Gertner AK, Rotter JS, Shafer PR. Association Between State Minimum Wages and Suicide Rates in the U.S. *Am J Prev Med*. May 2019;56(5):648–54. doi:10.1016/j.amepre.2018.12.008.
37. Lewiecki EM, Miller SA. Suicide, guns, and public policy. *Am J Public Health* Jan. 2013;103(1):27–31. doi:10.2105/ajph.2012.300964.
38. Raifman J, Larson E, Barry CL, et al. State handgun purchase age minimums in the US and adolescent suicide rates: regression discontinuity and difference-in-differences analyses. *Bmj* Jul. 2020;22:370:m2436. doi:10.1136/bmj.m2436.
39. Knopov A, Sherman RJ, Raifman JR, Larson E, Siegel MB. Household Gun Ownership and Youth Suicide Rates at the State Level, 2005–2015. *Am J Prev Med*. Mar 2019;56(3):335–42. doi:10.1016/j.amepre.2018.10.027.
40. Johnson RM, Barber C, Azrael D, Clark DE, Hemenway D. Who are the owners of firearms used in adolescent suicides? *Suicide Life Threat Behav* Dec. 2010;40(6):609–11. doi:10.1521/suli.2010.40.6.609.
41. Zeoli AM, Goldstick J, Mauri A, Wallin M, Goyal M, Cunningham R. The association of firearm laws with firearm outcomes among children and adolescents: a scoping review. *J Behav Med* Aug. 2019;42(4):741–62. doi:10.1007/s10865-019-00063-y.
42. Stark DE, Shah NH. Funding and Publication of Research on Gun Violence and Other Leading Causes of Death. *Jama*. Jan 3 2017;317(1):84–85. doi:10.1001/jama.2016.16215.
43. Kellermann AL, Rivara FP. Silencing the science on gun research. *Jama* Feb 13. 2013;309(6):549–50. doi:10.1001/jama.2012.208207.
44. Santaella-Tenorio J, Cerdá M, Villaveces A, Galea S. What Do We Know About the Association Between Firearm Legislation and Firearm-Related Injuries? *Epidemiol Rev*. 2016;38(1):140–57. doi:10.1093/epirev/mxv012.
45. Ludwig J, Cook PJ. Homicide and suicide rates associated with implementation of the Brady Handgun Violence Prevention Act. *Jama* Aug. 2000;2(5):585–91. doi:10.1001/jama.284.5.585. 284)
46. Webster DW, Cerdá M, Wintemute GJ, Cook PJ. Epidemiologic Evidence to Guide the Understanding and Prevention of Gun Violence. *Epidemiol Rev*. 2016;38(1):1–4. doi:10.1093/epirev/mxv018.
47. McGinty EE, Webster DW, Barry CL. Gun policy and serious mental illness: priorities for future research and policy. *Psychiatr Serv*. Jan 1 2014;65(1):50 – 8. doi:10.1176/appi.ps.201300141.

48. Grossman DC, Reay DT, Baker SA. Self-inflicted and unintentional firearm injuries among children and adolescents: the source of the firearm. *Arch Pediatr Adolesc Med*. Aug 1999;153(8):875–8. doi:10.1001/archpedi.153.8.875.
49. Parikh K, Silver A, Patel SJ, Iqbal SF, Goyal M. Pediatric Firearm-Related Injuries in the United States. *Hosp Pediatr* Jun. 2017;7(6):303–12. doi:10.1542/hpeds.2016-0146.
50. García-Carrión R, Villarejo-Carballedo B, Villardón-Gallego L. Children and Adolescents Mental Health: A Systematic Review of Interaction-Based Interventions in Schools and Communities. *Front Psychol*. 2019;10:918. doi:10.3389/fpsyg.2019.00918.
51. Olufajo OA, Zeineddin A, Nonez H, et al. Trends in Firearm Injuries Among Children and Teenagers in the United States. *J Surg Res* Jan. 2020;245:529–36. doi:10.1016/j.jss.2019.07.056.
52. Pompili M, Vichi M, Qin P, Innamorati M, De Leo D, Girardi P. Does the level of education influence completed suicide? A nationwide register study. *J Affect Disord* May. 2013;147(1–3):437–40. doi:10.1016/j.jad.2012.08.046.
53. McClellan C, Ali MM, Mutter R. Impact of Mental Health Treatment on Suicide Attempts. *J Behav Health Serv Res* Jan. 2021;48(1):4–14. doi:10.1007/s11414-020-09714-4.

