# EXPLORING THE EFFECTS OF FIREARM SALES ON STATE LEVEL GUN DEATHS

by

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**Abstract**

This study examines the effect of gun sales on firearm death, homicide, suicide, and accidents. To better understand the role of gun sales in firearm deaths, the National Instant Check System (NICS) data and Brady Scores were examined. Both represent the gun laws and restrictions in place and their effectiveness in performing these tasks within society. The literature suggests that age, gender, and race are important factors to account for in firearm studies. This study utilizes multiple regression to determine the statistically significant predictors for firearm death. Models examining gun death, measured as standardized incidents, will be examined. The current study examined firearm-related homicides, suicides, and accidents. This study also controlled for gender, race, age, location, and Part I crimes. Concentrations of gender, race, state crime rate, and firearm laws were significant predictors of firearm death, and provide a baseline for identifying the individuals at risk of falling victim to firearms.

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## Chapter 1: Introduction

According to the Centers for Disease Control and Prevention (CDC; 2013), there were 61,375 firearm related deaths in the United States between 2009 and 2010. These firearm-related deaths account for around 56% of the total violence-related deaths in these two years. If not just for mere exposure, firearm deaths have deservedly drawn attention from political officials, the public, and scholars.

The purpose of the current study is to analyze the effect of firearm sales on gun-related deaths. While there have been multiple studies examining gun deaths in general, there have been few studies that have analyzed specific types of firearm death: homicide, suicide, and accidents. There have also been a limited number of studies that have examined the possible contributing factors to these gun deaths. The research findings suggest that there is a relationship between gun laws and the number and rates of firearm-related deaths (Connor & Zhong, 2003; Fleegler, et. al., 2013; Hahn, et. al., 2005; Lanza, 2014; Ludwig & Cook, 2000) as well as a relationship between firearm sales and gun deaths (Hepburn, 2006; Wintemute, 2011). This research tests these broad claims in an attempt to narrow down possible predictors of firearm-related death.

Chapter 2 provides a review of the literature which examines gun deaths, homicides, suicides, and accidents in the United States. These empirical studies revealed that national rates of gun crimes are down significantly since the early 1990s (CDC, 2013) despite widespread belief to the contrary (Cohn, D., et. al., Pew Research Center, 2013). In fact, the Centers for Disease Control data states that the rate of firearm death has decreased from 15.2 per 100,000 in 1993 to 10.2 in 2000, a 32.9% decrease. While the current data suggests that the rate of deaths related to firearms has decreased, the

number of firearms available for sale, purchased by, and possessed by American citizens has grown substantially (Congressional Research Service, 2013). While gun sales are an important part of the study, the literature also revealed three crucial intervening variables that also need to be considered: age, race, and gender. The review of the relevant empirical studies provides the theoretical foundation for the current direction and models of this study.

Next, Chapter 3 will provide an explanation of the data employed and the methodology utilized. One method of measuring firearm sales is through the FBI's National Instant Check System (NICS) which is generally used to identify the number of gun background checks by states for firearm purchases or concealed carry permit checks; however, the levels of participation vary across the United States. For the purposes of this study, the raw counts of permit checks collected from the FBI were converted to rates to control for the effect of state population. This ensures that smaller states, such as Rhode Island, were not being unfairly compared to larger states, such as California. The Brady Score is a numerical representation created by the Brady Campaign to Prevent Gun Violence that is given to a state based on the number and type of gun restrictions in place, and serves as a measurement of the effectiveness of current gun laws and its relation to safety. The NICS data, Brady Score, and demographic variables will all be examined with univariate descriptive statistics. Bivariate statistics will then be used to investigate the relationship among variables. Finally, hierarchical linear regression will be used to determine the significant predictors of gun death, homicide, suicide, and accidents.

The results of the analytical techniques used in this study will be presented in Chapter 4. The analysis revealed that states with higher proportions of males and

Caucasians were more likely to experience higher levels of gun-related death. Similarly, states with higher proportions of violent crimes were more likely to experience these elevated gun death levels. Finally, states with more restrictive gun laws and programs experienced fewer gun-related deaths than states with less stringent laws and programs. The full model, which was comprised of the control and predictor variables, was found to be a significant improvement over the base model in explaining the predictors of firearm-related death. This suggests that it is important to consider factors besides demographics when examining gun deaths across the United States. It also implies that the fact that there is a relationship at the bivariate level does not mean that the same relationship will continue as a predictive variable in the full model. The interrelated nature of the variables plays a crucial role in better understanding the significant predictors of firearm-related death.

Finally, Chapter 5 presents the conclusions, limitations, policy implications, and future directions for research in this area. Even though the model determined the significant predictors of firearm-related death, the study was limited due to the aggregate level of the data, and the complexities involved with predicting death, such as the interrelated nature between the variables. The findings provide a baseline for future studies, and policy implications that can better identify the people most likely to commit crimes. It suggests policies that increase the number and effectiveness of background checks, and calls for the possible revocation of firearms from individuals identified as high risk.

## Chapter 2: Theoretical Foundations

Gun crimes are in the news with increased regularity (Boda & Szabó, 2011). This finding may have led to the belief that gun crimes are on the rise (Cohn, D., et. al., Pew Research Center, 2013). According to the Pew Research Center (2013), when asked about the trends in the number of crimes in recent years, 45% of Americans believed that the number is and has been increasing. Along the same lines, 56% of Americans believe that the number of crimes involving guns is higher than it was 20 years ago (Cohn, D., et. al., 2013).

In direct contrast to these perceptions, recent Bureau of Justice Statistics reported that criminal firearm violence has been generally on the decline from 1993 to 2010 (Planty & Truman, 2013). In 1993, there were 1,548,000 firearm crime incidents, but this number dropped significantly in 2010 to 426,100 incidents. These incidents represent a cumulative count of firearm homicides, nonfatal firearm victimizations, and nonfatal firearm incidents. In 1993, 9.2% of all violent incidents involved firearms, which decreased by 0.6% in 2010. An examination of this data suggests that firearm crime has not risen, but has instead decreased generally.

Many people believe that one reason for this perceived increase in firearm crimes is the large number of guns present in society (Cohn, D., et. al., 2013). According to the Congressional Research Service (2013), the number of firearms available for sale to and possessed by U.S. citizens has grown. In 2009, the per capita rate of one person per gun was 310 million, which is almost double the per capita rate in 1968. This idea that a higher number of available guns leads to an increase in firearm crimes is supported by research findings identified by Stroebe (2013), who found that firearm possession can be

expected to be positively related to overall rates of suicide and homicide, although these two acts are not exclusively committed with a firearm.

While the number of firearms in circulation has increased (Kaplan & Geling, 1998), it is important to understand the mentality behind ownership, as well as the types of purchases. As Kleck (2012) noted, much of the gun owning society can be divided into two groups with differing views on firearms. The first group sees guns as a rite of passage into the gun-owning subculture and manhood, while the second group views guns as a means of protection. These differing views coupled with the fear of victimization may have caused many people to go out and purchase a gun for self-protection (Kleck, Kovandzic, Saber & Hauser, 2011). While most legal firearms purchasers are not criminals, there are offenders who illegally purchase firearms, and unfortunately, those numbers are impossible to accurately record. Despite the belief that most gun crimes are committed with illegally purchased weapons, the present study examined the effect of the incidence and rate of legal gun sales on firearm death, more specifically, on firearm homicides, suicides, and accidents.

**Gun Death in the United States**

As a whole, national gun crimes are significantly lower than in the mid-1990s. According to the Centers for Disease Control (CDC), the rate of firearm deaths per 100,000 people in 1993 was 15.2 and fell dramatically to 10.2 in 2000. Between 2000 and 2010, the firearm death rate fluctuated between 10.2 and 10.4. In 2010, the death rate leveled off at 10.3. This corresponds to 39,595 firearm deaths in 1993 falling to 28,663 deaths in 2000, and an increase to 31,672 deaths in 2010. Firearm deaths encompass homicide, suicide, and homicide-suicides, in which the perpetrator will kill

another individual and then turn the gun on him or herself. This is an important phenomenon to examine because it contributes to the number of homicides and suicides in the nation. It is not a common event, but it does provide insight into the nature of homicides and suicides in the United States. Due to the nature of this crime, it is easier to identify these people as firearm victims. Sillito and Salari (2011) found that the Northeast and Midwest had the lowest percentage of interpersonal homicide-suicide with 12% and 17% respectively (p. 7). Interestingly enough, these are the regions that also had the most gun restrictions. On the other hand, 31% of all homicide-suicides occurred in the South, with another 41% occurring in the West. These regions also had the least stringent gun restrictions, which is an important factor when considering firearm homicide and suicide separately.

