

The Epidemiology of Firearm Injuries in Denver, Colorado

August 29, 2017

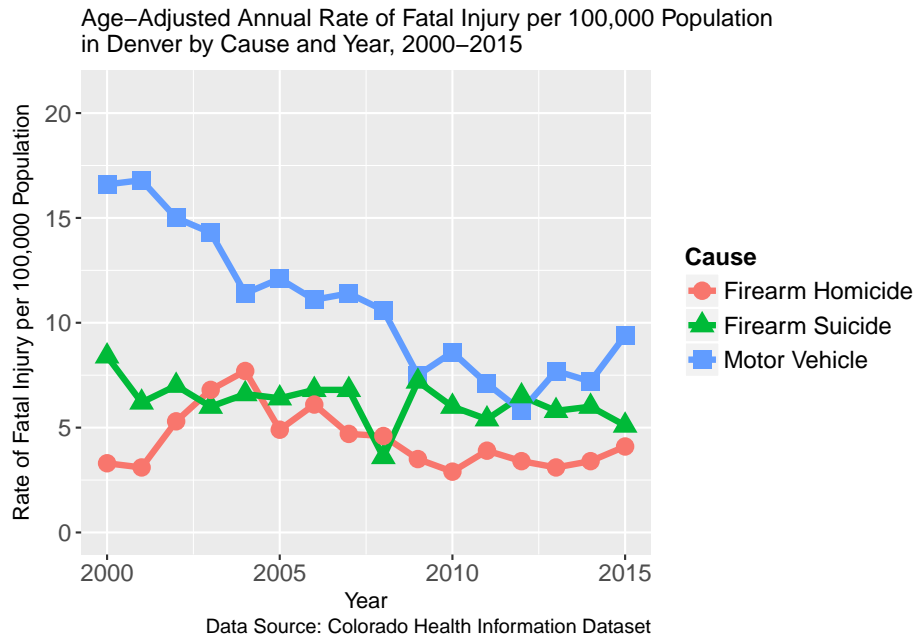
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Executive Summary

Unlike other types of fatal injuries, the rates of firearm homicides and firearm suicides in Denver have remained relatively stable during the initial 15 years of the 21st century. The figure below compares the rates of firearm homicides and firearm suicides to the rate of fatal motor vehicle crash injuries from 2000 through 2015.



The rate of motor vehicle crash deaths has decreased - on average - since 2000, even after dramatic improvements in road safety during the second half of the 20th century. Efforts to improve road safety have been systematic, ongoing and coordinated across sectors of the economy. Many public health professionals view the demonstrated success of motor vehicle safety efforts as a model of how firearm injuries might be prevented. After all, a public health approach effectively reduced motor vehicle injuries and deaths without limiting Americans' access to cars, as evidenced by the 11-fold increase in motor vehicles between 1925 and 1997.

The following initiatives from across the U.S. provide diverse examples of how a public health approach to preventing gun violence might work:

- The Colorado Firearm Safety Coalition is a partnership of gun shop owners, firearm trainers and public health researchers working together on firearm safety. Much of the Coalition's work focuses on suicide prevention. The group promotes awareness of and utilization of mental health services. Also, borrowing materials from a similar program in New Hampshire, the group provides tips to firearm retailers and firing range owners who are well-positioned to identify potentially suicidal individuals.
- LOK-IT-UP, based in Washington state's King County, is a public health campaign promoting the use of safe storage devices, such as gun safes and lock boxes. Retailers who offer discounted safe storage devices are recognized on the Public Health - Seattle & King County website. Law enforcement agencies and public health officials raise

awareness about safe storage devices through targeted communications. The campaign addresses both suicide prevention and crime prevention. Safe storage devices may reduce the likelihood a gun will be stolen and used in a crime, as well.

- Cure Violence is an evidence-based program that applies infectious disease control strategies to interrupting the spread of violence throughout communities. Specially-trained violence interrupters and outreach workers identify and mediate potentially lethal conflicts before they occur. Outreach workers assist individuals at a high risk of engaging in violence with access to social services, job training and other risk-reducing interventions. Workers also partner with local business owners and other community leaders to change norms around violence, reinforcing the idea that violence is a preventable health issue. A.I.M. (which stands for At-risk Intervention and Monitoring) - a program based in the Denver Health Emergency Medicine Department - follows a similar approach, intervening with victims of violence to reduce recidivism to the ED.

Strong partnerships across sectors underpin all of these initiatives. They involve stakeholders in the private sector, as well as the public sector. Both the Cure Violence model and the King County program connect public health agencies and public safety agencies, which are increasingly working together on various issues.

All programs are also grounded in epidemiology, the science of public health. A public health approach to injury prevention begins by gathering and analyzing data on the health of the population. This report, summarizing the burden of firearm injuries in Denver, is one step to help develop an evidence base that policymakers and community groups can use to guide action and evaluate campaigns like those described above.

Key Findings

- There were **326 deaths** due to firearm injuries in Denver from January 1st, 2011 through December 31st, 2015. Among the deceased were men and women, individuals in every age group and people of different races and ethnicities. Our data show that patterns are different for homicides and suicides, but firearm injuries can affect us all.
- The **rate of firearm-related deaths was stable** from 2011-2015.
- The **rate of non-fatal firearm injuries has increased since 2015**. Because it takes time to compile all of the data on deaths, it is unclear whether the rate of firearm-related deaths has increased, as well.
- There are **more firearm-related deaths due to suicide** than any other category of firearm-related death, including homicide.
- **Men are more likely to be injured by firearm than women**. Approximately 84% of firearm homicide victims and 91% of firearm suicide victims were male.
- **Firearm injuries are much more likely to result in death, compared to other injuries**. Of 575 trauma cases in which a paramedic found the patient dead at the scene, 40% were injured by firearm even though firearm injuries accounted for less than 1% of all trauma-related paramedic responses.
- The **patterns of suicide and homicide are very different from one another**.

- The rate of firearm homicide was highest among adolescents and young adults, whereas the rate of firearm suicide was highest among older adults.
- The rate of firearm homicide deaths was significantly higher among African Americans than whites, whereas the rate of firearm suicide deaths was not statistically different between whites and African Americans.
- The rate of firearm homicides was higher in high-poverty neighborhoods, whereas the rate of firearm suicides was not correlated with poverty.
- From data collected several years ago, Denver has a relatively low rate of firearm-related homicides compared to other U.S. cities, but a relatively high rate of firearm-related suicides.

Background

Purpose

The ultimate goal of this report is to inform injury prevention strategies with local data. Tracking the number of health events in a community and looking for patterns is the first step to taking a public health approach to any health or social problem. Various stakeholders in Denver, including community groups, government agencies and others can use these data to better understand how frequently people are being injured by firearms, who is at elevated risk, and what might be done to reduce death and disability associated with firearms.

Firearm Injuries as a Public Health Issue

Injuries are a leading cause of death and disability in the U.S. and globally. During 2015 suicide was the second leading cause of death for individuals 15-24 years of age (5,491 deaths) and 25-34 years of age (6,947 deaths), as well as the third leading cause of death for individuals 10-14 years of age (409 deaths).

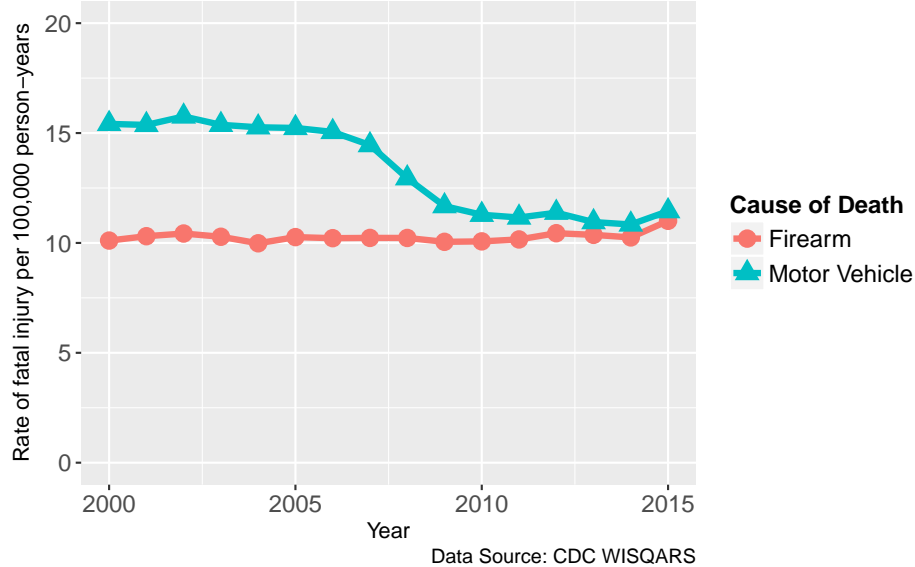
Suicide was among the top 10 leading causes of death for all age groups over 10 years of age. During the same year, homicide was among the top five causes of death for all age groups between 1 and 44 years of age.

Nearly 200,000 people die from injuries and violence in the U.S. each year. Suicide and homicide account for approximately 21% and 8% of these deaths, respectively. Approximately 17% of injury deaths are attributed to firearms. Leading causes of injury deaths by age group in the U.S. during 2015 are pictured on the following link: <https://www.cdc.gov/injury/wisqars/LeadingCauses.html>.

It is important to note that these rankings can change over time. The U.S. has seen substantial changes over the years - for better and for worse - in the frequency of injury deaths. For example, the Centers for Disease Control and Prevention (CDC) considers improved motor vehicle safety to be one of the top 10 greatest public health achievements of the 20th century. While still a leading cause of injury death, the annual motor vehicle death rate declined by 90% from 1925 to 1997 in spite of a 10-fold increase in the number of miles traveled and an eleven-fold increase in the number of motor vehicles. On the other hand, as has been widely reported in the popular press, the U.S. is currently experiencing an epidemic of opioid-related overdose deaths. The rate has increased quite dramatically in a relatively short period of time. Poisoning deaths now outnumber deaths due to motor vehicle crashes.

The figure below compares the age-adjusted rates (per 100,000 person-years) of select causes of fatal injuries during the first 15 years of the 21st century.

Age-Adjusted Rate of Fatal Injury per 100,000 Person-Years in U.S.
by Cause and Year, 2000–2015



These data show how the rate of motor vehicle crash deaths has continued to decrease, even after the much larger reductions during the 20th century. The rate of firearm-related death has increased slightly from approximately 10.1 deaths per 100,000 person-years in 2000 to 11.0 deaths per 100,000 in 2015.

It is natural to look at figures such as these and speculate about the possible reasons why the rate of fatal injury might go up or down. Uncovering the true drivers of fatal injury rates is of primary interest to epidemiologists, such as those employed at the CDC as well as state and local health departments. The CDC credits the steady drop in traffic deaths to systematic motor vehicle safety efforts that began in the 1960s, including changes in driver behaviors (e.g. more safety belt users, fewer intoxicated drivers, etc.) as well as regulations that established safety standards for motor vehicles and highways (e.g. the installation of safety belts and drunk driving laws). Renewed interest in preventing transportation-related deaths, exemplified by Vision Zero initiatives adopted by numerous U.S. cities, including Denver, may lead to even greater reductions in the rate of motor vehicle deaths in the coming years.

Public health approaches to reduce the occurrence of fatal firearm injuries have clearly been less successful, as evidenced by the relatively flat rate between 2000 and 2015. Strategies to intervene to prevent firearm injuries are rarely proposed or researched, primarily due to political challenges.

While firearm injuries are a leading contributor to the nation's overall injury burden, there is considerable geographic variation in the occurrence of firearm injuries. The Colorado Department of Public Health and Environment has produced descriptive epidemiology reports on violent deaths in the state and in particular health statistics regions. This is, to our knowledge, the first report describing the epidemiology of firearm injuries - including data on non-fatal as well as fatal injuries - in the City & County of Denver, Colorado. Analyzing data specific to a metropolitan area might reveal differences between Denver and

the country as a whole. Therefore, one of the purposes of this report is to provide accurate and timely data to underpin local efforts working to decrease firearm-related injuries.

Understanding the Data

Information provided in this report describes injuries experienced by Denver residents. Population characteristics, including health, disease and deaths are described by location or demographic group whenever possible to paint a portrait of Denver's health that accounts for the city's diverse population.

Figures (i.e., charts, graphs and maps) used throughout the report present an indicator in the form of counts, percentages or rates. Each indicator provides a different perspective, presented in a way that allows for comparison against other local or national data.

In some instances rates are used to demonstrate change over time. For example, rates are used to describe the number of events (such as disease, death or other conditions) per a standard number of residents (usually per 100,000 people) annually. These methods allow for comparison of different sized and diverse communities. Since injury and death vary depending on age of the residents, some rates are adjusted to account for differences in age distribution in specific groups. Any age-adjusted rates presented in this report account for this difference in age distribution.

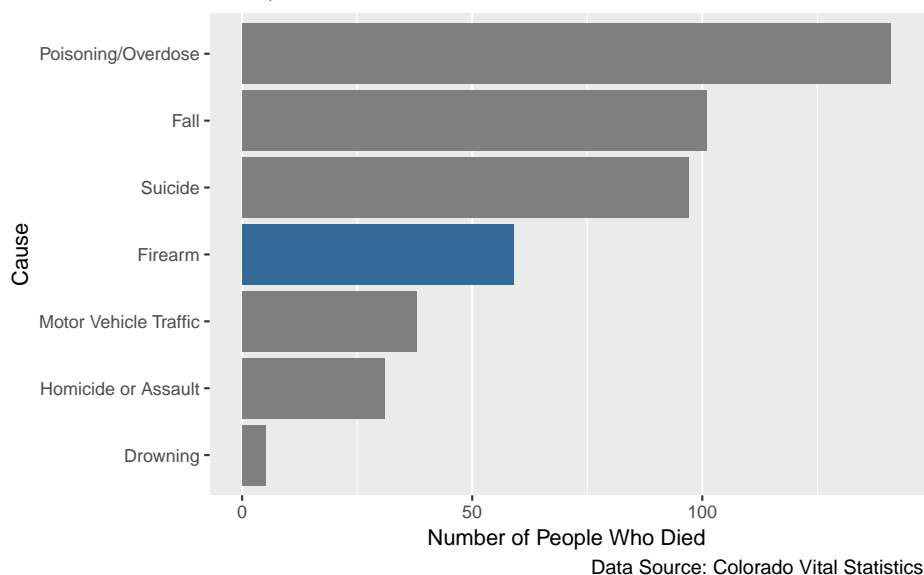
Fatal Firearm Injuries in Denver, Colorado

The following section compares the total numbers and rates of fatal firearm injuries in Denver by a number of factors, including the circumstances of the death and the firearm type as well as the victim's sex, age group, race, ethnicity, and census tract poverty. After this section, firearm homicides and firearm suicides are analyzed separately.

Number of Injury Deaths in Denver, 2014 (Vital Statistics)

The following figure presents the leading causes of injury deaths captured by the Denver Vital Records during 2014, using standard case definitions provided by the Council for State and Territorial Epidemiologists. Injury types with fewer than five total injury deaths were excluded. Also, these categories are not mutually exclusive. A self-inflicted fatal gunshot wound, for example, would be captured under both "Firearm" and "Suicide".

Leading Causes of Injury Deaths in Denver City & County:
2014; Counts >5



The leading cause of injury death in Denver during 2014 was poisoning (n=141), which includes drug overdoses. The U.S. is currently experiencing an epidemic of drug overdoses related to opioids, including overdoses from prescription narcotics as well as illicit drugs such as heroin. Falls were the second leading cause of injury death in Denver during 2014 (n=101). Nationally, falls are the leading cause of injury death among adults 65 years and older. Suicide was the third leading cause of death in Denver (n=97), followed by firearm deaths (n=59). There is overlap between these two categories, as well as with the sixth leading cause of injury death - Homicide/Assault (n=31). Some, but not all, suicides and homicides are caused by firearms. Conversely, some but not all firearm deaths are homicides and suicides. Motor vehicle crashes were the fifth leading cause of injury death in Denver during 2014 (n=38). Five individuals died by drowning during that year.

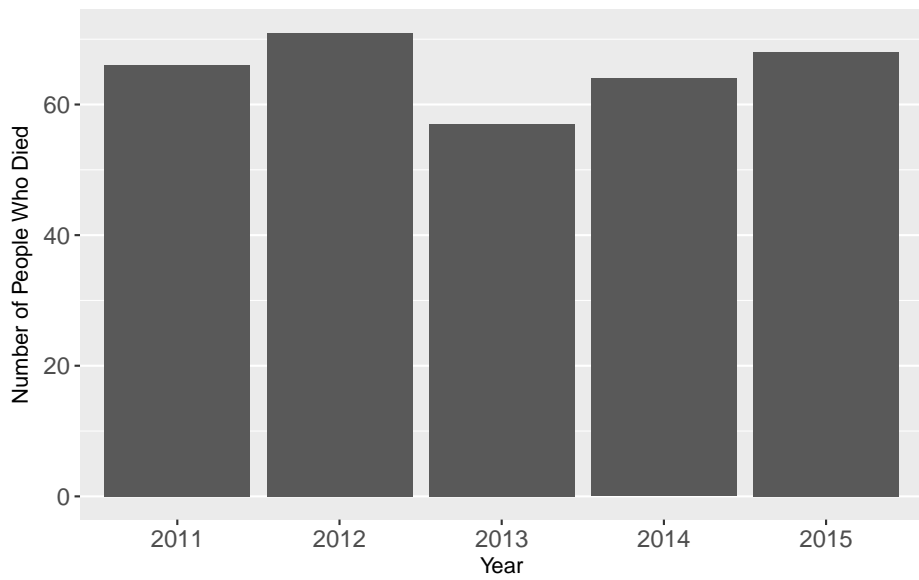
Firearm Injury Deaths in Denver, 2011-2015 (COVDRS)

The following section includes five years of data from the Colorado Violent Death Reporting System (COVDRS). COVDRS captures data on all violent deaths in Colorado and is described in more detail in a separate section of this report (see “Data Sources”). The data in this section pertain to Denver residents who died by firearm. Certain statistics might be different for individuals who died in the City and County of Denver, but who were residents of other jurisdictions. Five years of data were included in the report both to present some trends over time, as well as to increase the ability to make meaningful comparisons.

Fatal Firearm Injuries By Year

The COVDRS reported a total of 326 firearm deaths among Denver residents between 2011 and 2015.

