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Impact of State Firearm Regulations on Suicide Mortality Rates

Student ID: 930389901

Political Science Senior Research Capstone
The University of North Carolina Asheville
One University Heights
Asheville, North Carolina 28804 USA

Faculty Mentor:
Dr. Peter Haschke

Abstract

This study aims to answer the question why some states have higher rates of suicide, specifically by firearms, than others. I argue that state firearm policies that reduce overall firearm availability are the most effective at lowering suicide by firearm rates, as access to firearms increases a person's risk of suicide. Thus, gun regulation differences amongst states can explain the extreme variation of firearm suicide mortality rates. I hypothesize that state open carry and concealed carry regulations do not have a significant impact on lowering suicide by firearm death rates, that no purchase after violent offense policies have a moderate impact on lowering suicide by firearm death rates, that state waiting period regulations have a significant effect on lowering suicide by firearm death rates, and lastly that that extreme risk laws are state firearm policies have a significant effect on lowering suicide by firearm death rates. Through three separate regression analysis, I find that two of my hypotheses were strongly supported: waiting period and extreme risk laws have a negative effect on suicide by firearm rates. My hypothesis that open carry regulations have no effect on state firearm suicide rates was not strongly supported, as the effect in my regression analysis was negative. No Purchase After Violent Offense laws ended up having the largest effect on lowering state suicide mortality rates, while I predicted it would have the most minimal impact.

1. Introduction

There is no doubt that gun violence is a nationwide problem in the United States. An average of forty thousand Americans are killed by guns yearly. This average includes more than twenty three thousand Americans who die by firearm suicide, fourteen thousand who die by firearm homicide, five hundred who die by law enforcement intervention, nearly five hundred who die by unintentional firearm injuries, and more than three hundred who die by undetermined intent. Based on these averages, over one hundred Americans die from firearms every day. When comparing the statistics for gun violence to other developed nations, it is evident that the United States is somewhat of an outlier. A study found that the firearm homicide rate in the United States is almost twenty-five times higher than other high-income countries, and the firearm suicide rate is nearly ten times that of other high-income countries (Bangalore and Messerli 2013). The reality of gun violence in America explains why it is such a polarized topic amongst citizens, and why it is something that sparks frequent discussion amongst both politicians and American people.

The United States is one of three nations across the entire world that have given its citizens a constitutional right to own firearms. Amongst those three nations, which are the United States, Guatemala and Mexico, the U.S. is the only nation that has yet to amend its citizens' constitutional right to bear arms to include some form of restriction (Insider 2022). What is intriguing, however, is that although all citizens are guaranteed the right to "keep and bear arms," the burden of firearm violence is not shared equally throughout the United States. For example, rates of gun deaths specifically in terms of suicides vary substantially from state to state. In 2021, Wyoming (22.8), Montana (21.1), Alaska (19.9), New Mexico (13.9) and Oklahoma (13.7) had the highest gun suicide rates, while Massachusetts (1.7), New Jersey (1.9), New York (2.0), Hawaii (2.8) and Connecticut (2.9) had the lowest gun suicide rates (Pew Research Center 2023). So, what can explain why some U.S. states have higher gun suicide death rates than others? What contributes to such extreme variation?

While it is important to address gun violence on a national level and to ask the question why gun-related death rates are higher in the United States than other high-income nations, it could be potentially just as important to study why gun deaths rates differ significantly from state to state, specifically in terms of suicides. I am interested in studying suicides because I feel as if it is a category of gun violence that does not receive the majority of attention. Perhaps because of news outlets and social media, most people assume that the majority of gun deaths in the United States are caused by homicides. One reason news sources may attempt to limit coverage of suicide deaths is due to concern that coverage of suicide could result in suicide ideation amongst viewers. Gun violence is discussed when it takes place through mass shootings, violent interactions with law enforcement, crime scenes, and other acts of hatred amongst

individuals. What is rarely discussed, however, is the fact that suicides make up over half of all gun deaths consistently year to year. I believe there are different causations for firearm deaths depending on how the firearm was utilized, and therefore will focus this study on suicides specifically.

Because it is a constitutional right, all fifty states must respect the idea that citizens have a fundamental right to own and possess firearms. Nonetheless, there are various interpretations of this right, and various amounts of emphasis placed on public safety and welfare over individual rights, when specifically looking at the state level. Analyzing underlying causes of higher suicide by firearm death rates could help formulate mechanisms and practices that ultimately save lives.

My first step in conducting this study will be providing a literature review that covers previous research on suicide mortality rates in relation to policy, overall state gun strictness, and gun availability. Next, I will explain my theoretical argument, which involves introducing my hypotheses and causal mechanisms. I will then cover the empirics of my study and provide summary statistics for my dependent variable, independent variables, and controls. Then I will provide a detailed analysis and conclusions drawn from my findings.

2. Literature Review

Because it is important to understand the causes of gun violence in the United States in order to both address the problem and to identify solutions, suicide by firearm is a topic that has been heavily researched. Past studies have consistently indicated that high suicide by firearm death rates are linked to high gun ownership rates. The relationship has persisted even when other causes of suicide or suicide ideation are accounted for within studies. For an example, in their 2013 study Miller, Barber, White, and Azrael attempted to establish whether the relationship between household firearm ownership rates and suicide mortality in the United States persisted after accounting for rates of underlying suicidal behavior. Their study was a response to overall criticism that previous studies that linked household firearm ownership to suicide mortality did not adequately control for the possibility that members of households with firearms are inherently more suicidal than members of households without firearms. The authors aimed to test the hypothesis that the association between firearm ownership and suicide mortality reflects unmeasured suicidal tendencies associated with firearm ownership, rather than an independent risk of death by suicide conferred by access to guns. After conducting a standard linear regression analyses, the authors findings suggested that firearm ownership rates, independent of underlying rates of suicidal behavior, largely determine variations in suicide mortality across the fifty states. Their findings also

indicated that higher rates of firearm ownership are associated with higher rates of overall suicide and firearm suicide, but not with nonfirearm suicide. The results of their study supported their hypothesis that firearms in the home impose suicide risk beyond the baseline risk (Miller et al. 2013).