The number of non-fatal, violent crime victimizations is also down from 725.3 victims per 100,000 people in 1993 to less than 180 victims per 100,000 in 2010. The total number of non-fatal firearm-related violent crime victimizations also follows a similar trend with a drop from 7,976.3 victimizations in 1993 down to less than 2,250 victimizations in 2010.

**Homicide.** The U.S. homicide rate has declined by almost half from 9.3 homicides per 100,000 U.S. residents in 1992 to 4.8 in 2010 (Bureau of Justice Statistics, 2013). More specifically, the number of homicides decreased from 16,320 victims in 2002 to 14,720 victims in 2010. Even with the decrease in homicide incidents, the homicide rate in 2011 was highest among males, Blacks, and young adults. The peak homicide victimization rate for Black males was nearly 9 times higher than the peak rate for White males. Young adults ages 18 to 24 had the highest homicide rate of any age

group from 2002 to 2011; however, their rate dropped from 30% to 22% of all homicides for 18-24 year olds at the conclusion of 2011.

From 1992 to 2011, the rate of homicides involving a firearm decreased by 49%, but the percentage of homicide victims killed by a firearm remained at 67%. This implies that even though the number of firearm-related homicides decreased, the number of victims per incident stayed the same. Also, 95% of homicide incidents involved a single victim between 2002 and 2011. Of the homicides with single victims, 66% involved a firearm, compared to 79% of homicide incidents with multiple victims.

The present study relies on the Centers for Disease Control's definition of homicide as "a death resulting from the intentional use of force or power, threatened or actual, against another person, group, or community" (CDC Codebook, 2003, p. 7). Firearm homicide followed a trend similar to the overall gun death studies with the highest point of 7.0 per 100,000 in 1993 and declining until 2000 where it reached a rate of 3.8. There was a slight fluctuation between 2000 and 2010, but the rate at the conclusion of 2010 was 3.6.

When examining homicide in general, most of the prevailing criminological perspectives on the etiology of serious offending do not offer a precise hypothesis about the predictors of homicide, and this study aims to make these predictors clearer. Farrington, Loeber and Berg (2012) conducted a longitudinal study of three community cohorts of urban boys, deemed serious offenders, through repeated assessments. The researchers found that "89% of offenders, compared with 62% of controls, came from a broken home" (p. 108). In fact, the strongest predictors of homicide were broken homes, living in a disadvantaged neighborhood, family on welfare, and a young mother. Using

logistic regression, the researchers determined that the behavioral factors mentioned above predicted convicted homicide offenders more strongly than did the demographic factors such as race.

The theoretical foundation of general homicide is applicable to firearm homicide because the act of taking a life is still the same. According to the United States Department of Justice, Federal Bureau of Investigation (2010), criminal homicide is defined as "murder and nonnegligent manslaughter: the willful (nonnegligent) killing of one human being by another" (https://www2.fbi.gov/ucr/cius2009/about/offense_definitions.html). For the purposes of this study, this definition will be applied to firearm homicide. When comparing the gun homicide rate to its peak in 1993, the firearm homicide rate in 2010 was 49% lower (Cohn, D., et. al., 2013). This corresponds to the data gathered from the Centers for Disease Control data of 18,253 firearm homicides in 1993 and 10,801 homicides in 2000. As with the rate of firearm homicide, the number of gun homicides also fluctuated between 2000 and 2010 with the final count of firearm deaths at 11,078. A study by the Bureau of Justice Statistics (2011) found that homicides with more than one victim were more likely to involve firearms than single-victim homicides, and that in 2008, 77% of homicides with two or more victims involved guns, compared with 66% of single-victim homicides.

Duggan (2001) found that the 10% increase in gun ownership in 2001 was associated with the 2.14% increase in homicide rate the following year. Similar results were also found in 2005 by van Kesteren (2013) who examined individual and aggregate data on gun ownership and victimization from the International Crime Victim Survey

(ICVS). His research determined that there was a weak to moderate (r=0.39), significant relationship between homicide and handgun ownership, and a similar significant relationship between gun-related homicides and handguns (r=0.37, p. 62). This finding is important to the current study because it demonstrates the baseline relationship between homicide and handgun ownership. This bivariate association supports the inclusion of the measure of gun sales in the current study.

The explanatory power of this relationship was stronger between the proportion of homicides committed with a firearm and handgun ownership (r=0.55). In other words, as the number of handgun owners increased, so did the number of homicides committed with a firearm. Even with these results, it is important to remember that these findings do not claim that firearm-related homicides are caused by firearm ownership. In terms of the current study, this is an important finding because Duggan (2001) found that gun ownership is significantly and positively related to sales rates of guns. Therefore, the rates of gun sales, as recorded through the National Instant Check System and divided by the population for each individual state, should be a predictor of firearm homicide.

Siegel, Ross, and King (2013) also examined the relationship between levels of household firearm ownership and firearm homicide rates during 1981 to 2010. Using the data from the Centers for Disease Control and Prevention Web-Based Injury Statistics Query, the researchers conducted a negative binomial regression analysis. They determined that gun ownership was a significant predictor of firearm homicide rate. More specifically, the model indicated that for each percentage point increase in gun ownership, the firearm homicide rate increased by 0.9% (p. 2102). When the researchers lagged the gun ownership proxy by 1 year, it remained a significant predictor of firearm

homicide. However, when the gun ownership proxy was lagged by 2 years, the effect was attenuated or weakened (p. 2101). In their models, the authors also controlled for temporal trends in homicide rates by using linear and quadratic terms for time.

**Suicide**. This study also relies on the Centers for Disease Control definition of suicide as a "death resulting from the intentional use of force against oneself" (CDC Codebook, 2003). The CDC definition differentiates between firearms-related suicides and suicides by other means. According to the American Foundation for Suicide Prevention, over 38,000 Americans took their lives in 2010. This is the country's 10th leading cause of death. Studies show that a major contributing factor to suicide is mental disorders and more specifically major depression, substance use disorders, schizophrenia, personality disorders, and mood disorders (Bertolote & Fleischmann, 2002; Bangalore & Messerli, 2013; Kangas & Calvert, 2014). Previous suicide attempts are also important to recognize, since about 20% of people who die by suicide have made a previous attempt (Jenkins, et. al., 2002). Other factors that increase the risk of suicide include medical conditions and pain, suicide contagion or imitation, biological factors such as differences in brain composition, and finally, access to lethal means. In the U.S., the most common method of suicide is by firearm, which accounts for 51% of the total number of suicides (Jenkins, et. al., 2002).

Unlike firearm homicides, gun suicides did not experience as sharp a decrease. In fact, the total number of firearm deaths via suicide has remained relatively stable, with 18,940 suicides in 1993 before decreasing in 2001 to 16,586 firearm suicides. The number leveled off at 19,392 firearm suicides during 2010 (CDC WISQARS data), which is the highest annual total since the CDC began publishing data in 1981.

Research found that increased firearm availability and possession leads to higher levels of suicide (Kellerman et al., 1992). This means that the more guns that are available for purchase, the higher the number of suicides, even though the CDC data established that the suicide rate is stable and ownership increasing. Their research found that in homes with firearms, suicides were completed by gun in 86% of the cases as opposed to the 6% of firearm suicide cases in homes with no firearms. One reason for the availability of firearms increasing the risk of suicide, according to Miller and Hemenway (2008), is that one-third to four-fifths of all suicide attempts are impulsive (p. 989). Along the same lines, suicide attempts are self-limiting, in that the crisis is often caused by an immediate stressor, and once that stressor passes so does the suicidal feeling. However, guns are common in the United States, and a suicide attempt with a firearm rarely affords a second chance. When examining the means that account for more than 90% of all suicidal acts, such as drugs or cutting, these are fatal far less often (p. 990). These findings suggest that the availability of firearms within the home contributes to higher levels of firearm suicide. In fact, having a firearm at home increased the overall risk of suicide more than threefold (Wiebe, 2003). These results are supported by the finding that the New England region had the lowest percentage of households with firearms as well as the lowest firearm suicide rate (Kaplan & Geling, 1998, p. 1230). Conversely, the Southern regions have the highest percentage of households with firearms as well as the highest firearm suicide rates.