Number of Fatal Firearm Deaths among Denver Residents by Year: 2011–2015

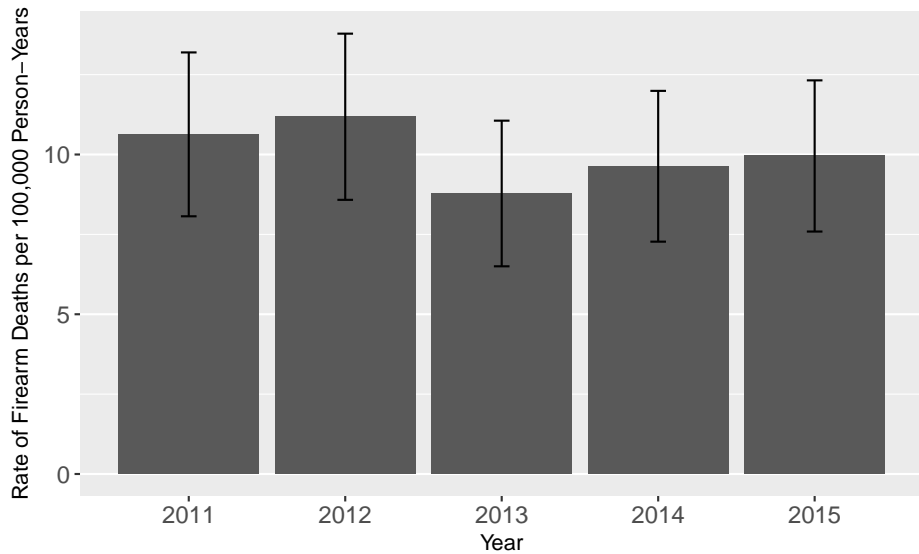


Data Source: COVDRS

During these years, the number of firearm-related deaths among Denver residents ranged from 57 in 2013 to 71 in 2012.

The total population of Denver has grown in recent years. In order to assess whether firearm deaths have become more or less common over time, accounting for the population at risk, we provide the one-year incidence of firearm injury deaths per 100,000 person-years in the figure below. These rates are estimated using population data from the Colorado Department of Local Affairs.

Rate of Firearm Deaths among Denver Residents by Year, 1/1/2011–12/31/2015



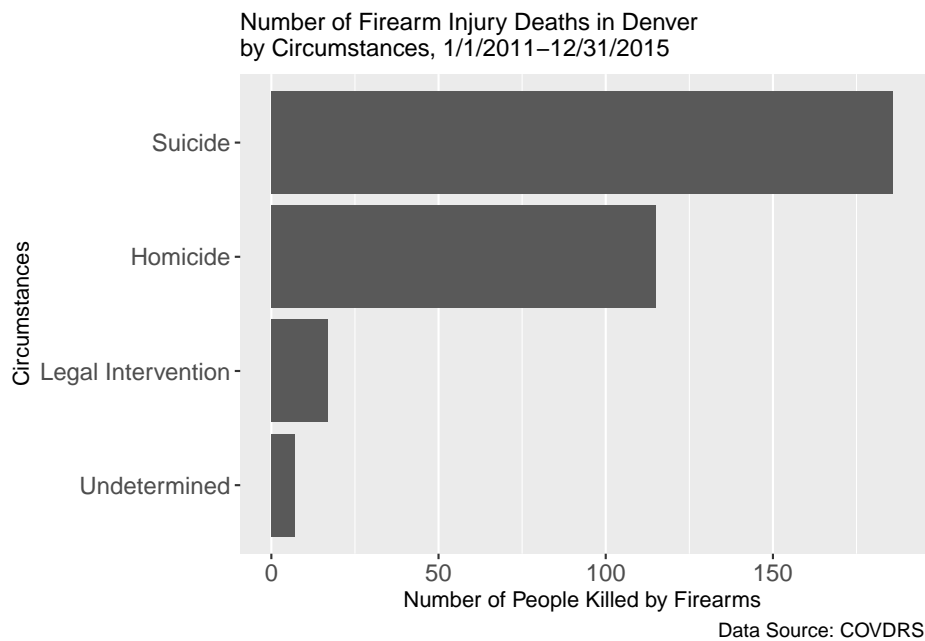
Data Source: COVDRS

Accounting for the at-risk population, there is no evidence of an upward or downward trend in the rate of firearm-related deaths among Denver residents from 2011-2015 ($p=0.46$).

During this period, the highest rate was in 2012 (11.2 per 100,000 person-years, 95% CI: 8.6, 13.8).

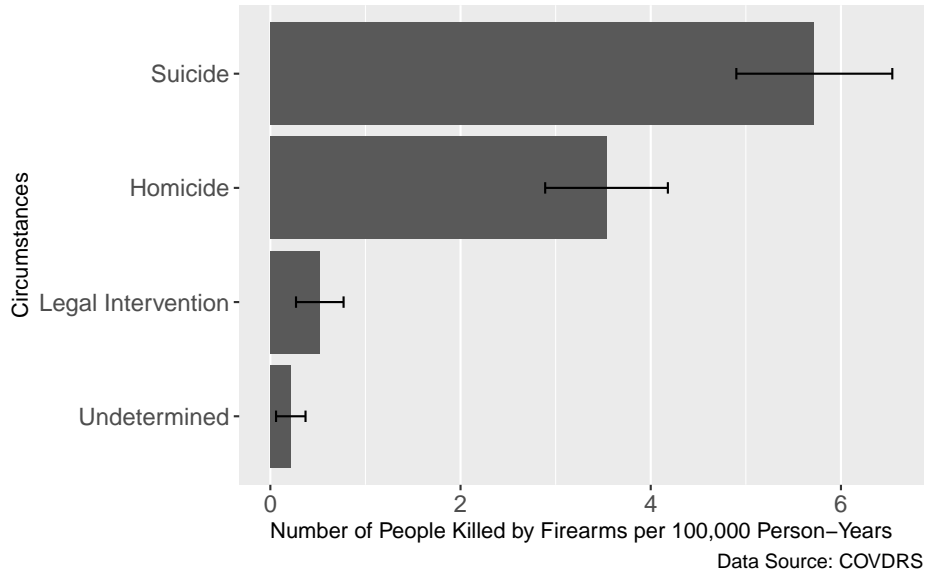
Fatal Firearm Injuries By Circumstances

In COVDRS, deaths caused by firearms are grouped into the following categories: homicide, suicide, deaths from legal intervention (a subtype of homicide where the victim is killed by or died as a result of law enforcement acting in the line of duty), deaths of undetermined intent, and unintentional firearm fatalities. Suicides and homicides account for the largest numbers of firearm deaths and are summarized in greater detail in separate sections. The following figures compare the total deaths by circumstances.

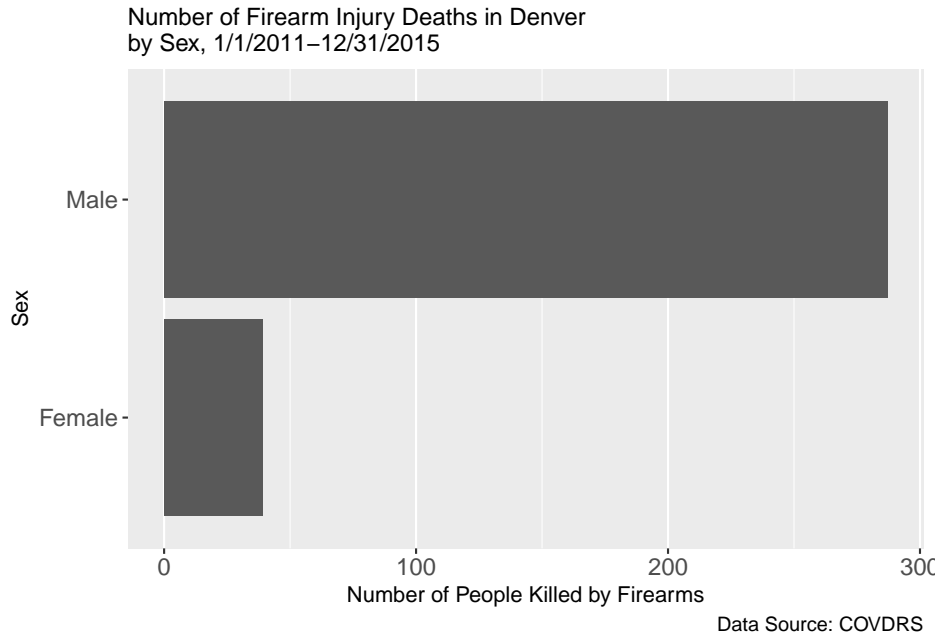


There were 326 deaths due to firearm injuries in Denver from 2011-2015. There were more firearm-related suicides (N=186, 57.1%) than firearm-related homicides (N=115, 35.3%), firearm deaths resulting from legal intervention (N=17, 5.2%) and firearm deaths with undetermined circumstances (N=7, 2.1%). There were between 0 and 2 unintentional firearm injury deaths during that time period. The exact number is not provided in order to protect victims' anonymity.

Unadjusted Average Annual Rate of Firearm Injury Deaths in Denver, by Circumstances, 1/1/2011–12/31/2015

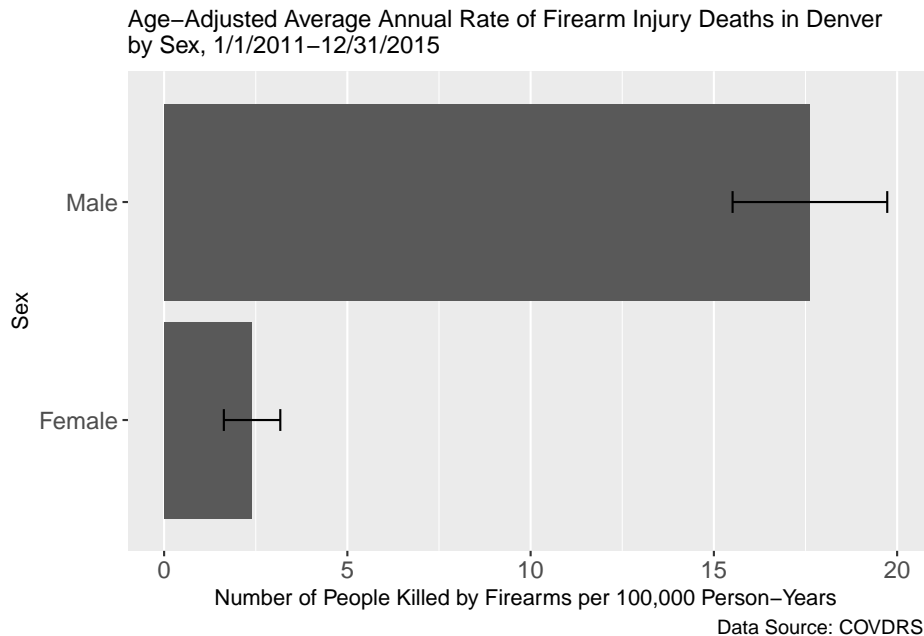


Fatal Firearm Injuries By Sex

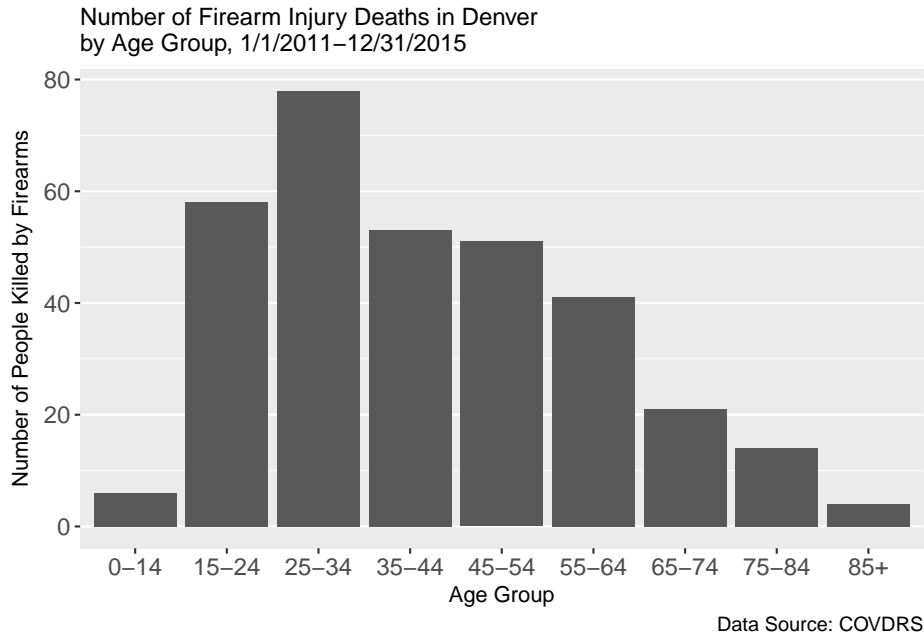


There were 326 deaths due to firearm injuries in Denver from 2011-2015. The majority of the victims (N=287, 88%) were men.

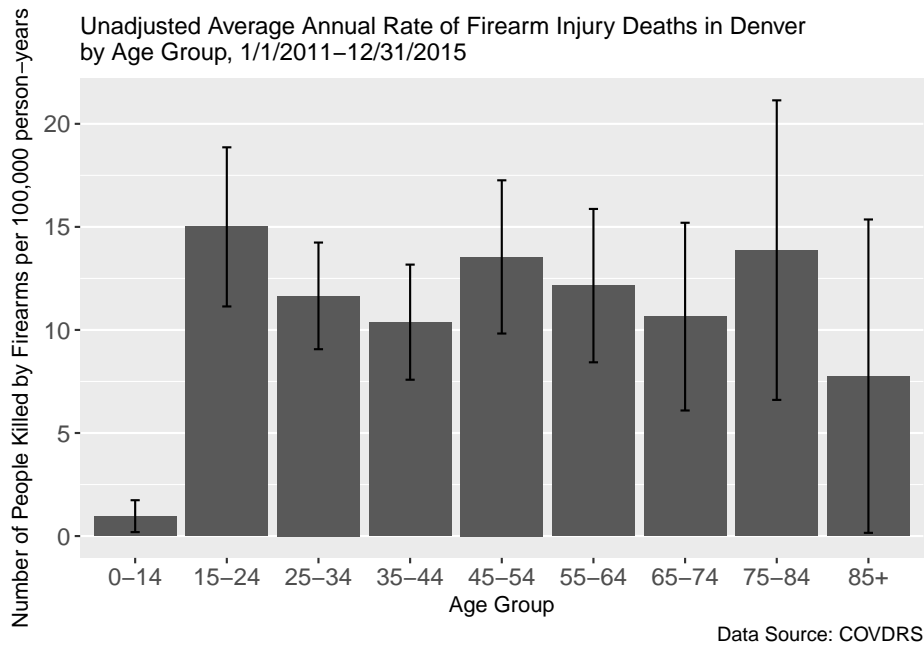
The rates of firearm death were also higher in men: 17.6 firearm deaths per 100,000 person-years in men (95% CI: 15.6, 19.7) compared to 2.4 firearm deaths per 100,000 person-years in women (95% CI: 1.6, 3.2). The rate of fatal firearm injuries was approximately 7.4 times higher among males than females (95% CI: 5.3, 10.3, $p < 0.0001$). Adjusting for age changed neither the estimates nor the confidence intervals.



Fatal Firearm Injuries By Age Group



The 25-34 year age group had the greatest number of firearm deaths (N=78), followed by the 15-24 year age group (N=58). The number of firearm deaths decreases with each subsequent age group above 34 years of age. Due to the underlying age distribution of the population, it is important to calculate age-group specific rates for firearm injury deaths.

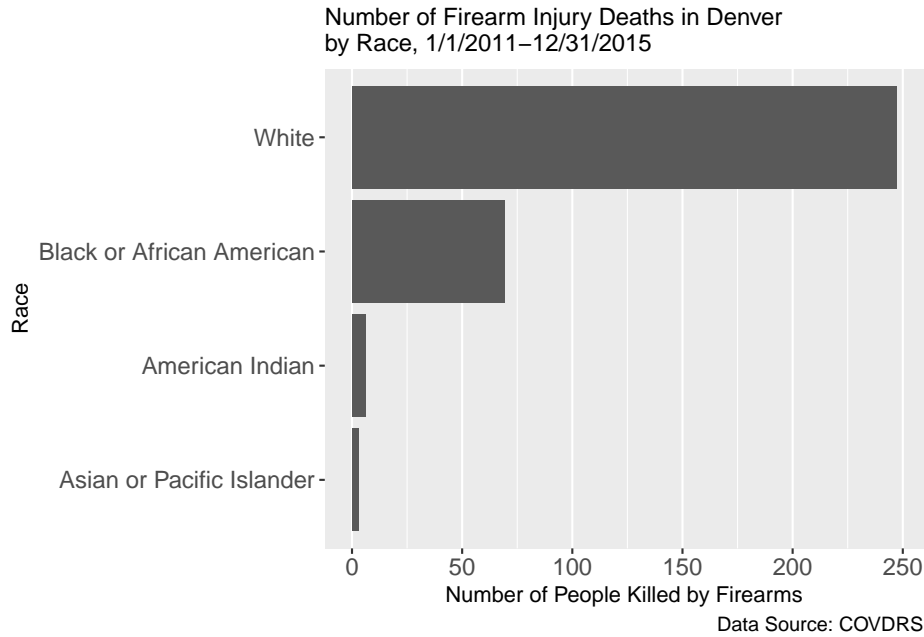


The confidence intervals are wide for each age-group-specific rate. This is due to two primary reasons. First, the number of deaths varies from year to year. Second, there is uncertainty in the total population estimate. Importantly, as the size of a given demographic group

decreases, the precision of the estimate decreases.

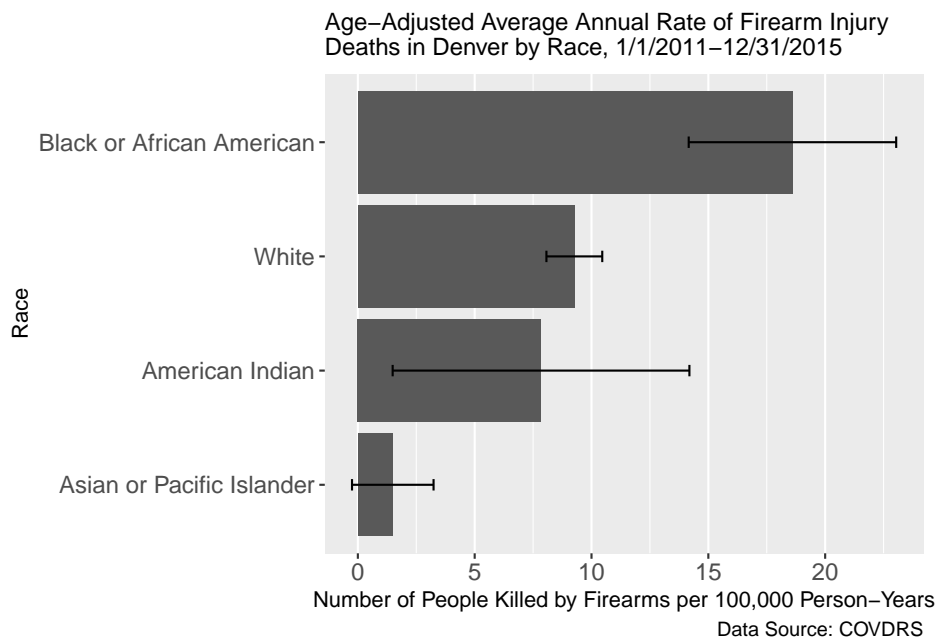
The highest age-group-specific rate is among people 15-24 years of age: 15 firearm deaths per 100,000 person-years (95% CI: 11.1, 18.9). Due to the wide confidence intervals it is difficult to say whether individuals 15-24 are consistently at an increased risk compared to other age groups.