Anestis and Houtsma (2017) sought to establish an association between gun ownership and statewide overall suicide rates. In order to show a relationship between gun ownership and suicide by firearm death rates, the authors utilized the most current data available and to control for demographic variables, geographic variables in terms of elevation, psychopathology variables like prior suicidal thoughts, depression diagnoses, substance use disorders, serious mental illnesses, and religiosity variables in terms of the percentage of the population identifying as Christian, Jewish, Muslim, Hindu, atheist, or agnostic, religiously unaffiliated, and religiously affiliated but not to a particular religion. The authors hypothesized that gun ownership would predict statewide overall suicide rates, even after accounting for the confounds. The authors also wanted to examine whether after controlling for the same covariates listed previously there would be an inverse association between gun ownership rates and nonfirearm suicides, as this would indicate that as guns are less prevalent, individuals seek out and die by alternative methods. Lastly, the authors attempted to determine whether state firearm suicide rates exhibit a significantly stronger correlation with state overall suicide rates than do state nonfirearm suicide rates, as such findings would imply that the rate at which individuals die by suicide is heavily contingent on the extent to which they can readily use specific lethal means and highlight that the means themselves matter in a robust way. After running three hierarchical multiple regressions, they concluded that gun ownership predicted statewide overall suicide rate beyond the influence of the controls identified in their study. In their first regression, gun ownership significantly predicted overall suicide rates, more so than the effect of all covariates. Their second regression illustrated that gun ownership significantly predicted overall suicide rates when controlling only for psychopathology-related variables. In their third regression, gun ownership was not significantly associated with nonfirearm suicides after controlling for the same list of covariates utilized in their initial analysis. Their study provided well founded support for the notion that access to firearms increases risk for death by suicide amongst suicidal individuals

Because of the research that supports the argument that higher gun ownership leads to higher suicide by firearm death rates, the relationship between state gun regulation and suicides by firearms have also been analyzed. Again, this is the result of a well-recognized positive relationship between access to firearms and suicide even when other factors that increase suicide risk are taken into account. In fact, the Centers for Disease Control and Prevention (CDC) has stated that “easy access to lethal means of suicide” is one of the factors that contribute to suicide risks amongst individuals

(Centers for Disease Control and Prevention 2022). In more recent years, a larger amount of people are advocating for restricting access to firearms and other lethal means, as they argue it is one of the most effective strategies for suicide prevention. Organizations like The Educational Fund to Stop Gun Violence (EFSGV) have promoted awareness for firearm suicide prevention, as well have made data available to the public to illustrate that state gun restriction laws can save lives (The Educational Fund to Stop Gun Violence 2020).

Kposow, Hamilton, and Wang (2016) aimed to determine whether or not the prevalence of firearms in the home is associated with state-level suicide rates, if loaded and unlocked firearms at the home increase suicide risk, and if state firearm regulations affect mortality rates. Their motivation for undergoing their study came from their desire to extend understanding of violence to influence both future research and public health policy. The authors explain that past research had consistently shown that home firearm availability is associated with elevated suicide risk, and that the risk for suicide is increased when firearms in the home are stored unloaded or unlocked. In regards to past studies that aim to analyze gun laws in relation to suicide by firearm rates, the authors admit that results have been mixed. In order to add a number of dimensions to the existing body of research on firearms and suicide, they applied advanced multivariate techniques to the most current state mortality data. The authors wanted to illustrate the effects of firearm ownership, gun loaded, gun readiness, and gun regulation separately. From their analysis, the authors found that states with higher household gun ownership tend to have higher overall suicide rates and higher firearm suicide rates. Their results also showed that the higher the percentage of households with loaded and unlocked guns in a state, the higher the overall suicide rate, and an even stronger association for firearm suicides. Additionally, they found that the percentage of households with loaded guns is significantly associated with suicide by all mechanisms and stricter state regulation of firearms is significantly associated with lower suicide rates, lower firearm suicide rates, lower firearm ownership, and reduced gun readiness.

Hamilton and Kposowa (2015) also focused on analyzing gun availability, in terms of ownership and state gun regulation strictness, and its relationship to suicide by firearm death rates. Unlike the study mentioned previously, this research directly compared the effects of gun ownership, access, and the relative strictness of state gun laws to both gun homicide death rates and gun suicide death rates. Hamilton and Kposowa found that states where guns are more widely owned tend to suffer higher rates of violent death, including higher rates of homicide and suicide combined, by all means and by firearms in particular. They note that this is not because murders are more frequent, but because suicides, especially gun suicides, are. Among the sixteen states in the study, the availability of reported legally owned firearms appeared to have no statistically significant relationship to their homicide rates, but it did to their suicide

rates. In regards to gun laws, the authors found that the more stringent state gun laws are, the lower their rate of violent death. They concluded gun laws appear to have no relationship, positive or negative, to murder rates in these states, but they do have a close connection with suicide rates, particularly when firearms are involved. Their findings help support the idea that gun regulation is an extremely justifiable mechanism for combatting suicide in the United States; perhaps far more than homicide and other forms of gun violence.

Despite the current evidence that gun regulation laws are correlated with lower suicide by firearm death rates at the state level, researchers have recognized that particular gun policies may be more effective than others in regards to lowering rates of firearm violence that specifically involve suicides. For an example, Andrés and Hempstead (2011) hypothesized that regulations such as permit requirements, which create overall barriers to gun ownership, are the most important way type of gun control in regards to suicide prevention. They applied a negative binomial regression model in order to identify the association between several existing firearm regulations and male suicide rates while controlling for variables of education, income, alcohol consumption, the proportion of the population over age of sixty-five, and the proportion of the non-Hispanic white population. The authors created three additive indices that reflected different categories of firearms regulations. The first index measured general prohibitions and was the sum of two indicator variables reflecting the presence or absence of permit requirements and prohibitions on firearm purchases by minors. The second index measured prohibitions based on behavioral problems and was the sum of five indicator variables reflecting the presence or absence of bans on persons with mental health, alcohol, or drug problems, as well as prohibitions on those with prior convictions for misdemeanors and for domestic violence offenses. The third index captured four types of prohibitions related to the potential purchaser's criminal history and was the sum of indicator variables measuring the presence of prohibitions against “aliens,” convicted felons, fugitives from justice, and those who committed serious offenses as juveniles. The results of their analysis suggested that firearms regulations which function to reduce overall gun availability have a significant deterrent effect on male suicide, while regulations that seek to prohibit high risk individuals from owning firearms have less of an effect. In their discussion, the authors stated their study suggests that permit requirements and bans on sales to minors were the most effective of the regulations they analyzed.

It is important to understand what specific types of gun laws contribute to lowering suicide by firearm deaths, as this information could lead to better awareness for suicide risks and more effective policy reform. Suicide is considered a public health crisis in the United States, and while there are many ways both people and the government are attempting to address and solve the issue, research must be conducted

to understand how the law directly affects it. Suicidal ideation and prevention has traditionally been addressed by pushing for mental health services such as therapy, prescribing medicine, suicide hotlines, and medical and profession personnel availability. More recently, people are beginning to understand the importance of viewing suicide from a public health approach, and not just at the individual level. There is a common viewpoint that prevention is a much more effective method than intervention. Therefore, the trends of suicide rates amongst state populations are important to analyze; and because firearms are by far the most lethal method for suicide attempts, there is reason to study the relationships between gun suicides and various gun regulation laws. If certain gun laws are shown to strongly lower gun suicide rates, policies can be identified that prevent lives from being lost.

