GVPedia
GUN VIOLENCE RESEARCH

Mass Shootings in America:

2013-2019

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GVPedia arms policymakers, advocates, and the public with facts and data to create evidence-based policy to reduce gun violence.

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The Importance of Studying Mass Shootings

Mass shootings have a uniquely devastating toll on American lives, yet account for 2% of all shootings in the United States. Relative to the 13,958 homicides and 39,740 overall gun deaths reported by the Centers for Disease Control (CDC) in 2018, mass shootings deaths cause 2.7% of homicides and just under 1% of overall gun deaths. Although this comparison might make mass shootings seem statistically insignificant, the numbers reflect the magnitude of America's gun violence crisis and the need to study this phenomenon.

Between 2013 and 2019, America experienced 2,341 mass shootings in which four or more individuals (excluding the shooter) were shot. Those shootings left 2,642 people dead and 9,766 physically wounded. This translates to an annual average of 334 mass shootings, 377 deaths, and 1,395 injuries.

The top 20 deadliest mass shootings between 2013 and 2019 resulted in 330 deaths. The 20 shootings with the most casualties (killed and injured), resulted in 1,072 people shot. This means that less than 1% of mass shootings are responsible for more than 10% of mass shooting deaths and casualties.

These staggering numbers highlight the importance of studying mass shootings, but while their occurrence dominates the media and public policy debates, there is very little academic research and guidance to help policymakers make sense of the data. Creating strong, effective policies to save lives requires a better understanding of mass shootings and how differing gun laws across the states impact the frequency and death toll of mass shootings. This report seeks to shed light on this tragic phenomenon through careful analysis of accurate data while dispelling myths and falsehoods that impede progress.

To GVPedia's knowledge, our report is the first in-depth examination of mass shootings using the Gun Violence Archive's (GVA) data from 2013 through 2019. Our analysis begins with a look at the competing definitions of what constitutes a mass shooting and reviews the recent scholarly literature on the topic. We then outline our methodology and how it differs from the previous literature. From there, we highlight the key statistics uncovered in the analysis. Finally, we detail our findings in five main sections:

1. The Impact of Laws on Mass Shootings
2. The Impact of Assault Weapons on Mass Shooting Fatalities and Casualties
3. The Variation in the Types of Mass Shootings Across States
4. The Variation in Mass Shooting Incidents Across Time
5. The Demographics of Mass Shooting Victims and Perpetrators

Our conclusion highlights our major findings and how they might shape public policy decisions.

Definitions Used In Previous Literature

Despite its position at the forefront of the gun debate and media attention, mass shootings do not have a single accepted definition.

- The FBI uses the term "mass murder" to define a case in which four or more individuals are killed, but not specifically for mass shootings.
- Congress defined "mass killings" as "3 or more killings in a single incident."
- The Congressional Research Service released a report in 2015 that adopted the mass murder lexicon for shootings, and many academics utilize it as well.
- Others have gone with their own variations, such as high-fatality mass shootings, which requires six or more people killed.
- Many academics also exclude various types of shootings from their analyses, such as gang or terrorism related cases.
- Finally, the FBI forgoes a mass shooting definition and instead focuses on active shooter cases (defined as "an individual actively engaged in killing or attempting to kill people in a populated area"), regardless of casualties.

One purpose of this report is to examine the previous mass shooting literature and compare existing data using a single definition to produce a clearer, more comprehensive, direct comparison of mass shootings.

The need for a uniform definition of mass shooting was a key finding in an April 6, 2020 article, "Advancing Mass Shooting Research to Inform Practice," released by The National Institute of Justice (NIJ). The authors called for a uniform definition of mass shootings that is more flexible than existing definitions based on the number of fatalities.

In addition to NIJ, a study appearing in *Injury Epidemiology* by Dr. Webster et al. argues:

"With this in mind, we advocate for a definition of 4 or more casualties, without a restriction on location of incident or whether the incident had gang or drug involvement. Databases that define mass shootings by victim fatalities – rather than total number of victims injured or killed – fail to capture the injury caused when people survive gun violence. Individuals who are nonfatally shot in these incidents are discounted, though they may suffer physical and psychological traumas for the remainder of their lives. Restricting incidents to those that occurred in a public place undercounts the true number of events that result in mass shooting casualties, especially domestic violence incidents that occur in the home. We also urge researchers not to exclude incidents that appear to be gang- or drug-related because uninvolved bystanders are still being killed or injured in these events. If we fail to count gang- and drug-related incidents, then these incidents will be less likely to receive the same attention in terms of prevention efforts. For these reasons, we urge the federal government to establish a mass shooting definition of 4 or more casualties, excluding the perpetrator, regardless of place or gang- and/or drug-involvement."

As our methodology section will detail, our report follows this guidance by using a mass shooting definition based on the number of people shot, not killed. Our report also answers the call to "help identify and debunk misconceptions with scientific evidence" while taking an important step in understanding mass shootings.

Using the eclectic group of definitions listed above, several recent analyses examined the relationship between firearm laws and mass shootings. Because they do not use a single definition of "mass shooting", it is impossible to compare and contrast the findings of each of these studies. However, we have included a short summary of those studies to provide important context for our findings concerning the impact of firearm laws on mass shootings.

- A 2020 study published in *Criminology & Public Policy* by Dr. Daniel Webster, et al. examined mass shootings in which four or more individuals, excluding the shooter, were killed from 1984-2017. The study excluded gang and drug related shootings and used FBI SHR data. The authors found that handgun purchaser licensing laws and large capacity magazine bans were significantly associated with fewer mass shootings.

- A 2019 study published in the *British Medical Journal (BMJ)* by Paul Reeping and several colleagues examined mass shootings in which four or more individuals, excluding the shooter, were killed from 1998-2015. The study used FBI data for shootings, law scores from the *Traveler's Guide to the Firearms Laws of the Fifty States*, and a gun ownership proxy of the percentage of suicides committed with firearms. The authors found that more permissive gun laws and higher gun ownership rates were significantly associated with a higher rate of mass shootings. Specifically, "... a 10 unit increase in state gun law permissiveness was associated with a significant 11.5% higher rate of mass shootings" and "a 10% increase in state gun ownership was associated with a significantly higher rate of mass shootings."

- A 2019 analysis by Nick Wilson for Guns Down America examined mass shootings in which five or more individuals were killed, excluding the perpetrator, as identified by the *Gun Violence Archive* from 2013-2018. Using a qualitative in-depth analysis, he determined that in cases where a firearm's origin could be determined, 52% of the shootings might have been prevented with a federal firearm licensing law.

- A 2020 analysis by Rahul Mukherjee of the *LA Times* utilized data collected by *The Violence Project* of mass shootings in which four or more individuals, excluding the shooter, were killed between 1966 and 2019. The paper looked at straw purchase, red flag (extreme risk protection order), safe storage, assault weapons ban, and background check laws and found that, had those laws been enacted at the federal level, 146 of 167 shootings might have been prevented.

Methodology of this Report

This report uses the mass shooting definition provided by GVA which defines mass shooting as an incident in which four or more individuals are shot, excluding the shooter. While many of the incidents included don't fit the popular conception of a mass shooting, GVA's definition provides a broader look at mass gun violence than other studies by including deaths and injuries, and removes the potential bias that comes from removing cases from an analysis.

Focusing on mass shootings with high death counts does help make research more accurate when studying older events because shootings with more deaths receive more media attention and therefore make it easier for researchers to find records of the events. However, such definitions tend to exclude high-casualty shootings that don't make national headlines despite being deeply traumatizing for the local community. For example, a July 1, 2017 shootout in a Little Rock, Arkansas nightclub resulted in 25 people shot. Fortunately, no one was killed so under the above definitions, it does not count as a mass shooting despite the 25 casualties. These types of incidents are included in our report.

Our analysis also examines the variation in mass shootings in all 50 states and Washington, D.C. between 2013 and 2019 using Law Scores provided by the Giffords Law Center. States with stricter gun laws score higher on an A to F scale (A representing the strictest laws and F representing the least restrictive). For example, Massachusetts has an A rating because of its strong laws, including firearm owner licensing, extreme risk protection orders, and stringent child access prevention. On the other end of the scale, Mississippi has an F rating. Mississippi allows permitless carrying of firearms and does not require universal background checks or allow for extreme risk protection orders.

The Law Center does not provide a grade for Washington, D.C. because it is a city, not a state. However, for the purposes of this analysis and to avoid discarding data, we assigned the city a consistent A rating for 2013 to 2019. Appendix B shows state laws and grades by year.

The analysis splits states into two categories each year:

1. Law Scores of A, B, and C are considered "strong"
2. Law Scores of D and F are considered "weak"

It is important to note that in lumping states into two categories, we are not suggesting that there is no real difference in laws within the two categories. States with an A rating have significantly stronger laws than those with a C rating, and states with a D rating have stronger laws than those states with an F. However, separating the states into two categories provides roughly equivalent populations in the two categories, which makes side-by-side comparisons easier, and provides enough incidents in each category to conduct a meaningful analysis with less potential for statistical noise.

Over the time period studied, states can shift to a different law score. For example, Nevada started at an F in 2013, moved to a C- in 2016 when it passed a background check law, moved to a D in 2017 when it became clear the law wasn't being properly implemented, and moved up to a C+ in 2019 when the legislature fixed those problems. If the background check law is not counted in 2016, the state would still be considered a D, though for our report we stick with Gifford's original coding.

Our analysis calculates a per capita rate of shootings, deaths, injuries, and overall casualties (deaths plus injuries). These annual per capita rates are formed into an average per capita rate for the entire period, allowing for a side-by-side comparison of the two state categories.

Our detailed statistical study (Appendix A) takes a Bayesian approach and uses Markov chain Monte Carlo analysis to examine whether the differences between mass shooting incidents, fatalities, and overall casualties between states with strong and weak gun laws are statistically significant for each year from 2013-2019.

Key Statistics from this Report

- States with D and F ratings have 4.7% more shootings, 50.3% more deaths, 11.1% more injuries, and 18.4% more overall casualties than states with A, B, and C ratings between 2013 and 2019.
- States with weaker gun laws suffer more fatalities from mass shootings than states with stronger gun laws at a statistically significant level. Our Markov chain Monte Carlo analysis finds that states with weaker gun laws have significantly more mass shooting fatalities in 5 of the 7 years studied than states with stronger gun laws. On the other hand, the difference in the number of incidents is not statistically significant.
- High-fatality shootings (6+ killed) occur 53.3% more often in states with weaker gun laws and are more deadly with an average death rate of 13.4 individuals per high-fatality mass shooting in D and F states, versus 9 individuals per high-fatality mass shooting in A, B, and C states (which translates to 48.8% more fatalities per high-fatality mass shooting).

- Cases in which assault weapons were used had 4.2 deaths, 11.8 injuries, and 16.0 casualties on average. In comparison, cases in which no assault weapon was reported had 1.0 deaths, 3.9 injuries, and 4.9 casualties on average.
- Despite assertions otherwise, gang-related shootings comprise 11.1% of overall mass shootings, which is in line with the estimated 10-20% of all firearm homicides that are gang related.
- In 2013, there were 254 mass shootings. By 2019, this jumped to 418 shootings, an increase of 65%.
- Of 12,147 mass shooting casualties during the time frame studied in this report, in cases where gender was known, 72.5% were male and 27.5% were female. In cases where age was known, 3.3% were children (age 0-11), 10.7% were teenagers (age 12-17), and 85.9% were adults (age 18+).

The Impact of Laws on Mass Shootings

We hypothesized that, while no one law is sufficient to prevent mass shootings, states with more stringent firearm laws that each address various aspects of gun violence will experience fewer and less lethal mass shootings compared to states with weaker laws.

States with D and F ratings have 4.7% more shootings, 50.3% more deaths, 11.1% more injuries, and 18.4% more overall casualties (deaths plus injuries) per capita than states with A, B, and C ratings from 2013 to 2019. Over the same time period, D and F rated states had an average population of 161,713,426 with 1,193 shootings, 1,580 fatalities, 5,129 injuries, and 6,709 casualties. In contrast, A, B, and C rated states had an average population of 160,827,111 with 1,148 shootings, 1,062 fatalities, 4,637 injuries, and 5,699 casualties. States with D and F ratings therefore had 45 more shootings, 518 more deaths, 492 more injuries, and 1,010 more overall casualties than states with A, B, and C ratings.

To test the statistical significance of the results above, we used a Bayesian approach and ran a Markov chain Monte Carlo analysis on the number of incidents, fatalities, and casualties in states with weak laws versus states with strong laws for each year. The null hypothesis is that there is no statistical difference between states with weak and strong laws for incidents, fatalities, and casualties.