Fatal Firearm Injuries By Race



The majority of firearm injury deaths in Denver from 2011-2015, when categorized by race, were experienced by white people (N=247, 75.8%), followed by individuals who were black or African American (N=69, 21.2%), American Indian (N=6, 1.8%) and Asian or Pacific Islander (N=3, 0.9%). There are more white people living in Denver than any other group, so it is important to adjust for the population size in each racial subgroup.

The rates of fatal firearm injuries show different patterns than the counts.

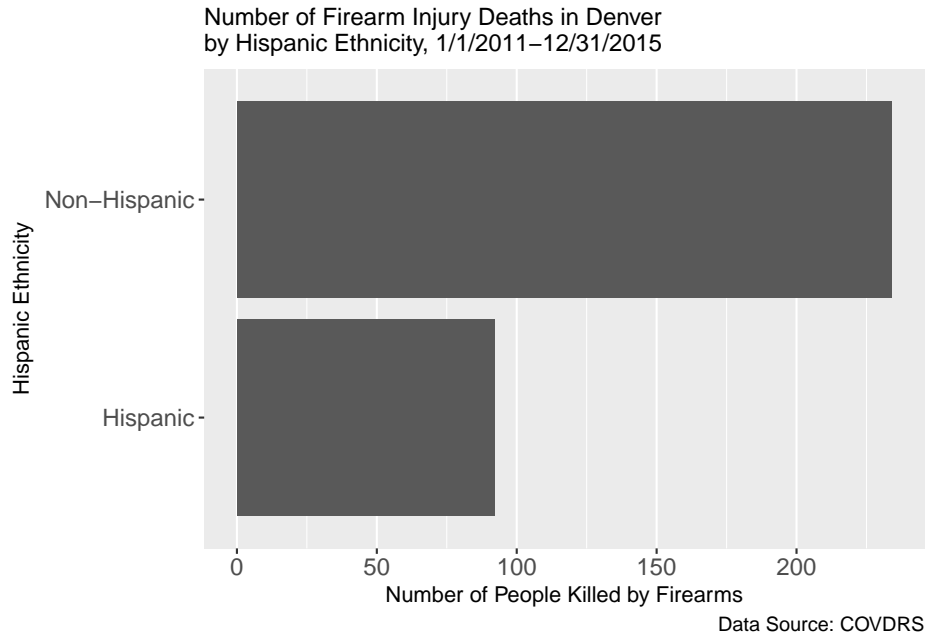


After accounting for the population size and age distribution of each racial subgroup, black and African-American individuals have the highest rate of fatal firearm injuries in Denver (18.6 per 100,000 person-years, 95% CI: 14.1, 23.0). If whites in Denver experienced the same rate of firearm-related fatalities, there would have been an additional 249 firearm deaths in Denver during this time period.

The rate of fatal firearm injury is approximately 2 times higher among black and African American individuals than among whites (95% CI: 1.6, 2.7, $p < 0.0001$).

Our inability to precisely estimate the population of American Indians limits our ability to compare the risk relative to other groups.

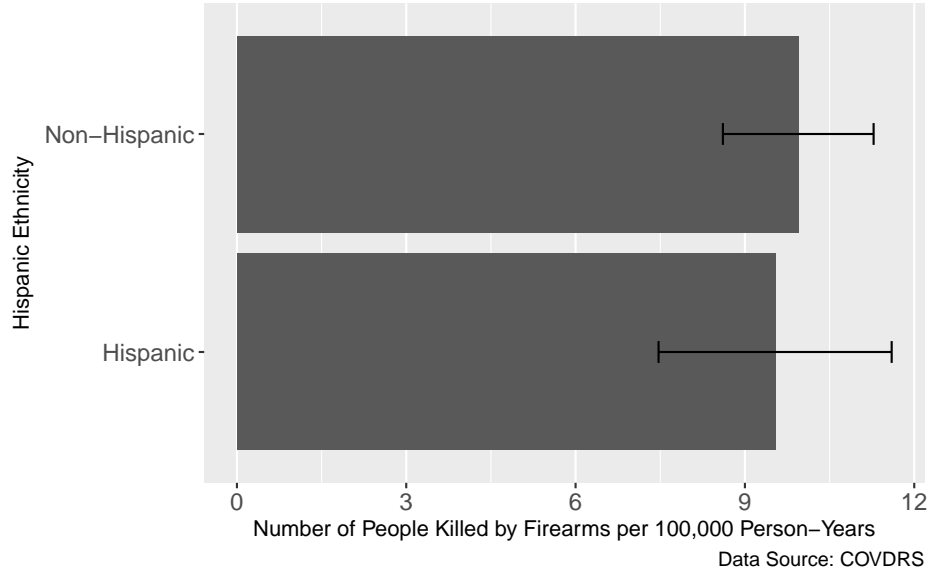
Fatal Firearm Injuries By Ethnicity



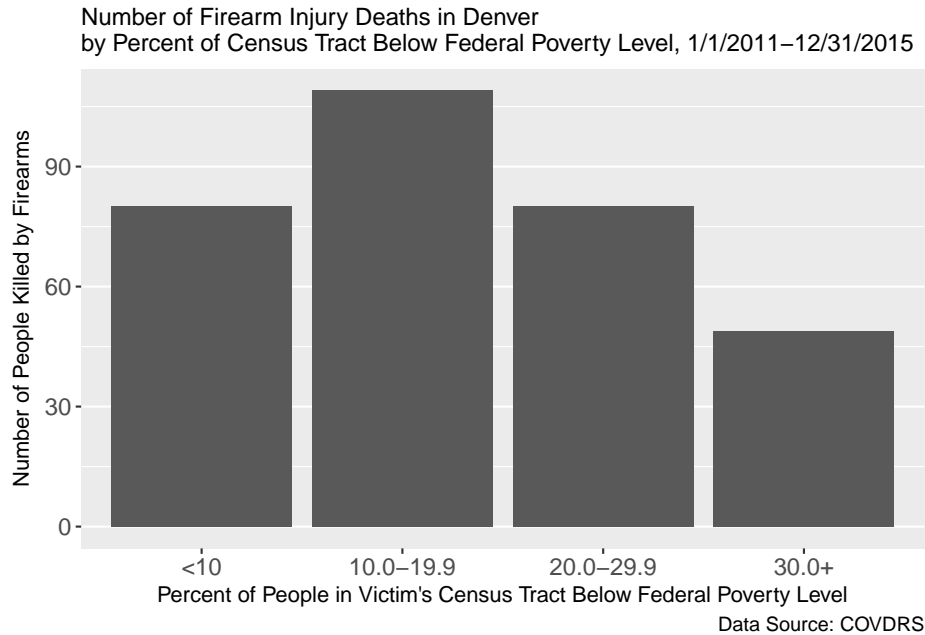
The majority of firearm injury deaths in Denver from 2011-2015, when categorized by Hispanic ethnicity, were experienced by non-Hispanic people (N=234, 71.8%). There are more non-Hispanic people living in Denver than there are Hispanic people, though, so it is important to adjust for the population size in each ethnic subgroup.

After accounting for the population size of each ethnic group, there was no evidence that the rate of fatal firearm injury was different between Hispanic and non-Hispanic individuals (Crude OR=0.9, 95% CI: 0.7, 1.1, p=0.29). Making additional adjustments for the age distribution of the population reduced the difference between the incidence estimates even further (Age-Adjusted Rate among non-Hispanic individuals: 9.95 per 100,000 person-years, 95% CI: 8.6, 11.3; Age-adjusted rate among Hispanic individuals: 9.54 per 100,000 person-years, 95% CI: 7.5, 11.6).

Age-Adjusted Average Annual Rate of Firearm Injury Deaths in Denver by Hispanic Ethnicity, 1/1/2011-12/31/2015

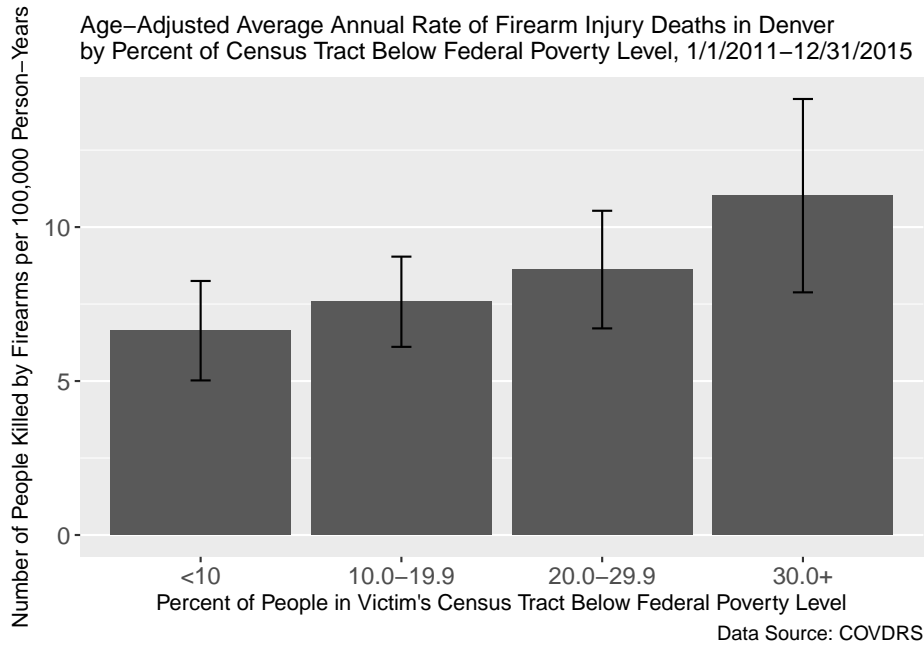


Fatal Firearm Injuries By Census Tract Poverty



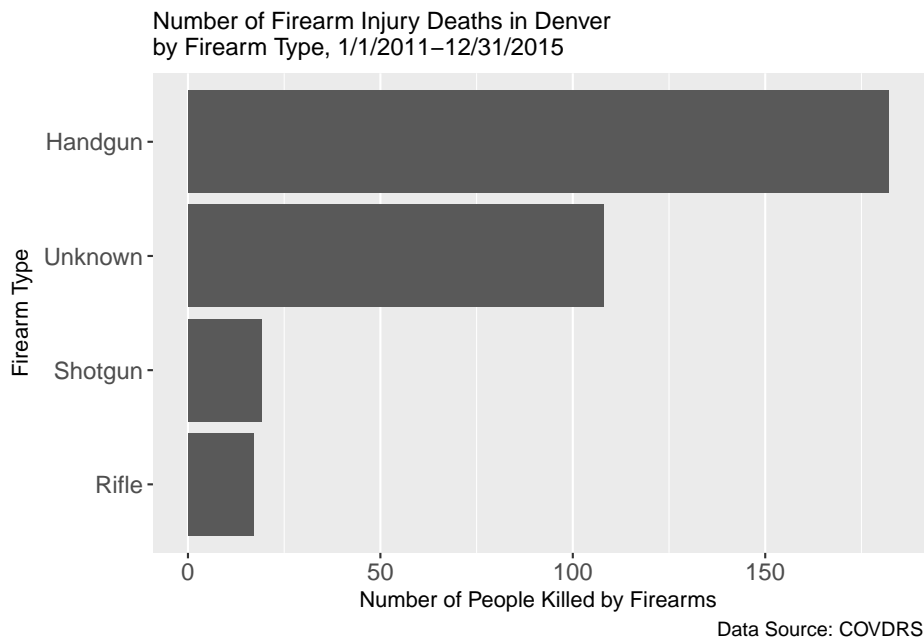
In order to assess the relationship between firearm injury deaths and poverty in Denver, we categorized the number of individuals who died by firearms according to the percent of people in their census tract who were living in poverty. The greatest number of deaths were experienced by individuals living in census tracts with 10-19.9% of people living in poverty (N=109).

As poverty increases in a census tract, the rate of fatal firearm injury tends to increase, as well. The rate estimates increase from a rate of 8.06 per 100,000 person-years in the wealthiest census tracts (95% CI: 6.3, 9.8) to 12.3 per 100,000 person-years among the poorest census tracts (95% CI: 8.8, 15.7). The rate of fatal firearm injury was approximately 1.5 times higher among residents of highest poverty census tracts compared to individuals residing in the lowest poverty census tracts (95% CI: 1.1, 2.2, $p=0.011$).



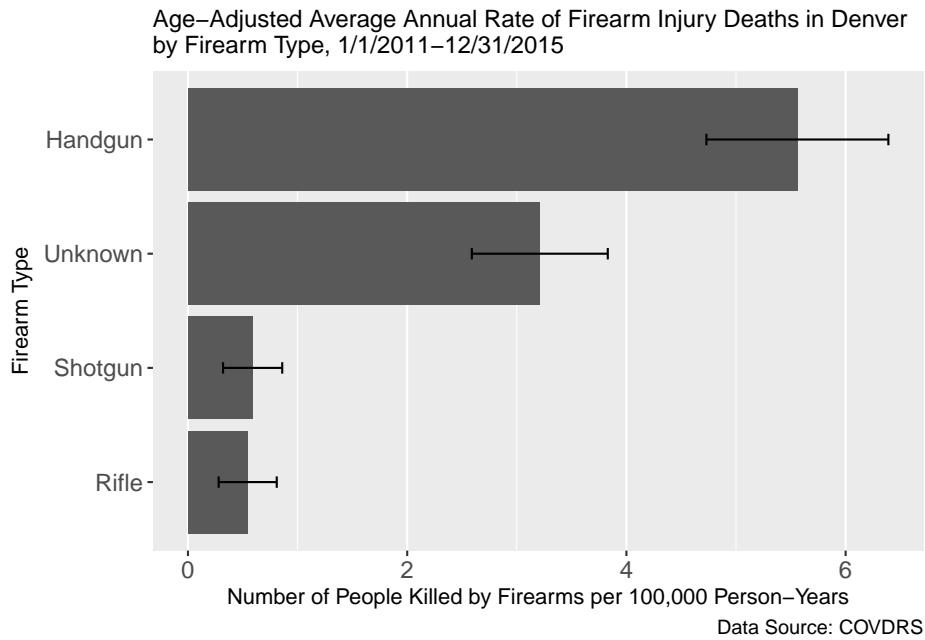
The crude rates exhibit a statistically significant trend ($p=0.015$). The age-adjusted rates exhibit consistent increases with increasing poverty, as well, from 6.6 (95% CI: 5.0, 8.3) to 11.0 per 100,000 person-years (95% CI: 7.9, 14.2).

Fatal Firearm Injuries By Firearm Type



The majority of firearm deaths in Denver were associated with handguns ($n \geq 182$, $\geq 55.8\%$). It is important to note that the type of firearm may be difficult to ascertain either because the weapon is never recovered or information about the weapon is not shared

with COVDRS for reasons related to litigation. For this reason, the type of firearm is listed as “unknown” in 108 firearm-related deaths. The type of firearm is more likely to be “unknown” in homicide cases than suicide cases (69.6% vs. 8.6%, respectively).



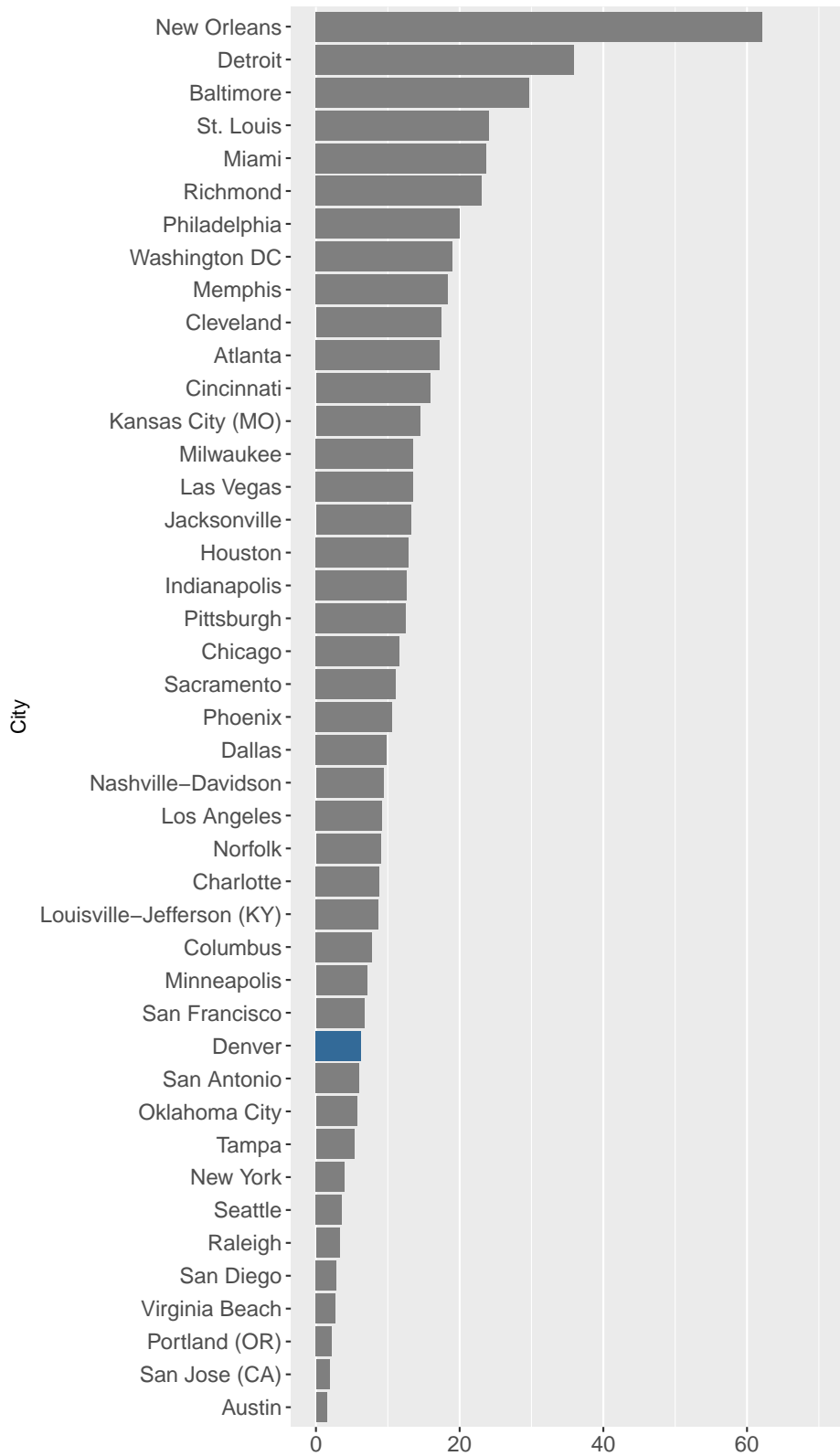
Adjusting for age does not substantially alter the crude incidence rates of fatal firearm injury by firearm type. Thus, the firearm-specific incidence rates reflect the number of deaths by each type of firearm. The highest age-adjusted rate is among handgun-related deaths (5.6 per 100,000 person-years, 95% CI: 4.7, 6.4).