The results extend beyond ownership in the house to ownership in general. Miller, Azrael, Hepburn, Hemenway and Lippmann (2002) compared data for all 50 states with high and low levels of firearm ownership and found that the states with high

ownership levels had firearm suicide levels that were almost four times higher than the states with low level ownership. Using a time series design, the researchers conducted multivariate analyses to control for age, unemployment, per capita alcohol consumption, and poverty. The analysis revealed that each 10% decline in household firearm ownership was associated with significant declines in rates of firearm suicide (4.2%) and overall suicide (2.5%) (p. 180). This study is important to examine because it provides further evidence for the relationship between firearms and suicide, and supports the current theory. The relationship between the two is not only applicable to suicide via firearm, but also to overall suicide, which suggests the presence of firearms may influence suicide more generally. This finding provides more empirical evidence to include suicide in the models in the current study.

Further support is derived from Andrés and Hempstead (2011) who found that firearm regulations that reduce gun availability have a significant deterrent effect on male suicide. This study examined the impact of firearm regulation on male suicides through the use of a negative binomial regression model on state level data from 1995-2004. The results also suggest that regulations that seek to prohibit high risk individuals from owning firearms may have a weaker effect. In other words, restrictions that limit firearm ownership will theoretically have a stronger effect at reducing male suicides than gun control measures that completely prohibit ownership because males were more likely to participate in risky behaviors than women. It ultimately suggests that restrictions may influence the rates of suicide. The current study examines the effectiveness of these restrictions on firearm-related death across the United States.

While ownership is an important consideration, it is equally important to understand the relationship between ownership and victimization. van Kesteren (2013) found that owners of handguns are "more often a victim of contact crimes than non-owners, especially in countries with low firearm availability" (p. 63). It suggests that in countries with minimal availability, owners are more likely to be victims of violent crimes due to the increased risk. Prior research has failed to support a statistically significant relationship between long-gun ownership and victimization by contact crimes (van Kesteren, 2013, p. 60). This study defines contact crimes as "robbery, sexual offences, threats, and assaults" (p. 62). This is an interesting finding because it suggests that handgun owners are more likely to be victimized and involved with crime than those who do not own a handgun. This study suggests that while both long guns and handguns have a relationship with contact crimes, only handgun owners were more likely to be victimized. It also suggests that handgun owners are, by virtue of occupation, more likely to be in high risk situations.

**Predictors of Firearm Sales**

To better understand gun sales, the National Instant Check System (NICS) data and Brady Score for each state will be included in the examined models. While the NICS data provides an indirect measurement of the number of firearm sales within a state, the Brady Score serves as a secondary means of gauging sales. States with a higher Brady Score have more restrictive firearm legislation than states with a lower score (The Brady Campaign to Prevent Violence, 2014). This means that these states also have more restrictions and requirements for purchasing a firearm, and therefore, higher scoring states should theoretically have fewer gun sales. By using both a direct and indirect

measurement of gun sales, it allows for a more holistic analysis of the effect of firearm sales on gun death.

**Brady Campaign Scores.** The Brady Campaign was originally founded in 1974 by Dr. Mark Borinsky as the National Council to Control Handguns. Following the murder of his twenty-three year old son, Pete Shields became the Chairman in 1978 and changed the name of the organization to Handgun Control two years later. The major turning point for this organization occurred when President Reagan's press secretary, Jim Brady, was shot on March 31, 1981 in a failed assassination by John Hinckley, Jr. of Ronald Reagan. The incident left Brady partially paralyzed. After Jim and his wife joined the campaign, the organization was renamed the Brady Campaign to Prevent Gun Violence in 2001 to honor the Brady family. Today the organization works to reduce gun violence "through acting and enforcing sensible regulations" (http://www.bradycampaign.org/programs/million-mom-march/state-gun-laws).

In order to determine which states have stricter gun laws, the Brady Campaign created a scorecard that quantitatively rates state's laws relating to firearms and ammunition. Each score is based out of 100 points with higher scores corresponding to states with more restrictive gun laws. The Brady Campaign contends that their "100-point scorecard…can prevent gun violence" (Brady Campaign to Prevent Gun Violence, 2014), since tighter restrictions suggests that it will be more difficult for unlawful citizens to obtain firearms and therefore, the number of firearm-related deaths will decrease. It is their belief that the fewer illegitimate individuals who possess firearms, the fewer firearm-related deaths, since a majority of the deaths are caused by illegal ownership and use.

Research testing these assumptions has resulted in mixed findings. Lanza (2014) determined that there was a fairly strong negative relationship between gun deaths and the Brady Score, which suggests that as the Brady Score increases, the number of gun deaths decreases. This result is also supported by Connor and Zhong (2003) who determined that greater state restrictions are associated with lower suicide rates. However, when examining firearm death more broadly instead of strictly suicide, much of the research returns mixed results (Hahn, et. al., 2005). For example, Ludwig and Cook (2000) found that there was no difference between firearm homicide rates and "adult victims…directly subject to the Brady Act provisions compared with the remaining states" (p. 904). Such differences include differing enforcement standards on current laws and various techniques for exploiting the legal loopholes in those laws. In other words, the literature suggests that while there is a relationship between the Brady Score assigned to each state and firearm homicide, the mere presence of a correlational relationship does not imply that there is a cause-and-effect relationship present.

**Demographic Characteristics and Gun Death**

According to Bac (2010), the offenders' and potential victims' demands for guns are related to each other through the "correlation between victims types and the private benefits from an offense" (p. 343). In other words, in order to better understand why offenders and victims desire firearms, it is necessary to examine the offenders' potential gain for committing firearm-related offenses, as well as the victim characteristics in these cases. Gender is an important variable to take into consideration because it is one of the fundamental organizational features of society. There are differences between males and females related to criminal offending and victimization, with generally lower rates of

both for females. In 2009, there were 11,880 homicides involving male victims, and this number dropped to 11,410 in 2010 (Bureau of Justice Statistics, 2013). Homicides involving female victims followed a similar trend, although there were only 3,520 victims in 2009 and 3,315 victims in 2010.

Another significant finding in the literature was the relationship between age and firearm death. In 2010, 69% of the gun homicide victims were between the ages of 18 and 40, and this group continues to have a higher rate than other age groups according to the Centers for Disease Control. Generally, 18-24 year olds had a rate of 10.7 gun homicides per 100,000 people, and people from 25 to 40 had a rate of 6.7 firearm homicides in 2010. The lowest rates belonged to children under 12 years old and adults older than 65. While these numbers appear troubling, they are dramatically lower than the rates in 1993.

Finally, the data suggests that there is a relationship between firearm death and race. As with gender, race is an integrated and important categorical system in today's society. While there is a constant push for the dissolving of racial boundaries, the statistics and studies show that there is a difference between races in terms of violent crimes and firearms. According to the Bureau of Justice Statistics (2013), there were 7,485 homicides involving White victims in 2009, and these figures dropped by 600 in the following year. On the other hand, the number of homicides with Black victims only decreased by 45 victims from 2009 to 2010 where there were 7,450 Black victims.

The research has found that age, gender, and race are important characteristics to examine. Therefore, the current study examined the relationship between gun sales and firearm death. As the previous literature suggests, these three demographic variables do

impact gun deaths so it would be unwise to examine this concept without including these variables in the models.

**Gender.** According to data from the Centers for Disease Control, in 2010, men and boys made up the vast majority (84%) of gun homicide victims. The firearm homicide rates have declined for both male and female victims since the 1990s; however, the male rate is considerably higher with 6.2 gun homicides per 100,000 people compared with a rate of 1.1 for females in 2010. Additionally, the percentage of firearm suicides correlated significantly with both males and females (Stroebe, 2013, p. 714). These results are supported by Miller, Azrael, and Hemenway's (2002) finding that women were more likely to die from suicide, homicide, and unintentional firearm injuries if they resided in states with more guns (pg. 35).

In a similar study, the associations between gun ownership and homicides involving guns were significant for females, but were not significant for males (Kaplan & Geling, 1998). In other words, females who owned firearms were more likely to be the victim in homicides than male gun owners. However, the authors did not state whether the firearm was personally owned by the female or was a firearm simply present within the house. These results are supported by separate findings that women had a higher risk of being killed by a spouse or intimate acquaintance (Kellermann & Mercy, 1992). This study also found that although women comprise more than half the U.S. population, they committed only 14.7% of the homicides within the research time parameters. It was also discovered that in 80% of the cases, men killed non-intimate acquaintances, strangers, or victims of undetermined relationship.

van Kesteren (2013) also determined that there was a significant difference between the two genders in terms of gun ownership and violence with a long gun and handguns. Males were more likely than females to own a firearm, and were more likely to be involved in contact crimes. These differences in ownership and fatal violence provide evidence that gender is an important component to take into consideration when examining firearm death.