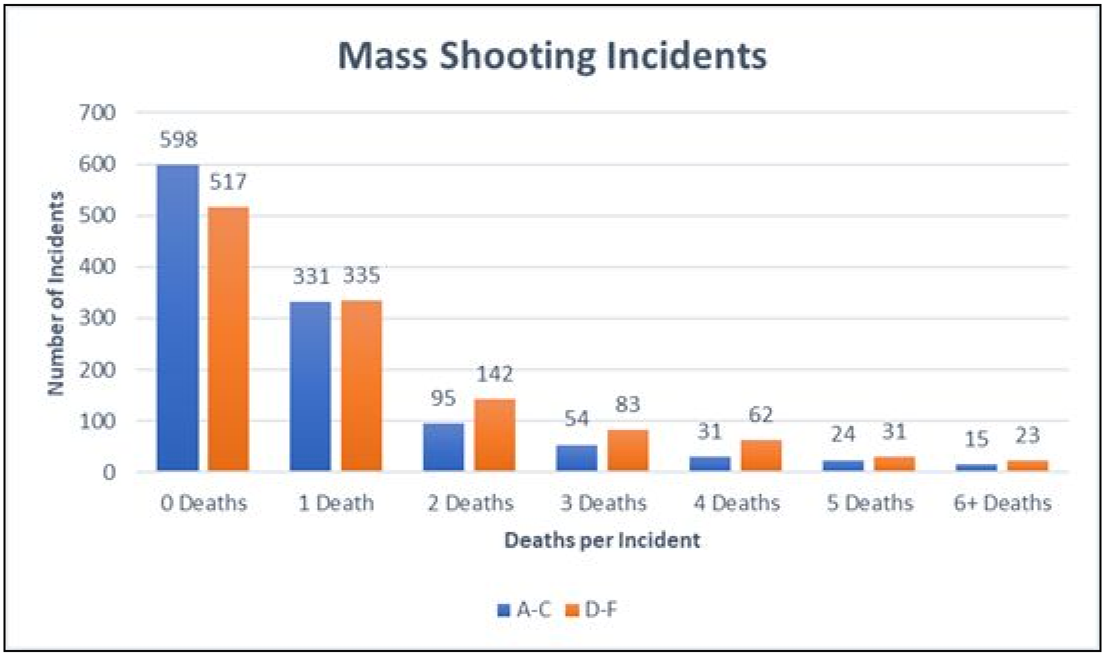
Our analysis revealed that there is no statistically significant difference in the number of incidents between weak and strong states for any year from 2013-2019, despite there being 4.7% more incidents per capita over the entire period in weaker states. States with weak laws had significantly more fatalities in 2014, 15, 16, 17, and 19 (5 of 7 years). They also had significantly more casualties in 2015, 16, 17, and 19 (4 of 7 years) while states with stronger laws had significantly more casualties in 2013. The results for fatalities were especially significant with p-values in the 5 significant years ranging from 0.0043 to 9.079x10^-15 (which translates to 0.000000000000009079 when written out). Traditionally, a result is statistically significant with a p-value of 0.05 (the lower the p-value, the more statistically significant). This means that for mass shooting fatalities, we are able to reject our null hypothesis.

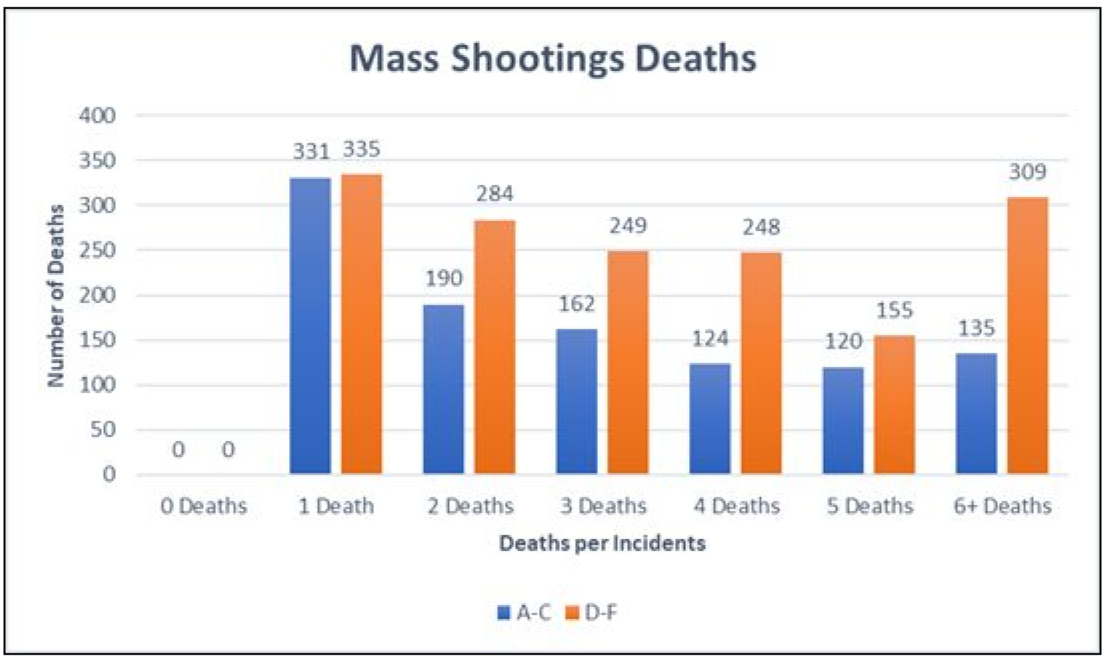
In short, the results of the statistical analysis confirm that states with weaker laws have significantly more mass shooting fatalities than states with stronger laws, while there was no statistically significant difference in the number of incidents. If you want to read about the Markov chain Monte Carlo analysis we conducted in much more detail, please see Appendix A at the end of this report.

Returning to our regular analysis, if Washington, D.C. is excluded, states with D and F ratings have 7.9% more shootings, 53.6% more deaths, 14.8% more injuries, and 22.1% more overall casualties per capita than states with A, B, and C ratings between 2013 to 2019. (Researchers frequently exclude Washington, D.C. from analyses of state laws given that it is not a state.)

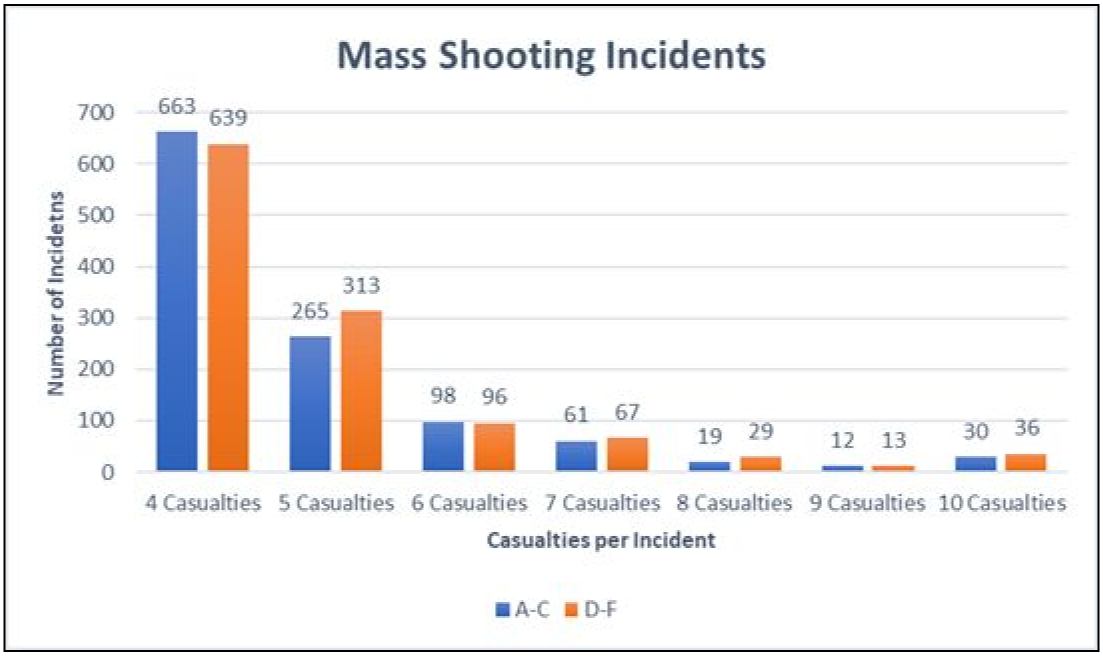
Appendices B and C show how State Law Scores changed from 2013 to 2019, as well as the number and rate of shootings, deaths, injuries, and casualties for each state over the entire time period.

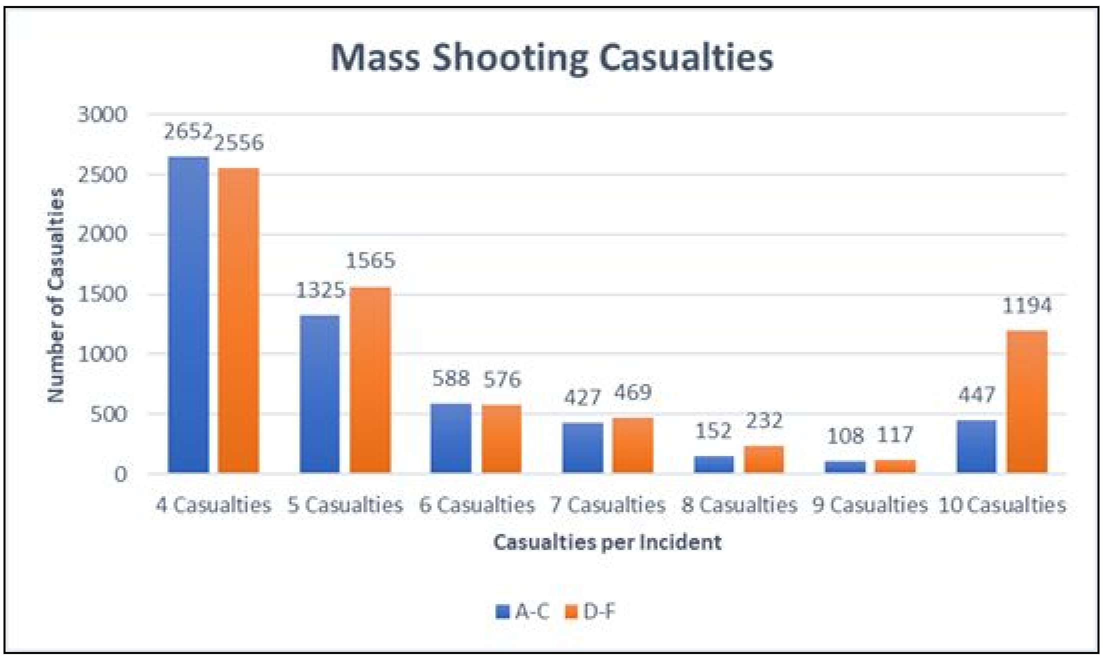
Shootings in states with weaker gun laws are, on average, significantly more lethal. Not only do high-fatality shootings (6+ killed) occur 53.3% more often in states with weaker gun laws, those high-fatality shootings themselves are more deadly with an average death rate of 13.4 individuals per high-fatality mass shooting in D and F states versus 9 individuals per high-fatality mass shooting in A, B, and C states (which translates to 48.8% more fatalities per high-fatality mass shooting). On the other hand, there are 13.5% fewer no-fatality mass shootings in D and F states than A, B, and C states.





When looking at casualties (killed and injured), there are 20% more high-casualty shootings (10+ casualties), and 167.1% more casualties in those shootings, in D and F states than in A, B, and C states. While the 167.1% differential is extreme, the majority of the gap results from the Las Vegas shooting in 2017 which had 500 casualties. There are 3.6% fewer 4-casualty mass shootings in D and F states than A, B, and C states. Comparing deaths with overall casualties demonstrates that the main difference in shootings between states with weaker and stronger laws is the lethality of the incidents.





The Impact of Assault Weapons on Mass Shooting Fatalities and Casualties

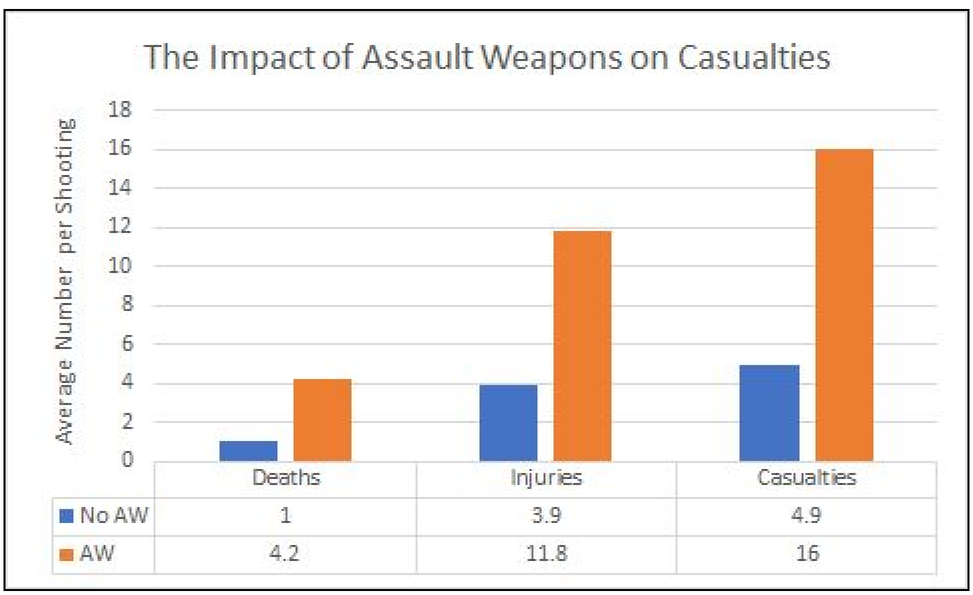
The conversation surrounding mass shootings and the debate over assault weapons are often inextricably intertwined but our evidence is clear: assault weapons significantly increase the rate of fatalities in mass shootings. Our analysis provides further context to this discussion.

GVA's assault weapon definition states in part: "AR-15, AK-47, and all variants defined by law enforcement."

