The Lethality of the American Gun Lobby

Pro-gun lobbying efforts and mental health effects on suicide by gun

Introduction

Gun violence continues to be a staple of American politics, especially following a series of high-profile assassination attempts on President-Elect Trump and the recent murder of UnitedHealthcare CEO Brian Thompson. Americans in opposition to federal gun ownership restrictions often cite mental health as the reason for America's gun violence epidemic. In contrast, supporters of gun restrictions regularly blame America's comparatively loose regulatory environment and special interest group involvement for the violence.

In the United States, injury and death by firearms are persistent problems. Although adults aged 25-44 are the most common victims of all firearm injuries (Kalesan et al. 2021), little research exists on the relationship between political activity and suicide by firearm. Research has shown an improvement in rates of youth suicide by firearm after enacting youth-targeted anti-gun legislation (Kappelman and Fording 2021). Literature also exists investigating the relationship between firearm availability and per-state suicide rates (Kposowa, Hamilton, and Wang 2016). However, further research is needed on the association between special interest group activity (which occurs before legislation passes) and age-agnostic rates of suicide by gun. In this study, we begin to bridge that gap, exploring the association between pre-legislative special interest group activity and combined rates of suicide by firearm by state.

According to the Centers for Disease Control and Prevention (CDC), suicide by firearm accounts for more than half of gun deaths in the United States. While school shootings, mass shootings, and high-profile assassinations are regularly brought into mainstream political discourse, suicide by gun is less frequently discussed. In this study, we investigate the potential relationships between pro-gun special interest group activity, mental health, and suicide by firearm. We aggregate over ten million responses to CDC health surveys, three million special interest group reports, and suicide by firearm rates for all 50 states. These data are then used to build a multiple linear regression model to control for the impact of lobbying efforts and mental health on rates of suicide by gun. We then use a novel weighting function to weigh each residual of that model, culminating in a weighted linear regression model to predict suicides by gun per 100,000 citizens.

Ultimately, we seek to answer the question: *Is increased pro-gun special interest activity associated with additional suicide by gun, controlling for mental health?*

The Data

We have aggregated and cleaned data from three distinct sources. First, mental health data is pulled from the CDC Behavioral Risk Factor Surveillance System (CDC 2024). The survey began including mental health questions in 1994. The question of interest for this study is:

"Now thinking about your mental health, which includes stress, depression, and problems with emotions, for how many days during the past 30 days was your mental health not good?"

Responses are given an integer value between 1 and 30. Respondents with zero days of poor mental health are encoded with the value 88, which we have re-encoded as 0. Non-responses are not considered. Ultimately, 10,249,613 were considered, aggregated by state and year, and included in the model. We encode these responses as binary: "Poor" or "Good" mental health. The CDC defines 15 or more days of poor mental health in a 30-day period as concerning, so we encode responses of 15 or greater as "Poor" and others as "Good."

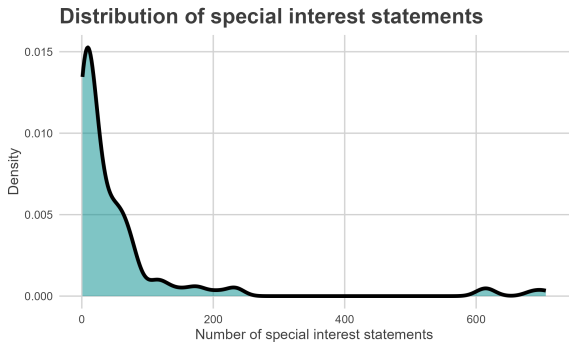
The CDC also provides absolute number and per-capita suicide data by state through their CDC WONDER data archive portal (WONDER 2024). Per-state proportions of suicides that were completed with firearms were compiled by the Rand Corporation, a non-profit, non-partisan think tank that tracks and reports on several high-profile political issues in the United States (Rand 2020). We calculate total firearm suicide deaths by multiplying the total suicides of all types reported by the CDC and the proportion of those that were completed by firearm reported by Rand.