Figures

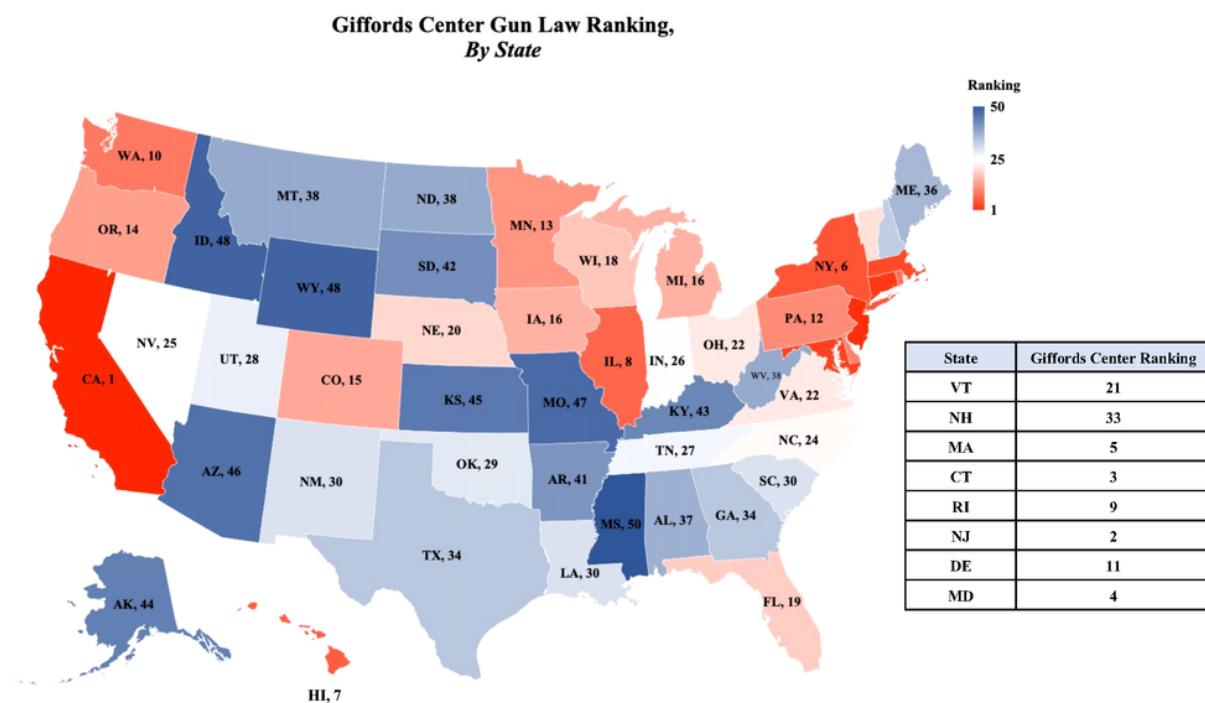


Figure 1

Giffords Ranking by State. Higher Giffords rankings are indicated in darker blue and are states with more relaxed gun laws while lower rankings are stricter gun laws and are indicated in darker red.

State	Handgun permit required	Handgun magazine size restriction	Handgun open carry prohibited	Background check on private gun sales required	Long gun carry permit required	Long gun magazine size restriction	Long gun open carry prohibited	Long gun purchase permit required	Long gun registration required	Child Access Prevention Law	Safe Storage or Gun Lock Requirement	Assault Weapons Ban	State	Handgun permit required	Handgun magazine size restriction	Handgun open carry prohibited	Background check on private gun sales required	Long gun carry permit required	Long gun magazine size restriction	Long gun open carry prohibited	Long gun purchase permit required	Long gun registration required	Child Access Prevention Law	Safe Storage or Gun Lock Requirement	Assault Weapons Ban
Alabama													Montana												
Alaska													Nebraska	✓											
Arizona													Nevada	✓											✓
Arkansas													New Hampshire												✓
California	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓	New Jersey	✓	✓	✓		✓	✓					✓	✓
Colorado	✓	✓	✓			✓	✓	✓			✓		New Mexico												
Connecticut	✓		✓			✓	✓	✓	✓	✓	✓	✓	New York	✓	✓	✓	✓	✓	✓					✓	✓
Delaware			✓							✓			North Carolina	✓											✓
Florida		✓					✓			✓			Ohio	✓											✓
Georgia										✓			Oklahoma	✓											
Hawaii	✓		✓					✓	✓				Oregon	✓				✓	✓					✓	
Idaho													Pennsylvania	✓											✓
Illinois	✓		✓	✓		✓		✓	✓	✓	✓	✓	Rhode Island	✓											✓
Indiana	✓									✓			South Carolina	✓			✓								✓
Iowa	✓								✓				South Dakota	✓											
Kansas													Tennessee	✓											✓
Kentucky	✓								✓				Texas	✓											✓
Louisiana	✓												Utah	✓				✓							✓
Maine													Vermont		✓		✓	✓	✓						
Maryland	✓	✓					✓			✓	✓		Virginia	✓											✓
Massachusetts	✓	✓			✓		✓	✓	✓	✓	✓	✓	Washington	✓											✓
Michigan	✓												West Virginia												
Minnesota	✓				✓					✓			Wisconsin	✓											✓
Mississippi													Wyoming												
Missouri																									

