

Are shootings caused by
inadequate mental institutions?

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Motivation

In the United States, the right to own a gun is secured by the second Amendment of the Constitution. When the Second Amendment was passed by Congress in 1789, the intended use of firearm was drastically different than that of today (Lund, N. & Winkler, n.d.). The interpretation of the Right to Bear Arms has been a hot button issue that has many politicians, and citizens debating.

As a consequence of the Right to bear arms, any and all citizens has a right to own a gun. Some of the debates focus on mental stability—particularly if gun owners should be mentally sound in order to be permitted to own a firearm (Sheridan, 2018). An argument that is against permitting anyone from gun ownership, Wan, et al. writes that the gunman of the Marjory Stoneman Douglas High School in Parkland, Florida, who killed 17 kids, had sought mental help (Wan, 2018). The shooting panned out to be the deadliest massacres in the United States.

In light of the deadliest shooting in the United States and its connection to mental instability, I was curious of what, if any, connections there are. Are gun deaths related to lackluster mental health facilities? Specifically, are there connections between gun homicide and mental treatments, rehabilitation services, and the ability to pay?

This paper is not an opinion piece—this is an objective analysis, and interpretation of data.

Specific questions explored:

1. Is there a correlation between gun deaths (homicide) and the comprehensiveness of mental treatment services each institution offers among different States?
2. Is there a correlation between gun deaths (homicide) and the average number of rehabilitation services each institution offers among different States?
3. Is there a correlation between gun deaths (homicide) and the availability of a crisis intervention among different States?
4. Is there a correlation between gun deaths (homicide) and the average number of payment reduction program offered among different States?

Data Source

The data on deaths caused by firearms is taken from the Center for Disease Control (CDC), specifically, the mortality dataset. The data has integer counts the number of deaths that occurred per State in 2015. The data was queried from the CDC website using their own, unique querying tool, Wonder, through <https://wonder.cdc.gov/controller/datarequest/D77> . Filter was used to only find firearm incidents that are classified as homicides, unintentional, or undetermined. There were 51 data points—one for each State, and one for the District of Columbia. The outputted data format is a messy txt file which resemble a tsv (Figure 1).

Underlying Cause of Death, 1999-2016 - Notepad

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Notes	State	State Code	Deaths	Population	Crude Rate
	Alabama	01	425	4858979	8.747
	Alaska	02	52	738432	7.042
	Arizona	04	249	6828065	3.647
	Arkansas	05	175	2978204	5.876
	California	06	1433	39144818	3.661
	Colorado	08	148	5456574	2.712
	Connecticut	09	82	3590886	2.284
	Delaware	10	55	945934	5.814
	District of Columbia	11	105	672228	15.620
	Florida	12	913	20271272	4.504
	Georgia	13	609	10214860	5.962
	Idaho	16	28	1654930	1.692
	Illinois	17	714	12859995	5.552
	Indiana	18	317	6619680	4.789
	Iowa	19	51	3123899	1.633
	Kansas	20	101	2911641	3.469
	Kentucky	21	185	4425092	4.181
	Louisiana	22	480	4670724	10.277
	Maine	23	14	1329328	Unreliable
	Maryland	24	452	6006401	7.525
	Massachusetts	25	87	6794422	1.280
	Michigan	26	462	9922576	4.656
	Minnesota	27	99	5489594	1.803
	Mississippi	28	293	2992333	9.792
	Missouri	29	482	6083672	7.923
	Montana	30	27	1032949	2.614
	Nebraska	31	54	1896190	2.848
	Nevada	32	141	2890845	4.877
	New Hampshire	33	12	1330608	Unreliable

Figure 1: Sample CDC data.