**Race.** In 2010, 55% of the shooting homicide victims were Black, which corresponds to only 13% of the population (CDC WISQARS data). The percentage of White victims stands in contrast at 25%, but representing 65% of the population. Both the Black and White victim death rates declined dramatically from their peak in 1993 to 2010. Since 1993, the Black homicide death rate has declined by 50% and the White homicide death rate has declined by 42%. This translates to the number of Black homicide deaths decreasing by more than a third (37%), and the number of White homicide deaths declining by 39%.

The association between gun ownership and the proportion of suicides by firearm was strongest among White males, $R^2$=0.95, p=.001 (Kaplan & Geling, 1998, p. 1230). A separate study by Price, Thomson, and Drake (2004) found that when controlling for African American race, the relationship with firearm homicide deaths was statistically significant, but did not identify in any particular direction. This suggests that there is an impact of race on the number of firearm-related deaths. In fact, Siegel, Ross, and King (2013) found that for each 1 percentage point increase in proportion of Black population, the firearm homicide rate increased by 5.2% (p. 2101).

Similarly, Baker, Whitfield, and O'Niell (1988) found that minorities were more likely than Whites to inhabit the low-income counties where firearm deaths were high. Additionally, lower rates of firearm-related homicides were not high in suburban counties, which were mostly populated by middle- to upper-class Whites. These low income areas are more likely to appear in rural counties than urban counties because of the lack of wealth in these areas. According to Carr et. al. (2012), rates of unintentional firearm death are significantly higher in rural counties than in urban counties, and those living in the most rural counties were significantly more likely to die of unintentional firearm deaths than those in urban counties (p. 1009). Fingerhut and Christoffel (2002) also found that states in the South and West had higher firearm homicide rates compared with the rest of the nation. These differences between races and physical locations are one of the crucial reasons why it is important to include these two variables as control variables in this study.

**Age.** The literature states that violence is a significant cause of morbidity and mortality among adolescents aged 10 to 17 years. (Connor, 2005; Johnson et al., 2008; Sillito & Salari, 2011; DeSimone, Markowitz & Xu, 2013; Hansen et. al., 2013). However, the older children are, the more likely they are to risk death by firearm (Fingerhut & Christoffel, 2002). In fact, according to the Firearm and Injury Center at Penn (2011), young adults aged 15-24 are the most likely to be affected by firearm injury, with homicide and suicide ranking second and third, respectively (p. 7).

Intimate partner homicide-suicide contributes to the number of firearm related incidents; however, this event is not mutually exclusive to the two partners. Children, both biological and adopted, also fall victim, and were over three times more likely to be

killed if they were the biological child of the perpetrator (Sillito & Salari, 2011, p. 292). However, children were less likely to be killed if the perpetrator had a known history of violence than if he or she did not have a past history (p. 292).

In addition to being the victim of crimes, adolescents can also be the perpetrator of violence. This is an important fact to keep in mind with the current study, because if an adolescent engages in violent behavior or is victimized, he or she will want to end the victimization or find a way to increase the lethality of the violent behavior. One way of accomplishing this task is through the procurement of a firearm. Adolescents are unable to purchase firearms, so in theory, violent behavior with a firearm suggests that the firearm is illegal or there was some other measure taken to circumvent the firearm laws in place.

However, not all firearm incidents involving adolescents were the direct result of violence, as juveniles also fall victim to firearm accidents. A study by Connor (2005) revealed that "firearms were the third leading cause of death for American children 5 to 16 years old" (p. e38). A second study in 2004 found that 6% of the 2,038 firearm fatalities of young people aged 1-18 years were accidental (Johnson et al., 2008, p. 592). This is an important component to this study because it provides the baseline support for including accidents within our outcome variable of firearm death.

Based on a review of the prior literature, the current study will test the model shown in Figure 1. It indicates that gun sales are a positive predictor of firearm death. In other words, as gun sales increase, the number of firearm deaths also increases. The literature revealed that the National Instant Check Systems (NICS) data and the Brady Score were important and influential factors that have been found to contribute to gun

sales. However, the literature also revealed that there were important intervening factors that needed to be considered in the model of firearm death: age, race, and gender. Taking into account the literature, this study examines the impact of gun sales through the NICS data and Brady Score on firearm death. The research model takes this one step further by differentiating between the different types of firearm death: homicide, suicide, and accidents. The model also includes the influence of the demographic variables on firearm death. The main hypothesis states that the NICS data and Brady Score are significant predictors of firearm death when controlling for age, gender, race, urban location, and UCR Part I crimes.

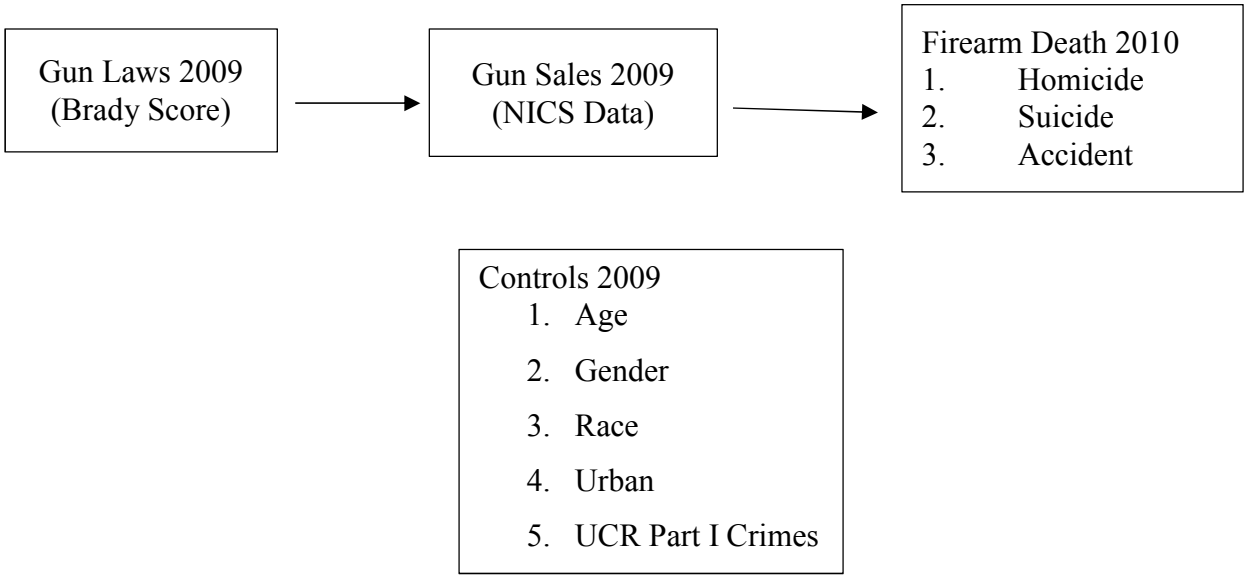


Figure 1. *Theoretical model*

In summary, part 1 of this chapter examined the overall trend of firearm death, homicide, suicide, and accidents from 1993 to 2010. Overall, the number of firearm deaths has been declining, although research suggests that the average American citizen is uninformed about the true nature of firearm trends. Predictors of firearm sales were also examined through a review of the Brady Score and the National Instant Check

System. Part 2 of the chapter examined the importance of age, gender, and race in terms of the number and percentage of victims and incidents. These findings form the basis for the current research project and provide the support for the proposed methodology.

## Chapter 3: Methodology

The current study examines the role of gun sales in predicting incident count and rate of gun death. The research question examined in this study is: "What is the impact of gun sales on firearm death?". More specifically, do the NICS and Brady Scores predict gun sales across the United States, and how do the sales influence gun-related deaths? The previous literature suggests that there may be a relationship between firearm interest and gun laws with respect to firearm death. However, much of the research presents mixed results which warrant further investigation. There have been few studies conducted on the relationship between the two concepts, particularly the effect of gun sales on rates of gun death. The literature also revealed that gender, race, and age may contribute explanatory power to the model predicting the total number and rates of firearm deaths (Baker, Whitfield & O'Niell, 1988; Connor, 2005; DeSimone, Markowitz & Zu, 2013; Hansen et. al., 2013; Johnson et. al., 2008; Kaplan & Geling, 1998; Kellermann & Mercy, 1992; Sillito & Salari, 2011; Spano, Pridemore & Bolland, 2012; van Kesteren, 2013). Many studies only examined the relationship between one demographic characteristic and one form of death (Andrés & Hempstead, 2011; Connor & Zhong, 2003; Duggan, 2001; Fleegler et. al., 2013; Lanza, 2014; Ruddell & Mays, 2005; Sen & Panjamapirom, 2012; Stroebe, 2013; Sumner, Layde & Guse, 2008; Webster et. al., 2004). By examining one form of firearm death, such as homicide or suicide, the researchers discovered the specific predictors for either homicide or suicide; however, in order to gain a more complete understanding of firearm death, studies need to examine more than one form of death simultaneously.