From 2013 to 2015, GVA did not emphasize tracking whether the weapon used in a shooting was an assault weapon (this lack of emphasis does not impact the other subcategories of mass shootings we will examine). As such, this segment of the analysis will focus on mass shootings from 2016 to 2019. Further, it is important to recognize that if a weapon is not recovered, police may not report whether it was an assault weapon. As such, GVA's tally likely undercounts the true number of assault weapon shootings. Shootings in which a weapon is not recovered or reported typically have lower casualty counts, thereby skewing the relative lethality of assault weapon shootings upwards.

While recognizing the potential for omission bias, the available data still provide some useful metrics:

- Out of 1,483 mass shootings that killed 1,723 individuals and wounded 6,287 from 2016-2019, assault style weapons were used in at least 79 cases (5.3%), killing 329 individuals (19.1%) and wounding 933 (14.6%).
- Cases in which assault weapons were used had 4.2 deaths, 11.8 injuries, and 16.0 casualties on average. In comparison, cases in which no assault weapon was reported had 1.0 deaths, 3.9 injuries, and 4.9 casualties on average.



Although these results should be tempered by the aforementioned potential for omission bias, the disparity in lethality between known assault weapon and non-assault weapon mass shootings is sizable enough to safely conclude the difference is significant. While assault weapon use is comparatively rare in mass shootings, when used, they have a devastating impact. Previous academic literature has also found a significant link between the use of large-capacity magazines and higher death tolls. GVA data does not consistently track the use of large-capacity magazines so our analysis does not include this factor.

The increased lethality of assault weapons can be seen in the highest casualty mass shootings. Of the top 20 highest casualty mass shootings from 2013 to 2019, 14 were committed with an assault weapon, as were 8 of the top 10. Of the top 20 deadliest mass shootings, 10 were committed with an assault weapon, as were 7 of the top 10.

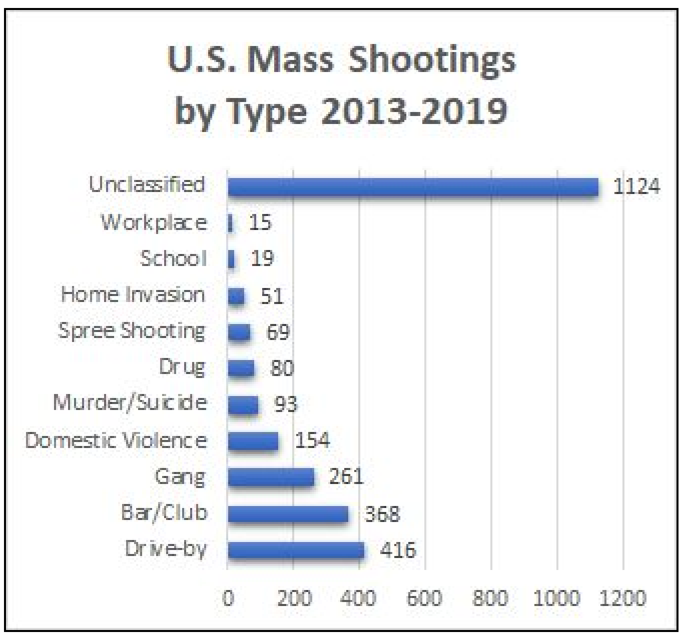
The tables containing the specific data for the 20 highest casualty mass shootings can be found in Appendix D.

The use of assault weapons partially explains the lethality gap between states with stricter laws and those with weaker laws. From 2016-2019, states with D and F ratings had 63.3% more incidents in which an assault weapon was reported than A, B, and C rated states (49 incidents versus 30). Texas, Florida, and Nevada are the three states with the most deaths from mass shootings with assault weapons, with Florida and Nevada improving their laws to a C- and C+ (from previous ratings of F and D), respectively, in 2018 and 2019, after particularly deadly shootings in those states.

The Variation in the Types of Mass Shootings Across States

Of the 2,341 mass shootings, these are the most prominent categories consistently tracked by GVA.

In addition, there were 1,124 mass shootings that did not fall into any of these categories. While some of the police and media reports may just be lacking necessary information to classify these cases, more frequently the shootings don't fall neatly into any classification scheme. Further, many of the categories experience significant overlap (for example, many gang shootings are also drive-bys and many domestic violence shootings are murder-suicides).



States with weaker gun laws (D and F ratings) were more likely to experience the following categories of shooting incidents versus their counterparts with stronger laws (A, B, and C ratings):

Drive-by: 5.9%
Bar/Club: 76.7%
Domestic Violence: 90.6%
Murder Suicide: 44.7%
Drug: 120.0%
Spree Shooting: 65.4%
Home Invasion: 140.0%
Workplace: 14.3%

States with weaker gun laws (D and F ratings) were less likely to experience the following categories of shootings versus their counterparts with stronger laws (A, B, and C ratings):
Gang: -31.6%
School: -27.3%
Unclassified: -19.6%

One of the most prevalent critiques of GVA's mass shooting definition is that it includes incidents that critics believe it shouldn't, primarily gang and drug related shootings. As one of those critics, pro-gun commentator John Lott has opined: "Mass shootings have different definitions. A 'mass public shooting' is where somebody is trying to shoot people in public, where they are trying to harm as many people as possible and it's not part of some other type of crime. It wouldn't be part of a robbery or something like that. And those are the ones that get the national news attention. Traditional FBI definition is 4 people or more killed besides the attacker." And further: "A mass shooting is a much broader category and it's where 4 or more are shot and it could include the attacker. Sometimes no deaths occur. Overwhelmingly these are going to be gang shootings and the rest will be linked to some kind of crime that occurred. Generally the national media does not cover these types of shootings. They are the kind of shootings that occur in areas like Chicago."

The data concludes this statement is false. Gang-related shootings comprise only 11.1% of overall mass shootings, which is in line with the estimated 10-20% of firearm homicides that are gang related. While some gang related shootings might not have been recorded as such (as precise motive can be difficult to discern from police and media reports), there is no evidence to suggest that mass shootings are overwhelmingly gang related.

All too often, the "gang" shooting critique is used as a problematic short-hand for shootings that occur in predominantly urban areas or in communities of color, designed to dismiss such shootings as irrelevant and not worthy of study. At best, it is an inaccurate assertion that gang-related shootings have such different motivations from other types of shootings that they are an entirely different form of gun violence. While this may be the case if researchers limit their analyses to mass public shootings which were designed to indiscriminately maximize public casualties, these mass shooting cases in particular are the outliers when it comes to mass violence incidents.

Instead, arguments and grievances escalating into lethal violence, aided in large part by ready access to firearms, is the most prominent common thread throughout these shootings, including gang-related and high-fatality shootings.

Pro-gun activists also frequently contend that the best way to stop a “bad guy” with a gun is a “good guy” with a gun and that defensive gun uses (DGUs) occur millions of times annually. The myth of widespread defensive gun use has been repeatedly debunked and analyzing mass shootings lends further credence against the myth. Of the 2,341 mass shootings from 2013-2019, only 46 involved a DGU (slightly less than 2% of the total). Mass shootings with a DGU had 2.5 deaths, 4.4 injuries, and 6.8 casualties on average versus 1.1 deaths, 4.2 injuries, and 5.3 casualties on average for those without a DGU. Of the 46 DGU incidents, only 7 resulted in a bystander stopping the shooting (0.3% of all mass shootings), and in 14, a bystander shot the shooter but the mass shooting either continued or was already over.

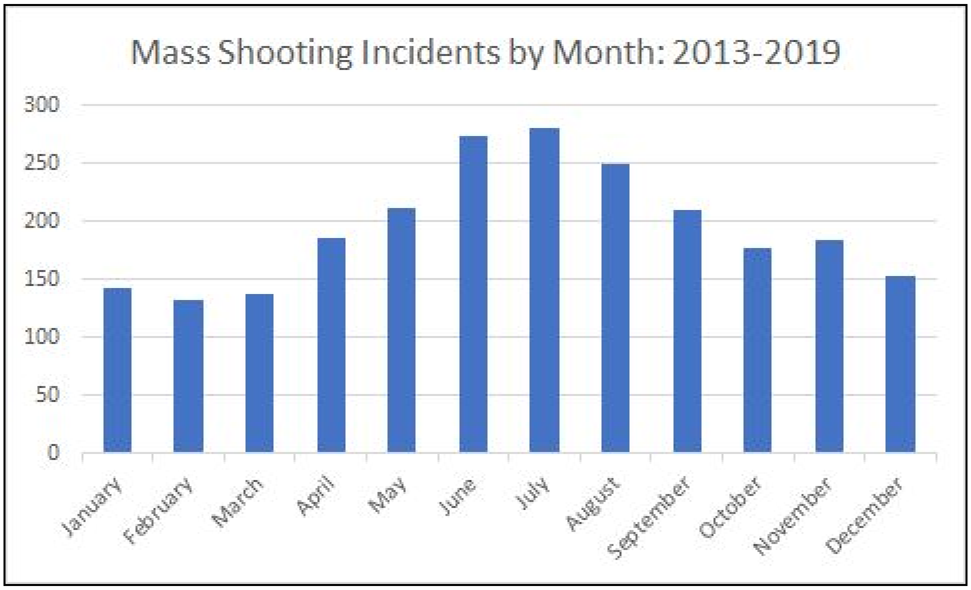
The Variation in Mass Shooting Incidents Across Time

While on average the United States suffered nearly one mass shooting per day from 2013-2019 (334 per year or 0.9 per day), that statistic hides the significant increase in mass shootings over the previous 7 years, as well as intra-year fluctuations.

In 2013, 254 mass shootings occurred. By 2019, the number jumped to 418 shootings, an increase of 65%. The second highest year was 2016 with 382 shootings. Mass shooting deaths and casualties have increased in a similar fashion, escalating from 289 deaths and 1,254 casualties in 2013 to 464 deaths and 2,174 casualties in 2019, an increase of 61% and 73% respectively.

The increase in mass shootings has not been shared equally between states with stringent gun laws and those with weaker gun laws. From 2013-2019, A, B, and C rated states saw their annual mass shooting incident rate increase by 33.2%, death rate increase by 25.8%, and overall casualty rate increase by 34.2%. In contrast, D and F rated states saw their annual mass shooting incident rate increase by 90.9%, death rate increase by 91.6%, and casualty rate increase by 111.0% from 2013 to 2019.

Mass shootings during our studied timeframe also had a significant intra-year variation. June (274), July (281), and August (250) consistently have the highest incidents of mass shootings. July’s shootings are more than twice that of February, which had 132 shootings over the 7-year period. The deadliest and highest casualty month is June, with 289 deaths and 1,447 casualties. The least deadly and lowest casualty month is March, with 136 deaths and 678 casualties.


Mass Shooting Incidents by Month: 2013-2019
300
250
200
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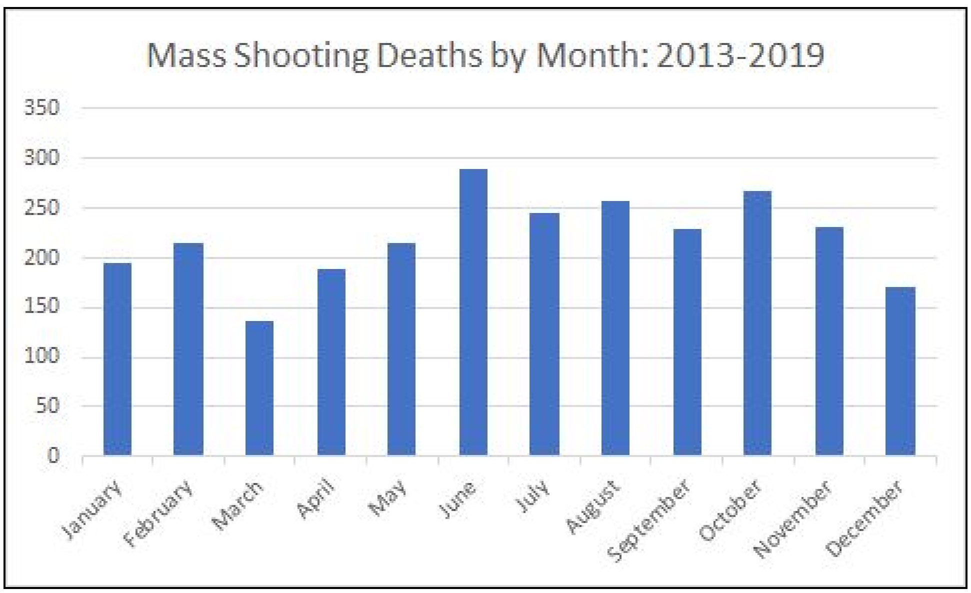
100
50
0
January
February
March
April
May
June
July
August
September
October
November
December