3. Theoretical Argument

I aim to test whether state gun regulation policies is one of the factors that directly contributes to states experiencing higher rates of gun deaths caused by suicide. Specifically, I want to identify the different effects on suicide by firearm death rates amongst two general categories of gun policies: those that achieve reducing overall gun availability and access, and those that are implemented with intentions to reduce gun violence and conflict.

I argue that policies that reduce overall firearm availability are the most effective at lowering suicide by firearm rates, as access to firearms increases a person's risk of suicide. Waiting period and extreme risk laws are two types of state gun policies that are effective at preventing suicidal firearm deaths. No purchase after violence offense laws moderately lower suicide rates, as they ultimately restrict firearm access and ownership. These various policies allow for individuals with suicidal ideations, which may very well be impulsive and temporary, to have limited ability to possess and purchase firearms.

I also argue that policies that reduce the presence of firearms in public, or that reduce gun violence and escalation amongst individuals, cannot be assumed to significantly reduce firearm suicides. Suicides by guns are not the result of conflict, but rather an individual's choice. Therefore, it is difficult to see the theoretical connections between crime rates, overall community safety standards, open carry and concealed carry regulations when considering the variations in gun deaths by suicide across the nation, as suicides typically take place in the home and in private. Furthermore, it is hard to fathom that the differences amongst states can be thoroughly explained by some states having significantly higher concentrations of citizens with mental illnesses or that possess natural predisposition for depression and suicide ideation. In fact, non-

firearm suicides rates vary little across states (KFF 2022). I aim to show that open carry regulations have a minimal effect on lowering suicide by firearm death rates.

3.1 Hypothesis 1: Open carry and concealed carry regulations do not have a significant impact on lowering suicide by firearm death rates.

Currently thirteen states regulate open carry in some form. Some U.S. states have prohibited all types of firearms being openly carried in public, while others have adopted policies that only prohibit particular types of firearms, or require permits to do so. In regards to concealed carry of firearms, twenty-three states require its citizens to obtain a permit. Some of these states require people to undergo training programs that include live-fire instruction. Studies of states that have weakened their permitting systems have shown an eleven percent increase in handgun homicide rates and a thirteen to fifteen percent increase in overall violent crime rates (Everytown Research 2023). However, while implementing open carry and concealed carry regulations may very well lower overall gun violence in states, because these regulations address gun violence that occurs in public I predict they do not contribute to lower suicide by gun death rates. These regulations address gun violence that results from people being armed in populated or communal areas, and cannot explain guns being used to inflict death in situations where people are alone, unthreatened, and most likely in a private setting. Therefore, I hypothesize that state open carry and concealed carry regulations do not have a significant impact on lowering suicide by firearm death rates.

3.2 Hypothesis 2: No purchase after violent offense policies have a moderate impact on lowering suicide by firearm death rates.

No purchase after violent offense policies currently exist in fifteen states. While federal gun laws ban nearly all people with felony convictions from purchasing and owning firearms, these laws do not place bans on people convicted for any misdemeanors other than domestic abuse. As a result, some states have adopted so-called no purchase after violent offense policies that cover bans for people that have committed violent misdemeanors. Some of the states with this type of gun policy have bans that cover people who have been convicted of assault and battery crimes. Some of the most strictly implemented no purchase after violent offense policies last indefinitely, while in some states they last three, five, or ten years. State laws covering violent misdemeanor crimes are associated with a twenty-one percent reduction in intimate-partner homicide with a firearm and an eighteen percent reduction in overall homicide rates (Everytown Research 2023). Like open and concealed carry regulations,

no purchase after violent offense policies seem to adequately address gun violence that takes place between individuals. These laws ultimately make gun availability more difficult for people that have been convicted of threatening or causing harm to others, and are implemented with the intention of reducing violence. However, although no purchase after violent offense policies may be more effective at preventing gun homicide deaths, there is a possibility that these policies do keep firearms away from people who have been convicted of violent misdemeanors that also happen to be suicidal. No purchase after violent offense laws decrease gun availability and place purchase and ownership restrictions on state populations, and I predict that gun regulations that achieve reducing overall gun availability lower firearm suicide rates. Because of the chance that these specific types of have the ability to keep firearms away from people who may be suffering mental distress or suicidal ideation, I hypothesize that no purchase after violent offense policies have a moderate impact on lowering suicide by firearm death rates.

3.3 Hypothesis 3: Waiting period regulations have a significant effect on lowering suicide by firearm death rates.

Currently eleven states have adopted waiting period laws, which require people desiring to purchase firearms to wait a certain number of days to pass between the purchase of a firearm and when they can actually take possession of that firearm. Existing waiting period laws range from three days to fourteen days, with the majority of these laws requiring people to wait seven or ten days before taking possession of a gun they purchased. It is important to note that suicide attempts are often impulsive. For example, a 2005 study that examined one hundred and fifty-three people who made near-lethal suicide attempts found that twenty-four percent of participants took less than five minutes between the decision to kill themselves and the actual attempt, and seventy percent of participants took less than one hour (Thomas 2005). In situations where people attempt suicide due to an immediate stressor, such as a tragic event like the loss of a job or loved ones, perhaps days in between the decision to purchase a firearm and actually possessing the firearm can impact whether or not people follow through with plans to end their lives. The temporary impulse to commit suicide may be supported by the fact that more than ninety percent of people who survive a suicide attempt, including attempts do not go on to commit suicide in the future (Miller 2008). While firearms are not the only way people can take their own lives of course, it is by far the most deadly mechanism; fatality rates for suicide by firearm attempts are roughly ninety percent (Everytown Research 2023). Because guns are the most effective ways to commit suicide, and often the quickest and least painful, it makes the decision to purchase or utilize a gun for ending one's life desirable. I believe that due to the impulsive nature present in many suicide attempts, waiting period policies have the

ability to prevent people who are contemplating suicide from using the most lethal mechanism for taking their lives. Therefore, I hypothesize that state waiting period regulations have a significant effect on lowering suicide by firearm death rates.

3.4 Hypothesis 4: Extreme Risk laws are state firearm policies have a significant effect on lowering suicide by firearm death rates.

Currently, twenty-one states have adopted extreme risk gun laws, which allow for legal intervention in situations where people who own firearms are at an extreme risk for harming themselves or others. Extreme risk policies vary across states in terms of who is allowed to petition a civil court for an extreme risk protection order. In some states only law enforcement can, while in others this act can be performed by family and household members, employers, coworkers, medical professionals, or educators. Judges consider evidence presented by both the person at risk and the concerned party or parties. Factors such as substance abuse, recent firearm or ammunition acquisition, and behavioral patterns are considered. If courts issue a protection order, the person at risk is temporarily prohibited from both purchasing and possessing guns. Guns are confiscated by law enforcement or another authorized party for the duration of the order, which can last up to a year. Like waiting periods, extreme risk protection orders reduce gun availability and access from people who are at a high risk for attempting suicide. If people notice signs of mental health issues and suicidal behavior amongst loved ones, colleagues, patients, and students, perhaps extreme risk protection orders are an effective mechanism for decreasing the likelihood of suicidal firearm deaths. Therefore, I hypothesize that extreme risk laws are state firearm policies have a significant effect on lowering suicide by firearm death rates.