Figure 2

Measures of Gun Strictness in Each State. Green checks indicate that the associated law or restriction is present in a given state whereas an absence of check marks indicates no such law or restriction is present as of May 2022.

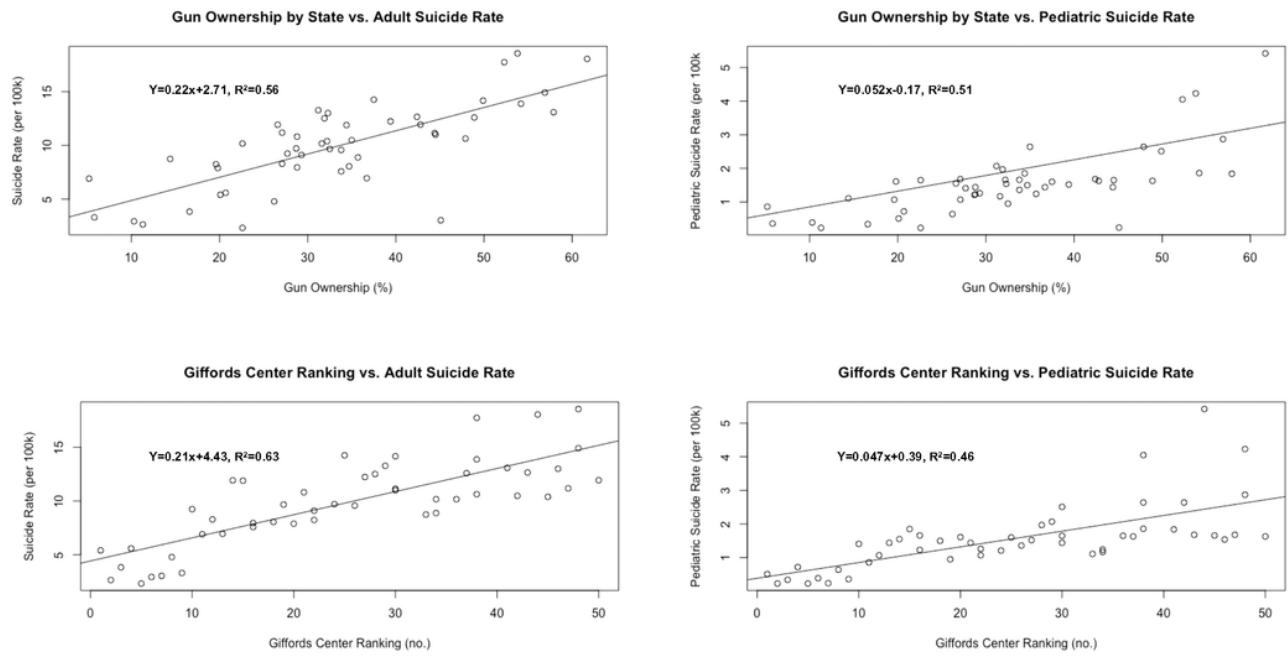


Figure 3

Linear Regressions of Giffords Center Ranking and Gun Ownership vs. Suicide Rate. (Top): The bivariate analyses of Giffords Center Ranking (left) and gun ownership (right) vs. the adult suicide rate. (Bottom): Bivariate analyses of Giffords Center Ranking (left) and gun ownership (right) vs. the pediatric suicide rate. The R^2 value and corresponding equation of the fitted regression is included for each graph.