Mass Shooting Deaths by Month: 2013-2019
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300
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200
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100
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August
September
October
November
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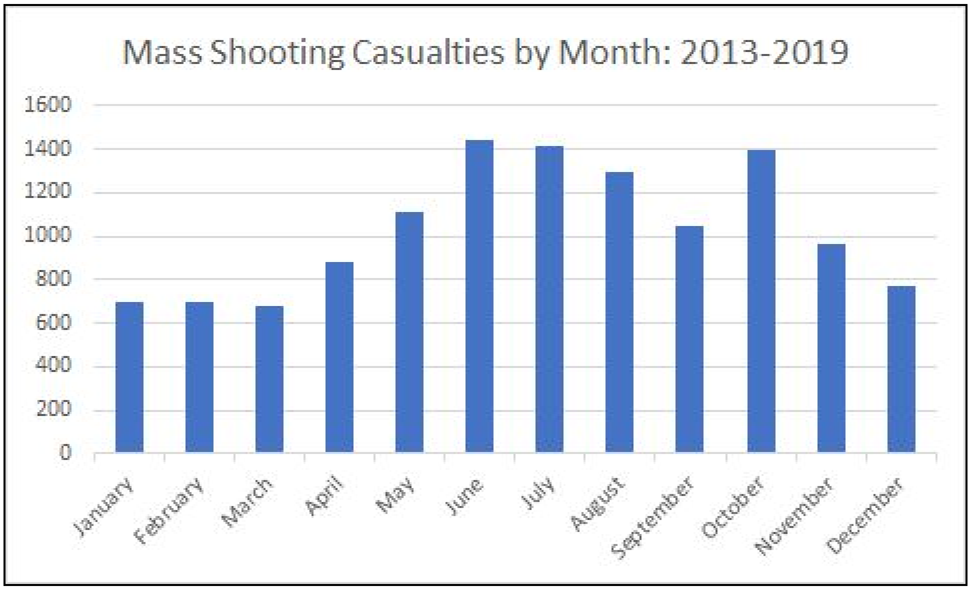
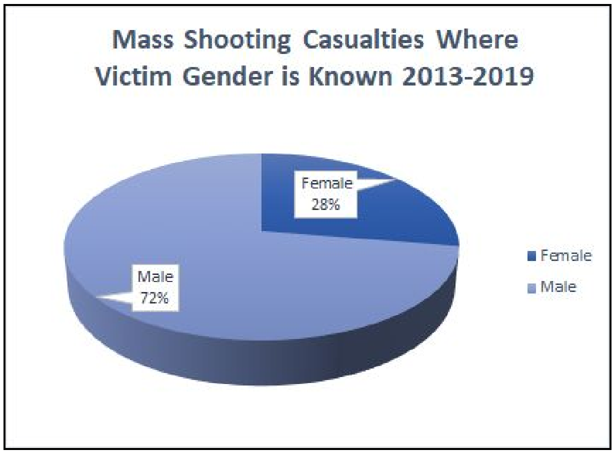


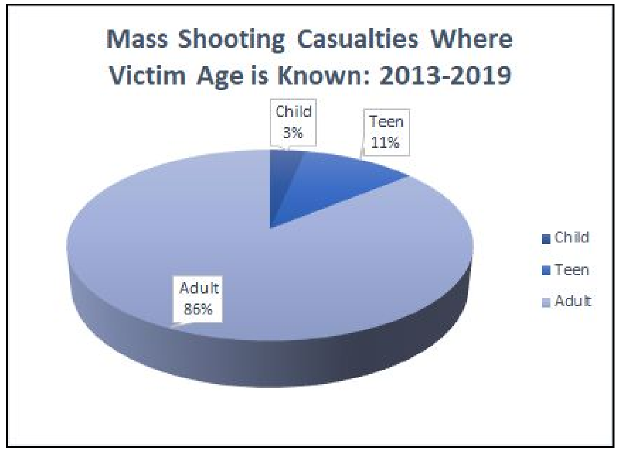
The tables containing the specific data for these graphs can be found in Appendix E.

The Demographics of Mass Shooting Victims and Perpetrators

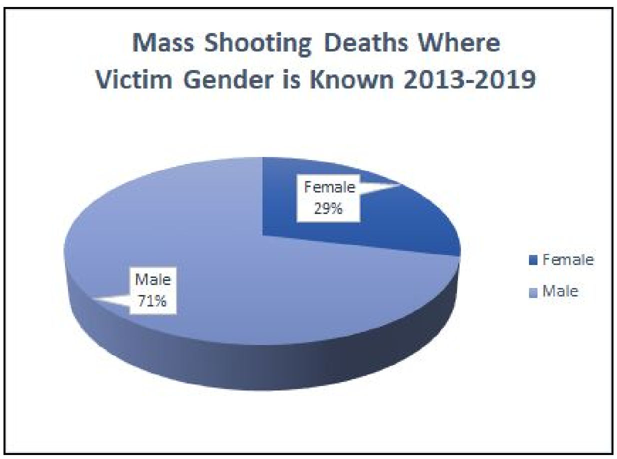
From 2013-2019, 2,341 mass shootings left 2,642 people dead and 9,766 wounded. GVA tracks the gender and age group (children 0-11, teenager 12-17, and adult 18+) of the individuals involved in a mass shooting when that demographic information is reported by law enforcement or media. While GVA does track the individual age, not just age group of participants, the age group data was significantly more complete so GVPedia limited its analysis to age groups instead of precise ages. It is important to note that GVA does not track race related data.

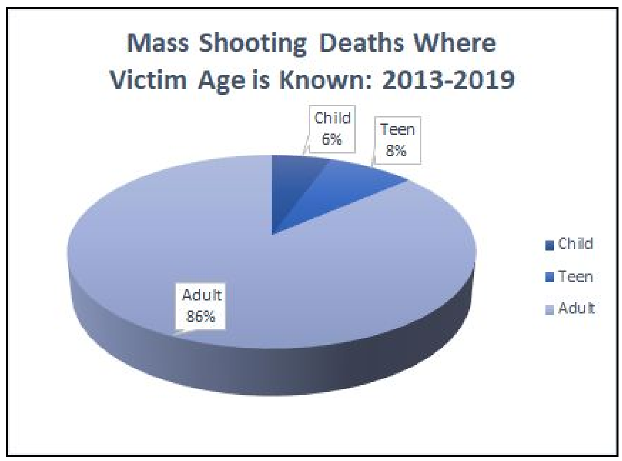
Of 12,147 mass shooting casualties (deaths plus injuries), in cases where gender was known, 72.5% were male and 27.5% were female. In cases where age was known, 3.3% were children, 10.7% were teenagers, and 85.9% were adults.



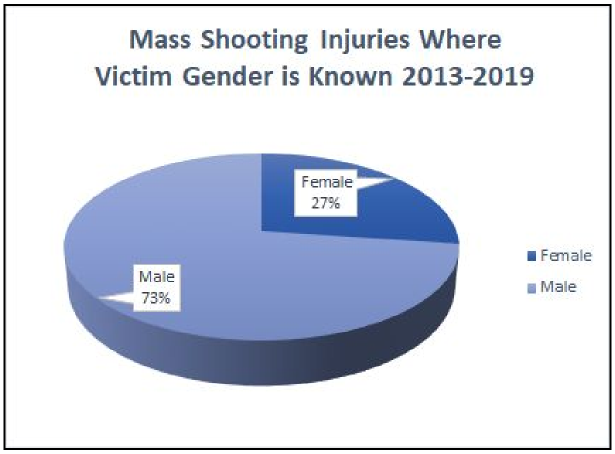


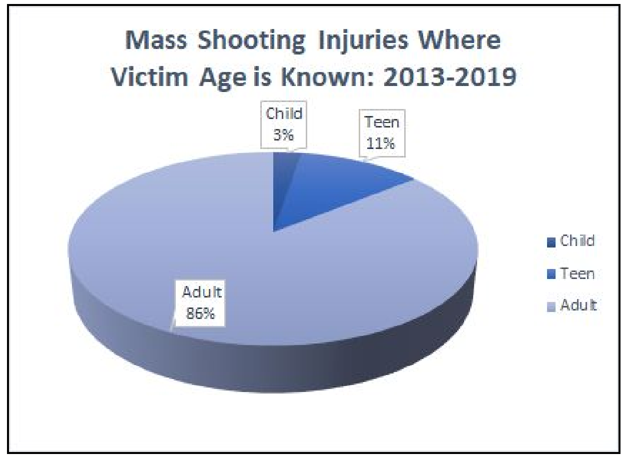
Of 2,478 mass shooting fatalities, in cases where gender was known, 71.4% were male and 28.6% were female. In cases where age was known, 5.6% were children, 8.1% were teenagers, and 86.3% were adults.





Of 9,669 mass shooting injuries, in cases where gender was known, 72.9% were male and 27.1% were female. In cases where age was known, 2.6% were children, 11.6% were teenagers, and 85.8% were adults.





Of female mass shooting casualties, 26.8% were fatalities and 73.2% were injuries. Of males, 25.4% were deaths and 74.6% were injuries.

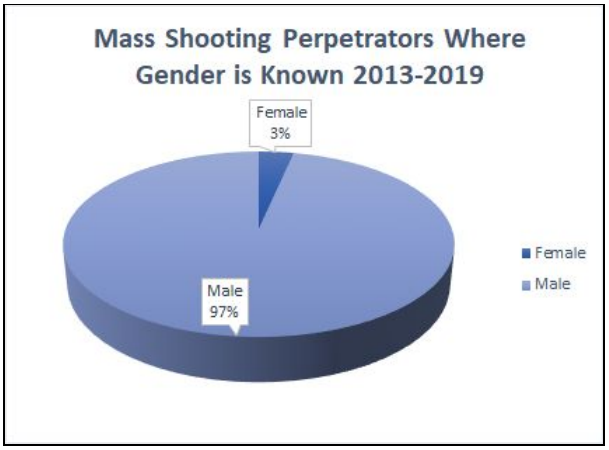
Of child mass shooting casualties, 40.2% were fatalities and 59.8% were injuries. Of teenagers, 18.2% were fatalities and 81.8% were injuries. Of adults, 24.3% were fatalities and 75.7% were injuries.

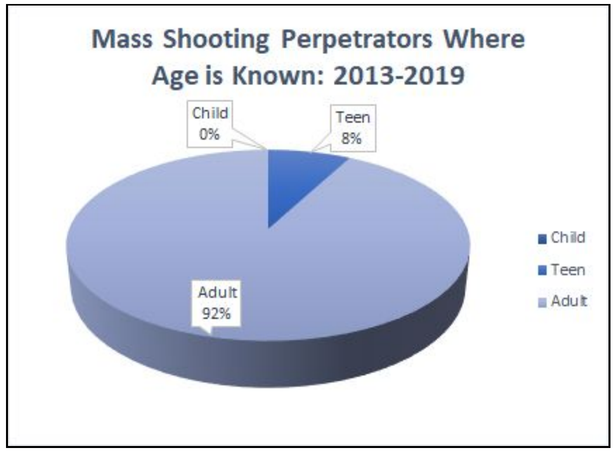
While on an absolute basis the ratios of female to male and child/teenager to adult victims appear low (significantly more men and adults are killed and injured in mass shootings), comparing these statistics to 2018 overall firearm homicide numbers from the CDC paints a different picture. By age group, children ages 0-11 compromise 1.1% of firearm homicide victims, teenagers 12-17 comprise 5.1%, and adults 18+ comprise 93.8%. This means the proportion of children killed in mass shootings is 5.1 times higher than the proportion of child firearm homicide victims. Women make up 16.6% of firearm homicide victims, while men are 83.4%. This means the proportion of female deaths is 1.7 times greater in mass shootings than in overall firearm homicides.

Either age or gender information was unrecorded for 28.6% (3,483 of 12,147) of victims, with 13.7% missing both. Age and gender information is only unrecorded for 4.8% (119 of 2,458) of deaths, whereas such information is unrecorded for 34.8% (3,364 of 9,669) of injuries. This unrecorded information likely biases the male and adult demographics downwards, as shootings involving adult males are more likely to involve shootings that aren't as heavily reported (such as urban shootings with mostly injuries rather than deaths). It also means that when examining demographic information in mass shootings from GVA, deaths will be more accurate than injuries.

For perpetrators, in cases where the gender is known, 96.6% of shooters are male and only 3.4% are female. Where age is known, 92.2% of shooters are 18 or older and 7.8% are 12-17 years old (there are no child mass shooters recorded). It is important to note that some shootings do not even have a perpetrator recorded and of the ones that do, 17.8%

(379 of 2,119) of the perpetrators either had their age or gender unrecorded with 6.3% missing both (134). Similar to the victim data, unrecorded cases likely bias male and adult demographics downwards.





Conclusion

The most striking finding from our analysis is that from 2013 to 2019, states with weaker gun laws (D and F rated by the Giffords Law Center) experience substantially more mass shooting fatalities than states with stronger gun laws (A, B, and C rated). A Markov chain Monte Carlo analysis confirms this finding is highly statistically significant in 5 of the 7 years.

The difference in death rates is driven by states with weaker laws experiencing significantly more high-fatality (6+ killed) shootings than their counterparts, and those high-fatality shootings themselves having more deaths. This is likely due to states with weaker laws having substantially more shootings with assault weapons, which are more lethal than other shootings.

Our report finds clear evidence that weaker gun laws are strongly associated with more mass shooting fatalities. However, determining how much of this disparity in deaths is due to the gun laws themselves, more gun ownership in states with weaker laws, or a more permissive gun culture requires further study. It is important to note that these three factors are intertwined. Stronger gun laws can lead to less firearm ownership and encourage a more responsible firearms culture. Likewise, changing the culture around firearms can lead to greater receptiveness for stronger gun laws and a decrease in ownership. The impact of the permissiveness of gun culture was outside the scope of this report but should be considered for further study in future research. The authors of this report also recommend that policymakers and those in a position to collect data put a greater focus on 1) solidifying data on firearm ownership by state, 2) defining measures to track gun culture, and 3) refining the tracking of firearm laws by state.

The GVA data clearly show that mass shootings have increased significantly over the past seven years, confirming previous academic evidence about the increase. This increase is not evenly shared among states with strong and weak laws, with weaker states experiencing more substantial spikes in mass shooting incidents than their stronger counterparts.