Firearm Homicides

Firearm Homicide Rates in Denver and Select U.S.Cities, 2006-2007

In 2011, the Centers for Disease Control and Prevention published a comparison of firearm deaths among residents of metropolitan areas and cities in the US, using vital statistics data collected between 2006 and 2007. The authors tabulated firearm and suicide counts for the 50 largest Metropolitan Statistical Areas and for 62 cities within those MSAs. The figure below presents age-adjusted rates of firearm homicides for Denver and other cities from that report that contributed data.

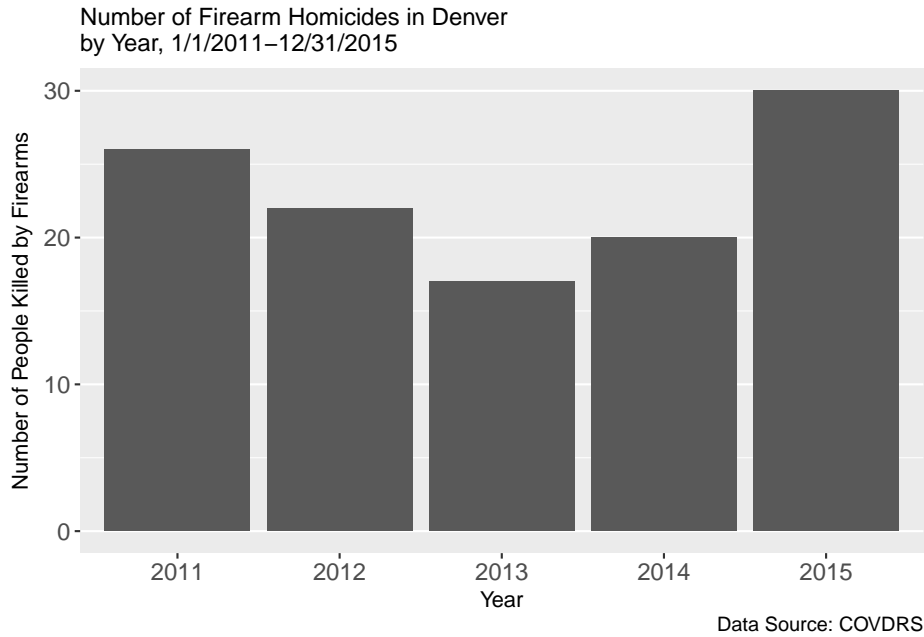
Firearm Homicide Rate per 100,000 Population
in Select U.S.Cities, 2006–2007



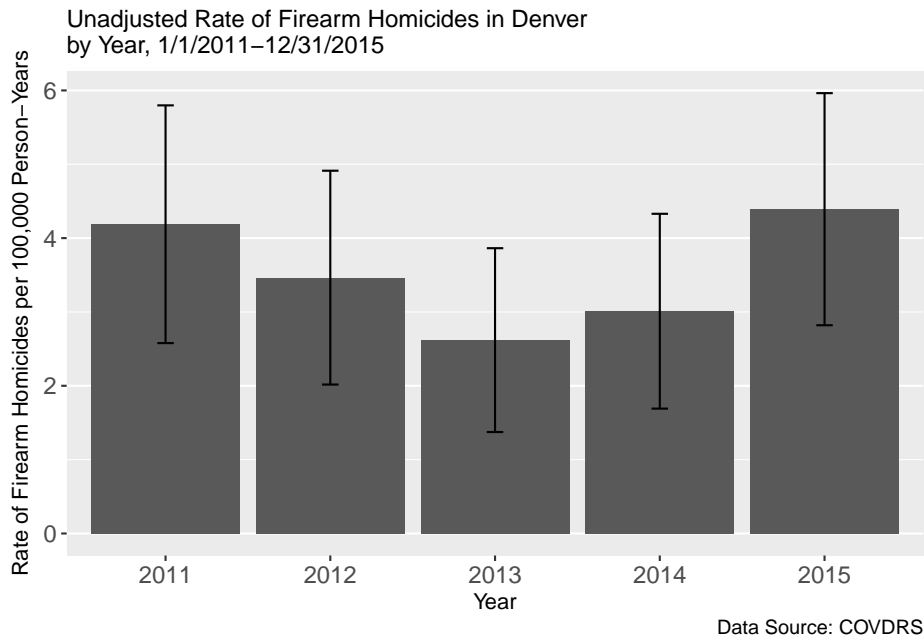
Homicide Rate per 100,000 Population
Data Source: MMWR May 13, 2011 / 60(18); 573–578

Of the cities contributing data to the figure above, Denver ranked 32nd, with a firearm homicide rate of 6.3 per 100,000 people. New Orleans had the highest rate of firearm homicide (62.1 per 100,000).

Firearm Homicides By Year

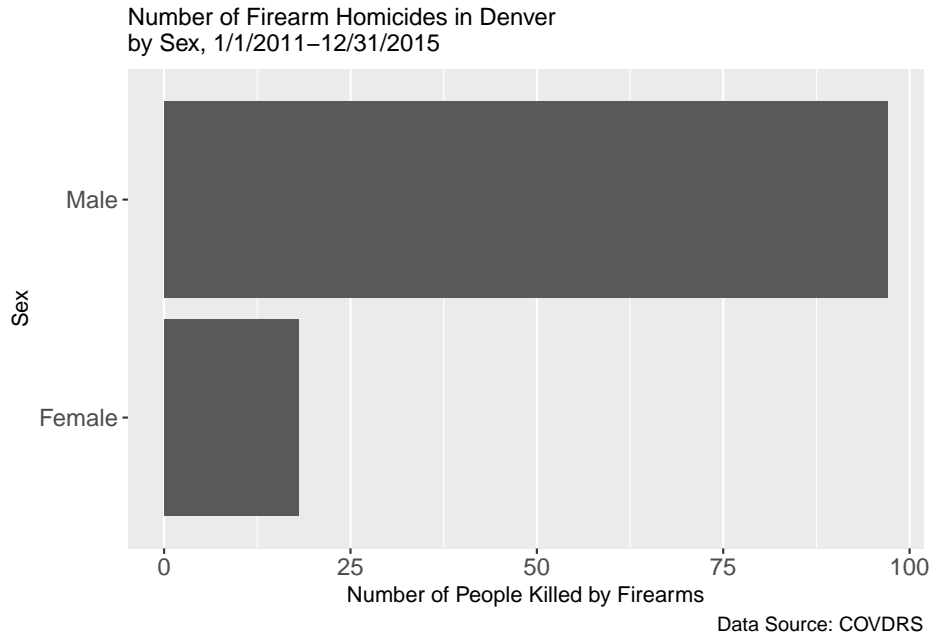


During the time period under study, the number of firearm homicides in Denver was highest in 2015 (n=30) and second-highest in 2011 (n=26).

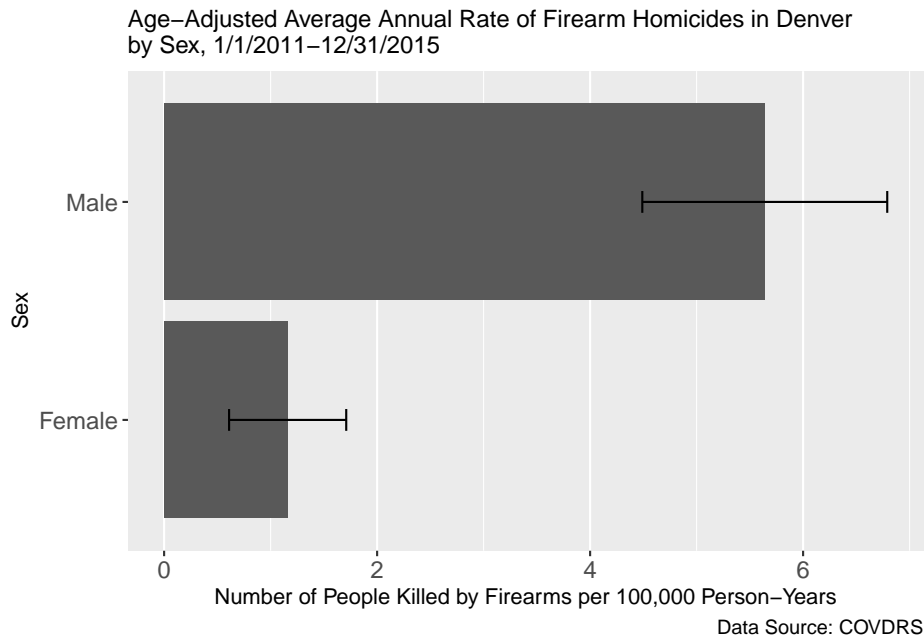


The rate of firearm homicide in Denver ranged from 2.6 per 100,000 person-years in 2013 (95% CI: 1.4, 3.9) to 4.4 per 100,000 in 2015 (95% CI: 2.8, 6.0).

Firearm Homicides By Sex

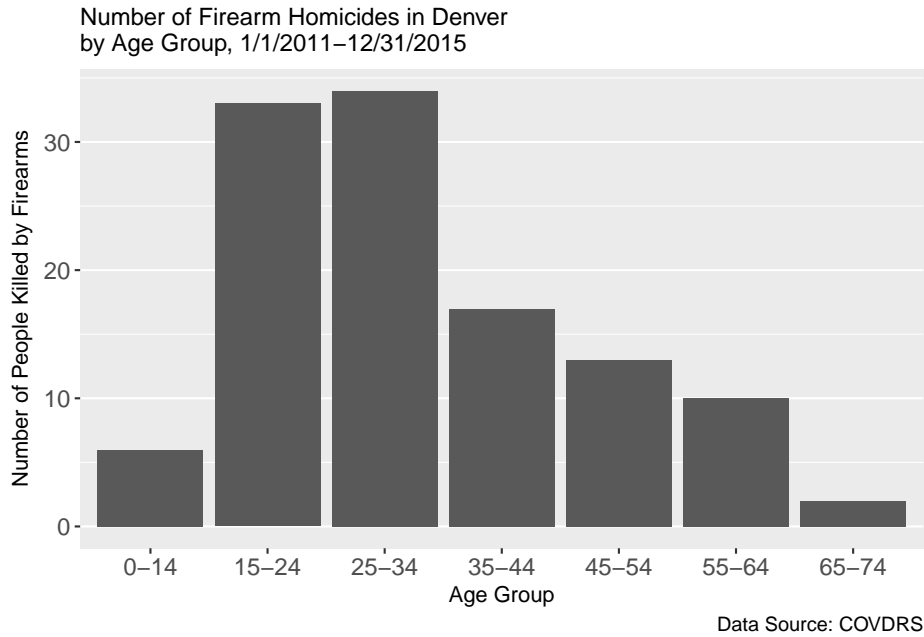


There were 115 homicides attributed to firearm injuries in Denver from 2011-2015. The majority of the victims (N=97, 84.3%) were men.

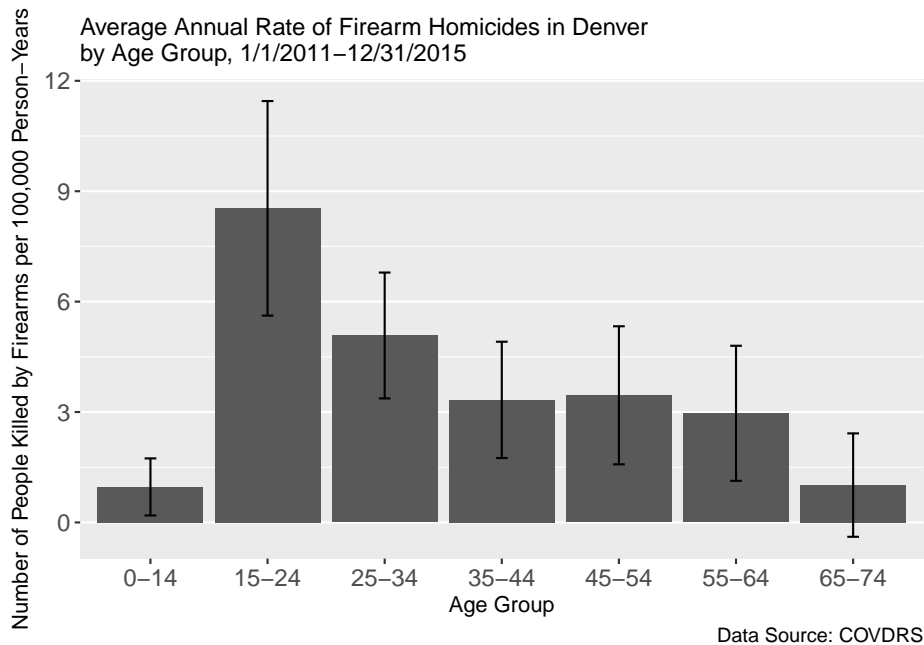


The age-adjusted rates of firearm homicide were higher in men: 5.6 firearm homicides per 100,000 person-years in men (95% CI: 4.5, 6.8) compared to 1.2 firearm homicides per 100,000 person-years in women (95% CI: 0.6, 1.7). The rate of firearm homicide was approximately 5.4 times higher among men than women (95% CI: 3.3, 8.9, $p < 0.0001$).

Firearm Homicides By Age Group

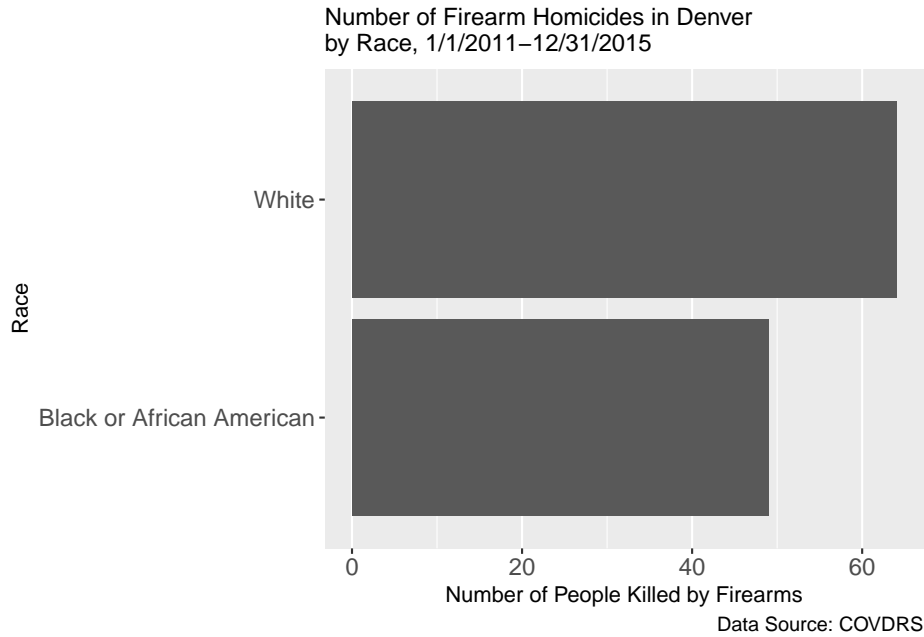


The greatest numbers of homicides, when classified by age group, were experienced by individuals 25-34 years of age (N=34, 29.6%) and 15-24 years of age (N=33, 28.7%).

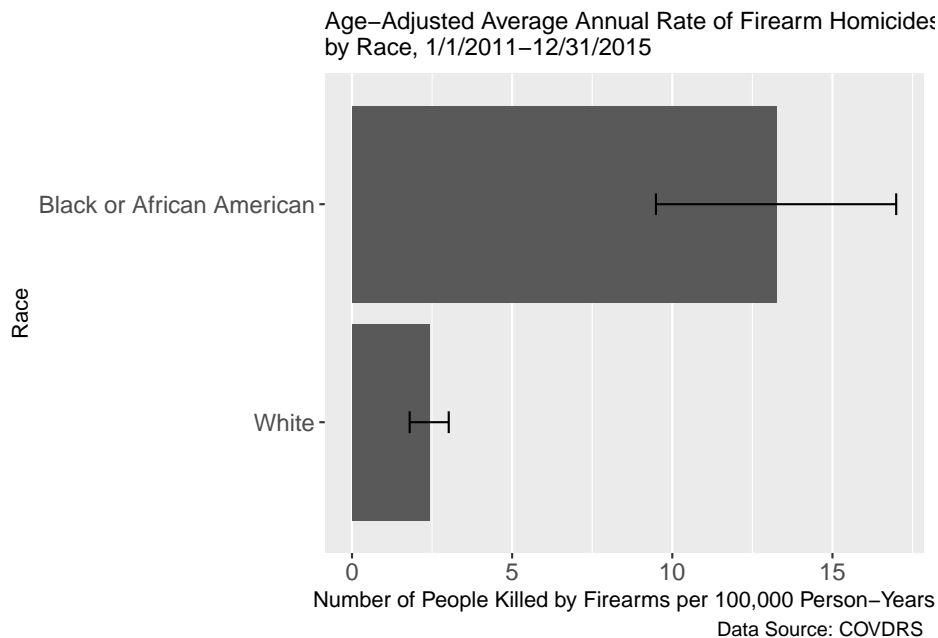


The highest age-group-specific homicide rate is among people 15-24 years of age: 8.5 firearm homicides per 100,000 person-years (95% CI: 5.6, 11.5). The rate of firearm homicides decreases with age after age 24 (Chi-square test for trend $p < 0.0001$).