The current study examines the combined contribution of the demographic factors in explaining firearm deaths while testing the significance of firearm interest and gun laws in predicting firearm-related death. Many studies have examined firearm homicide, suicide, or accidents as a single entity, which provides a good insight into the nature of such events, but does not provide a holistic approach. The current study builds upon these previous studies through an examination of the impact of firearm sales on gun death in general, which includes homicides, suicides, and accidents.

Each model is based on previous findings, and adds to the current knowledge base. Since this study uses state level data, the most appropriate way to analyze the data is through the use of hierarchical linear regression that tests various models of firearm death predictors based on gun sales and demographic information. The overarching hypothesis for this study states that firearm death is predicted by the measures of gun interest (NICS sales data) and firearm laws (measured by the Brady Score), while controlling for age, gender, race, location, and UCR Part I crime rates.

**Data**

The current study used data collected at the state level that measured basic demographic information such as the number of juveniles, males, and Whites from each state in 2009, and is displayed in Table 1. Data were also collected that examined the amount of urban space per state based on geographic land size, as well as the number of UCR Part I crimes. Part I crimes include murder and nonnegligent manslaughter, forcible rape, robbery, aggravated assault, burglary, larceny-theft, motor vehicle theft and arson. Next, Table 1 displays the data for the average gun law restrictions across the U.S., as measured via the Brady Score, in addition to the average number of firearm

instant checks that were run through the FBI's National Instant Check System. Finally, Table 1 displays the average number of firearm-related deaths across the United States in 2010. It is important to remember that the data were lagged, with the predictor variables from 2009 and the outcome variable of firearm-related death from 2010. Each of these areas is discussed individually below.

Table 1. *Descriptive Statistics for Count Data*

| | N | Median | Mean | SD | Skew | Kurtosis | Shapiro-Wilk | *p* |
|---|---|---|---|---|---|---|---|---|
| Firearm death | 50 | 456.5 | 614.34 | 615.94 | 1.99 | 4.28 | 0.77 | 0 |
| Juvenile | 50 | 462755.5 | 662319.4 | 760485.4 | 2.66 | 8.4 | 0.70 | 0 |
| Male | 50 | 2146630 | 3021853 | 3379789 | 2.53 | 7.63 | 0.72 | 0 |
| White | 50 | 2996750 | 3982522 | 3473003 | 1.3 | 1.17 | 0.86 | 0 |
| Urban | 50 | 898.5 | 1210.42 | 1165.81 | 1.56 | 2.27 | 0.82 | 0 |
| Part I Crime | 50 | 301,187 | 424,113.68 | 493,636.59 | 2.18 | 5.56 | 0.76 | 0 |
| Gun laws (Brady) | 50 | 9.5 | 17.02 | 18.98 | 1.69 | 2.01 | 0.75 | 0 |
| Firearm Interest (NICS) | 50 | 206,148 | 279,486.46 | 347,247.811 | 3.57 | 15.97 | 0.62 | 0 |

**National Instant Check System.** The National Instant Check System (NICS) is used to determine whether a prospective buyer is eligible to buy firearms or explosives from Federal Firearms Licensees (FFLs). Generally, these checks identify the number of gun background checks by state which can be used in firearm sales or concealed carry permit checks; however, there are various levels of participation across the United States. The data for this experiment is obtained from the FBI database for the years of 2009 and 2010; however, it is important to note that the numbers from the FBI do not provide an extensive view of the number of background checks for firearm purchases. For this

study, the NICS data measure firearm interest instead of firearm purchases, due to the inability for the researcher to separate firearm purchases from routine checks on owners. An example of this is the routine checks that Kentucky runs on any gun owner within the state, even if that owner has not purchased a gun recently. By constantly running these checks, it inflates the NICS number for the state. This is also due to the aggregate measures within the NICS data. The data in this experiment cannot be separated out from actual purchases or permit checks run by some states. Due to the inability to decisively separate the effect of these concepts at the individual level, the NICS data more accurately represents interest in guns, rather than a pure measure of gun purchases.

According to the Federal Bureau of Investigation, there are 13 states that adhere to the full Point-Of-Contact (POC) capacity. This means that these states conduct NICS checks for all firearms purchases and/or for alternate permits for handguns and long guns, and includes Oregon, California, Hawaii, Nevada, Utah, Colorado, Illinois, Tennessee, Florida, Virginia, Pennsylvania, Connecticut, and New Jersey. These particular states conduct background checks for Federal Firearms License (FFL) transactions by accessing the NICS electronically or via the phone. This occurs for all firearm background checks, including permits. There are also states that adhere to a partial-POC contact, which means the states have their own agencies that conduct checks for handguns and/or handgun permits, while the NICS Section simply deals with the state transaction processing for long gun purchases. Washington, Wisconsin, New Hampshire, and Maryland use a partial-POC contact to conduct handgun background checks, and use the FBI for long gun background checks. Three states, Nebraska, Iowa, and North Carolina, also use a partial-POC contact, but these partial-POC contacts conduct checks for

handgun permits, and use the FBI for long gun background checks. The remaining 36 states do not use any POC and rely on the FBI to conduct all firearm background checks.

The total number of NICS firearm background checks are comprised of purchases, pre-pawn, redemption, returned, rentals, private sales, and return to seller – private sale. The data for this experiment was obtained from the FBI database from the total NICS firearm background checks from January through December of 2009.

**Brady Score.** The Brady Campaign created a 100-point scorecard that ranks all 50 states on the "basis of laws that can prevent gun violence" for laws that were enacted by the end of 2011 (Brady Campaign to Prevent Gun Violence, 2014). The ratings are broken down into five different star scores. Five stars are given to states that have received 75 to 100 points, and in 2009, only California received enough points (79) to achieve a 5-star rating. States with a 4-star rating, or a score between 50 and 74 points, were determined to have the second strongest gun laws; however, the Brady Campaign did not award any states four stars during this year. States with a 3-star rating were determined to have strong gun laws, but still left gaps in the prevention of gun deaths. In 2009, five states met these criteria: New Jersey, Massachusetts, Connecticut, Maryland, and New York. Two-star states possess "common sense gun laws", such as not providing firearms to criminals or minors, but do not have policies to prevent illegal trafficking and harm to children, and earn between 25 and 49 points. Rhode Island, Hawaii, Illinois, and Pennsylvania met these criteria in 2009. States with a one star rating and between 11 and 24 points have weak gun laws and allow for the sale of firearms without background checks. According to the Brady Scorecard, 12 states met these criteria, including Michigan, Delaware, North Carolina, Oregon, Virginia, Washington, Alabama, Colorado,

Minnesota, Iowa, Maine, and Ohio. Finally, states with a zero-star rating have extremely weak gun laws or no gun laws at all, and received a score between zero and 10 points. In 2009, these states included South Carolina, Wisconsin, Wyoming, Nevada, New Hampshire, Texas, Georgia, Nebraska, Tennessee, Vermont, Kansas, Florida, Indiana, Mississippi, Arkansas, Missouri, Montana, New Mexico, North Dakota, South Dakota, West Virginia, Alaska, Arizona, Idaho, Kentucky, Louisiana, Oklahoma, and Utah.

The points are broken down into six major categories: curbing firearm trafficking, strengthening Brady background checks, banning of assault weapons, child safety, guns in public places/ local control, and an extra credit/ demerit category as displayed in Table 2 below. A maximum of 35 points can be earned in the "Curb Firearm Trafficking" category by examining gun dealer regulations, bulk purchase limitations, record retention, crime gun identification, and reporting of lost/stolen guns. States can earn a maximum of 40 points under the "Strengthen Brady Background Checks" category based on points earned in the background checks on all gun sales, purchase, and ammunition regulation categories. Ten points can be earned in the "Ban Assault Weapons" category if a state has appropriate assault weapons bans and large capacity magazine bans. A maximum of 7 points can be earned under the "Child Safety" category if the state requires some type of child safety locks in addition to access prevention. The final category, "Guns in Public Places and Local Control", has a maximum of 8 points that are earned by restricting guns in public places to trained law enforcement and security by having no guns in workplaces, no guns on college campuses, is not a Concealed-Carry (CCW) shall issue state, and has no state preemption. States with CCW shall issue licensing systems require authorities to provide a license to any applicant who meets

specified criteria (Cleary & Shapiro, 1999). A state receives extra credit points if the law enforcement matches firearm records with records of prohibited persons, while demerits are earned if there is a gag rule on doctors or if there is no permit required for carrying concealed weapons (CCW).