Our report also debunks some common myths. Despite contrary opinions, no evidence exists to indicate that these mass shootings are overwhelmingly the result of gang violence. Instead, the consistent motivation behind these attacks appear to be personal grievances and arguments that spill into lethal violence, aided in large part by easy access to firearms. Further, there is scant evidence that firearms have a significant beneficial impact through direct or indirect deterrence. Defensive gun use is rare, and even more rarely effective.

Finally, our report shows that while a significant majority of mass shooting victims are male (72.5%) and adults (85.9%), the proportion of women and children killed in mass shootings versus gun homicides is significantly higher. Mass shooting perpetrators are almost exclusively male (96.6%) and adult (92.2%).

The findings in this report point to several conclusions:

1) No single gun law or program can address the totality of the crisis. Mass shootings are a multifaceted problem that require a comprehensive package of solutions.
2) Stronger gun laws matter in reducing deaths from mass shootings.
3) The type of weapon used in a mass shooting matters. The use of assault weapons increases the rate of fatalities and injuries.
4) Mass shootings are a growing crisis with no sign of abatement.
5) Additional data collection at the state level is required to more effectively study and understand the correlation of gun ownership, gun laws, and gun violence so that policymakers can make decisions based on facts and data.

Appendix A: Bayesian Analysis

By Christopher Danko

By examining a dataset including every mass shooting death in the United States in 2019, we examined the following questions:

1. Do states in the U.S. with strong gun control laws have fewer mass shootings compared to states with weak gun control laws?

2. Do states in the U.S. with strong gun control laws have fewer mass shooting fatalities compared to states with weak gun control laws?

This study divides the data into two sets: one set of states with “strong” gun laws and another with “weak” gun laws. Here, “strong” gun laws are indicated by an A, B, or C rating by Giffords Law Center for 2019 whereas “weak” gun laws are indicated by a D or F rating. State-by-state ratings and information about the Center’s rating methodology can be found here.

States with strong gun laws make up approximately 56% of the sample population (329 million people lived in the US in 2019) but only 44% of mass shooting fatalities. They make up 51% of total mass shooting incidents.

To decide whether this difference is statistically significant, we conducted a binomial experiment. To analogize, this is like flipping a coin of uncertain weight and trying to ascertain the probability it comes up heads by the results of our flips.

First, the study treats every mass shooting fatality as a trial. If mass shooting fatalities were evenly spread among the population, we would expect 56% of the trials to occur in states with strong gun laws. Given that only 51% occured in these states, what is the likelihood that there is no actual difference between the two populations?

p-value=.05447

The binomial experiment produced a p-value of .05447, which is above the traditional p-value of .05 for statistical significance and thus failed to reject our null hypothesis that states with A, B, or C ratings had the same amount of mass shootings as states with D or F ratings in 2019.

This doesn’t provide evidence that states with stronger gun laws have fewer mass shootings at a statistically significant level. However, we also wanted to investigate whether there are more mass shooting fatalities in D or F states.

Next, the analysis treated every mass shooting fatality as a trial. If mass shooting fatalities were evenly spread among the population, we would expect 56% of our trials to land in states with strong gun laws. Given that only 44% occured in these states, what is the likelihood there is no actual difference between the two populations?

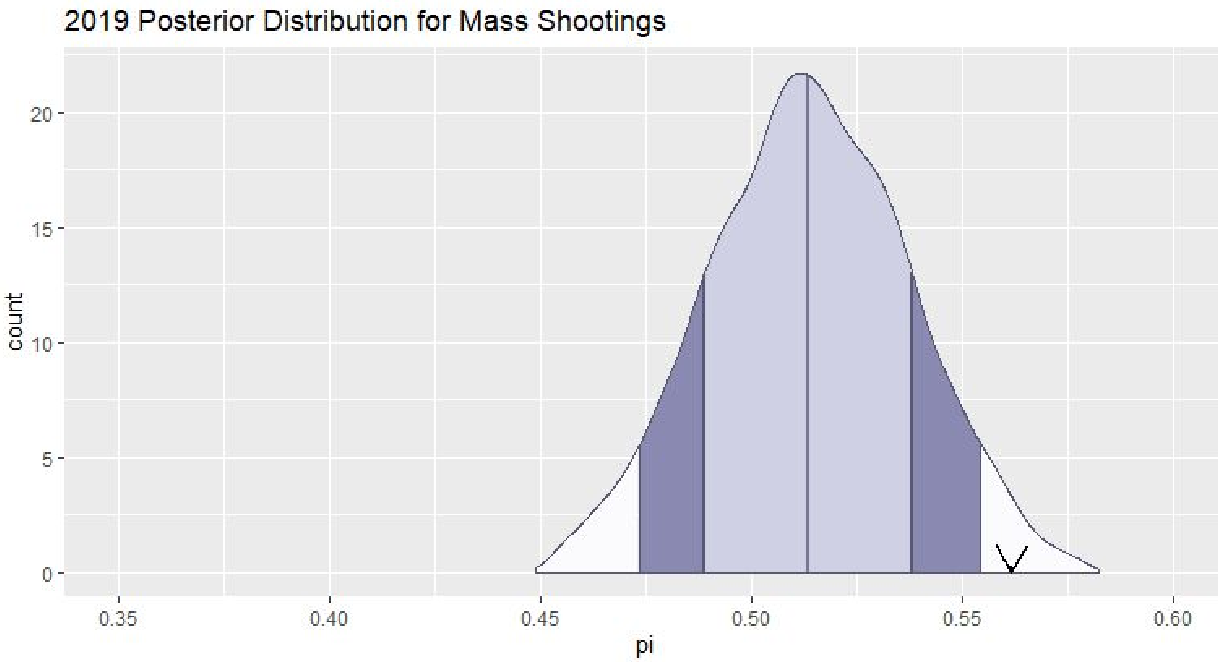
p=.0000002361

Not very likely. We rejected our null hypothesis that states with D or F ratings had no difference in mass shooting fatalities from states with A, B, or C ratings in 2019.

From here, we estimated the probability that a mass shooting fatality will happen in a state with strong gun law grades. If that probability is significantly different than the proportion of the population these states make up, it demonstrates these states have fewer mass shooting fatalities than states with weaker gun laws.

To estimate this, the report used a Monte Carlo Markov chain (MCMC) to sample from our statistical experiment and generate a posterior distribution of this probability. This method generates a distribution of samples and frequencies rather than one answer. If we sample 10,000 trials from our binomial test experiment, how many of those samples will have 56% of fatalities happening in A, B, or C states?

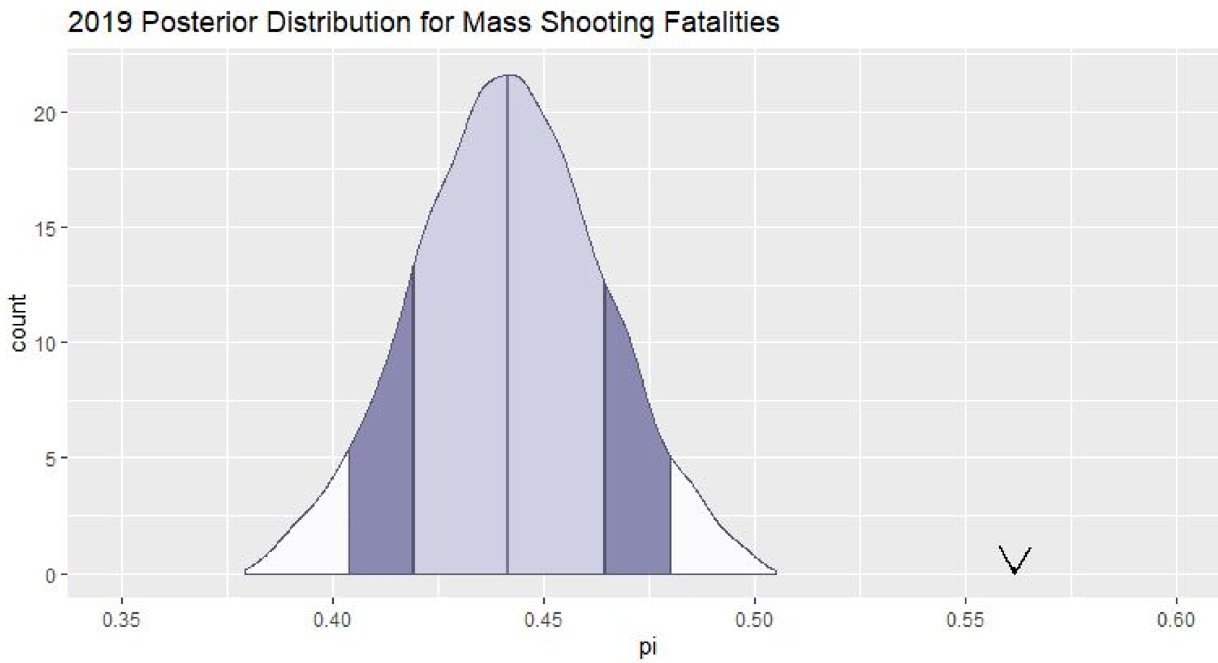
For the first set of chains, we choose our prior to be uniform between zero and one. These priors impose no shape on our posterior distribution. This model, which generates the graph below, finds the posterior distribution of our raw count of mass shootings:



The black arrow marked on the plot is the population ratio, or where we would expect the distribution to be centered if mass shootings were distributed evenly across the population. The mean for this collection of samples is .5138. The likelihood that the distribution is even across the population is within the third tail – still in the realm of statistical insignificance with a one-sided binomial test. We can be even more precise, however, and calculate the exact number of random samples that fall at or above this value.

Of 10,000 random samples from the posterior distribution, only 239 were at or above the value we would expect if shootings were evenly distributed across the population.

We took a similar approach and conducted a Markov Chain for the posterior probability of mass shooting fatalities.



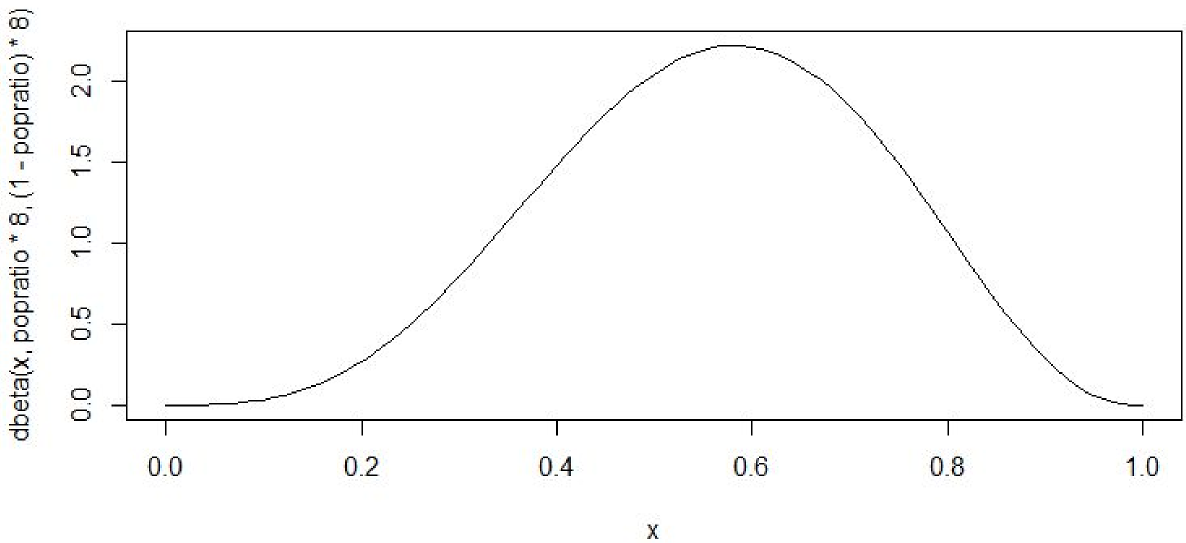
Not only is the mean not centered around .56, the closest point to it is .5377 - out of 10,000 samples. That means that no points were at or above the expected level

Let's look at some summary statistics for this distribution.