Firearm Homicides By Race



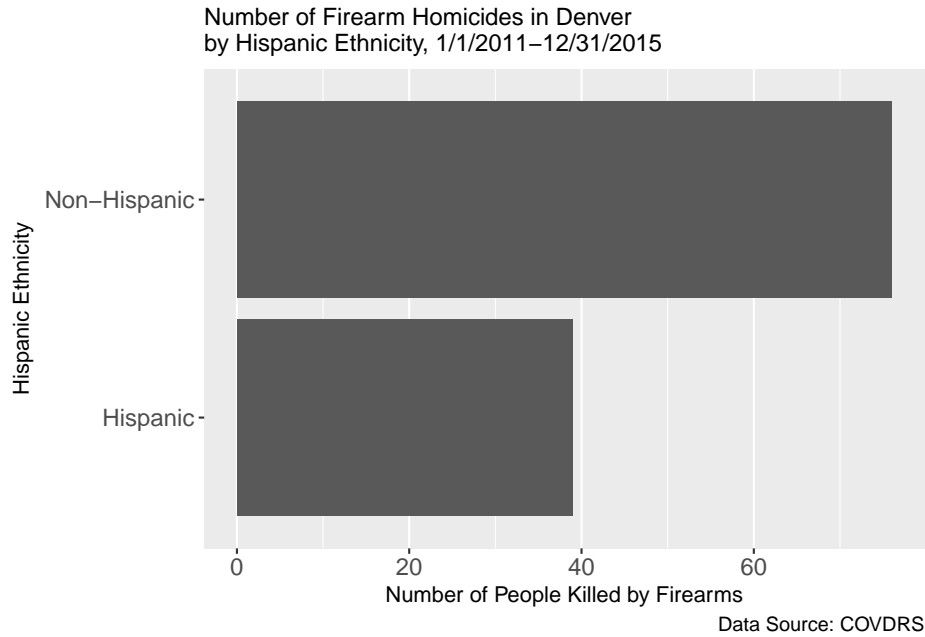
The racial subgroup that experienced the greatest number of firearm homicides in Denver between 2011 and 2015 were whites (N=64, 55.7%). There were 49 black and African-American individuals murdered by firearm between 2011 and 2015 (42.6%). There were not enough homicide victims in other racial subgroups to contribute data.



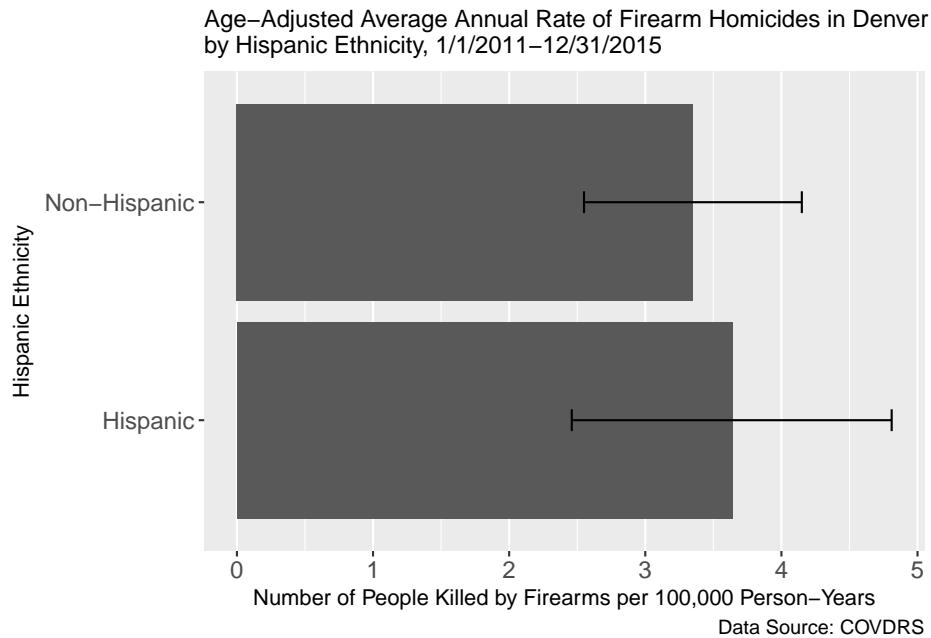
Among black and African American individuals the age-adjusted firearm homicide rate was 13.2 per 100,000 person-years (95% CI: 9.5, 17.0). Among white individuals the age-adjusted firearm homicide rate was 2.4 firearm homicides per 100,000 person-years (95% CI: 1.8, 3.0).

Firearm homicide rates were approximately 5.4 times higher among black and African American people than among white people (95% CI: 3.7, 7.7, $p < 0.0001$).

Firearm Homicides By Ethnicity



The majority of firearm homicides in Denver from 2011-2015, when categorized by Hispanic ethnicity, were experienced by non-Hispanic people (N=76, 66.1%). There are more non-Hispanic people living in Denver than there are Hispanic people, though, so it is important to adjust for the population size in each ethnic subgroup.

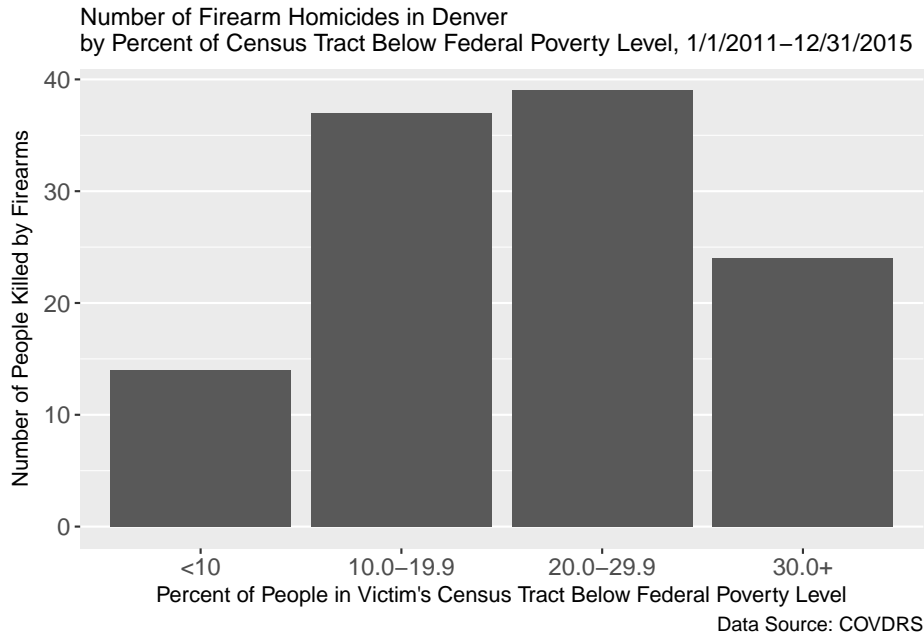


After accounting for each group's population size, there was no detectable difference in homicide rates among Hispanic individuals compared to non-Hispanic individuals (Crude OR=1.1, 95% CI: 0.8, 1.7, p=0.49). Making additional adjustments for the age distribution

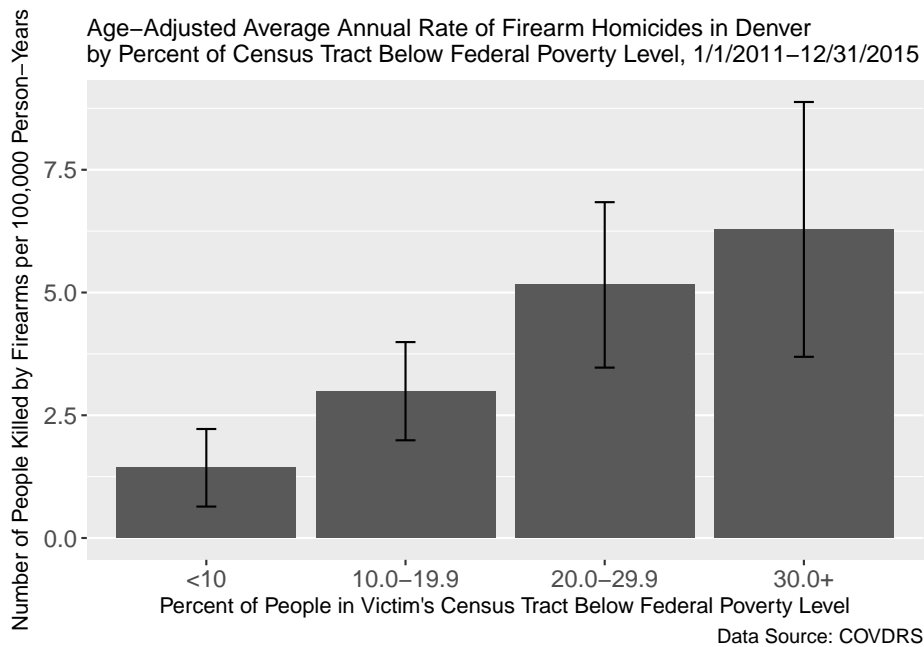
of the population reduced the difference between the incidence estimates even further (Age-Adjusted Rate among non-Hispanic individuals: 3.4 per 100,000 person-years, 95% CI: 2.6, 4.2; Age-adjusted rate among Hispanic individuals: 3.6 per 100,000 person-years, 95% CI: 2.5, 4.8).

Importantly, the non-Hispanic group includes both non-Hispanic whites and non-Hispanic blacks who may have different homicide rates.

Firearm Homicides By Census Tract Poverty



When analyzed by census tract poverty levels, the greatest number of homicides were experienced by individuals living in census tracts with 20-29.9% of people living in poverty (N=39, 33.9%). There was one firearm homicide victim who was missing data on this variable.



When comparing crude rates of firearm homicides in Denver, there appears to be a direct relationship with the level of poverty in a victim's census tract (Chi-Square test for trend $p < 0.0001$). Confidence intervals are somewhat wide, but the homicide rate estimates

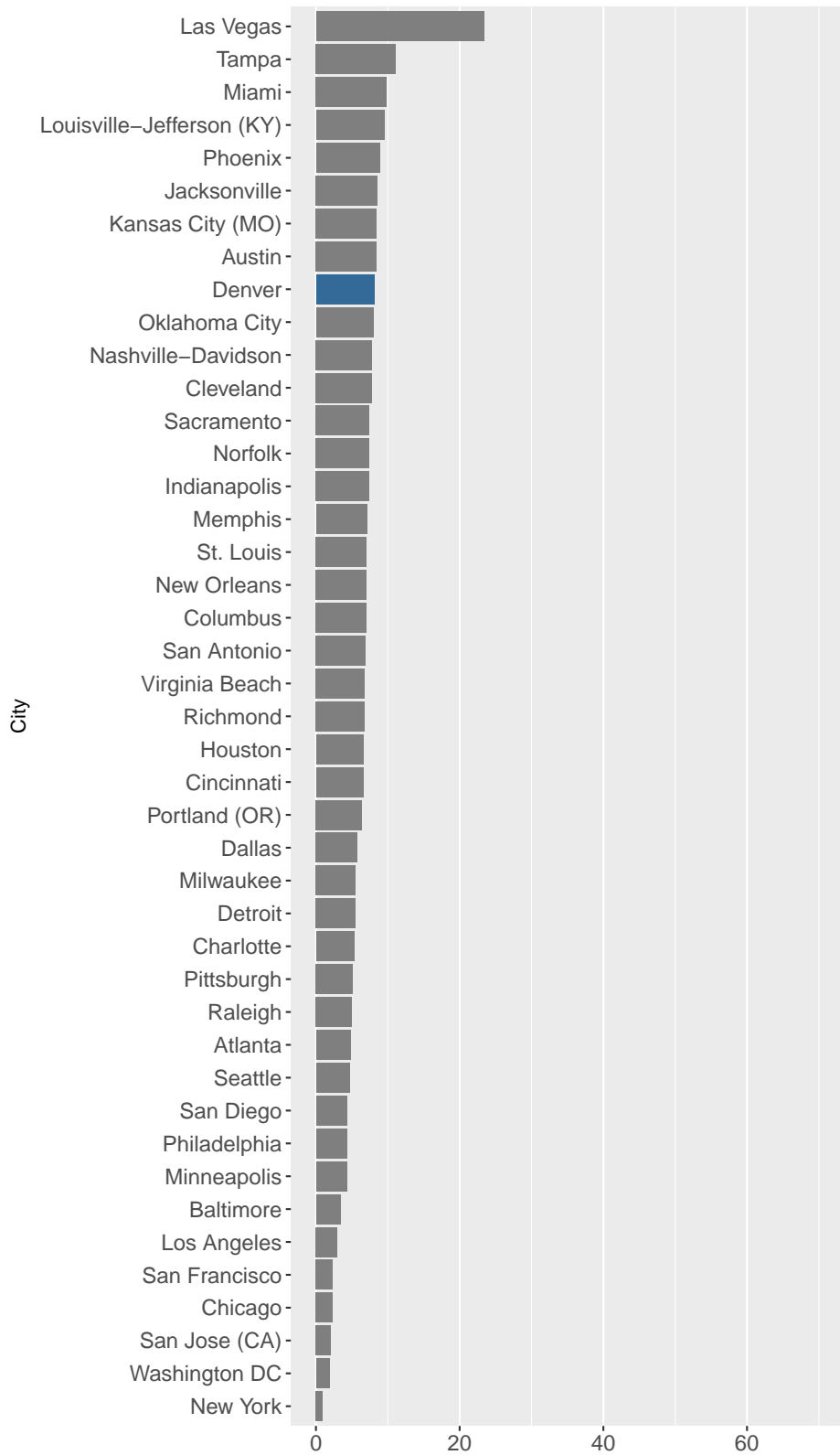
increase consistently with increasing levels of poverty from a rate of 1.4 per 100,000 person-years in the richest census tracts (95% CI: 0.6, 2.2) to 6.3 per 100,000 person-years among the poorest census tracts (3.7, 8.8). In other words, individuals residing in the highest poverty census tracts were more than 4 times more likely to die by firearm homicide than individuals living in census tracts with the lowest levels of poverty ($p < 0.0001$).

Firearm Suicides

Firearm Suicide Rates in Denver and Select U.S. Cities, 2006-2007

In 2011, the Centers for Disease Control and Prevention published a comparison of firearm deaths among residents of metropolitan areas and cities in the US, using vital statistics data collected between 2006 and 2007. The authors tabulated firearm and suicide counts for the 50 largest Metropolitan Statistical Areas and for 62 cities within those MSAs. The figure below presents age-adjusted rates of firearm suicides for Denver and other cities from that report that contributed data. These data are restricted to individuals 10 years of age and older.

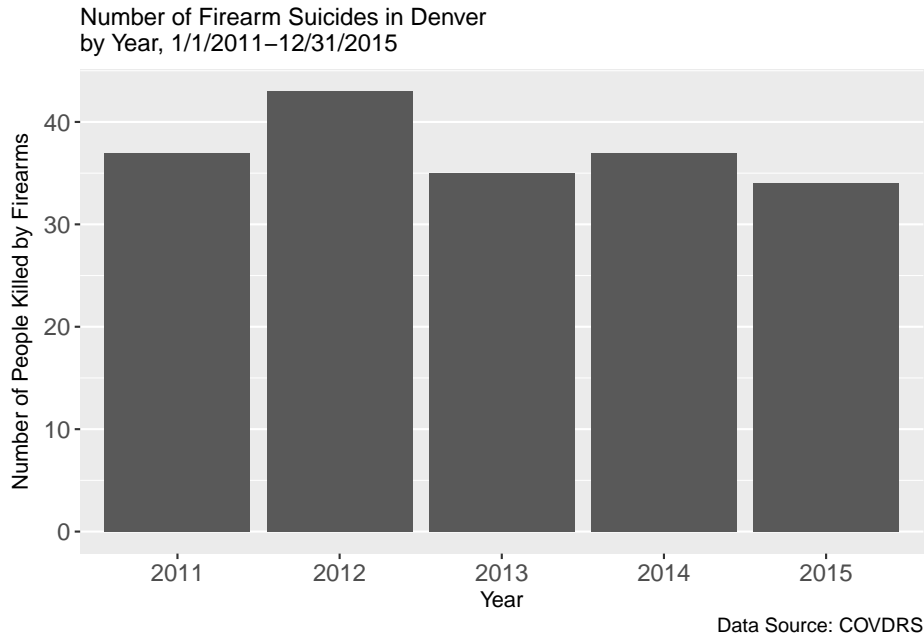
Firearm Suicide Rate per 100,000 Population
 >=10 Years of Age in Select U.S. Cities, 2006–2007



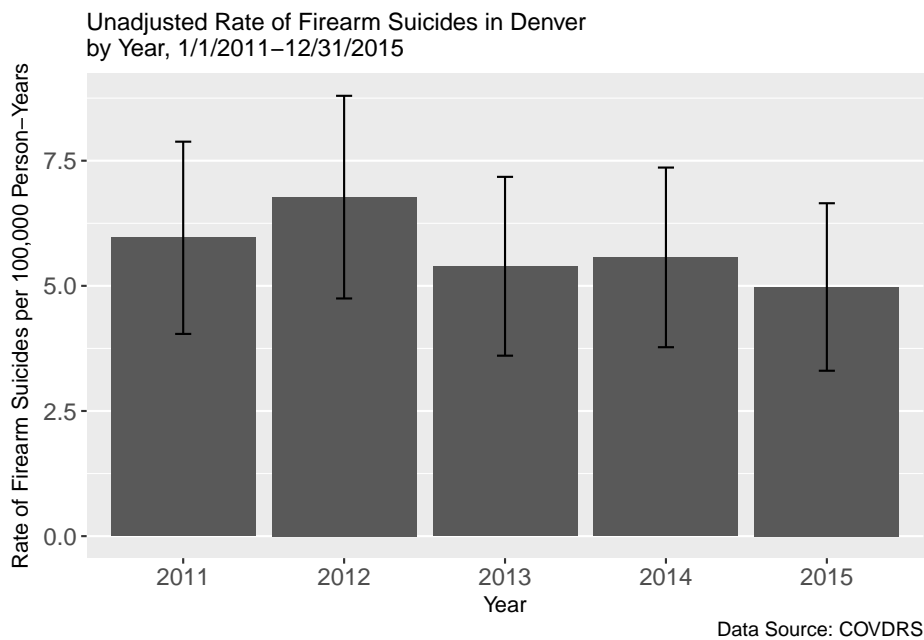
Data Source: MMWR May 13th, 2011 / 60(18); 573–578

Of the cities contributing data to the figure above, Denver ranked 9th, with a firearm suicide rate of 8.1 per 100,000 people. Las Vegas had the highest rate of firearm suicides (23.4 per 100,000).