Table 2. *Brady Scorecard Categories and Points*

| **Category** | **Points** |
|---|---|
| Curb Firearm Trafficking | 35 |
| Strengthening Brady Background Checks | 40 |
| Ban Assault Weapons | 10 |
| Child Safety | 7 |
| Guns In Public Places and Local Control | 8 |
| Extra Credit/Demerit | --- |

A basic examination of the distribution of the Brady Scores reveals that the average score is 17.02, which is the equivalent of one star. The median score is 9.5, and the standard deviation is 18.98. The standard deviation score indicates that the data are fairly dispersed, which is confirmed by the range of 79. While the Brady Campaign did create this scorecard based on firearm laws within each state, it is important to remember that the scores are a projection of the organization's political agenda, and is not an objective measure of gun laws in the United States.

**Death, Homicide, Suicide, and Accidents.** The data for firearm death was obtained from the Centers for Disease Control (CDC) via the statistical analysis program called the Web-based Injury Statistics Query and Reporting System (WISQARS). This online database provides information on the number of fatal and nonfatal injuries for each of the 50 states. The CDC receives its data from a national mortality database, which is compiled by the CDC's National Center for Health Statistics. The database contains

information from death certificates that include the cause of death as reported by attending physicians, medical examiners, and coroners. The type of death or injury can be specified to reflect the mechanism of the injury, such as a firearm, as well as the manner of the injury (homicide or suicide). In this case, firearms are defined as either a handgun or a long gun, and this study used data from 2010. The average number of firearm-related deaths across the 50 states was 614.34 with a standard deviation of 615.94. This indicates that the data were very dispersed, which is supported by the range of 2,854 deaths. The state with the fewest number of firearm deaths was Hawaii, with 44 deaths, while the state with the largest number of deaths was California, with 2,898 deaths.

**Models**

In order to test the effect of firearm sales on gun deaths, a main model examining the predictors for firearm death rates is used. The model is run on two levels. The base model will include only control variables. Full models will be examined with controls and gun interest predictors added in one at a time. The reason a base model is used is because the literature suggests that the various controls of age, race, gender, city location, and overall crime, serve as important predictors for each type of firearm death outcome. Using the base model allows the researchers to determine how much predictability in the models is due solely to the influence of control variables.

The model specifically examines the predictors of firearm death, and does not differentiate among homicide, suicide, and accidents, although this data is contained within the firearm death category. The base model uses age, gender, and race as the base predictors. Once this model is run using hierarchical linear regression, the Brady Score

measure is added to the model. The final model for firearm death will add the firearm interest measure. The hypothesis for these models is that the Brady Score and NICS handgun checks are significant predictors of firearm death.

**Analysis**

Before any models were created and run, descriptive statistics were run to check for normality in the data. It is important to conduct these tests because violations of normality can substantially increase the likelihood of making a Type I error. In order to check for normality, visual data analysis, skew and kurtosis, and a Shapiro-Wilk test were used as outlined by Field, Miles, and Field (2012). The visual data analysis was accomplished through an examination of histograms with their respective density curves. By analyzing the skew and kurtosis scores, it revealed whether any of the data clustered around the lower or higher side of the distribution. Finally, the Shapiro-Wilk test compared the values in a sample to a normally distributed set of values with the same mean and standard deviation, and if the test returned a non-significant value, then the sample distribution does not differ from a normal distribution.

To gain a better understanding of the type of data and the pattern of the variables across the sample, univariate analysis techniques were used since a single variable was analyzed. This type of test does not deal with causes or relationships, as the major purpose is to describe. In order to accomplish this, measures of central tendency, dispersion, and frequency distributions were used. These tests examined the Brady Scores of the states. Similar to the Brady Scorecard, each category is broken down into the number of stars earned through the Brady Campaign's analysis of each state's gun laws and restrictions. Traditionally, the NICS data examines gun sales across the United

States by tallying up the number of times requests come in from the FFLs background checks on potential buyers. This study, however, cannot separate the actual checks for purchases versus checks that individual states conducted on current permit holders during the year. Due to this complication, the NICS data were used to explain firearm interest across each state.

A univariate analysis was conducted on the demographic variables as well. The count data were analyzed and broken down into categories based on quartile breakdown. In other words, there were four quartiles that represent 25%, 50%, 75% and the top 25% of the data. As previously stated, the purpose of this initial analysis is to describe the data used in the study.

Next, a bivariate data analysis was used to explain the relationships between the data. This was accomplished through the use of correlations of the independent and dependent variables. For this study, the dependent variable is firearm death, and the independent variables are the demographic variables (e.g. age, race, gender, location, and Part I crimes). A correlation was also run between the independent variables in order to measure collinearity. It is important to remember that even if there is a significant correlation between variables at this stage, it does not imply that one causes or predicts the other. In order to determine causality or predictability, a stronger statistical analysis is needed.

To determine predictability between the independent and dependent variables, this analysis used hierarchical linear regression. This measure replaced absolute statistical methods, such as Stepwise functions, because it has more flexibility. This method is also most appropriate when the data does not meet the assumptions of normality. Hierarchical

linear regression will be used because it attempts to model the relationship between two or more explanatory variables (NICS data and Brady score) and a response variable (firearm death). Through the systematic addition of predictors (e.g. the Brady Score and the NICS data), it allows the researchers to determine how much variability each predictor has on the overall model. These models were used to draw conclusions about the statistical predictability of these various gun control policies.

Tests for normality indicated that the data do not conform to normality standards, which would make any findings non-generalizable, and increases the chances of making a Type I error. In order to avoid this, the researcher first converted all the raw count data into rates by dividing each variable by its state population. From here, each of the variables was standardized and converted to a z-score. A z-score is a measurement of a score's relationship to the mean in a group of scores. Therefore, a z-score of zero means the score is the same as the mean, while a score that is positive is located above the mean by the indicated number of standard deviations. Similarly, a negative z-score indicates that the score is below the mean (Field, Miles, & Field, 2012).

By examining the theoretical model, this research tested the predictability of the firearm interest and available access to firearms via gun laws on firearm death. Univariate and bivariate statistics tested the relationship between the predictor and intervening variables. Not only does this study determine the predictors of firearm death, it also contributes to the growing knowledgebase of firearm death.

## Chapter 4: Analysis

As previously mentioned, this experiment examines the predictors of firearm-related death rates across the United States. The main research question asks if firearm-interest and laws are significant predictors of gun death. The control variables are age, race, gender, urban, and UCR Part I crimes, and the predictor variables are the firearm availability as measured by gun laws and firearm interest. The outcome variable is the number of firearm-related deaths.

A cursory examination of the data in its raw count form revealed that the data, especially the outcome variable of firearm death, was extremely positively skewed. Data that are skewed, especially to this degree, violates the assumption of normality and renders the results un-generalizable. In order to combat this issue, the population of each state was taken into account. This involved taking the raw count data for each variable and dividing it by its respective state population. For example, take the count of firearm deaths for Florida and then divide it by Florida's population in order to get the rate of death for that particular state. This process is done for the control variables as a count of the number of people in each class (e.g., age, race, gender, location, and Part I crimes), the NICS predictor, and the death outcome variable. This is similar to how rates are calculated on other widely used statistics such as national crime rates.

At this point, all of the variables except the Brady Score were in rate form. It would be unwise to continue with the analysis given that the data are not all in the same form. To avoid any issues, all of the variables were standardized and converted to a z-score for easier analysis. Once this was accomplished, the univariate descriptive tests were conducted, and the results appear in Table 3.

Table 3. *Standardized Descriptive Statistics*

| | N | Median | Mean | SD | Skew | Kurtosis | Shapiro-Wilk | *p* |
|---|---|---|---|---|---|---|---|---|
| Firearm death | 50 | -0.05 | 0 | 1.01 | 0.06 | -0.42 | 0.99 | 0.93 |
| Juvenile | 50 | -0.14 | 0 | 1.01 | 0.71 | 0.83 | 0.96 | 0.11 |
| Male | 50 | -0.22 | 0 | 1.01 | 0.85 | 0.45 | 0.94 | 0.02 |
| White | 50 | 0.22 | 0 | 1.01 | -0.79 | 0.38 | 0.95 | 0.02 |
| Urban | 50 | -0.36 | 0 | 1.01 | 2.26 | 4.44 | 0.66 | 0 |
| Part I Crime | 50 | -0.01 | 0 | 1.01 | 1.10 | 4.54 | 0.91 | 0 |
| Gun laws (Brady) | 50 | -0.40 | 0 | 1.01 | 1.69 | 2.02 | 0.75 | 0 |
| Firearm Interest (NICS) | 50 | -0.13 | 0 | 1.01 | 5.55 | 33.58 | 0.41 | 0 |

In a normal distribution, the mean and the median are close in comparison. An examination of the mean and median for the standardized death variable reveal that these scores are fairly close at 0 and -0.05. The standard deviation of 1.01 indicates that the data are not widely dispersed. The skew score of 0.06 indicates that there is a slight positive skew in the data, which means that there are more scores on the lower end of the distribution. The kurtosis score of -0.42 discusses the nature of the curve for the data. The negative score indicates that the data are platykurtic, which means the curve is more flattened out than a normal distribution. Finally, the non-significant score for the Shapiro-Wilk test indicates that the data are not statistically different from the normal distribution.