Mean: .4418
Interquartile range: .0307
Standard Deviation: .023

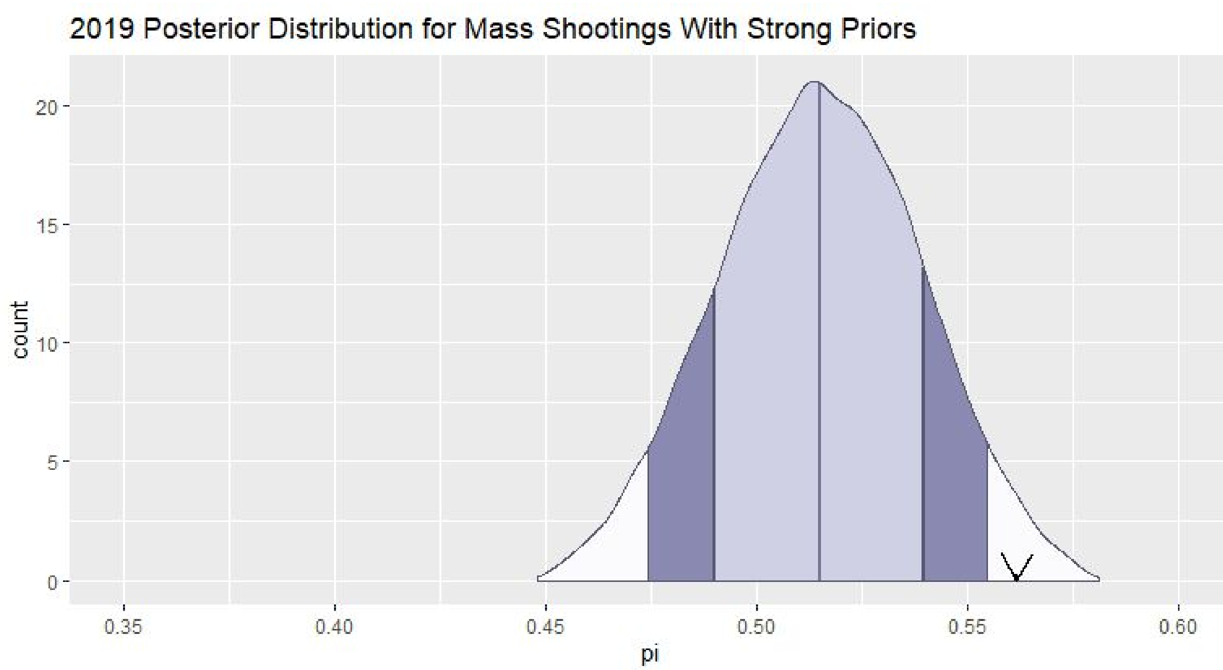
The interquartile range is the distance between the 25th and 75th percentiles of the posterior distribution. In other words, 50% of our samples fell within .015035 of the mean. The standard deviation measures the amount of *variance* in the posterior. A lower standard deviation means we should expect most of the values to fall close to the mean while a larger standard deviation suggests we should expect our values to fall farther away. Here, our standard deviation is small and all of our points are fairly close to the mean.

This analysis was done with no expectation conditioning on the model. However, let's say we hold strong priors that A, B, and C states are just like the D, F states and that there is no factual difference between populations. To condition our model on this expectation, we abandon a uniform beta distribution in favor of one with a mean around .56: *Beta*(8*.56, 8*(1-.56)). This is what the distribution looks like:



This distribution is centered around our expectation point of .56, and curves off when moving away from this point.

To see how this prior affects our MCMC model, let's use these prior for our model of total mass shootings.

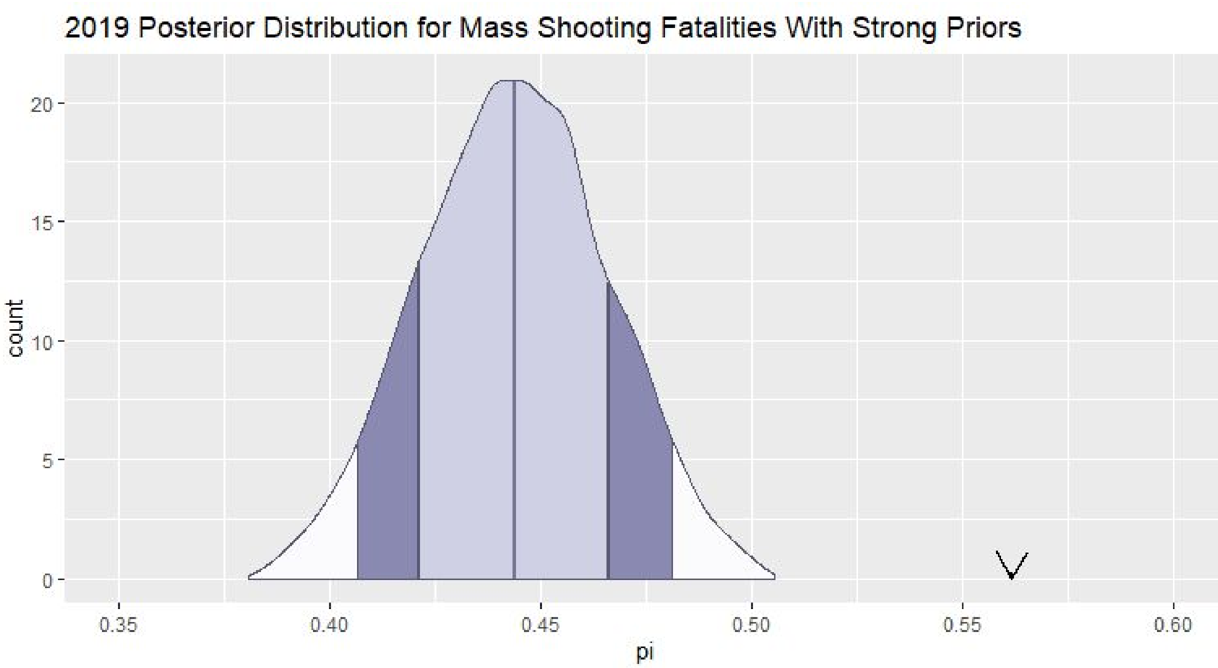


Our new mean is .5151, which isn't too far from our original mean. However, more of our samples land at or above the target point. This judicious choice of beta biases our distribution towards our null hypothesis.

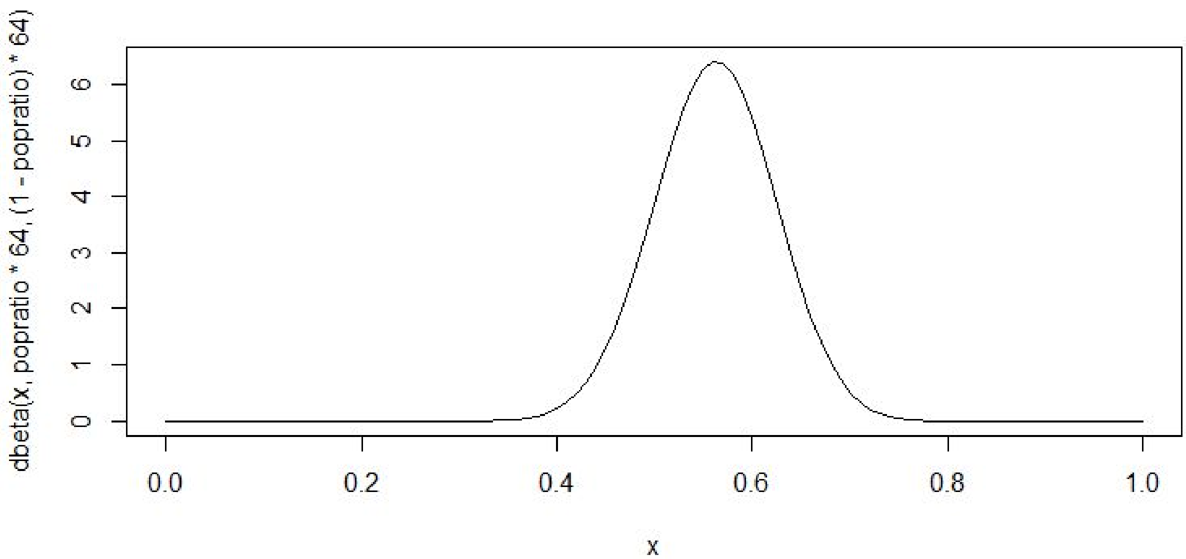
Next we sampled using our MCMC model for mass shooting fatalities, again with these updated priors. First, let's look at some summary statistics:

Mean: .4439
IQ: .305
SD: .023

Note that the mean has shifted to the right, but not by much once again. Informative priors that bias our model towards thinking these populations are the same do not dramatically change our posterior distribution. We graph the new posterior here:



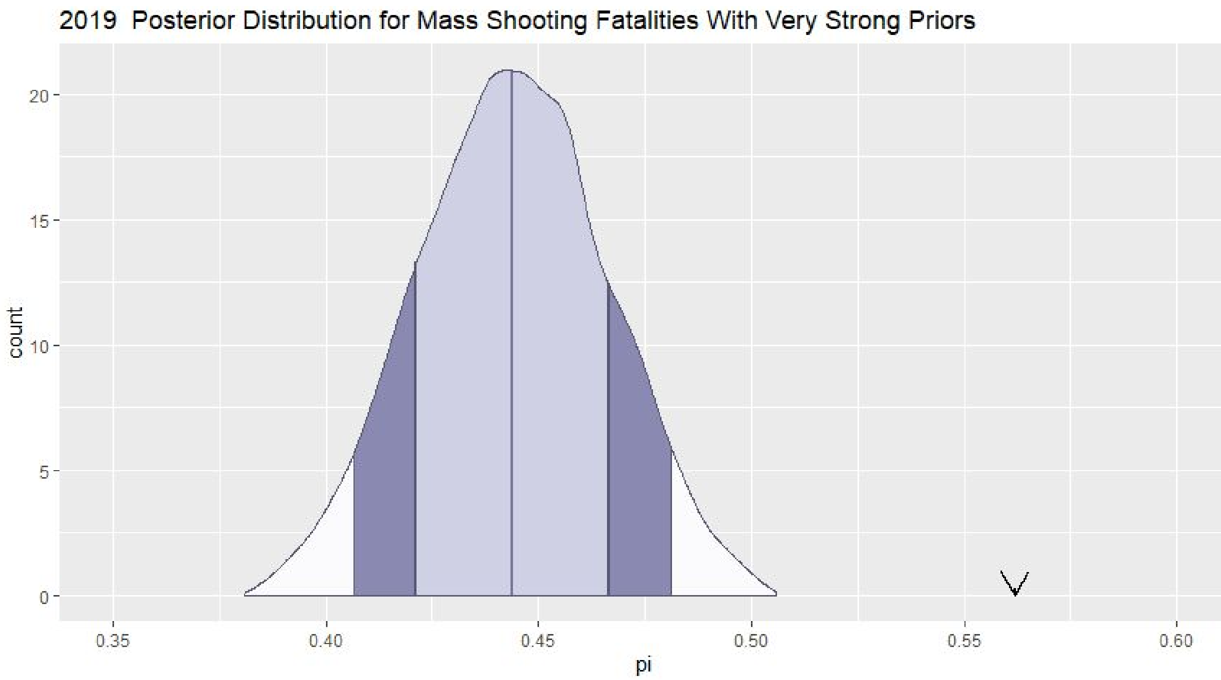
It appears the distribution may have shifted slightly to the right, but is still nowhere close to where we would expect it to be if shooting fatalities were evenly spread across the population. Next we choose still-stronger priors biasing our model towards believing the populations are congruent: *Beta*(64*(.56), 64*(1-.56)). Our new prior is plotted here:



This prior is much more biased towards the two populations being equal. We impute these priors into our model and sample anew:

Mean: .4564
SD: .0215
IQ: .0288

This model has moved closer to our expectation value, which means our priors are indeed regulating. However, the posterior mean is still more than four standard deviations from the mean we would expect if the populations were identical. Below is the graph for this distribution:

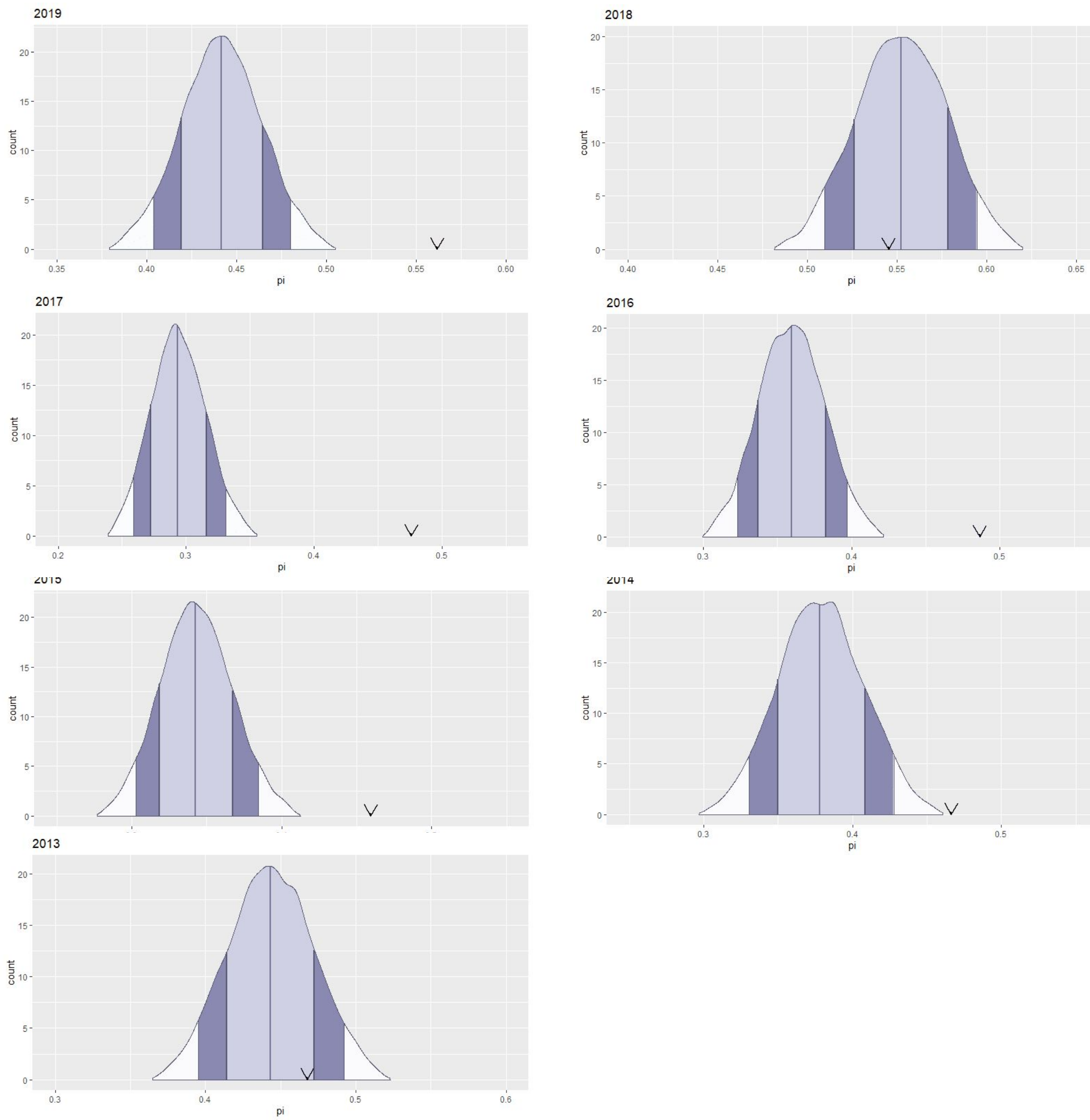


The maximum value for this very biased distribution is still less than our population proportion, which means that out of 10,000 samples from our experiment, not a single one supports the argument that states with strong gun laws have the same problem with mass shootings as states with weak gun laws.