Firearm Suicides By Year

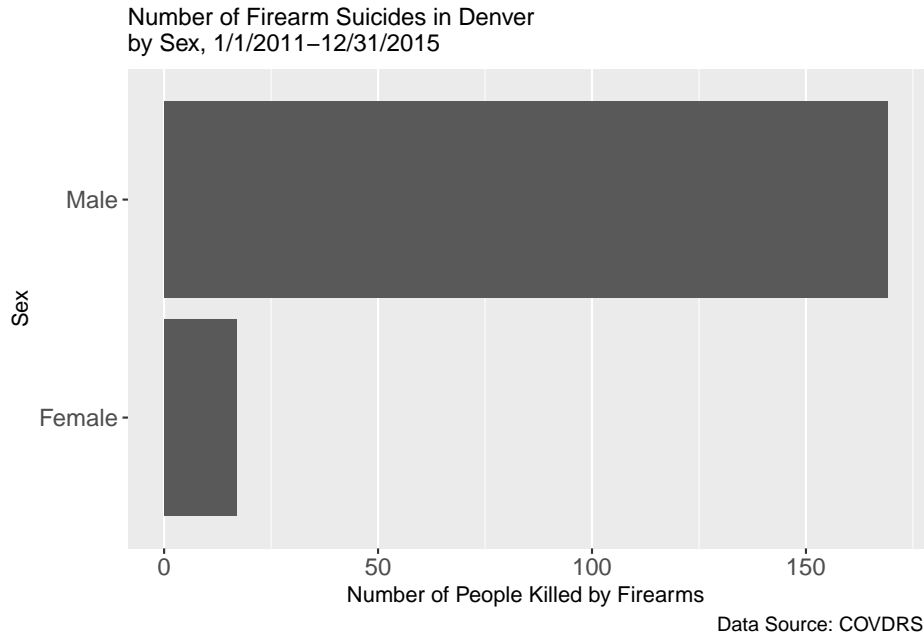


There were 186 suicides attributed to firearm injuries in Denver from 2011-2015. The highest annual count was during 2012, in which 43 Denver residents died by firearm suicide.

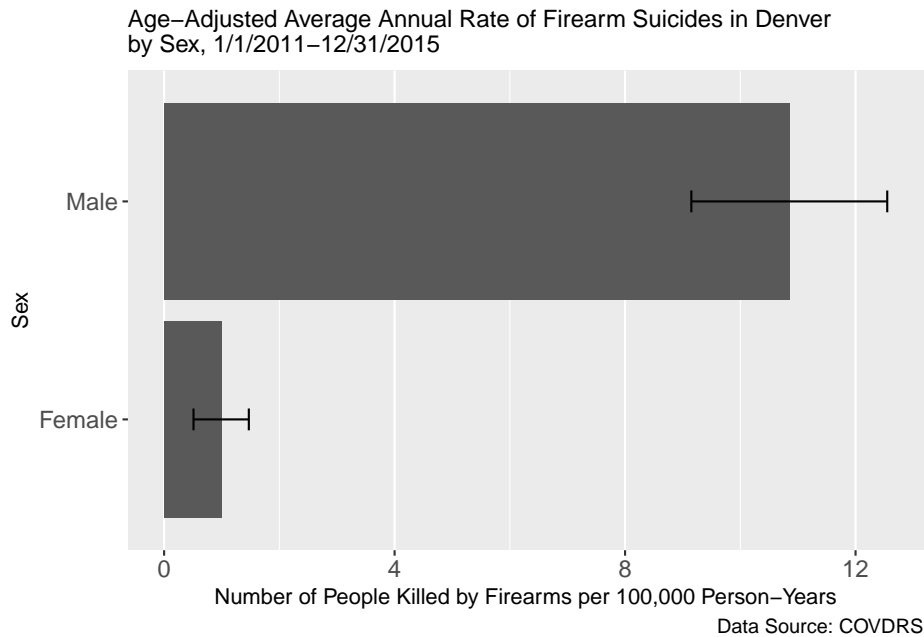


The highest rate of firearm suicide was in 2012, as well (6.8 deaths per 100,000 person-years, 95% CI: 4.7, 8.8), though this may be due to random variation.

Firearm Suicides By Sex

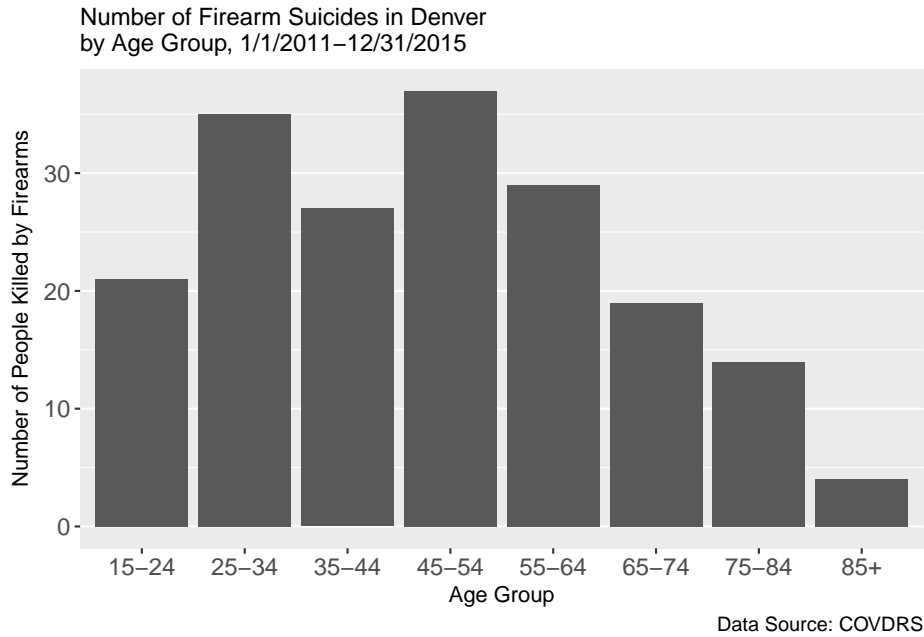


The majority of the victims (N=169, 90.9%) were men.

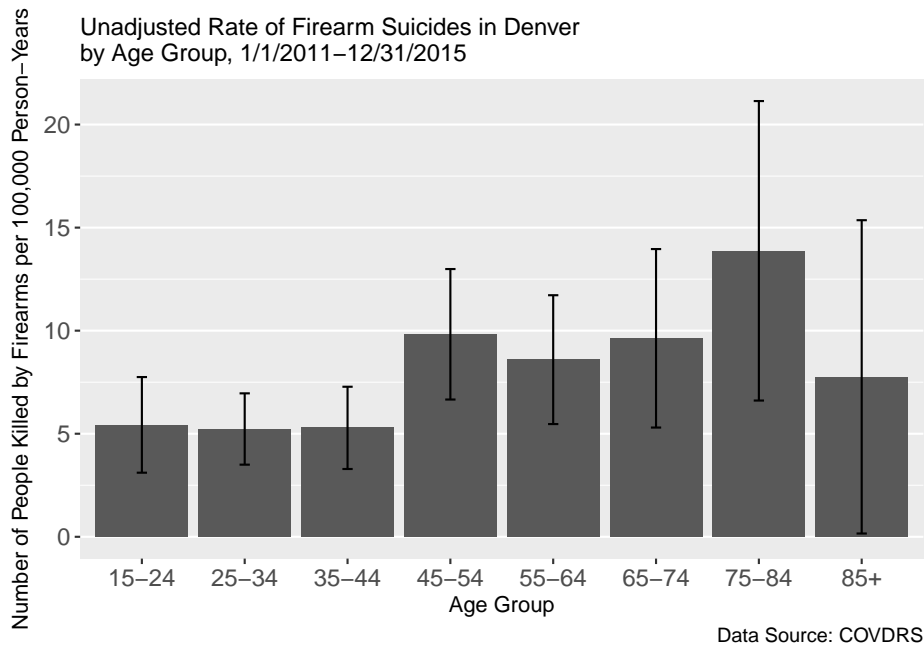


The age-adjusted rates of firearm suicide were also higher in men: 10.9 firearm suicides per 100,000 person-years in men (95% CI: 9.2, 12.6) compared to 1.0 firearm suicides per 100,000 person-years in women (95% CI: 0.5, 1.5). Victims of firearm suicide were approximately 9.9 times more likely to be men than women (95% CI: 6.0, 16.4, $p < 0.0001$).

Firearm Suicides By Age Group

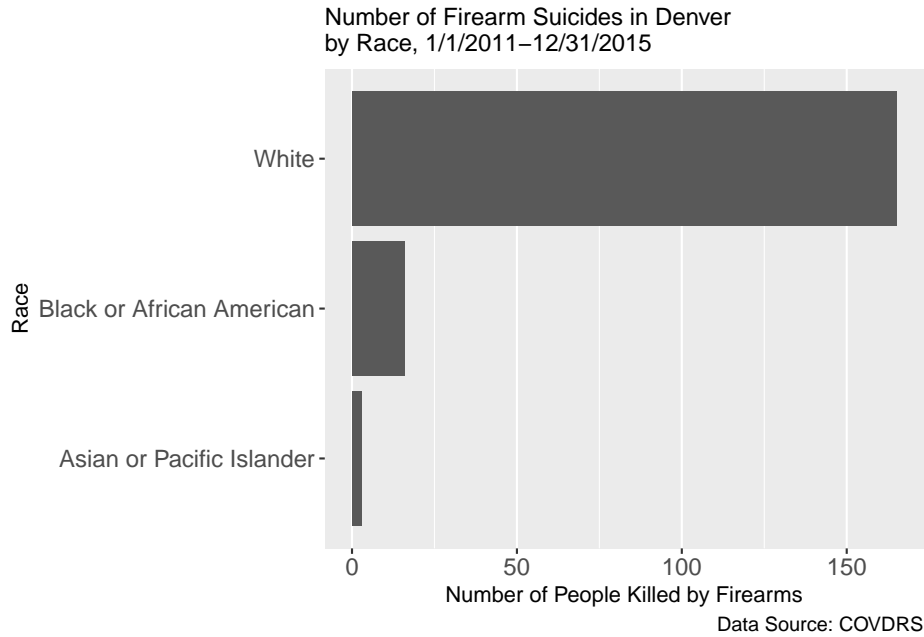


The greatest numbers of suicides, when classified by age group, were experienced by individuals 45-54 years of age (N=37, 19.9%) and 25-34 years of age (N=35, 18.8%).

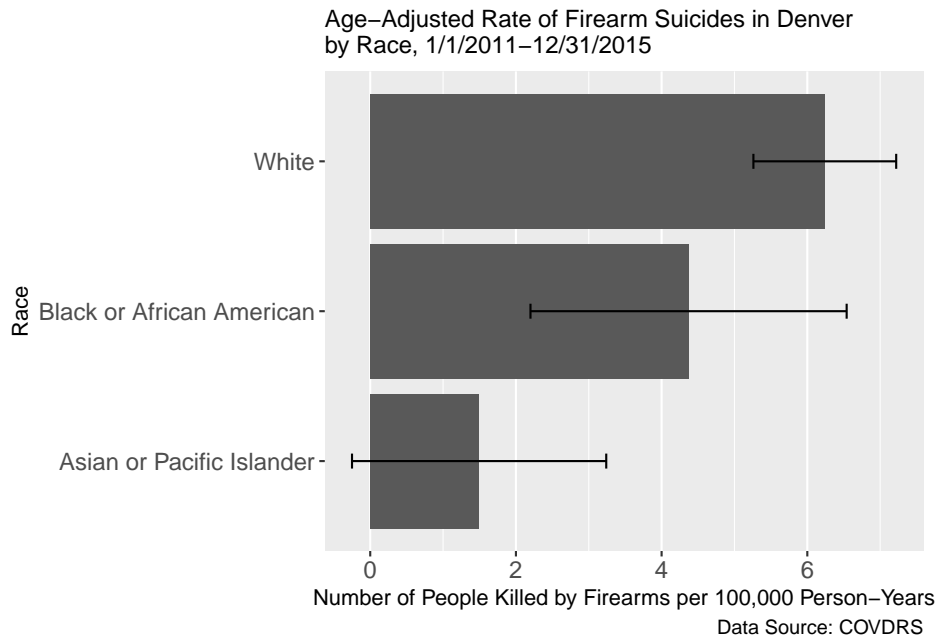


The highest age-group-specific suicide rate in Denver is among people 75-84 years of age: 13.9 firearm suicides per 100,000 person-years (95% CI: 6.6, 21.1). The next highest rate is among adults 45-54 years of age: 9.8 firearm suicides per 100,000 person-years (95% CI: 6.7, 13.0). Confidence intervals are relatively wide, particularly among adults 75 years and older.

Firearm Suicides By Race



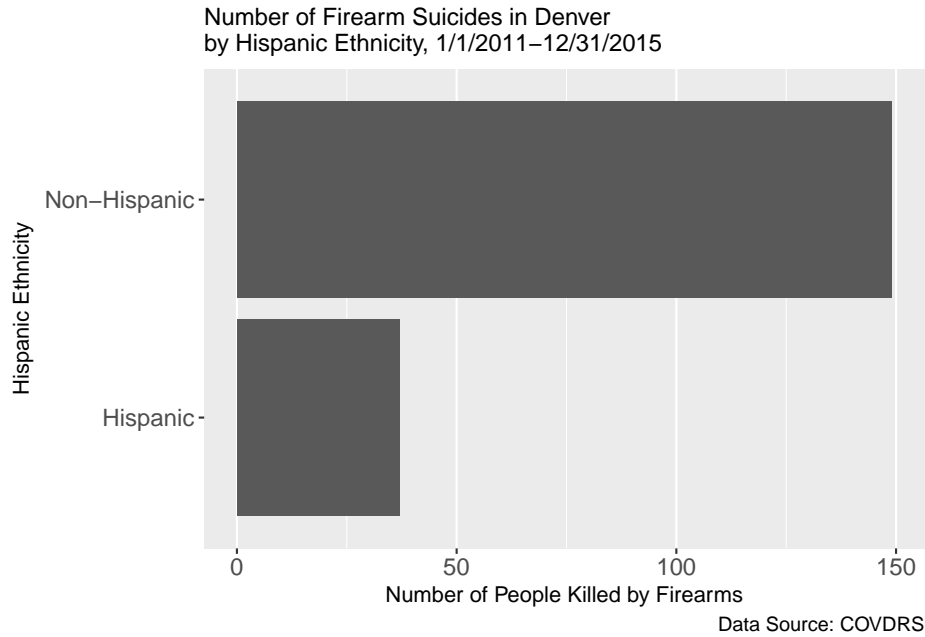
Whites experienced the greatest number of firearm suicides in Denver between 2011 and 2015 (N=165, 88.7%). There were 16 black and African-American individuals (8.6%) and 3 Asian or Pacific Islanders (1.6%) who completed suicide during the same time frame. There were not enough American Indian suicide victims to contribute data.



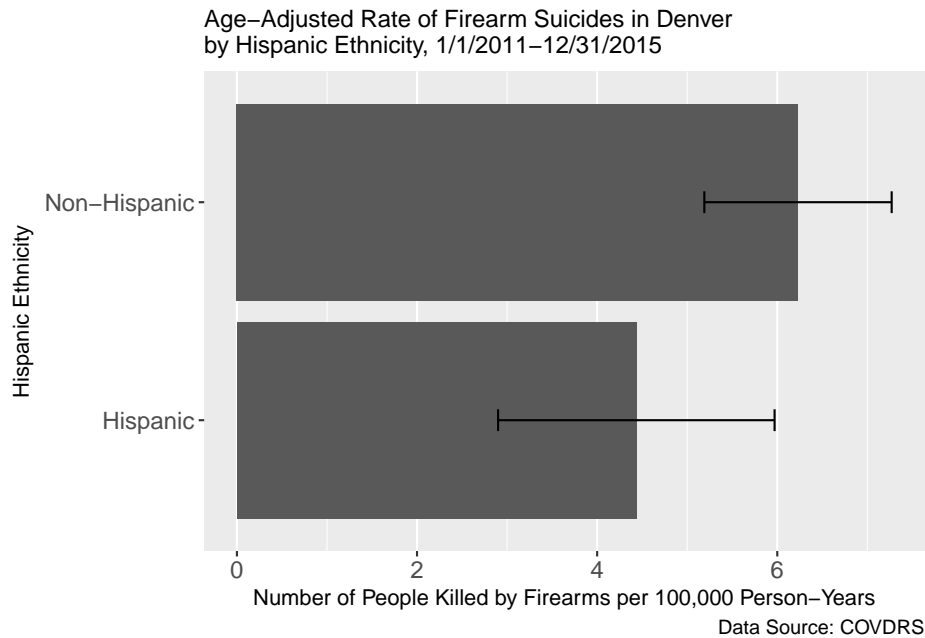
The age-adjusted rate of firearm suicide was highest among whites (6.2 firearm homicides per 100,000 person-years, 95% CI: 5.3, 7.2). The estimates for other groups were relatively imprecise, as evidenced by the large confidence intervals. Black and African Americans

experienced a suicide rate of 4.4 per 100,000 person-years (95% CI: 2.2, 6.5). The rates among Asians and Pacific Islanders was 1.5 per 100,000 person-years (95% CI: -0.3, 3.2). Firearm suicide rates may be higher among whites than black and African-American individuals (Crude OR=1.4, 95% CI: 0.8, 2.4), though this difference was not statistically different ($p=0.19$).

Firearm Suicides By Ethnicity



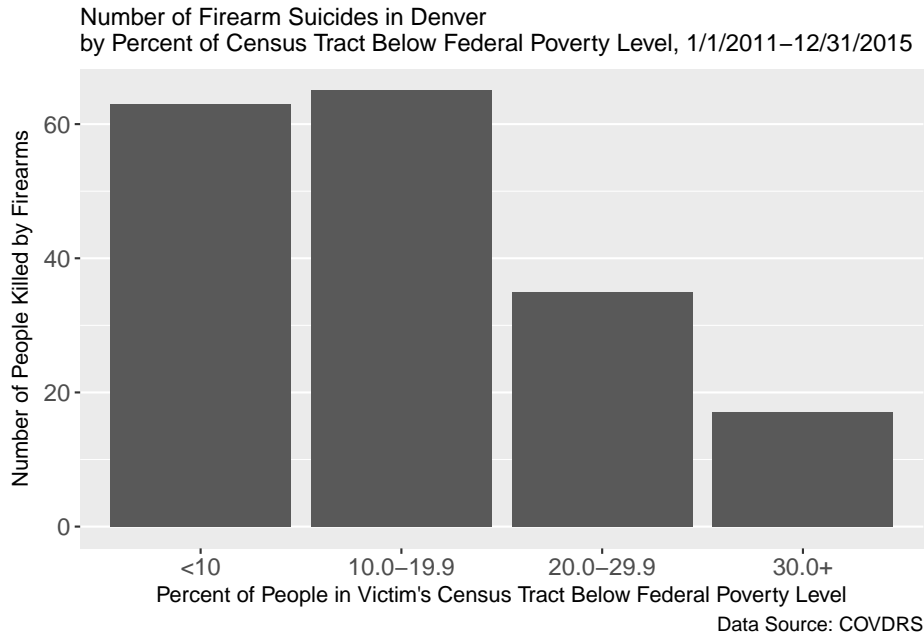
There were more firearm suicides among non-Hispanic people (N=149, 80.1%) than among Hispanic people (N=37, 19.9%). There are more non-Hispanic people living in Denver than there are Hispanic people, though, so it is important to adjust for the population size in each ethnic subgroup.