The same close relationship occurs between the mean and median for the juvenile data with 0 and -0.14 respectively. The positive skew score of 0.71 indicates that there is a positive skew in the data, with a pointed distribution as indicated by the kurtosis score

of 0.83. The non-significant Shapiro-Wilk score indicates that this data are normally distributed.

The male distribution has a fairly close relationship between the mean (0) and median (-0.22). The positive kurtosis score of 0.85 indicates that the data are positively skewed and leptokurtic in nature. Unlike the previously mentioned variables, the significant Shapiro-Wilk score (W=0.94, $p = 0.02$) indicates that the data are not normally distributed and is significantly different from the norm.

The distribution for gun laws has the largest separation between the mean and the median with a mean of 0 and a median of -0.40. This suggests that this data are more spread out, and is less likely to be normally distributed. The skew score of 1.69 indicates that the data are positively skewed, and is very leptokurtic with a kurtosis score of 2.02. The Shapiro-Wilk test indicates that the data are significantly different from the norm (W=0.75, $p = 0$).

Finally, the firearm interest data has fairly close mean and median scores of 0 and -0.13, respectively. The skew score indicates that the data are positively skewed, and is the most skewed of all the variables. The kurtosis score is problematic at 33.58, which indicates that the data are highly leptokurtic, and the Shapiro-Wilk test further supports the finding that the data are significantly different from the normal distribution (W=0.41, $p = 0$).

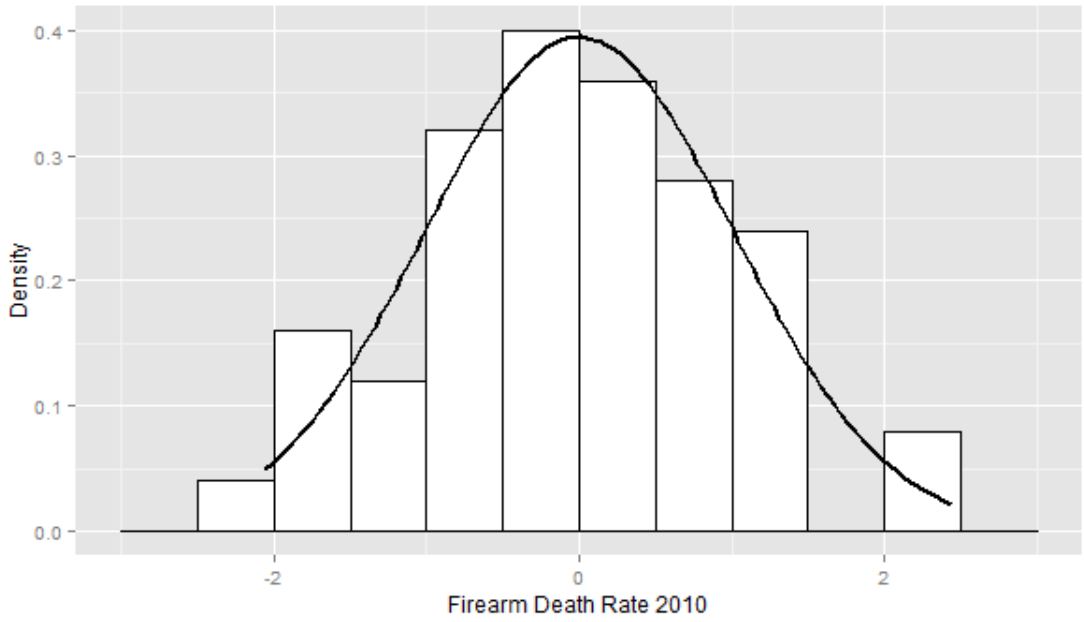


Figure 2. *Histogram of Firearm Death Rate*

An examination of the histogram for firearm death rates provides visual support for the conclusion that the outcome variable is nearly normally distributed; however the density curve is platykurtic in nature. While it is ideal for all of the variables, controls, and predictors to be normally distributed, it does not always occur in real-world applications. For this reason, research typically only examines the outcome variable for normality (Field, Miles, & Field, 2012). Through an examination of the visual and descriptive statistics, it can be concluded that the firearm-related death rate data are normally distributed. This finding is crucial because it allows the researcher to continue with the analysis with confidence that the results will represent what it is testing.

Table 4. *Variance Inflation Factor for Predictor Variables*

| Juvenile | Male | White | Part I Crime | Gun Laws (Brady) | Urban | Firearm Interest (NICS) |
|---|---|---|---|---|---|---|
| 1.29 | 1.97 | 3.40 | 3.48 | 2.83 | 2.78 | 1.15 |

Table 4 displays the variance inflation factor (VIF) for the variables used in this study. This number provides an index that measures how much the variance of an estimated regression coefficient is increased because of collinearity. According to Field, Miles and Field (2012), VIFs of less than 5 indicate that there are no problems from multicollinearity. This means that none of the variables are highly correlated, which occurs when one can be linearly predicted from others with a non-trivial degree of accuracy. The next step in the data analysis is to examine the bivariate relationship between the variables. To accomplish this, correlations were conducted, and the results placed into Table 5.

Table 5. *Correlations between Predictor and Outcome Variables*

| | Death | Juvenile | Male | White | Gun Law | Urban | Part I Crime | Gun Interest |
|---|---|---|---|---|---|---|---|---|
| Death | -- | | | | | | | |
| Juvenile | 0.25 | -- | | | | | | |
| Male | 0.18 | 0.29* | -- | | | | | |
| White | 0.0079 | -0.29* | -0.08 | -- | | | | |
| Gun Law | -0.66*** | -0.12 | -0.21 | -0.37** | -- | | | |
| Urban | -0.53*** | -0.14 | -0.45*** | -0.11 | 0.72*** | -- | | |
| Part I Crime | 0.30* | -0.0042 | 0.34* | 0.73*** | -0.41** | -0.23 | -- | |
| Gun Interest | 0.26* | 0.019 | 0.038 | 0.28* | -0.31* | -0.21 | 0.27 | -- |

The results in Table 5 revealed that there is a strong negative correlation, $r(48)=-0.66$, $p<0.001$, between the state gun laws and the number of firearm-related deaths. In other words, as the Brady Score increases, the number of firearm deaths decreases, and vice versa. This relationship is also statistically significant, which means that it has the possibility of being a significant predictor in later analysis. On the other hand, there is a

significant moderate positive correlation, $r(48)=0.26$, $p<0.05$, between firearm-related deaths and firearm interest across the United States. This implies that as firearm interest increases, so does the rate of firearm-related deaths.

There is also a significant moderately strong negative relationship, $r(48)=-0.41$, $p<0.01$, between the gun laws and Part I crimes. This means that as the Brady Score increases, the number of Part I crimes decreases. It also suggests that the firearm laws could be affecting the commission of Part I crimes in a respective state.

Along the same lines, there is a fairly negative relationship, $r(48)=-0.31$, $p<0.05$, between firearms interest and the gun laws that is significant. As Brady Score for a state increases, firearm interest decreases. This could imply that states that have harsher gun laws make people less interested in purchasing firearms because of all the restrictions put in place.

While these relationships provide interesting insight, it is unwise to state that these are causal relationships. This means that one variable does not cause another one to occur. In order to determine significant predictors of firearm-related deaths, stronger statistical tests are needed.

Using hierarchical linear regression, this study is able to determine which factors can predict firearm-related death. Table 6 displays the results of these tests.