There are three variables that are of interest in our analysis:

1. Deaths (type: quantitative): The number of deaths that are caused by firearms,
2. State (type: nominal): The which the number of deaths apply to, and
3. Crude rate (type: quantitative): the ratio between deaths and population

National Mental Health Services Survey (N-MHSS) is a government sponsored survey that looks at mental health institutions and its different properties in 2015. There are a whole host of variables categorized by location, and characteristics of mental health institutions. The data was downloaded from <https://datafiles.samhsa.gov/study-dataset/national-mental-health-services-survey-2015-n-mhss-2015-ds0001-nid17098> with the dataset format in csv file. There are 12826 data points in this file (Figure 2).

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In [18]: df_mental_raw.sample(10)
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Out[18]:
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	CASEID	LST	MHINTAKE	MHDIAGEVAL	MHREFERRAL	TREATMT	ADMINSERV	SETTINGIP	SETTINGRC	SETTINGDTPH	...	LICENMH	LICENSED
10607	201510608	TN	1	1	1	0	1	1	0	0	...	0	0
7550	201507551	NY	1	1	1	0	1	0	0	1	...	1	0
1767	201501768	CA	1	0	1	1	1	0	1	0	...	1	0
11569	201511570	VA	1	1	1	1	0	0	0	0	...	0	-1
4392	201504393	KY	0	0	1	0	1	0	1	0	...	0	0
430	201500431	AZ	0	0	0	0	0	0	1	0	...	1	0
1115	201501116	CA	0	1	1	0	1	0	0	0	...	1	0
9593	201509594	OR	1	1	1	1	0	0	0	0	...	1	0
9798	201509799	PA	0	1	0	0	0	0	0	1	...	1	0
11877	201511878	WA	1	1	1	0	1	0	0	0	...	1	0

Figure 2: Sample MHSS data, as a Pandas dataframe.

The following variables are used to determine the adequacy of mental institutions per State:

1. Mental health treatment approaches (type: quantitative): a simple average options available per institution, per state using the following variables from N-MHSS:
 - a. Psychotherapy
 - b. Couples/Family Therapy
 - c. Group Therapy
 - d. CBT
 - e. Dialectical Therapy
 - f. Behavioral modification
 - g. Integrated dual disorder treatment
 - h. Trauma therapy
 - i. Activity therapy
 - j. Electroconvulsive therapy
 - k. Telemedicine therapy
 - l. Psychotropic medication
2. Mental health rehabilitation approaches (type: quantitative): average per institution per State using the following variables from N-MHSS:
 - a. Psychosocial rehabilitation services
 - b. Psychiatric emergency walk-in services
 - c. Suicide prevention services
3. Crisis intervention team that handles acute mental health issues offered at facility and/or off-site (type: nominal)
4. Availability of payment reduction (type: nominal): whether the institution has payment reduction plans

Methods

In cleaning up the CDC data, I used Python to clean up the messy CDC data by getting rid of the non-data related sections using a RegEx split. I then replaced the tab spaces with a single comma. I then read this csv file into a Pandas dataframe.

The MHSS data was already a csv file, so I just read this into a Pandas dataframe. In order to fully analyze the questions, I filtered the data where I thought the response made sense. For example, the responses

to the question that checked whether an institution had psychotherapy had 3 possible response: “Yes”, “No”, and “Missing”. When filtering for this question, I used a Boolean mask in Pandas to only find the institution which answered “Yes” or “No.”

In order to answer any of the questions, I had to merge the two aforementioned datasets together. Because the variable I wanted to use to merge (i.e. State names) were either coded in abbreviation, and full State name, I utilized the “us” Python library to create a function to convert the abbreviations into full State name. I then used Pandas dataframe merge function to merge on the State name variable.

Neither of the datasets had missing data, so no imputation was done for any of the questions.

Gun deaths vs Treatment Services

To measure comprehensiveness of mental treatment services, I aggregated 12 variables (mentioned in Data Source section) and created a mean value, and set it to a new column called “treat_agg.” This variable shows the number of available treatment options out of 12 listed, per institution, per State—effectively, the “probability” of finding a full suite of treatment options for each State. The variables for the correlation here was a Pandas dataframe column.