3.5 Controls

There are several variables that must be accounted for when analyzing various gun regulation policies and their relationship to gun suicide death rates, as access to firearms does not inherently lead to people desiring to end their life. Following previous research on suicide and suicide prevention, I control for the most supported factors that lead to suicidal ideation, planning, and execution. These factors are usually present simultaneously, and are linked to one another within the lives of those that decide to attempt suicide.

Demographic factors that must be taken into consideration are religious adherences, poverty levels, and unemployment rates. Cultural and religious beliefs can encourage people to seek help and guidance during difficult times, discourage suicidal

behavior by core values and shared beliefs, and create a strong sense of purpose. State poverty levels will be relevant when studying suicide, as lack of financial stability, unmanageable debt, and poor housing conditions have been linked to increase suicide risk (Samaritans 2023). Unemployment has also been linked to increase suicide risk, regardless whether or not unemployment is short-term or long-term (Mathieu 2022).

Psychopathology factors that must be considered include rates of substance abuse and mental illness prevalence. Substance abuse significantly increases a person's risk for suicide attempt. Roughly twenty-two percent of deaths by suicide involved alcohol intoxication, and opiates are on average present in twenty percent of suicide deaths (Substance Abuse and Mental Health Services Administration 2016). A diagnosis of alcohol dependence is associated with a suicide risk that is ten times greater than the suicide risk of the general population, and individuals who inject opiates and other types of drugs have a suicide risk roughly fourteen times than those that do not suffer from drug dependence (Wilcox 2004). Mental illness prevalence in each state is important to take into consideration, as certain mood and psychiatric disorders such as bipolar disorder, post-traumatic stress disorder, borderline personality disorder, and schizophrenia are diagnoses that increase a person's risk for suicide. Mental health disorders often coexist or lead to anxiety, depression, and feelings of hopelessness and despair. Because of the impact mental health disorders have on people's over wellbeing, prevalence of mental illnesses from state to state may influence the rates of suicides.

Geographical factors that will be accounted for include rurality and state elevation levels. The suicide rate is nearly twice as high in the most rural areas of the United States compared to the most urban areas (Hedegaard 2018). Residents in rural areas are more likely to be geographically distant from neighbors, friends, and family, and even mental healthcare facilities. People residing in rural areas may face more challenges in regards to engaging and participating within a community; thus, social isolation is far more prevalent and leads to an increase the risk of suicide. Higher elevation has also been linked to increased suicide risk. Although more research is needed to understand the relationship between altitude and suicide, recent findings implicate chronic hypoxia and a reduction in serotonin synthesis as a contributing factor, as well as social and environmental factors (U.S. Department of Veterans Affairs 2022).

4. Methodology

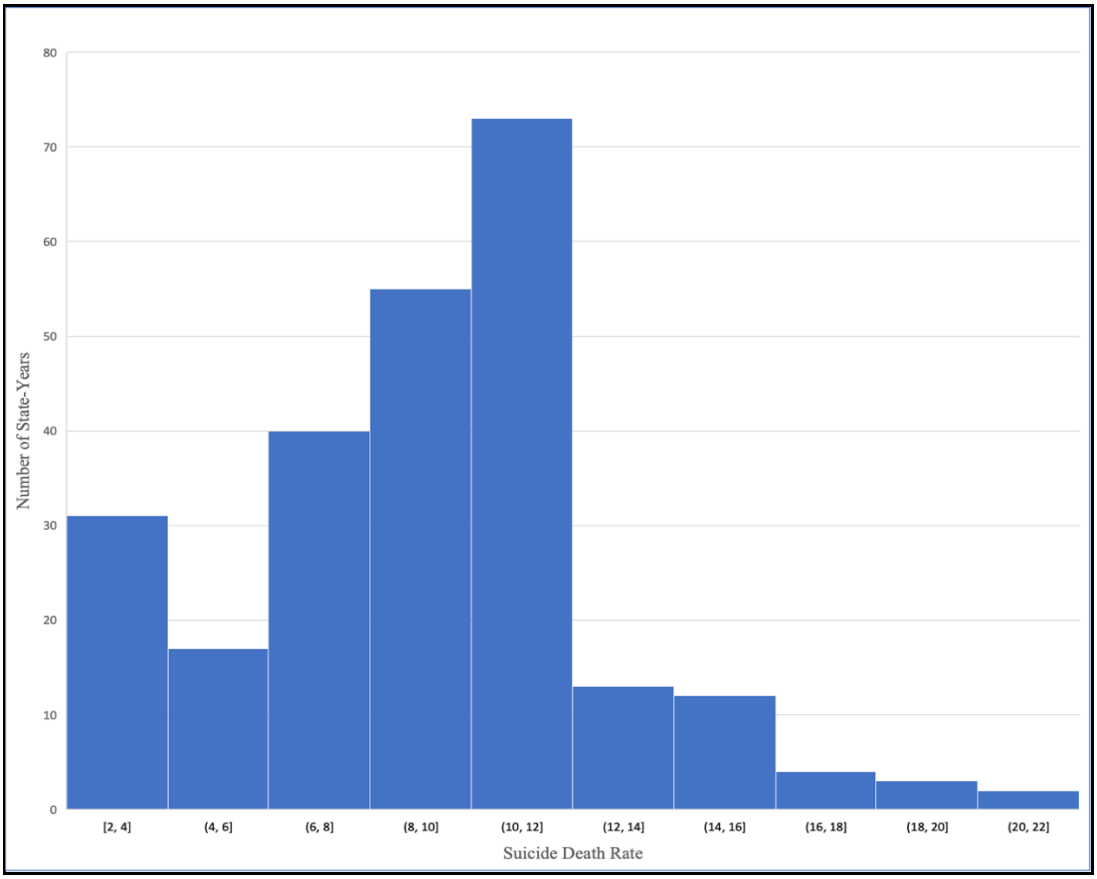
The units of this study will be U.S. state-years, and will not include the District of Columbia. The controls for this study will be states' poverty rates, unemployment rates, percentages of state populations with substance abuse disorders, percentages of state populations that reside in rural areas, state mean elevation levels, percentages of state

populations that are highly religious, and percentages of state populations that report to have mental illnesses.