To show that this difference is systemic across time, and not just a product of the year 2019, we reported the results of binomial regressions for each year using the same methodology as the first regression in the table below, with 2019 included as comparison. Asterisks are placed next to statistically significant p-values.

Year	Fatality Ratio	95% Confidence Interval	Population ratio targeted	P-value
2019	.44	(.394, .486)	.552	1.38x10^-6*
2018	.553	(.5, .604)	.545	.7946
2017	.293	(.251, .338)	.476	9.079x10^-15*
2016	.359	(.315,.405)	.486	6.727x10^-8*
2015	.342	(.294,.393)	.46	6.268^-6*
2014	.378	(.319, .44)	.466	.0043*
2013	.443	(.385, .502)	.468	.4097

The results demonstrate that 2019 is the rule, not the exception. We present the posterior distributions resulting from a MCMC model here side-by-side with the population ratio marked on the x-axis for reference.



We constructed similar tables for the ratio of incidents and the ratio of casualties (fatalities and injuries) below. Note that no years in the dataset had a statistically significant different likelihood than the population ratio.

Year	Incident Ratio	95% Confidence Interval	Population ratio targeted	P-value
2019	.514	(.465, .563)	.552	.0545
2018	.56	(.506, .615)	.545	.5847
2017	.436	(.383, .49)	.476	.4364
2016	.476	(.425,.528)	.486	.476
2015	.43	(.376,.485)	.46	.2977
2014	.480	(.419, .54)	.466	.669
2013	.504	(.441, .567)	.468	.258

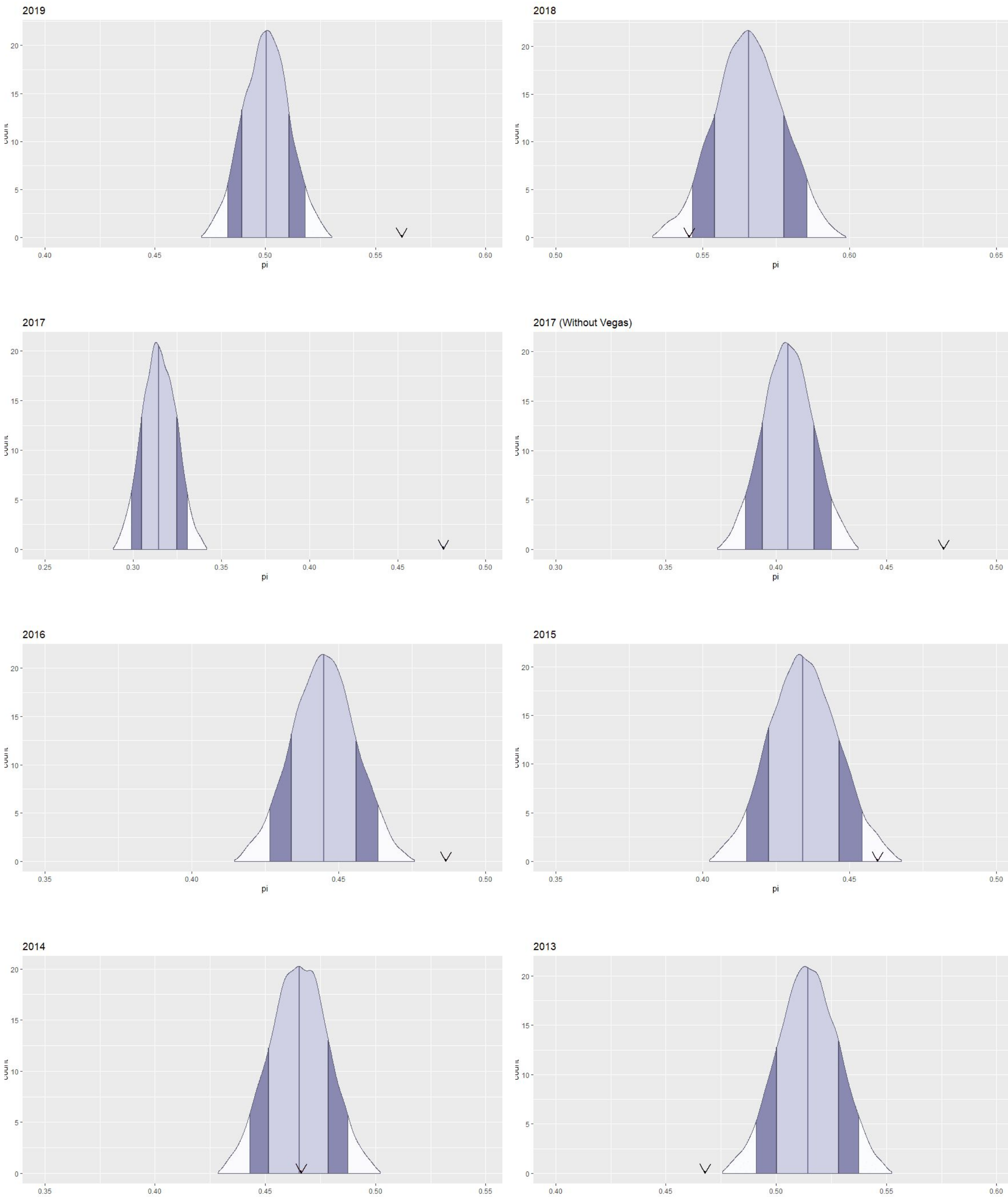
Important note on the table for casualties: in 2013, the result of the binomial test is statistically significant, but observing the casualty rate and the confidence interval shows that the population ratio is BELOW the confidence interval. This means that A, B, and C states in this year had statistically significantly more mass shooting casualties than would be expected. Since this is the only time this happened in our report for any of our variables, it deserves acknowledgement so as not to be misleading.

We also included two binomial tests and two posterior distributions for the year 2017. In 2017, the mass shooting in Las Vegas left 500 casualties in a single shooting. We do not believe this is a statistical outlier, but a meaningful datapoint as it could have been influenced by the gun laws of the state.Theoretically, allowing access to higher magazine-capacities and higher fire rate guns extends the plausible limits for how many casualties can be caused in a single shooting.

Still, we wanted to put these gun laws to the most strenuous tests we can so we provided an additional set of calculations with this data point removed.

Year	Casualty Ratio	95% Confidence Interval	Population ratio targeted	P-value
2019	.50	(.479, .522)	.552	9.8x10^-9*
2018	.566	(.542, .59)	.545	.09
2017 (with Vegas)	.315	(.296, .334)	.476	2.2x10^-16*
2017 (without Vegas)	.405	(.382, .43)	.476	3.34x10^-9*
2016	.445	(.423,.467)	.486	.0002327*
2015	.434	(.410,.458)	.46	.037*
2014	.465	(.438, .492)	.466	.935
2013	.514	(.486, .542)	.468	.001*

We present the posterior distributions for the above binomial tests below:



Appendix B: Giffords Rankings

These Law Scores are provided by the Giffords Law Center. States with stricter gun laws score higher on an A to F scale (A representing the strictest laws and F representing the least restrictive). Please see page 7 for more information.

Giffords Law Rank by State, 2013-2019

State	Rank 2013	Rank 2014	Rank 2015	Rank 2016	Rank 2017	Rank 2018	Rank 2019
Alabama	24	37	36	37	36	37	38
Alaska	49	44	46	44	44	44	42
Arizona	50	48	47	47	47	47	46
Arkansas	34	32	37	38	39	41	40
California	1	1	1	1	1	1	1
Colorado	15	16	16	14	15	15	14
Connecticut	2	2	2	2	3	3	3
Delaware	10	10	10	11	11	11	11
District of Columbia	0	0	0	0	0	0	0
Florida	25	32	28	26	26	19	22
Georgia	28	27	28	29	32	34	32
Hawaii	7	7	7	7	7	7	5
Idaho	37	39	44	46	46	48	48
Illinois	8	8	8	8	8	8	8
Indiana	23	23	23	24	23	26	28
Iowa	16	15	17	16	18	16	19
Kansas	44	41	50	48	48	45	43
Kentucky	43	47	43	42	42	43	46
Louisiana	40	50	44	43	43	30	32
Maine	25	24	35	36	35	36	34
Maryland	4	4	4	5	6	5	6
Massach-usetts	6	6	5	4	4	5	7
Michigan	14	14	15	16	16	16	19
Minnesota	12	12	12	12	12	13	13
Mississippi	44	48	49	50	50	50	50
Missouri	39	44	41	48	48	47	46
Montana	42	39	37	38	37	38	34

Nebraska	21	21	21	20	19	20	18
Nevada	31	29	27	18	22	25	15
New Hampshire	22	22	22	23	31	33	30
New Jersey	3	3	3	3	2	2	2
New Mexico	37	34	33	29	29	30	17
New York	5	5	6	5	5	6	4
North Carolina	31	29	25	23	25	24	24
North Dakota	28	27	28	29	37	38	39
Ohio	19	19	19	21	21	22	24
Oklahoma	34	24	25	27	27	29	40
Oregon	18	28	14	15	14	14	15
Pennsylvania	11	13	13	13	13	12	12
Rhode Island	9	9	9	9	9	9	9
South Carolina	34	34	28	29	29	30	31
South Dakota	47	43	40	40	40	42	44
Tennessee	28	34	32	27	24	27	29
Texas	31	29	33	34	32	34	34
Utah	40	38	37	29	27	28	27
Vermont	44	41	41	41	41	21	23
Virginia	20	20	20	21	20	21	23
Washington	12	11	11	10	10	10	10
West Virginia	25	24	24	34	32	38	34
Wisconsin	17	17	18	19	17	18	21
Wyoming	48	44	48	45	45	48	48

Giffords Law Grade by State, 2013-2019

State	Grade 2013	Grade 2014	Grade 2015	Grade 2016	Grade 2017	Grade 2018	Grade 2019
Alabama	D-	F	F	F	F	F	F
Alaska	F	F	F	F	F	F	F
Arizona	F	F	F	F	F	F	F
Arkansas	F	F	F	F	F	F	F
California	A-	A-	A-	A	A	A	A
Colorado	C	C-	C-	C	C	C	C+
Connecticut	A-	A-	A-	A-	A-	A-	A-

Delaware	B-	B-	B	B	B	B	B
District of Columbia	(A)	(A)	(A)	(A)	(A)	(A)	(A)
Florida	F	F	F	F	F	C-	C-
Georgia	F	F	F	F	F	F	F
Hawaii	B+	B+	A-	A-	A-	A-	A-
Idaho	F	F	F	F	F	F	F
Illinois	B+	B+	B+	B+	B+	B+	A-
Indiana	D-	D-	D-	D-	D-	D-	D-
Iowa	C-	C-	C-	C	C-	C	C
Kansas	F	F	F	F	F	F	F
Kentucky	F	F	F	F	F	F	F
Louisiana	F	F	F	F	F	F	F
Maine	F	F	F	F	F	F	F
Maryland	A-	A-	A-	A-	A-	A-	A-
Massach-usetts	B+	A-	A-	A-	A-	A-	A-
Michigan	C	C	C	C	C	C	C
Minnesota	C	C	C	C+	C+	C+	C+
Mississippi	F	F	F	F	F	F	F
Missouri	F	F	F	F	F	F	F
Montana	F	F	F	F	F	F	F
Nebraska	D	D	D	D	D	C-	C-
Nevada	F	F	F	C-	D	D	C+
New Hampshire	D-	D-	D	D	F	F	F
New Jersey	A-	A-	A-	A-	A-	A	A
New Mexico	F	F	F	F	F	F	C
New York	A-	A-	A-	A-	A-	A-	A-
North Carolina	F	F	F	D-	D-	D	D
North Dakota	F	F	F	F	F	F	F
Ohio	D	D	D	D	D	D	D
Oklahoma	F	F	F	F	F	F	F
Oregon	D+	D+	C	C	C	C+	C+
Pennsylvania	C	C	C	C	C	C+	C+
Rhode Island	B-	B+	B+	B+	B+	B+	B+

South Carolina	F	F	F	F	F	F	F
South Dakota	F	F	F	F	F	F	F
Tennessee	F	F	F	F	D-	D-	D-
Texas	F	F	F	F	F	F	F
Utah	F	F	F	F	F	D-	D-
Vermont	F	F	F	F	F	D+	C-
Virginia	D	D	D	D	D	D	D
Washington	C	B-	B-	B	B	B+	B+
West Virginia	F	F	D-	F	F	F	F
Wisconsin	C-	C-	D	C-	C-	C-	C-
Wyoming	F	F	F	F	F	F	F

Appendix C: Giffords Rankings and Mass Shooting Incidents

Actual numbers of mass shooting incidents, deaths, injuries, and casualties per state for the time period 2013 - 2019.