Table 6. *Hierarchical Linear Regression Model for Gun-Related Death*

| | Base Model | | Theoretical Model | |
|---|---|---|---|---|
| Variable | B | SE | B | SE |
| Juvenile | 0.12 | 0.12 | 0.032 | 0.11 |
| Male | -0.40** | 0.15 | -0.27* | 0.13 |
| White | -0.58** | 0.20 | -0.71*** | 0.17 |
| Urban | -0.59*** | 0.12 | -0.12 | 0.16 |
| Part I Crime | 0.72*** | 0.20 | 0.60** | 0.18 |
| Gun Law (Brady) | | | -0.61*** | 0.16 |
| Gun Interest (NICS) | | | 0.09 | 0.10 |

| | | | | |
|---|---|---|---|---|
| Intercept | -0.000000000095 | 0.11 | 0.00000000011 | 0.095 |
| $R^2$ | 0.47*** | | 0.62*** | |
| AIC | 123.70 | | 110.94 | |
| BIC | 137.08 | | 128.15 | |

*$p$ <.05
**$p$<.01
***$p$<.001

This model was run to determine the significant predictors of firearm death in the United States. A base model, consisting of predictors for age, race, gender, location, and crime, was run first. The second model was built by adding in the firearm laws and firearms interest predictors. The results indicated that the base model was a fair fit for the data ($R^2$=0.47, $p$ <.001), and indicated that the controls accounted for 47% of the variance in firearm deaths. This means that 53% of the variance is accounted for by outside variables that were not included in this model. Gender, race, location, and crime were all significant predictors. In addition, the base model itself was significant, $F(5,44)=7.95$, $p$<.001.

The full model added predictors for the firearm laws and firearm interest. In the theoretical model, 62% of the variance was accounted for by firearm death. The overall model was significant, $F(7,42)=9.97$, $p$<.001 , and gender, race, crime, and the Brady Score were significant predictors. The results suggest that for every point increase in the Brady Score, there is a 0.61 unit decrease in the rate of firearm-related death. Similarly, for every unit increase in Type I crimes, there is a 0.60 rate increase in firearm-related deaths. The full model was also a significant improvement over the base model with $F$ = 8.36, $p$<0.01. This means that the addition of firearm interest and gun laws created a more holistic model that more accurately predicts firearm-related death.

Diagnostics indicated that the model was a good fit for the sample data, and is likely to result in generalizable predictions. In summary, over half (56%) of the variance in firearm-related deaths can be accounted for by gender, race, crime, and Brady Score for each state.

## Chapter 5: Discussion

Between 2009 and 2010, firearm-related deaths accounted for approximately 56% of the total violence--related death (CDC, 2013). To better examine the causes for firearm-related death, firearm interest levels and firearm laws were analyzed for these two years. As previous research suggests, gun deaths can be explained when examining age, race, gender, type of location, violent crimes, firearm interest, and firearm laws. For this study, measurement of firearm interest was accomplished through an examination of the National Instant Check System (NICS) data, and gun laws were measured by examining the Brady Score for each state. This chapter includes a discussion of the overall findings of the study, limitations of the outcomes, and suggestions for future research.

### Discussion

The analysis revealed that there were significant bivariate relationships between variables that did not always translate over as significant predictors of firearm-related deaths within the multivariate models. States with more Whites do not have more gun deaths, according to the bivariate relationship. However, when other demographic factors are taken into account, race becomes a significant predictor of gun death. A similar situation occurs when examining the relationship between firearm deaths and firearm interest. The correlation test suggests that as the interest in firearms increases, the number of firearm-related deaths also increases. This relationship, however, becomes non-significant when other demographic variables are included into the relationship. This difference in causal relationship provides an important finding because it contradicts some of the previous literature on causes of gun death (Miller, Azrael, Hepburn,

Hemenway, & Lippmann, 2002; Wiebe, 2003; Boda & Szabó, 2011; Stroebe, 2013), and reveals the distinct nature of the interrelatedness of the variables. This interrelatedness also demonstrates the complexities associated with predicting death. It ultimately suggests that there is not one specific cause of firearm death, but that it takes the combination of demographic variables to be able to determine which concepts significantly contribute to death.

The analysis also revealed an inverse relationship between firearm laws and firearm-related death at the bivariate level. This relationship indicates that as a state's gun restrictions increase, the number of firearm deaths decrease, and vice versa. Unlike the previously mentioned relationships of gender and guns, the association between laws and death is significant when the demographic variables are introduced. These findings appear to support the idea that stricter gun laws lead to a decreased number of firearm deaths. However, there are limitations to this finding, particularly due to concerns about the measurement of this concept. This finding cannot be taken at face value because the Brady Score used in this study is not the most precise level of measurement of firearm laws. In addition, each score is influenced by political factors, and there are fluctuations within each star rating. For example, there are high and low 3-star states, which makes it difficult to compare within each category or across states with different star ratings.

The results also found an inverse relationship between urban locations and the number of firearm deaths. This means that the more urban a state, the fewer the gun deaths. As with the correlation between gender and death, urban location was not found to be a significant predictor of gun death even though there was a significant bivariate correlation. This finding must be carefully considered. The data here are aggregate level.

In order to provide more accurate results, a smaller unit of analysis, particularly data at the individual level, may be needed for this urban/rural measure.

**Limitations**

There are several limitations in the current study that are important to address in order to better understand the results. As previously mentioned, using the Brady Score as a measure of firearm laws in a state is not a precise measurement because it is comprised of many different components and measurements. These are not clearly defined. It provides a challenging measure because it takes into account both gun laws and programs across each of the states. In essence, it could be measuring how "gun friendly" a state is as opposed to the level of firearm involvement and access in a state. In addition, the measurement of firearm interest was also quite complex.

There is also a problem with the aggregate level data employed in this study. For example, the urban rate for each state does not accurately measure the amount of urban areas in a state. In an examination of the data concerning New York, the urban rate is artificially inflated due to the high concentration of people in New York City; however, once outside the city, many of the towns are smaller, and so the original rate is not representative of the actual urban environment. In order to reduce the amount of error, future studies should use a smaller unit of analysis. This means, instead of examining the urban or rural score for all 50 states, it would be wiser to examine the same score for different counties or cities within a state, possibly comparing across different states. This would reduce the problem of aggregate level data and provide more accurate results.

Finally, there is the issue of the complexity of predicting death. The interrelated nature of the variables shows how complicated this relationship is between all the

variables examined. Even if there is a relationship between two variables at a bivariate level, it does not mean that this correlation constitutes a predictive relationship. This project, like many previous studies, has taken this complex phenomenon and oversimplified it in order to create the most parsimonious predictive model. While this produces cleaner results, it also distorts and oversimplifies this complex theoretical issue.

**Future Research**

The recommendations for future research center around improving upon the limitations discussed above, such as measurement, sample, and type of data. Future research projects should attempt to use individual level data to produce more accurate results. This may mean that future researchers need to create their own measurement of urban locations and/or firearm interest.

Future research could also choose to examine a different sample of locations. Instead of examining across the 50 states, researchers could examine gun trends across jurisdictions within one specific state. Researchers could also compare cities with similar population densities across different states or regions. By doing this, the issue of measurement could also be reduced. More individual level data would lead to a better measurement of each of the variables, and thus create more accurate results.

In addition, future researchers could examine the demographic variables in more depth, or for different years or longer time periods. This would allow scholars to determine if firearm interest and gun laws were equally predictive across time or if it is a new phenomenon.

**Policy Implications**

This study revealed important policy implications that should be considered in the future. These results provided information on identifying the people who are most likely to commit crime: White males in high crime areas. While this information is not intended to be used to state that all White males are more likely to be victims of gun related crime, it does provide law enforcement agencies with more information to help identify and prevent the number of deaths from increasing. Along the same lines, it also identifies states that are more likely to have gun deaths than others. By identifying these states more at risk, law enforcement can request extra funds in order to combat this issue.

The results also reinforce the importance of background checks, especially for the higher risk states. If the information identifying the people most likely to commit crime was provided to FFLs, they would be able to examine firearm applications more closely. Along these same lines is the idea about revocation of firearms. This does not imply that FFLs or gun shop owners should automatically deny firearms to these higher risk individuals, but they would be more aware of the risk factors associated with providing these individuals with firearms.

**Conclusion**

This study highlights the significant predictors of firearm-related death: race, gender, crime level, and firearm laws. This suggests that firearm laws, and not firearm interest, are predictors of gun death. In spite of the commonly held belief that minority criminals have the biggest impact on firearm-related death across the United States, this research project revealed that the individuals with the highest risk of being involved in firearm-related incidences were White males in high crime urban environments. With

this base knowledge, policymakers are able to identify locations and groups of people who are at higher risk, and create the appropriate policies to combat these problems. More research is needed within this field, but as it stands, the current study examines the impact of firearm interest and laws on the number of gun deaths across the United States, and identifies significant predictors.

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