Hall et al. created a special interest dataset reports 13,619,409 individual state-level special interest group positions (Hall et al. 2024). We filter those positions using regular expression filters built by hand from group names listed on OpenSecrets, the website of the eponymous non-profit organization that tracks lobbying groups and campaign finance in Washington, DC. We aggregate firearm-related special interest group activity by year and state ("Lobbying Industry Data for 2024" 2024). Once gun-related groups were compiled, we manually reviewed the 1,168 groups to remove any anti-firearm special interest groups from the data. Note that manual review is prone to human error. Further details of these limitations are in the discussion section of this article.

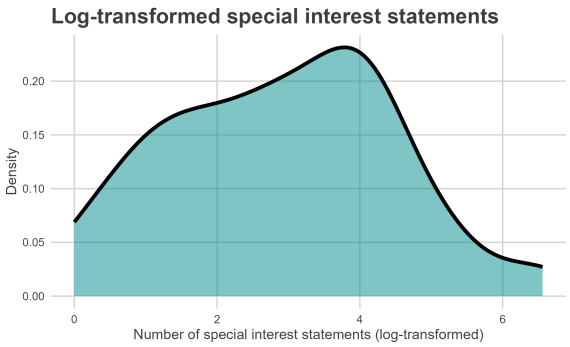
Most year/state combinations have no special interest group representation (i.e., the number of reported special interest statements is 0). Initially, we attempted to include these zero values but ran into issues with heteroscedasticity. Ultimately, we maintained homoscedasticity by removing rows with no special interest involvement. This reduction in data lessened the scope of our findings to states in which the pro-gun lobby has been active since 1997 but allowed us to construct a more trustworthy model. The resulting dataset is 186 observations in which a pro-gun group was active in a given state and year.

Methodology

In this study, we first construct an ordinary least squares (OLS) model using state, the proportion of poor mental health, and the number of special interest statements to predict the number of gun deaths from self-inflicted gunshot wounds per 100,000 citizens. However, Figure 1 shows that the number of special interest statements in our dataset is power-law distributed. Thus, we perform a log transformation to arrive at the predictor that we ultimately use in our model. Figure 2 shows the distribution of the log-transformed number of special interest statements used in our model. In all cases, we will assume an $\alpha = 0.05$ level of significance.



(a) Figure 1



(a) Figure 2

We evaluated the assumption of homoscedasticity (i.e., constant variance of residuals) using a Breusch-Pagan (BP) test on our OLS model (Breusch and Pagan 1979). However, with a p-value of 0.007, our BP test showed a violation of homoscedasticity. Figure 3 shows the distribution of residuals by state for our OLS model. We observe that residual variance differs widely between states. To adjust for these changes in residual variance, we construct a weighted linear regression model using weights derived from the following equation:

$$w_i = \frac{1}{\sqrt{|r_i|}}$$

where r_i is the residual for observation i.