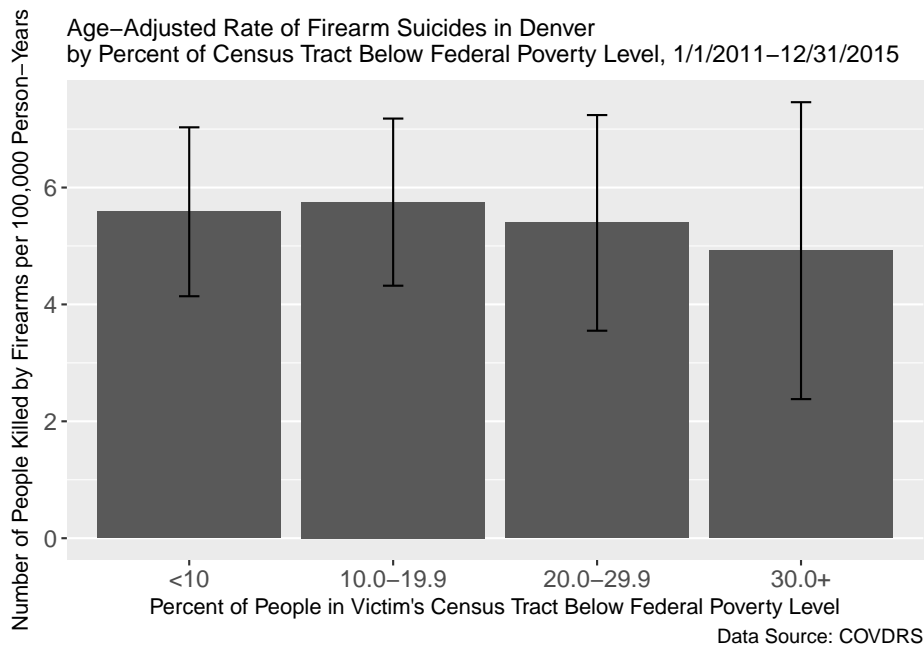
The rate of firearm suicide was approximately 1.8 times higher among non-Hispanic individuals than Hispanic individuals (Crude OR=1.8, 95% CI: 1.3, 2.6, p=0.001). After adjusting for age, the difference between the rate among non-Hispanic individuals (6.2 per

100,000 person-years, 95% CI: 5.2, 7.3) and Hispanic individuals (4.4 per 100,000 person-years, 95% CI: 2.9, 6.0) was smaller. Due to the nature of the data that were provided, we could not calculate an age-adjusted risk estimate.

Firearm Suicides By Census Tract Poverty



The greatest number of firearm suicides were experienced by individuals living in tracts with 10-19.9% of people living in poverty (N=65, 34.9%), followed closely by victims living in areas with less than 10% poverty (N=63, 33.9%). There were six firearm suicide victims who were missing data on this variable.

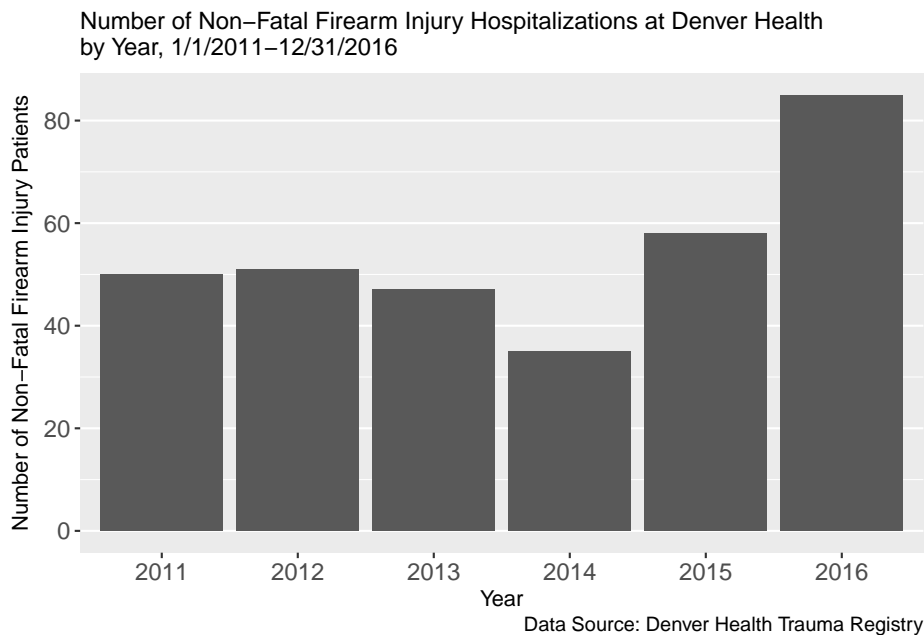


We did not find any evidence that the rate of suicide is related to the level of poverty in a census tract.

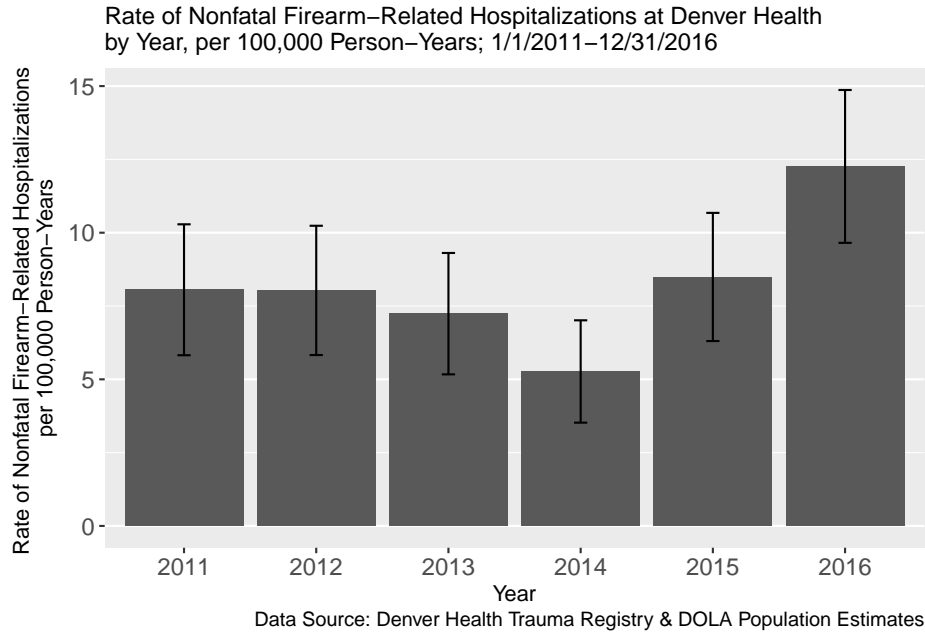
Non-Fatal Firearm Injury Hospitalizations

Non-Fatal Firearm Injury Hospitalizations Treated Through the Denver Health Trauma Center

Due to its status as a Level I Trauma Center, its affiliation with the Denver Health Paramedics Division and its central geographic location in the City and County of Denver, Denver Health Medical Center treats the majority of firearm injuries in Denver. According to the Colorado State Trauma Registry approximately 72% of the non-fatal firearm injuries experienced by Denver residents were treated at Denver Health Medical Center.



After a nadir in 2014 (n=35), the number of non-fatal firearm injuries treated at Denver Health rose in 2015 (n=58) and again in 2016 (n=85).

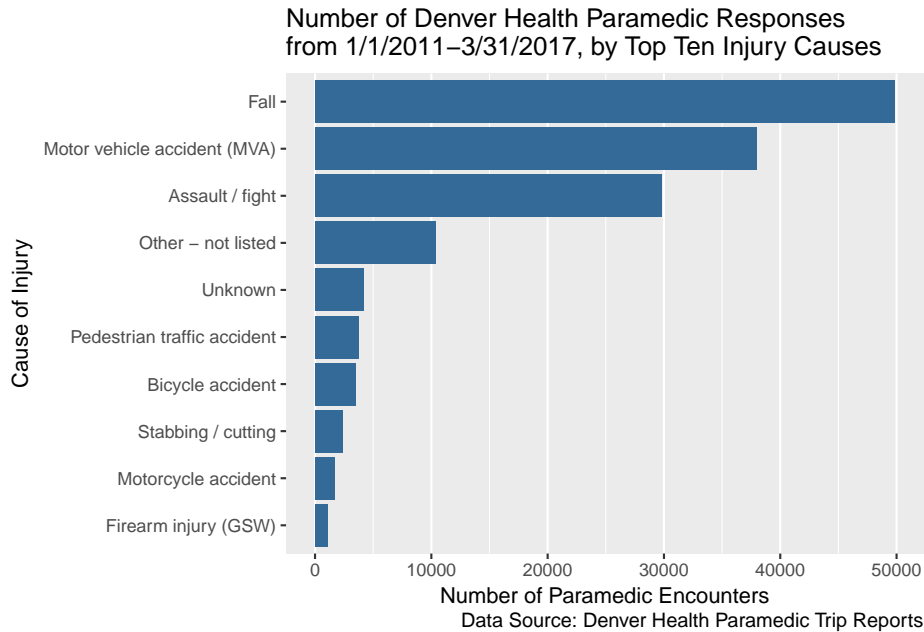


In order to assess whether the increase from 2015 to 2016 could be attributed to the recent growth in Denver’s population, rates were estimated using population data from the Department of Local Affairs. Importantly, these are not rates of non-fatal firearm injury hospitalizations for Denver as a whole. The counts included in the numerator are restricted to patients treated at Denver Health Medical Center. Nonetheless, population growth alone does not appear to account for the rise in nonfatal firearm injuries treated at Denver Health. A Chi-square linear test for trend is significant across all years from 2011-2016 ($p=0.02$) as well as from 2014-2016, specifically ($p<0.0001$).

This trend could be evidence of a rise in firearm violence in recent years. There are possible explanations that were outside the scope of this report to explore. For example, the coding system used by Denver Health to classify injuries changed from 2015 (ICD-9-CM) to 2016 (ICD-10-CM). Also, it is possible that Denver Health has received an increasingly greater share of Denver’s firearm injury patients since 2014. Whether or not this is the case can be assessed once the data submitted to the Colorado State Trauma Registry has been received, aggregated and finalized.

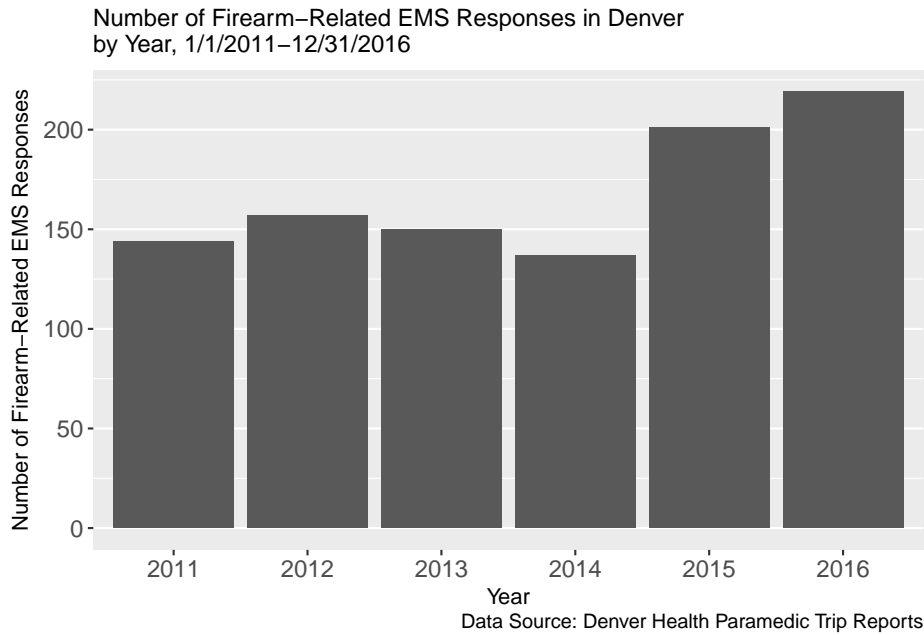
Paramedic Encounters for Firearm Injuries

For the sake of providing context, the figure below presents the top 10 leading causes of injury treated by the Denver Health Paramedics Division from 2011 through the first quarter of 2017.



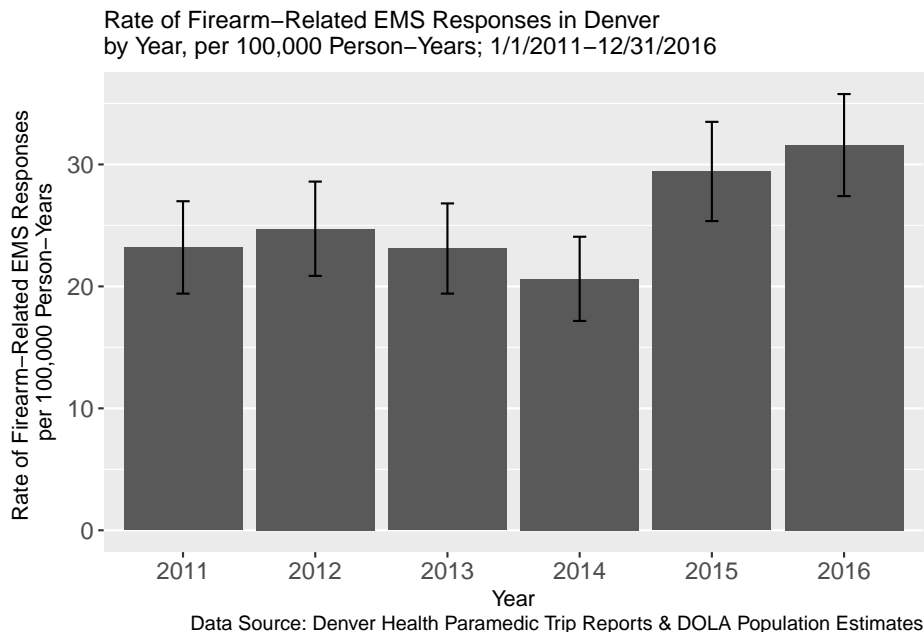
Denver paramedics responded to 1,061 firearm injuries from 1/1/2011 through 3/31/2017. Firearm injuries were the 10th leading cause of trauma-related EMS response during that time period. Falls (n=49,816), motor vehicle crashes (n=37,939) and assaults/fights (n=29,830) were the three leading causes of trauma-related paramedic response. Notably, injuries categorized as “Other - not listed” and “Unknown” were the fourth and fifth leading categories with 10,394 and 4,134, respectively. This suggests that there is a possibility of some injuries being misclassified.

Paramedic Encounters for Firearm Injuries by Year



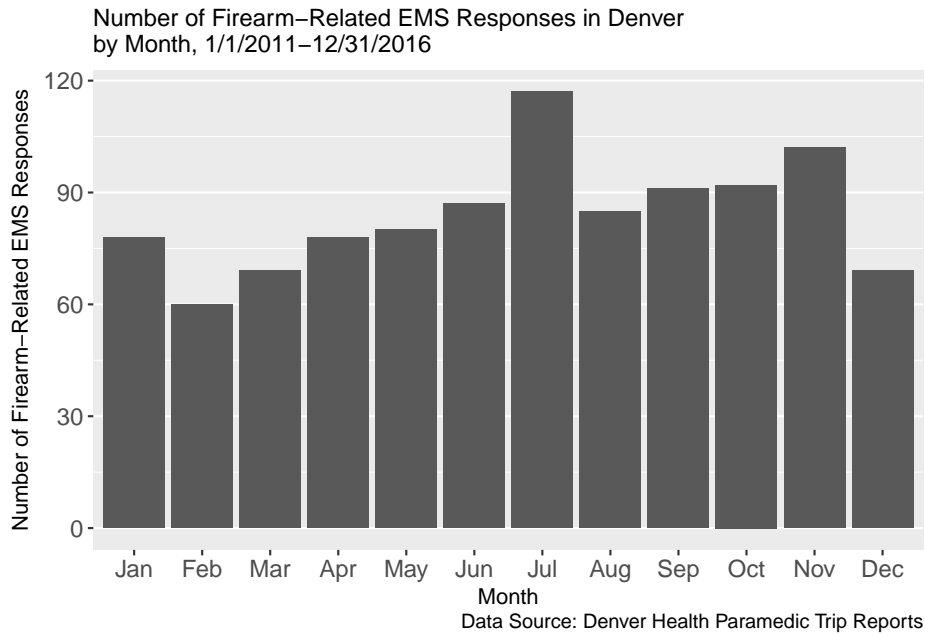
The number of firearm-related paramedic encounters from 2011-2014 ranged from 137 in 2014 to 157 in 2012. The years 2015 and 2016 saw elevated numbers of firearm-related paramedic encounters, including 201 and 219, respectively.

In light of Denver’s recent population growth, we were interested to see whether the uptick in 2015 was attributable to population growth in Denver. We calculated the annual rate of firearm-related responses by Denver Health paramedics, per 100,000 person-years, using annual population estimates from the Colorado Department of Local Affairs (DOLA).