4.1 Defining Main Concepts

The dependent variable for this study is annual state gun suicide death rates, which is data that is collected WISQARS fatal injury data visualization data tool of the Centers of Disease Control and Prevention. The data source for WISQARS Fatal Injury Data Visualization is the National Vital Statistics System (NVSS) operated by the National Center for Health Statistics. WISQARS provides death counts and death rates for the United States and by state, county, age, race, Hispanic ethnicity, sex, leading cause of death, injury intent, and injury mechanism categories. WISQARS can be used to query death data for the years 2001 - 2020, of which the underlying cause of death is specified. For this study, state gun suicide death rates were collected individually for the years 2016, 2017, 2018, 2019, and 2020 (Centers for Disease Control and Prevention 2023). The state suicide death rates are defined as the number of deaths per 100,000 total population.

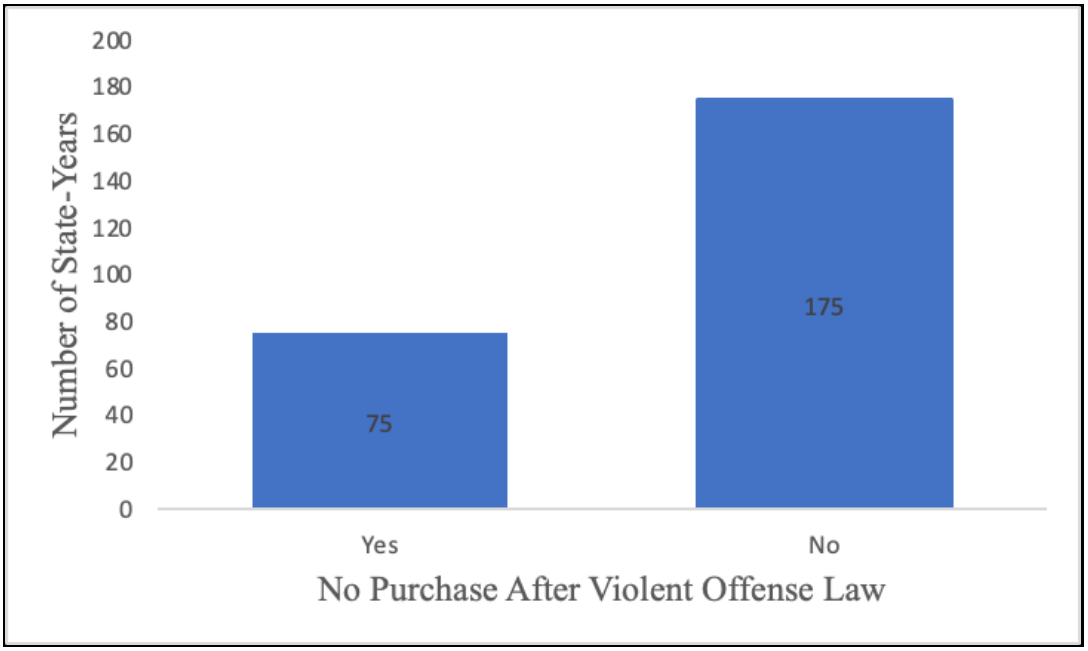
Figure 1: Firearm By Suicide Death Rates



4.2 Independent Variables

No purchase after violent offense policies prohibit gun purchases for people with violent misdemeanor offenses. Federal law bars nearly all people with felony convictions from having guns, but does not cover any misdemeanors aside from domestic abuse. Prohibitions through this law vary across states; while some ban people charged with violent misdemeanor offenses for four or five years, some ban convicted persons for ten years or indefinitely. The strongest policies bar all gun possession, and not just new purchases. The most strict no purchase after violent offense laws also bar people convicted of assault and battery crimes from purchasing and possession firearms. For the purpose of this study, a state will be evaluated based on whether any form of a no purchase after violence offense policy is enacted. Currently, fifteen states have enacted no purchase after violent laws, but for my study the years in which these laws took place will be reflected in the data collection process (Everytown Research 2023). A state will not be considered to have a no purchase after violent offense policy for a particular year unless the law was enforced throughout the entire year.

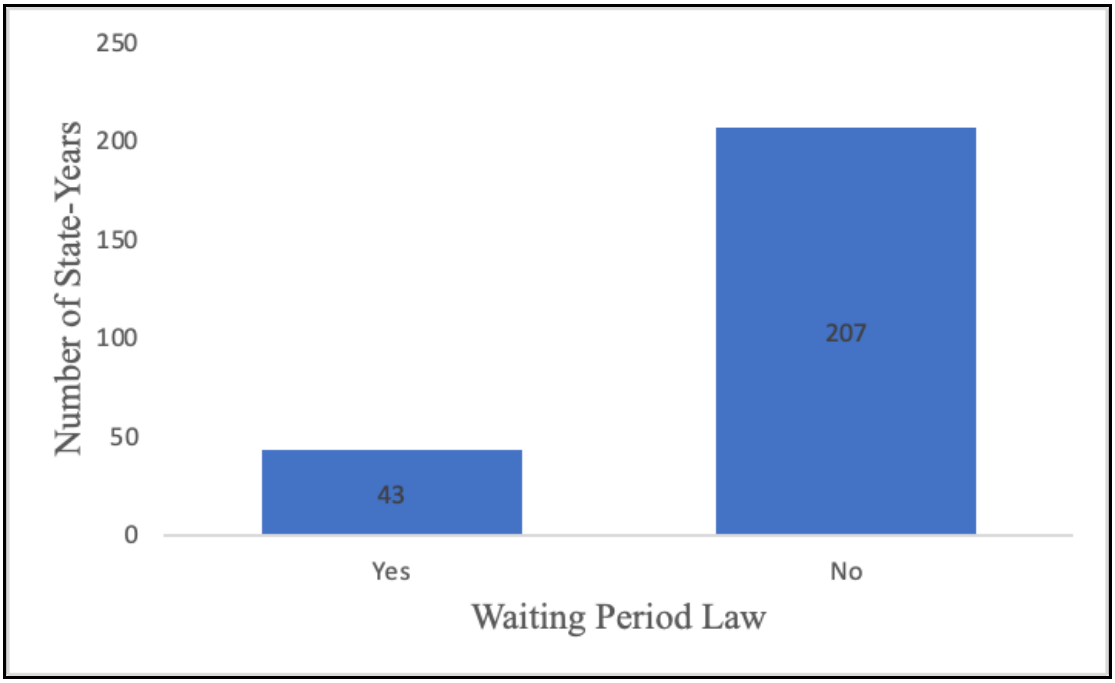
Figure 2: No Purchase After Violent Offense Laws



Waiting-period laws require a certain number of days to elapse between the purchase of a firearm and when the purchaser can actually take possession of that firearm. Waiting periods were once part of federal law, mandated by the Brady Handgun

Violence Prevention Act of 1993. However, they disappeared when the National Instant Criminal Check (NICS) came online in 1998, as the five-day waiting period mandated under the Brady Bill was replaced with the instant check system (Giffords Law Center 2023). Some states have decided to enact waiting periods under their state legislation. Across states, waiting periods take various forms. For example, Minnesota and Washington impose waiting periods for handguns and semi-automatic rifles, while Maryland and New Jersey have waiting periods only for handguns. California, Florida, Hawaii, Illinois, Rhode Island and the District of Columbia have waiting periods for purchases of all types of weapons, ranging from three to fourteen days. For the purpose of this study, regardless of what type of waiting period a state mandates, it will be counted as having the policy solely based on whether or not a period exists. Currently, eleven states have mandated waiting periods for gun purchases (Everytown Research 2023). For my study, the years in which these laws were enacted will be taken into consideration, and the state will only be considered having a waiting period law if the law had been enforced for the entirety of the year.