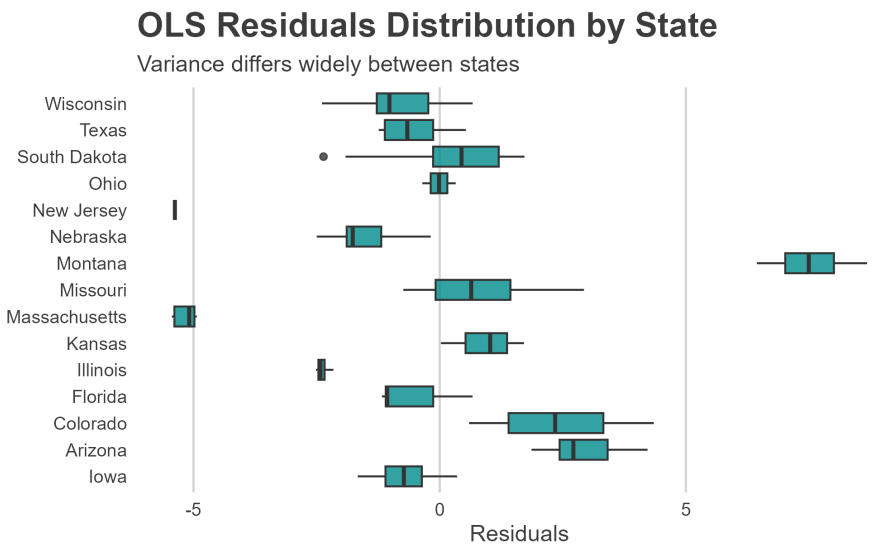


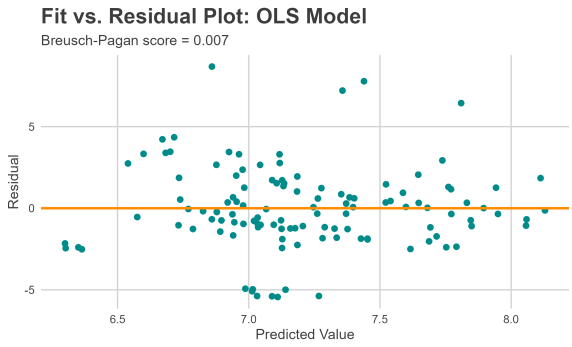
Figure 3: Per-state residuals

In addition to adjusting weights based on initial residuals, we add another predictor, state, to create a weighted regression model. State was withheld from the OLS model due to its addition causing inferior weights to be produced.

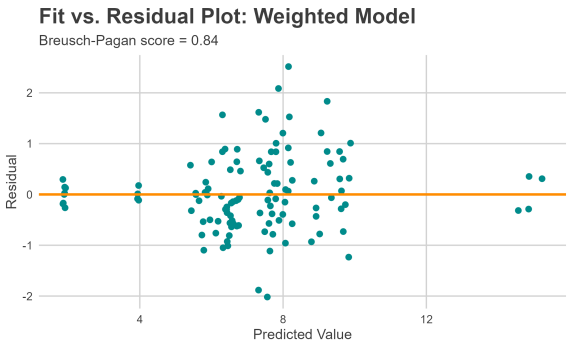
Results

In both the OLS and weighted models, we use state, the proportion of poor mental health reports, and the log-transformed number of special interest statements to predict the number of gun deaths per 100,000 citizens in a state. Figures 4 and 5 show the predicted values, residuals, and BP test results for both the unweighted and weighted models. We observe a much higher (i.e., improved) BP score for our weighted model, although visually, the performance benefit is less apparent.

To verify the normality of our residuals, we conduct a Shapiro-Wilk test. A significant p-value from a Shapiro-Wilk test (at the $\alpha = 0.05$ level) was produced by the Shapiro-Wilk test, which rejects the null hypothesis that our residuals come from a normal distribution (Shapiro and Wilk 1965). However, if we remove a single residual (the largest one), our Shapiro-Wilk p-value becomes 0.8. Figure 6 shows that our outlier has a wide disparity between our two predictors both within its own state (Missouri) and between all states. That is it has exceptionally low pro-gun special interest activity and an exceptionally high proportion of citizens reporting poor mental health. Because the outlier is statistically exceptional, we can be confident in the normality of our residuals with the exception of a single outlier. Figure 7 shows the



(a) Figure 4



(a) Figure 5

result of removing that outlier, and Figure 8 further verifies our model's normality using a quantile-quantile plot.