Before analysis, I checked for normality using a QQ plot. Because the column for the number of deaths was not normal, I used a log-transformed deaths. This was more normal. “treat_agg” was also normal. I then calculated and plotted a correlation between “treat_agg” and log-death count.

Gun deaths vs Rehabilitation Services

Similar to Treatment services, I mean aggregated mental rehabilitation services variables (see Data Source section) to create a “rehab_agg” column in the merged dataframe. I checked for normality in this variable, then proceeded to calculate, and plot the correlations.

Gun deaths vs Crisis Intervention Services

Because crisis intervention services was a single column, I simply used a Pandas Series corr method. I checked for normality in the crisis intervention services variable, then proceeded to calculate, and plot the correlations.

Gun deaths vs Payment

Because payment reduction services was a single column, I simply used a Pandas Series corr method. I checked for normality in the payment reduction variable, then proceeded to calculate, and plot the correlations.

Analysis and Results

Normality Check

The number of deaths caused by guns showed a non-normal distribution (Figure 3). Log transformation was applied for analysis to improve normality.

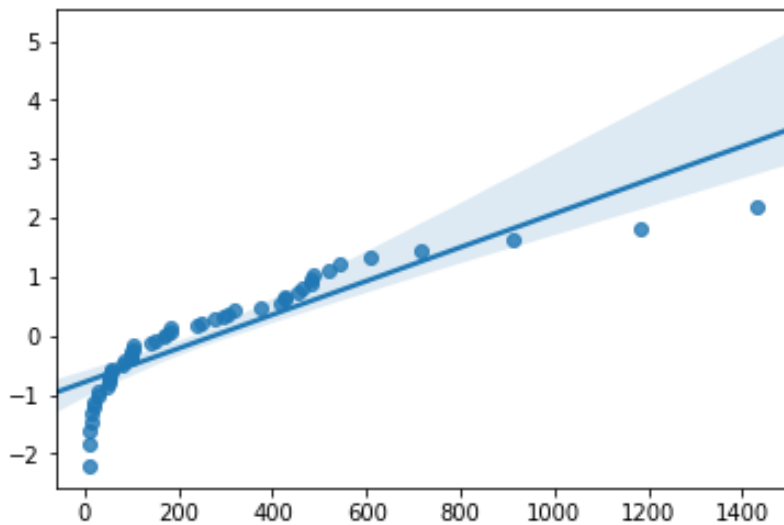


Figure 3: QQ Plot of Deaths by firearm variable.

Gun deaths vs Treatment Services

There was a Pearson's r correlation of -0.031 ($p = 0.028$). There was a statistically significant negative correlation between deaths caused by guns and the average availability of treatment (Figure 4)—that is, the more treatment options a State offers, the lower the death count caused by firearm is. This analysis seems to suggest a connection between comprehensive mental healthcare and firearm deaths.