State	Population	Law Rank	Law Grade	Incidents	Killed	Injured	Casualty
Alabama	4,903,185	38	F	56	59	224	283
Alaska	731,545	42	F	1	0	6	6
Arizona	7,278,717	45	F	28	47	94	141
Arkansas	3,017,804	40	F	21	21	105	126
California	39,512,223	1	A	272	308	1087	1395
Colorado	5,758,736	14	C+	25	26	98	124
Connecticut	3,565,287	3	A-	19	8	91	88
Delaware	973,764	11	8	10	9	38	47
Dist of Columbia	705,749	0	(A)	37	25	163	188
Florida	21,477,737	22	C-	153	236	665	901
Georgia	10,617,423	32	F	96	99	367	466
Hawaii	1,415,873	5	A-	0	0	0	0
Idaho	1,787,065	48	F	0	0	0	0
Illinois	12,671,821	8	A-	223	153	930	1083
Indiana	6,732,219	28	D-	55	50	214	264
Iowa	3,155,070	19	C	7	5	27	32
Kansas	2,913,314	43	F	20	35	77	112
Kentucky	4467673	46	F	28	31	112	143
Louisiana	4,648,794	32	F	101	90	440	530
Maine	1,344,212	34	F	2	9	1	10
Maryland	6,045,680	6	A-	67	61	257	318
Massachusetts	6,892,503	7	A-	19	12	79	91
Michigan	9,986,857	19	C	72	63	290	353
Minnesota	5,639,632	13	C+	22	17	93	110
Mississippi	2,976,149	50	F	37	51	130	181
Missouri	6,137,428	46	F	83	90	295	385
Montana	1,068,778	34	F	4	13	6	19
Nebraska	1,934,408	18	C	8	6	36	42
Nevada	3,080,156	15	C+	18	73	500	573
New Hampshire	1,359,711	30	F	0	0	0	0

New Jersey	8,882,190	2	A	66	49	269	318
New Mexico	2,096,829	17	C	18	41	46	87
New York	19,453,561	4	A-	99	63	416	479
North Carolina	10,488,084	24	D	63	57	241	298
North Dakota	762,062	39	F	0	0	0	0
Ohio	11,689,100	24	D	86	103	344	447
Oklahoma	3,956,971	40	F	24	27	81	108
Oregon	4,217,737	15	C+	7	15	31	46
Pennsylvania	12,801,989	12	C+	101	98	399	497
Rhode Island	1,059,361	9	B+	4	1	16	17
South Carolina	5,148,714	31	F	49	65	179	244
South Dakota	884,659	44	F	2	10	1	11
Tennessee	6,829,174	29	D-	85	69	339	408
Texas	28,995,881	34	F	144	292	598	890
Utah	3,205,958	27	D	5	12	13	25
Vermont	623,989	23	C-	1	4	0	4
Virginia	8,535,519	26	D	56	60	228	288
Washington	7,614,893	10	B+	26	52	72	124
West Virginia	1,792,147	34	F	3	5	9	14
Wisconsin	3,822,434	21	C-	17	20	57	77
Wyoming	578,759	48	F	1	2	2	4

Rate of mass shooting incidents, deaths, injuries, and casualties per state for the time period 2013 - 2019.

State	Population	Law Rank	Law Grade	Rate Incidents	Rate Killed	Rate Injured	Rate Casualty
Alabama	4,903,185	38	F	1.6316	1.719	6.5264	8.2454
Alaska	731,545	42	F	0.1983	-	1.1717	1.1717
Arizona	7,278,717	45	F	0.5495	0.9225	1.8449	2.7674
Arkansas	3,017,804	40	F	0.9941	0.9941	4.9705	5.9646
California	39,512,223	1	A	0.9834	1.1136	3.9301	5.0436
Colorado	5,758,736	14	C+	0.6202	0.6450	2.4311	3.0761
Connecticut	3,565,287	3	A-	0.7613	0.3206	3.6463	3.9668
Delaware	973,764	11	8	1.4671	1.3204	5.5748	6.8952

Dist of Columbia	705,749	0	(A)	7.4895	5.0605	32.9943	38.0548
Florida	21,477,737	22	C-	1.0177	1.5697	4.4232	5.9929
Georgia	10,617,423	32	F	1.2917	1.3320	4.9380	6.7200
Hawaii	1,415,873	5	A-	-	-	-	-
Idaho	1,787,065	48	F	-	-	-	-
Illinois	12,671,821	8	A-	2.514	1.7249	10.4845	12.2093
Indiana	6,732,219	28	D-	1.1671	1.0610	4.5411	5.6021
Iowa	3,155,070	19	C	0.3170	0.2264	1.2225	1.4489
Kansas	2,913,314	43	F	0.9807	1.7163	3.7758	5.4920
Kentucky	4467673	46	F	0.8952	0.9912	3.5813	4.5725
Louisiana	4,648,794	32	F	3.1037	2.7657	13.5212	16.2869
Maine	1,344,212	34	F	0.2126	0.9565	0.1063	1.0628
Maryland	6,045,680	6	A-	1.5832	1.4414	6.0728	7.5142
Massachusetts	6,892,503	7	A-	0.3938	0.2487	1.6374	1.8861
Michigan	9,986,857	19	C	1.0299	0.9012	4.1483	5.0495
Minnesota	5,639,632	13	C+	0.5573	0.4306	2.3558	2.7864
Mississippi	2,976,149	50	F	1.7760	2.4480	6.2401	8.6881
Missouri	6,137,428	46	F	1.9319	2.0949	6.8665	8.9614
Montana	1,068,778	34	F	0.5347	1.7376	0.8020	2.5396
Nebraska	1,934,408	18	C	0.5908	0.4431	2.6586	3.1017
Nevada	3,080,156	15	C+	0.8348	3.3857	23.1899	26.5756
New Hampshire	1,359,711	30	F	-	-	-	-
New Jersey	8,882,190	2	A	1.0615	0.7881	4.3265	5.1146
New Mexico	2,096,829	17	C	1.2263	2.7933	3.1340	5.9273
New York	19,453,561	4	A-	0.727	0.4626	3.0549	3.5175
North Carolina	10,488,084	24	D	0.8581	0.7764	3.2826	4.0590
North Dakota	762,062	39	F	-	-	-	-
Ohio	11,689,100	24	D	1.051	1.2588	4.2042	5.4630
Oklahoma	3,956,971	40	F	0.8665	0.9748	2.9243	3.8991
Oregon	4,217,737	15	C+	0.2371	0.5081	1.0500	1.5580
Pennsylvania	12,801,989	12	C+	1.1271	1.0936	4.4524	5.5460
Rhode Island	1,059,361	9	B+	0.5394	0.1349	2.1576	2.2925
South Carolina	5,148,714	31	F	1.3596	1.8035	4.9666	6.7701

South Dakota	884,659	44	F	0.323	1.6148	0.1615	1.7763
Tennessee	6,829,174	29	D-	1.7781	1.4434	7.0914	8.5348
Texas	28,995,881	34	F	0.7095	1.4386	2.9462	4.3849
Utah	3,205,958	27	D	0.2228	0.5347	0.5793	1.1140
Vermont	623,989	23	C-	0.2289	0.9158	-	0.9158
Virginia	8,535,519	26	D	0.9373	1.0042	3.8160	4.8202
Washington	7,614,893	10	B+	0.4878	0.9755	1.3507	2.3263
West Virginia	1,792,147	34	F	0.2391	0.3986	0.7174	1.1160
Wisconsin	3,822,434	21	C-	0.4171	0.4907	1.3985	1.8892
Wyoming	578,759	48	F	0.2468	0.4937	0.4937	0.9873

Appendix D: Top Twenty Mass Shootings

Twenty Deadliest Mass Shooting Incidents, 2013-2019

Date	State	City or County	Num Killed	Num Injured	Num Casualty	Assault Weapon Used
10/1/2017	Nevada	Las Vegas	59	441	500	Yes
6/12/2016	Florida	Orlando	50	53	103	Yes
11/5/2017	Texas	Sutherland Springs	27	20	47	Yes
8/3/2019	Texas	El Paso	22	24	46	Yes
2/14/2018	Florida	Parkland	17	17	34	Yes
12/2/2015	California	San Bernardino	16	19	35	Yes
9/16/2013	Dist of Columbia	Washington Navy Yard	13	3	16	No
11/7/2018	California	Thousand Oaks	13	2	15	No
5/31/2019	Virginia	Virginia Beach	13	4	17	No
10/27/2018	Pennsylvania	Pittsburgh	11	7	18	Yes
10/1/2015	Oregon	Roseburg	10	9	19	Yes
5/18/2018	Texas	Santa Fe	10	13	23	No
8/4/2019	Ohio	Dayton	10	17	27	Yes
5/16/2015	Texas	Waco	9	18	27	No
6/17/2015	South Carolina	Charleston	9	0	9	No
9/10/2017	Texas	Plano	9	1	10	No
9/17/2014	Florida	Bell	8	0	8	Yes
2/26/2015	Missouri	Tyrone	8	1	9	No
8/8/2015	Texas	Houston	8	0	8	No
4/22/2016	Ohio	Piketon	8	0	8	No

Twenty Highest Casualty Mass Shooting Incidents, 2013-2019

Date	State	City or County	Num Killed	Num Injured	Num Casualty	Assault Weapon Used
10/1/2017	Nevada	Las Vegas	59	441	500	Yes
6/12/2016	Florida	Orlando	50	53	103	Yes
11/5/2017	Texas	Sutherland Springs	27	20	47	Yes
8/3/2019	Texas	El Paso	22	24	46	Yes

12/2/2015	California	San Bernardino	16	19	35	Yes
2/14/2018	Florida	Parkland	17	17	34	Yes
8/31/2019	Texas	Odessa	8	23	31	Yes
8/4/2019	Ohio	Dayton	10	17	27	Yes
5/16/2015	Texas	Waco	9	18	27	No
7/1/2017	Arkansas	Little Rock	0	25	25	No
5/18/2018	Texas	Santa Fe	10	13	23	No
7/28/2019	California	Gilroy	4	17	21	Yes
7/25/2016	Florida	Fort Meyers	2	19	21	Yes
4/2/2014	Texas	Fort Hood	4	16	20	No
6/17/2018	New Jersey	Trenton	1	19	20	No
10/1/2015	Oregon	Roseburg	10	9	19	Yes
5/12/2013	Louisiana	New Orleans	0	19	19	No
10/27/2018	Pennsylvania	Pittsburgh	11	7	18	Yes
11/14/2017	California	Corning	6	12	18	Yes
2/25/2016	Kansas	Hesston	4	14	18	Yes

Appendix E: Mass Shooting Numbers by the Month

Number of Mass Shooting Incidents Per Month, 2013-2019

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2013	12	12	19	17	24	31	32	25	28	18	21	15
2014	17	17	16	20	22	25	33	37	20	18	23	21
2015	22	17	22	19	36	36	43	39	34	20	27	20
2016	11	27	21	33	29	45	49	41	32	31	36	27
2017	32	25	22	39	23	35	37	33	28	27	24	21
2018	22	14	17	25	28	51	45	35	34	30	21	15
2019	27	20	20	33	50	51	42	40	35	34	32	34
	143	**132**	**137**	**186**	**212**	**274**	**281**	**250**	**211**	**178**	**184**	**153**

Yearly Mass Shooting Deaths By Month, 2013-2019

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2013	16	14	24	26	18	25	30	32	39	18	26	21
2014	15	22	13	16	24	17	28	32	18	28	23	26
2015	36	33	20	17	41	33	38	45	28	17	34	26
2016	21	42	20	40	24	96	49	31	37	31	27	33
2017	39	27	36	38	27	44	27	27	27	85	45	15
2018	23	42	11	27	30	39	41	21	35	40	49	13
2019	45	36	12	25	51	35	33	69	46	48	27	37
	195	**216**	**136**	**189**	**215**	**289**	**246**	**257**	**230**	**267**	**231**	**171**

Number of Mass Shooting Injuries By Month, 2013-2019

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2013	39	45	75	52	99	130	110	84	111	80	86	54
2014	63	63	62	91	94	111	140	151	96	51	83	75
2015	71	54	90	71	147	151	177	155	135	90	103	90
2016	33	108	81	112	117	201	219	160	128	133	152	94
2017	121	88	80	149	103	131	162	127	107	532	126	77
2018	87	62	67	88	120	218	181	153	128	116	59	57
2019	86	62	87	130	213	216	183	210	114	124	129	156
	500	**482**	**542**	**693**	**893**	**1158**	**1172**	**1040**	**819**	**1126**	**738**	**603**

Number of Mass Shooting Casualties By Month, 2013-2019

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2013	55	59	99	78	117	155	140	116	150	98	112	75
2014	78	85	75	107	118	128	168	183	114	79	106	101
2015	107	87	110	88	188	184	215	200	163	107	137	116
2016	54	150	101	152	141	297	268	191	165	164	179	127
2017	160	115	116	187	130	175	189	154	134	617	171	92
2018	110	104	78	115	150	257	222	174	163	156	108	70
2019	131	98	99	155	264	251	216	279	160	172	156	193
	695	**698**	**678**	**882**	**1108**	**1447**	**1418**	**1297**	**1049**	**1393**	**969**	**774**