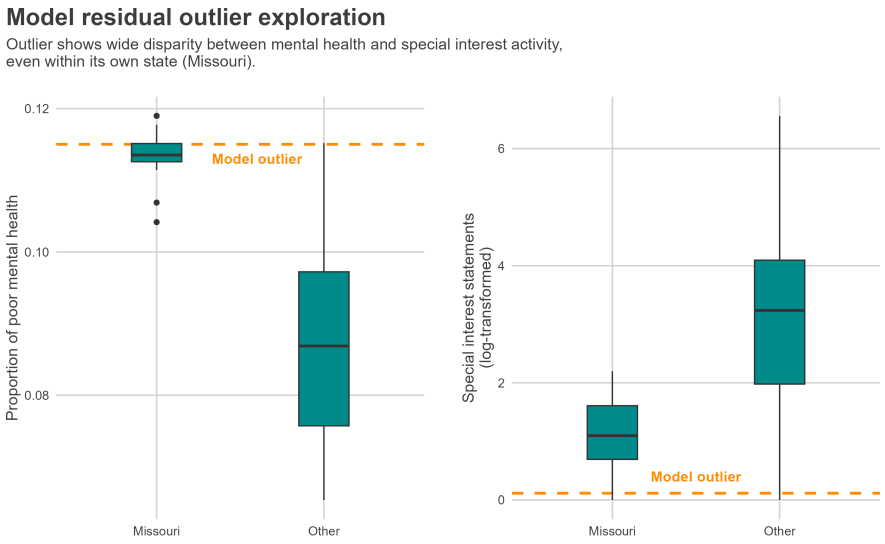
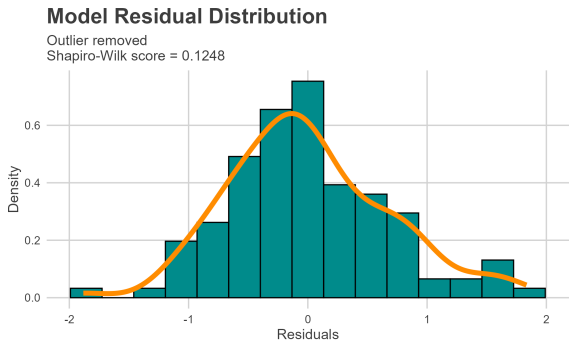
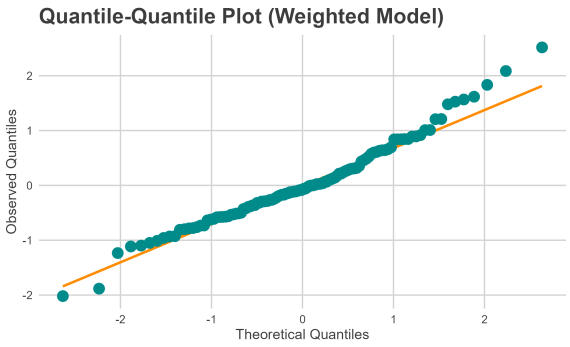


Figure 6: Outlier predictor exploration

After confirming the validity of our model, we can display its results. Figure 9 contains the weighted regression model output. Recall that states are not included here but are corrected for. Results for all states in the dataset are included in the appendix.



(a) Figure 7



(a) Figure 8

Weighted model output (no states listed)

Variable	Estimate	Std. Error	Statistic	P-value
Intercept	5.884	1.192	4.935	<0.001
log(Positions)	0.176	0.081	2.179	0.032
Poor mental health proportion	<0.001	14.884	<0.001	0.885

Figure 9: Model output

We observe from our model that, holding mental health and state constant, every e-fold increase (i.e., ≈ 2.72-fold) in the number of pro-gun special interest statements, we expect an additional 0.18 deaths per 100,000 citizens in that state ($p = 0.03$). Also importantly, with a p-value of 0.89, mental health does not show a statistically significant impact on per-capita rate of suicide by firearm while holding state and special interest activity constant.

Discussion

In this study, we found statistically significant evidence that, holding state of residence and self-reported mental health constant, increasing pro-gun special interest group activity leads to additional suicide by gun. Perhaps equally importantly, we have shown that, while holding pro-gun special interest activity constant, self-reported mental health rates do not show a statistically significant impact on the rate of suicide by gun.