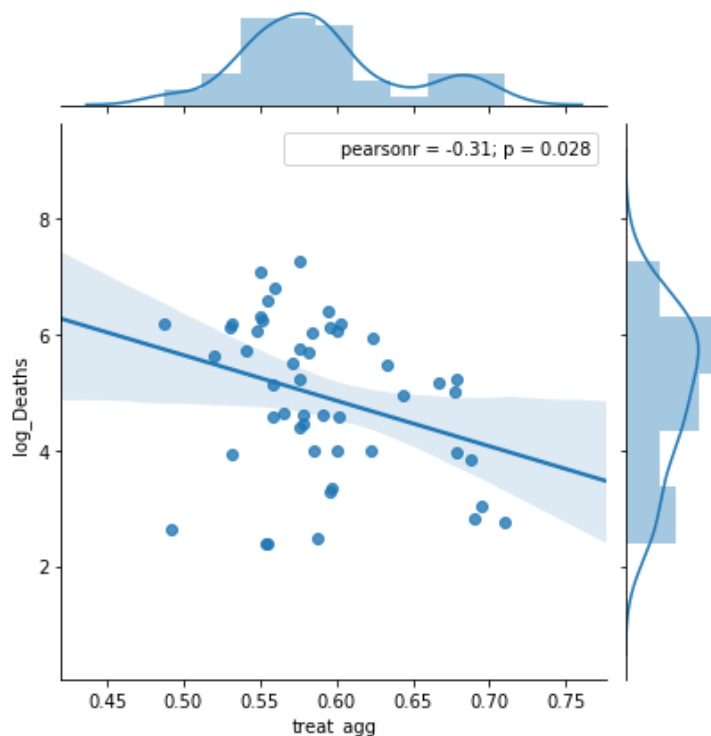


Figure 4: Scatterplot of log-transformed death count and treatment aggregate value.

Gun deaths vs Rehabilitation Services

There was a Pearson's r correlation of -0.12 ($p = 0.39$). Although statistically insignificant, there was a negative correlation between deaths caused by firearm and the availability of rehabilitation services (Figure 5). It is sound to say that there is no relationship between gun deaths and rehabilitation services. However, this analysis suggests that there is something inherently different about rehabilitation that cannot impact gun homicide like that of mental treatments. There are a handful of differences between rehabilitation services and mental health treatments:

- 1) Length of the service. Rehab seems to be a shorter term, while mental treatments take longer.
- 2) Rehabilitation and Treatments are different solutions to fix different problems. While rehabilitation, like counseling, focuses on one behavioral issue, treatment of mental problems is a generalized problem that effects all areas of life.

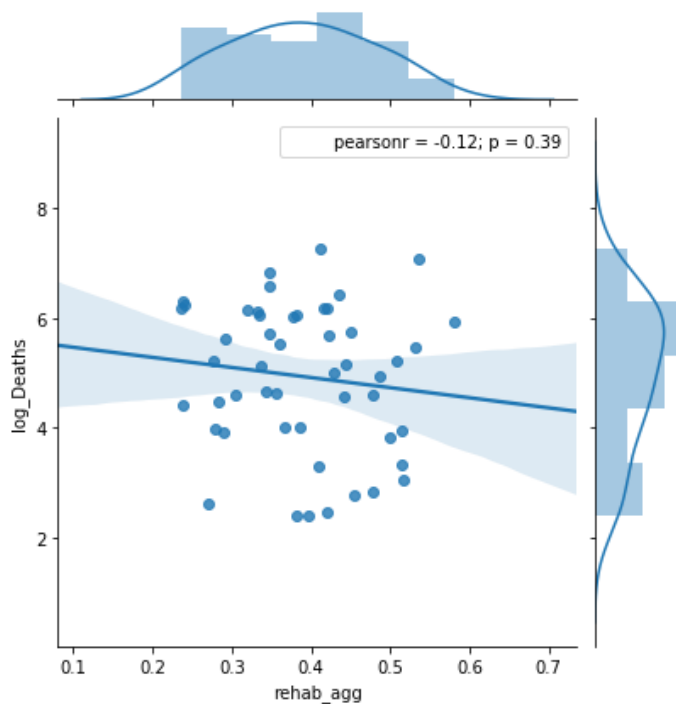


Figure 5: Scatterplot of log-transformed deaths caused by guns and rehabilitation services.

Gun deaths vs Crisis Intervention Services

There was a Pearson's r correlation of -0.2 ($p = 0.15$). There was a marginal correlation between log-transformed deaths caused by firearm and the availability of Crisis intervention services (Figure 6). There are less gun deaths with the availability of more crisis intervention team. Although this isn't statistically significant at $\alpha = 0.05$, there is a weak negative correlation between the two variables. There is reason to believe that there may be inpatient intake speed that needs to be considered as well—i.e., more immediate treatment to mental problems such as a crisis team can decrease deaths caused by guns.