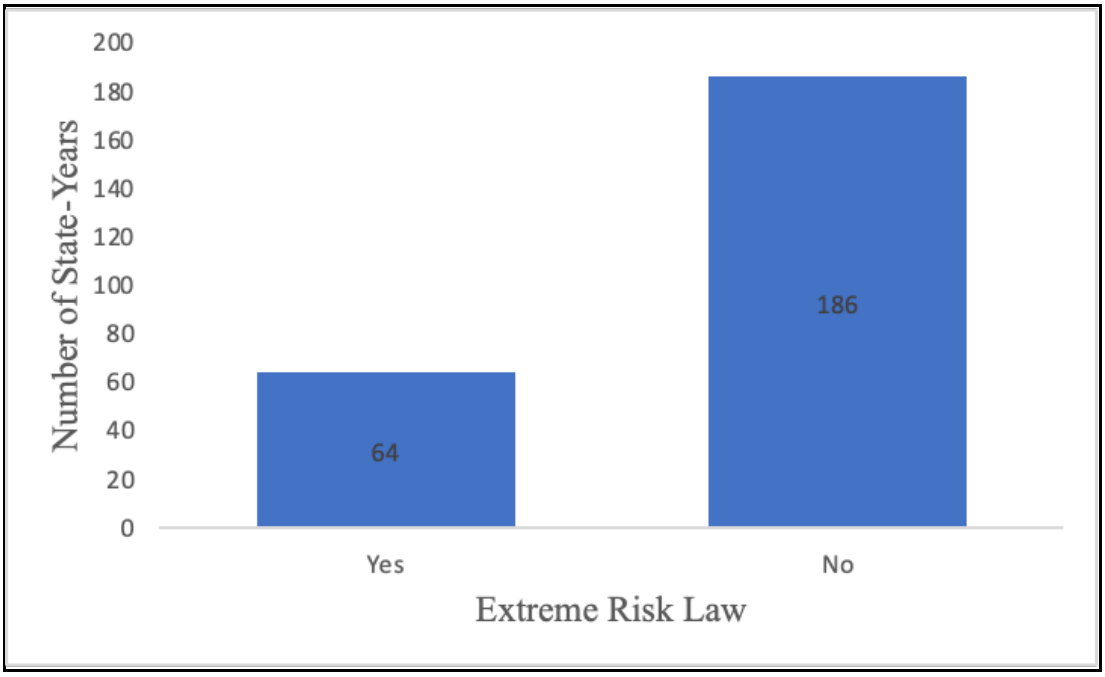
Figure 3: Waiting Period Laws



Extreme Risk laws allow for quick intervention when a person is at serious risk of harming themselves or others with a firearm. These laws enable law enforcement to ask for a court order that temporarily removes guns from these dangerous situations and prohibits the person from buying new guns. The strongest policies allow family members and people of other relationships to file petitions as well. For the purpose of

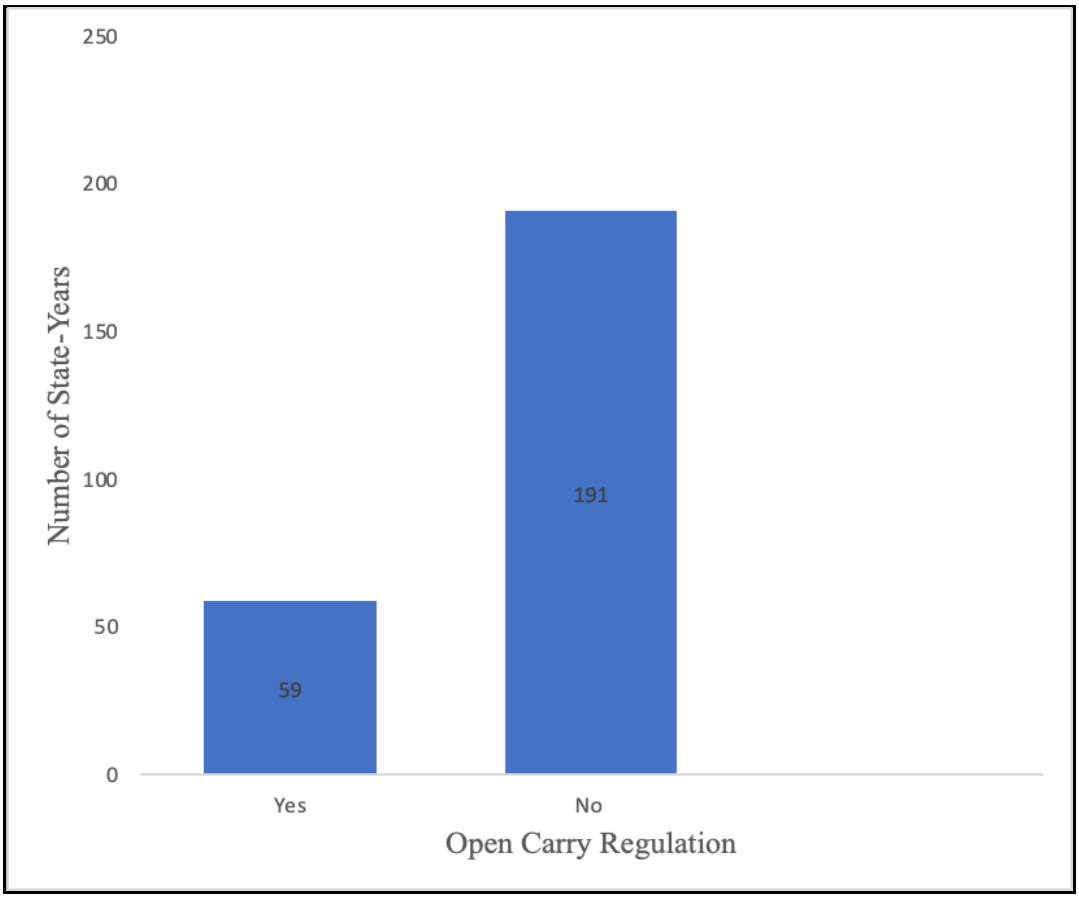
this study, states will be categorized by either having extreme risk gun laws or lacking any form. Currently, twenty-two states have enacted extreme risk laws (Everytown Research 2023). The year in which the law was enacted will be taken into consideration during my data collection, and a state will only be considered to have extreme risk law if the law had been enforced for the entirety of the year.