However, there are some crucial limitations and room for further research. First, only 17 states were ultimately included in the dataset used to train the model. Those 17 states were the ones

in which pro-gun special interest activity was tracked by Hall et al. It is possible that using a different metric for pro-gun activism (pro-gun social media pages, pro-gun protests, etc.) would result in more robust data across all states, leading to a much larger dataset and more room for additional predictors.

Second, pro- and anti-gun groups were tagged by hand. We developed custom regular expressions using manual research, but it is possible that some pro-gun groups were removed and some anti-gun groups remained in the dataset. A dataset tagged with "pro-gun" and "anti-gun" when the dataset was created would help remove potential human error during filtering.

Finally, although our results were statistically significant and passed model assumption checks, we did need to remove an outlier to pass our Shapiro-Wilk test. There may be additional covariates for which a broader dataset may be able to correct to strengthen our confidence in our model further.

Different states have varying political environments, legislative processes, and sentiments toward firearms and pro-gun organizations. Although these systemic variations make broad policy recommendations challenging, we have shown that decreased pro-gun special interest activity is associated with a reduction in death across any state included in our data. National legislation reducing the ability of large pro-gun organizations to influence state policy would save lives. Because our special interest activity variable was log-transformed, states with little (but non-zero) pro-gun lobbying activity are especially susceptible to the dangerous effect of increases in such activity. That is, it is easier to arrive at a 2.72-fold increase in special interest efforts when the absolute number of those efforts is small.

For states where pro-gun special interest statements are rare, we recommend preventing additional pro-gun special interest efforts by classifying large pro-gun special interest groups as threats to public health and reducing their ability to influence state politics. Suicide by firearm is a public health issue and should be treated as such.

Conclusion

The American gun debate shows no signs of ceasing anytime soon. However, we have shown that there is reason to doubt the claim that America's gun violence problems are caused by mental health alone. Although our result leaves room for future research, there is statistically significant evidence that, even when holding reported mental health constant, each 2.72-fold increase in pro-gun activity is associated with 0.18 additional deaths per 100,000 people. In a state like Texas (population approximately 30.5 million), that is an expected 55 additional deaths in Texas alone.

Suicide by gun is a public health issue and should be treated as such. Reciprocally, pro-gun special interests using mental health as a scapegoat for this type of unnecessary death should be considered direct threats to public health and be regulated as such. Our weighted linear

regression model shows that, correcting for state and pro-gun special interests, poor mental health rates are not associated with an increase in suicide by gun.

We hope that our work can help forward the cause of reasoned debate for all public health matters, especially suicide by gun. This type of death represents a rare public health threat of our own making. However, through reasonable debate and objective research, we can craft an effective response and save lives.

Appendix

Below is the total result table, including all 17 states in the dataset. To select the baseline state, we took the average of all states' suicide by gun per 100,000 residence rates. The median of those weights served as the baseline. In this case, the baseline state was Iowa.

Full model results

term	estimate	std.error	statistic	p.value
Intercept	5.884	1.192	4.935	<0.001
log(Positions)	0.176	0.081	2.179	0.032
Poor mental health proportion	<0.001	14.884	<0.001	0.885
Arizona	3.250	0.520	6.250	<0.001
Colorado	2.683	0.384	6.980	<0.001
Florida	1.702	0.676	2.515	0.017
Illinois	<0.001	0.601	<0.001	<0.001
Kansas	1.964	0.432	4.544	<0.001
Massachusetts	<0.001	0.683	<0.001	<0.001
Missouri	2.232	0.694	3.218	0.003
Montana	8.771	0.746	11.763	<0.001
Nebraska	<0.001	0.337	<0.001	0.268
New Jersey	<0.001	1.254	<0.001	0.001
Ohio	1.793	0.696	2.577	0.016
South Dakota	1.593	0.348	4.584	<0.001
Texas	0.256	0.370	0.692	0.490
Wisconsin	0.312	0.385	0.810	0.452

Figure 10: Full model results

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