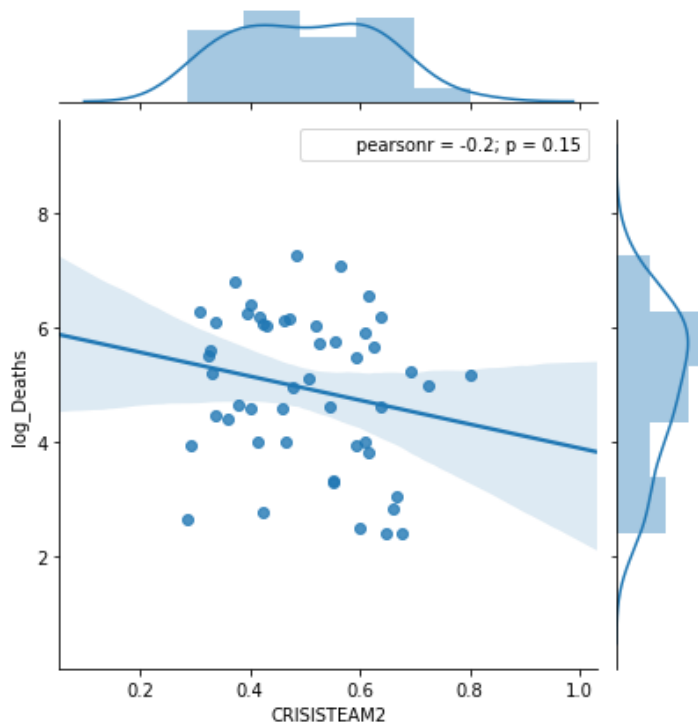


Figure 6: Scatterplot of log-transformed deaths by firearm and crisis intervention services.

Gun deaths vs Payment

There was a Pearson's r correlation of 0.0023 ($p = 0.99$). There is no correlation between deaths caused by guns and the institution's ability to pay with cost of services (Figure 7). While some studies point to higher crime rate in impoverished areas (Sampson, 2012), this analysis failed to show the connection between the need for payment assistance (an aspect of poverty), and deaths caused by gun homicides.

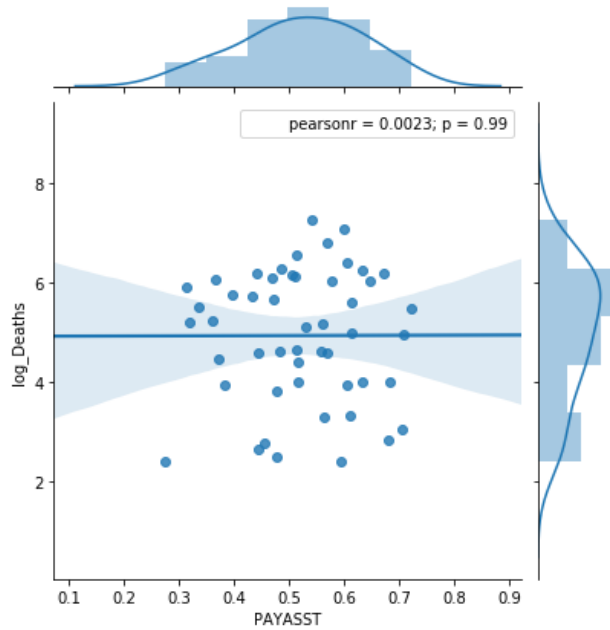


Figure 7: Scatterplot of log-transformed deaths caused by firearm and payment assistance.

Discussion

The analysis from the CDC on gun related homicides, and the MHSS dataset on mental health facilities in the United States offer an interesting insight on how gun wielders and mental health infrastructure impact each other. While mental health treatment and gun homicides show a clear negative correlation to each other, gun homicides and rehabilitation services, and, to an extent, crisis intervention services offer a murkier interpretation. The payment reduction program seems to be completely unrelated to gun deaths.

Gun regulation is a complex topic. From a mental health professional's perspective, advocating for a more comprehensive seems to decrease deaths by guns. However, from a rehabilitation psychologist's perspective, rehabilitation's effects on lowering gun homicide is insignificant. There are many angles from this can be tackled—this analysis hopes to provide an objective picture of the connections between gun violence and psychological health.

References

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