Figure 4: Extreme Risk Law



Open carry regulations, which are laws that control people's ability to bear arms in public, vary across states. While some states ban the open carry of all firearms, some require permits. Some states also have different requirements depending specifically on the type of firearm. For this study, I am categorizing states based on whether they have any form of open carry regulation or not. Currently, thirteen states regulate the open carry of firearms (Everytown Research 2023). However, the years in which open carry regulations will be taken into consideration, and a state will not be counted as having open carry laws for a given year unless the laws were enforced for the entirety of the year

Figure 5: Open Carry Regulation



4.3 Controls

State poverty levels refer to the percentage of people living at or below the federal government's Official Poverty Measure (OPM). Data for this study was taken from the reports of the U.S. Census Bureau Current Population Survey (Shrider and Creamer 2023). Because state poverty rates are available through the U.S. Census Bureau website for previous years, I used the exact state poverty rates for the years 2016, 2017, 2018, 2019, and 2020.

Unemployment Rates, which represent the number of unemployed people as a percentage of the labor force, were derived from the U.S. Bureau of Labor and Statistics. The Bureau of Labor and Statistics has published state unemployment rates by month, starting in September of 2013 and up to September 2023 (U.S. Bureau of Labor 2023). For my study, I used the unemployment rates of the total state population in the month of January for the years 2016, 2017, 2018, 2019, and 2020.

Substance Use Disorder is defined as meeting criteria for illicit drug or alcohol dependence or abuse. Dependence or abuse is based on definitions found in the 4th edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV). The combined 2018 and 2019 NSDUH reports provide state estimates for select measures

of substance use and mental health outcomes by age group Rates of Substance Use Disorder (Substance Abuse and Mental Health Services Administration 2023). State and regional estimates are based on a small area estimation (SAE) methodology in which state-level NSDUH data are combined with county and sub-county level census data from the state. For this study, information was derived from Table 23 of the Substance Use Disorder in the Past Year, by Age Group and State: Percentages, Annual Averages Based on 2018 and 2019 NSDUHs report (Substance Abuse and Mental Health Services Administration 2023). Data was collected from the 12 years and older category, as I have not limited the study to just adults. State and census region estimates, along with the 95 percent Bayesian confidence (credible) intervals, are based on a survey-weighted hierarchical Bayes estimation approach and generated by Markov Chain Monte Carlo techniques. The percentages of state populations that have substance abuse disorders are consistent across all years I am analyzing, as the report is based on data from 2018 and 2019. Therefore, this control stays the same for years 2016, 2017, 2018, 2019, and 2020 in my observation.

Mental illness prevalence amongst states refers to the percentages of state populations who report having any mental illness for a given year through the Substance Abuse and Mental Health Services Administration (SAMHSA) National Survey on Drug Use and Health (NSDUH). For my study, I will use consistent data for the years 2016, 2017, 2018, 2019, and 2020 in regards to this specific control. These percentages are the averages from the NSDUH official report for the years 2018 and 2019 (KFF 2023). In the report, the number of adults reporting any mental illness and serious mental illness in the past year are rounded to the nearest thousand. Any mental illness is defined as having a diagnosable mental, behavioral, or emotional disorder, other than a developmental or substance use disorder, as assessed by the Mental Health Surveillance Study (MHSS) Structured Clinical Interview for the Diagnostic and Statistical Manual of Mental Disorders—Fourth Edition—Research Version—Axis I Disorders (MHSS-SCID), which is based on the 4th edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV).

Rural populations are recorded for states through the 2020 Census (The United States Census Bureau 2023). “Rural” is defined by the Census Bureau as areas containing at least 2,500 and less than 50,000 people. The Census Bureau has published official urban and rural information for the 2020 Census and 2010 Census, which can give state-specific percentages of residents that reside in areas deemed rural . For my study, I use the state rural population percentages from the 2020 Census for years 2016, 2017, 2018, 2019, and 2020.

State mean elevation levels can be found in the U.S. Census Bureau Statistical Abstract of the United States 2012 report. For my study, the mean elevation levels recorded in the 2012 report will be used consistently during my analysis, with the same values for all states in the years 2016, 2017, 2018, 2019, and 2020.

Percent of the state populations that are religious are derived from Pew Research Center's most recent Religious Landscape Study, which was conducted in 2014 (Lipka and Wormald 2016). The 2014 Landscape Study described the changing size and demographic characteristics of the nation's major religious groups, and was conducted among a nationally representative sample of 35,071 adults interviewed by telephone, on both cellphones and landlines, from June 4-Sept. 30, 2014. Findings based on the full sample have a margin of sampling error of plus or minus 0.6 percentage points. The official report published by Pew Research had data on the percentages of adults who consider themselves highly religious, separated by state. For my study, I use the 2014 results for 2016, 2017, 2018, 2019, and 2020, as it is the most recent survey that Pew Research has conducted on religiosity.

Table 1: Summary Statistics

Variable	Min	Max	Median	Mean	SD
Firearm By Suicide Death Rates	1.9	22	9.3	8.9	3.8
Open Carry Regulation	0	1	0	0.2	
No Purchase After Violent Offense Law	0	1	0	0.3	
Waiting Period Law	0	1	0	0.2	
Extreme Risk Gun Law	0	1	0	0.3	
Unemployment Rate	2.1`	6.7	4	4.1	1
Percent of the Population with Substance Use Disorders	5.8	11.2	7.5	7.7	1.1
Poverty Rate	6.2	22.3	13.1	13.3	3.1
Rural Population	5.8	64.9	27.4	27.6	14.7
State Mean Elevation Levels (in feet)	60	6800	1000	1799.8	1810.2
Percent of the Population that is "Highly Religious"	3.3	77	54	54.7	10.7
Mental Illness Prevalence (Percent of the Population)	16.4	26.9	20.6	20.7	2.1

5. Analysis

I ran a regression analysis in order to test my hypotheses. The regression analysis tests the independent variables' effects on firearm suicide rates without state or year fixed effects. The results are below in Table 2.

Table 2: Regression Analysis Without State or Year Fixed Effects

Coefficients:	Estimate	Std. Error	t-value
(Intercept)	- 6.3	2.1	-2.9
Open Carry Regulation	-0.7	0.5	-1.5
No Purchase After Violent Offense Law	-1.5	0.3	-4.7
Waiting Period Law	-1	0.4	-2.2
Extreme Risk Gun Law	-0.8	0.4	-2.1
Unemployment Rate	0.67	0.2	4.5
Substance Use Disorders	0.6	0.2	3.2
Poverty Rate	-0.1	0.1	-2.1
Rural Population	0.1	0	9.4
State Mean Elevation Levels	0	0	12
Percent Highly Religious	0.1	0	4.3
Mental Illness Prevalence	0.1	0.1	1.3

5.1 Analysis of Independent Variables

I found that open carry regulations have a negative effect on suicide by firearm rates. When a state does have an open carry regulation in effect, the firearm suicide rate decreases by -0.722. According to the estimate, a state that chooses to adopt open carry regulations can save forty-six lives per year. The t-value does not make this estimate statistically significant, as it is -1.468. My hypothesis that open carry regulations have no effect on state firearm suicide rates is not strongly supported; however, it is important to note that the estimate found in my regression analysis is not statistically significant.

The regression analysis illustrates that No Purchase After Violent Offense laws have a negative effect on suicide by firearm rates. When this type of law exists in a state, the firearm suicide rate decreases by -1.465. According to the estimate, a state that chooses to adopt a No Purchase After Violence Offense law can save ninety-five lives per year. The t-value makes this estimate statistically significant, as it is -4.738. While I hypothesized that No Purchase After Violence Offense laws lowers state suicide rates only moderately lowered state suicide by firearm death rates, these laws actually had a greater impact than both Waiting Periods and Extreme Risk laws.

I found that Waiting Period laws have a negative effect on suicide by firearm rates. When a state has a waiting period in effect, the firearm suicide rate decreases by -0.976. According to the estimate, a state that chooses to adopt a Waiting Period law can save sixty-three lives per year. The t-value makes this estimate statistically significant, as it is -2.216. Because the effect is both negative and statistically significant, my hypothesis that Waiting Periods reduce firearm suicide death rates is sufficiently supported.

I found that Extreme Risk Gun laws have a negative effect on suicide by firearm rates. When an Extreme Risk law is in effect, the firearm suicide rate decreases by -0.799. According to the estimate, a state that chooses to adopt an Extreme Risk policy can save fifty-two lives per year. The t-value makes this estimate statistically significant, as it is -2.070. Based on these results, my hypothesis that Extreme Risk Gun laws reduce firearm suicide death rates is sufficiently supported.

5.2 Analysis of Controls

The unemployment rate has a positive effect on suicide by firearm rates. For every one unit the unemployment rate rises, the firearm suicide rate rises by 0.691. The t-value makes this estimate statistically significant, as it is 4.508. These results align with my prediction that higher rates of unemployment within the population increases suicide risk due to the hardships associated with less people actively participating in the workforce.

Substance abuse disorder prevalence, in terms of the percentage of the population, has a positive effect on suicide by firearm rates. For every percentage substance abuse disorders rise, the firearm suicide rate rises by 0.554. The t-value makes this estimate statistically significant, as it is 3.247. These results align with my prediction that higher rates of substance abuse disorder lead to higher rates of firearm suicide deaths.

Poverty rates have a negative effect on suicide by firearm rates. For every one unit the poverty rate rises, the firearm suicide rate decreases by 0.131. The t-value makes this estimate statistically significant, as it is -2.118. These results contradict what I predicted about poverty levels. While I made the argument that higher levels of poverty

increases a state's overall firearm suicide death rates, the estimate is negative and statistically significant. Because previous research has found that poverty impacts individuals' mental health and wellbeing, and thus increases individuals' risk of suicide ideation and attempt, I believe that there must have been error in my data collection process and measurement.

Rurality, which was measured in terms of the rate of the population of a given state residing in rural areas, has a positive effect on suicide by firearm rates. For every one unit the rural population rises, the firearm suicide rate rises by 0.113. The t-value makes this estimate statistically significant, as it is 9.436.

State mean elevation levels have a negative effect on suicide by firearm rates. For every foot the elevation increases, the firearm suicide rate decreases by 0.001. The t-value makes this estimate statistically significant, as it is 12.024. These results contradict what I argued for; that is, higher state elevation levels increases a population's risk for suicides by firearm. I found past research that did find a correlation between higher elevations and higher suicide death rates. However, I believe these results illustrate that state elevation levels have little to no effect on suicide rates specifically in terms of firearms.

Religiosity, which is measured in terms of the percentage of the population that identifies as highly religious, has a positive effect on suicide by firearm rates. For every percentage increase of highly religious people, the firearm suicide rate increases by 0.076. The t-value makes this estimate statistically significant, as it is 4.321. These results contradict my argument that higher numbers of religious people within a population leads to lower suicide by firearm death rates. Because the estimated effect is both negative and statistically significant, I believe that there were errors in my measurement and data collection processes. Past research does support the idea that religion provides people with a sense of wellbeing, purpose, and also discourages suicidal thoughts and attempts.

Mental illness prevalence, or the percentage of the population that has mental illness disorders, has a positive effect on suicide by firearm rates. For every percent mental illness prevalence increases, the firearm suicide rate rises by 0.091. The t-value does not make this estimate statistically significant, as it is 1.324. Because the estimated effect is positive, but not statistically significant, my argument that higher percentages of mental illness leads to higher rates of suicides by firearms within a population is supported to a certain degree. I believe that more appropriate and accurate measurements of people who suffer from mental illnesses that lead to suicide ideation would make this control more well supported.

6. Conclusion

In conclusion, my hypotheses that waiting period and extreme risk laws lower firearm suicide death rates were both strongly supported by my observational study. However, my hypothesis that state open carry regulation policies do not lower suicide firearm death rates was not support. I also predicted that no purchase after violent offense laws would have a minimal effect on lowering state suicide by firearm death rates, and this category of firearm policy actually had the largest impact on lowering suicide death rates. In regards to my controls, religiosity, poverty, and increased elevation levels did not impact firearm death rates in the way I predicted. I thought that a larger highly religious population within a state would lead to less firearm suicides, but found that the high religious population percentage of state actually increases firearm suicide death rates. I thought that higher rates of poverty would increase likelihood of higher suicide by firearm death rates, but found that poverty rates lower suicide by firearm death rates in states. Lastly, I predicted that increased elevation would increase the risk of firearm suicide, but found that increased elevation levels has a negative effect on suicide by firearm mortality rates. I recognize that there are limitations to this observational study. I want to note that I used dummy variables to categorize states as either having one of the four policies or not. However, it is important to note that these policies vary greatly amongst states. There is a chance that the execution of the four policies make a significant difference in firearm mortality rates.

Overall, the findings of this study reveal effective state policy strategies for decreasing firearm suicide deaths. Understanding how to combat gun violence in the United States from a policy standpoint can lead the government to create effective and beneficial strategies for saving thousands of lives every year. Future research should continue to focus on studying gun regulation at the state level and its relation to gun violence.

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