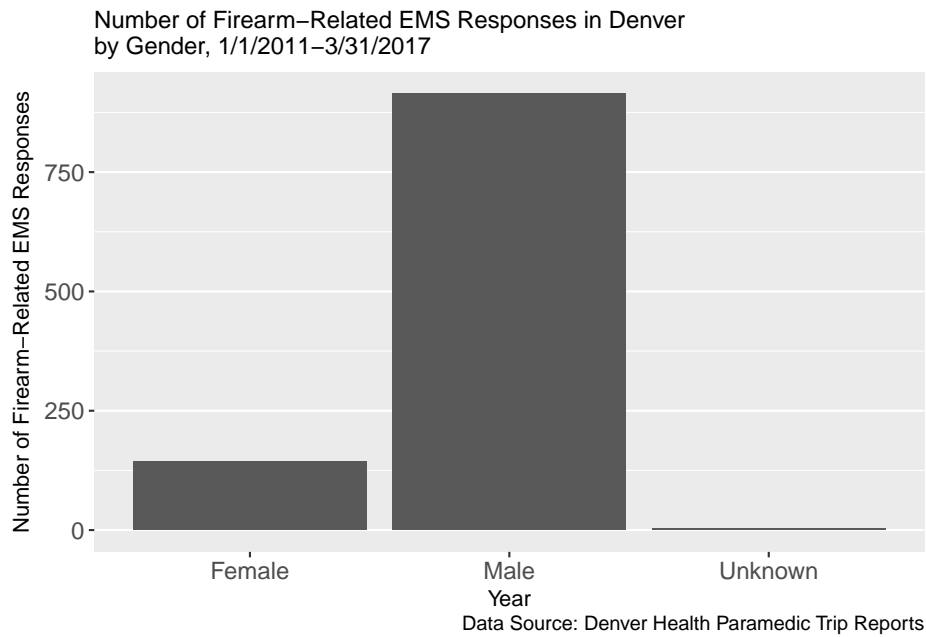
The rate of firearm-related EMS encounters by Denver Health paramedics was higher in 2015 and 2016 than in previous years. The observed increase in the number of firearm-related EMS responses from 2014 to 2015 is unlikely to be due to population growth.

Paramedic Encounters for Firearm Injuries by Month



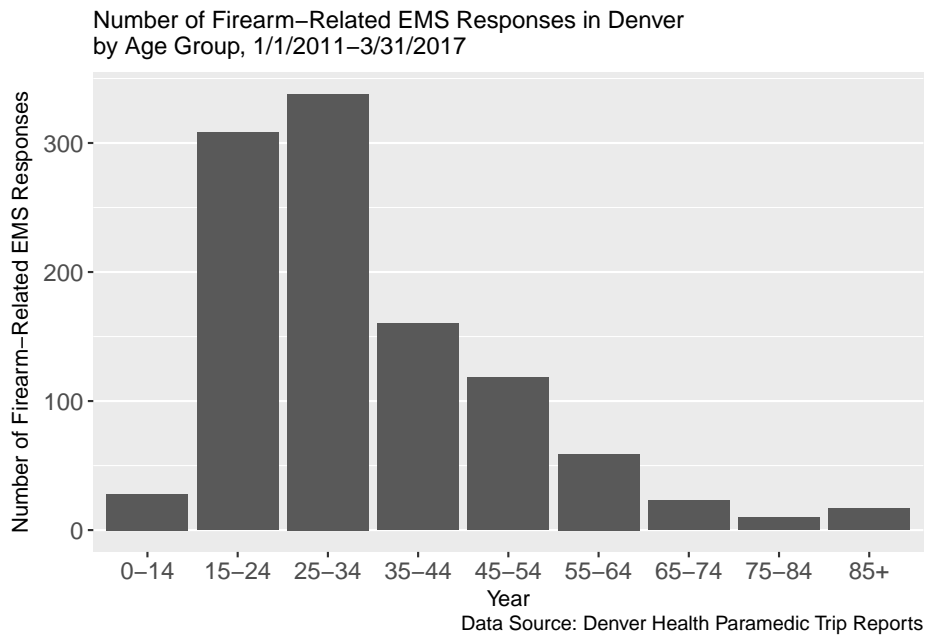
Excluding data from the first quarter of 2017, July had the highest number of firearm-related paramedic encounters (117, 11.6%).

Paramedic Encounters for Firearm Injuries by Gender



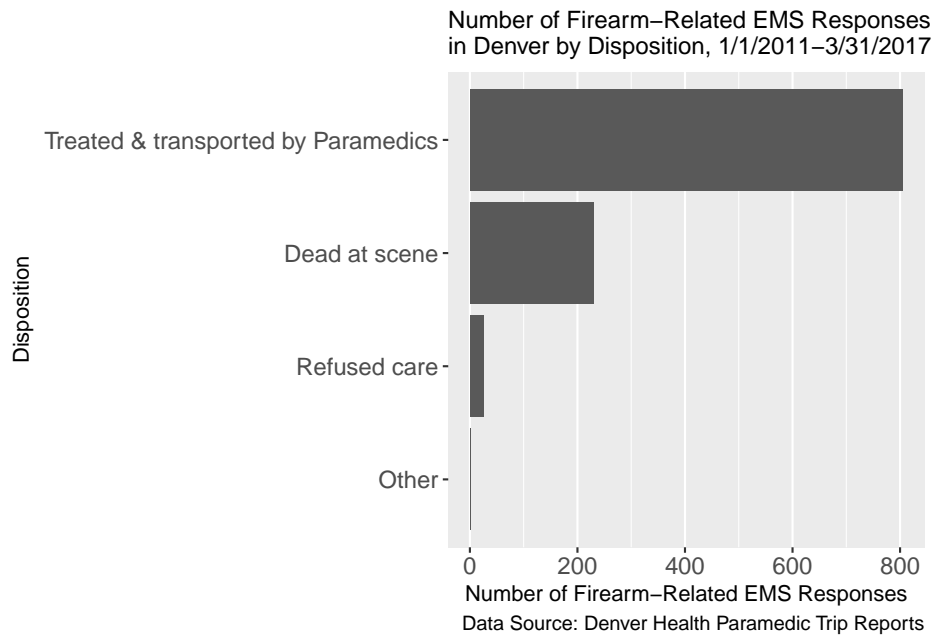
During the time period 1/1/2011-3/31/2017, there were 914 male firearm injury patients seen by paramedics (86.1%), 144 female firearm injury patients (13.6%), and 3 firearm injury patients with unknown gender (0.3%).

Paramedic Encounters for Firearm Injuries by Age Group



Of the 1061 EMS responses related to firearm injuries from 1/1/2011-3/31/2017, 646 patients (60.9%) were between the ages of 15 and 34.

Paramedic Encounters for Firearm Injuries by Disposition



Of the 1061 firearm-related paramedic encounters, 805 (75.9%) patients were treated and transported by Denver Health paramedics, compared to 230 (21.7%) patients, who were dead at the scene. In spite of the relatively small percentage of EMS responses for gunshot wounds (0.7%), firearm injuries account for 40% of the 575 cases in which the patient is found dead at the scene. Less than 0.4% of the 149,781 trauma-related EMS responses involved a patient who was dead at the scene. In other words, compared to patients with a different disposition, trauma victims found dead at the scene when paramedics arrived were approximately 122 times more likely to be injured by a firearm than some other cause (95% CI: 103, 147). This relatively high likelihood of death prior to paramedics' arrival strongly suggests that primary prevention may be an important way to influence firearm injury outcomes in Denver.

Paramedic Encounters for Firearm Injuries by Geographic Location of the Incident & Suspected Intent

Paramedic trip reports usually include geographic information (latitude & longitude) assigned during the 911 call. In order to assess the overall geographic distribution of firearm injuries, we mapped the locations to which Denver Health paramedics responded (excluding 48 records without latitude and longitude data).

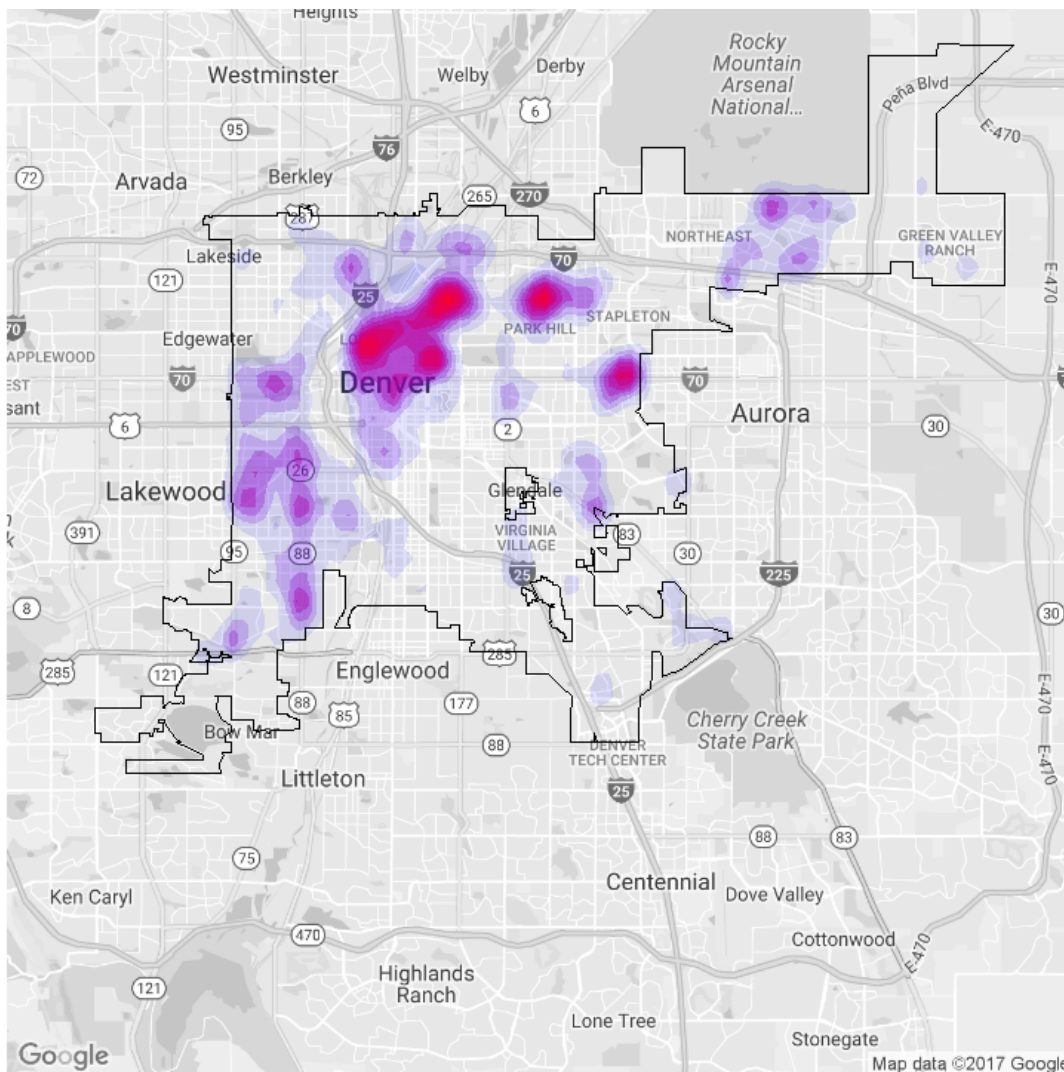


Figure 1: Geographic Distribution of Paramedic Responses for Firearm Injuries in Denver, 1/1/2011-3/31/2017 (N=1,013)

Perhaps reflective of the patterns identified above related to census tract poverty, firearm assaults and self-inflicted firearm injury appear to exhibit different geographic distributions in Denver. Based on visual inspection alone, firearm injury assaults are relatively concentrated in the downtown area, southwest Denver and northeast Denver. These include areas with relatively high poverty. Self-inflicted firearm injuries are less centralized and

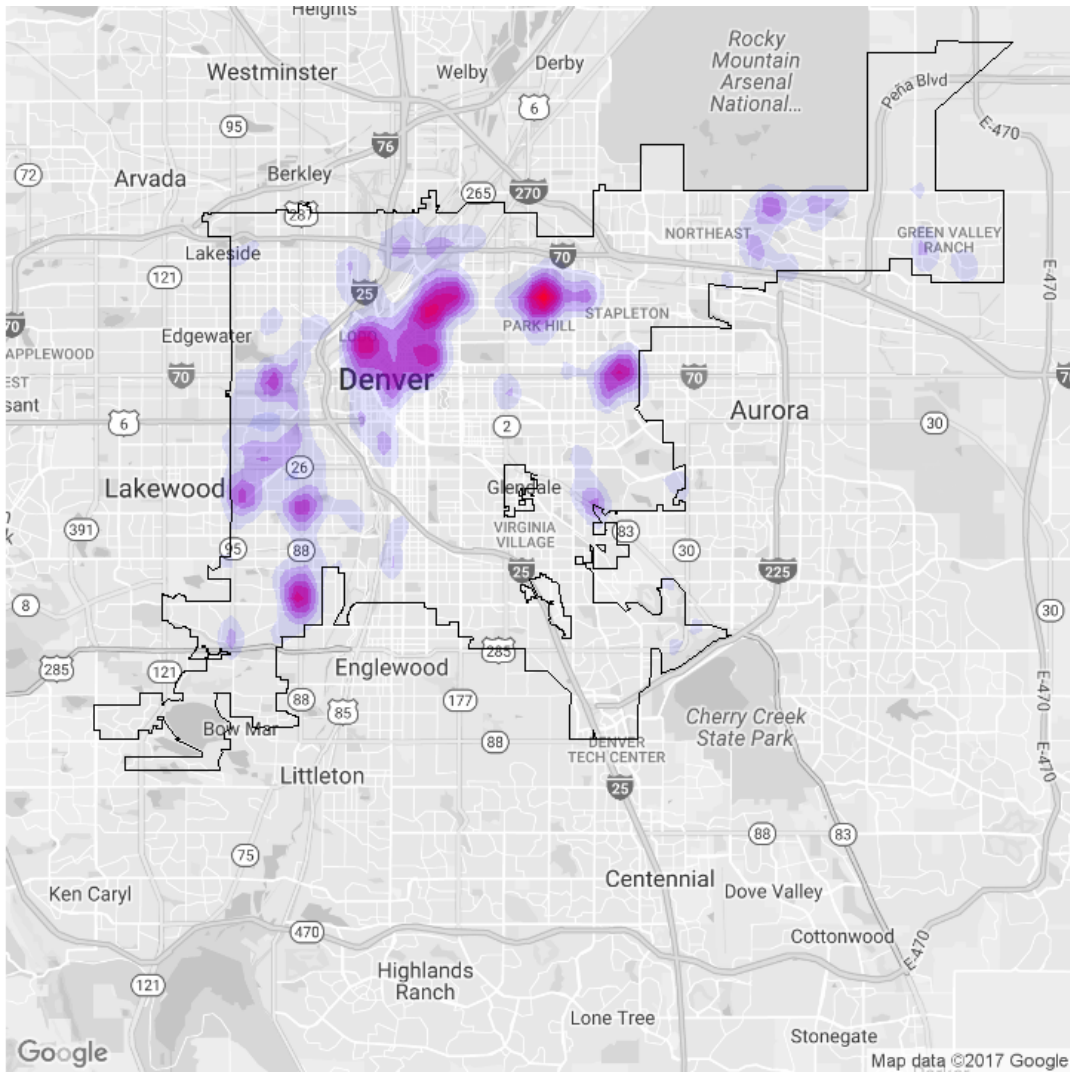


Figure 2: Geographic Distribution of Paramedic Responses for Firearm Injury Assaults in Denver, 1/1/2011-3/31/2017 (N=395)

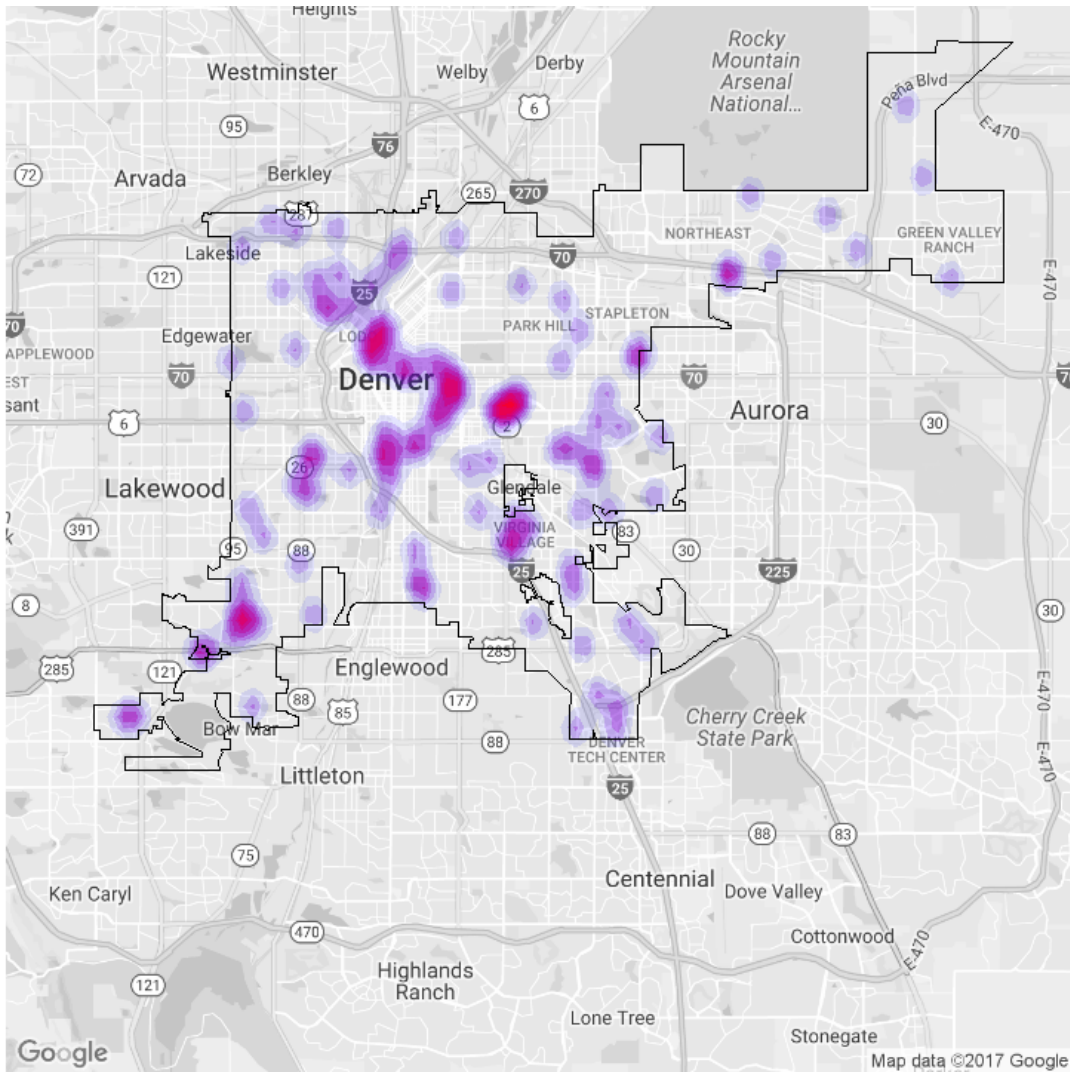


Figure 3: Geographic Distribution of Paramedic Responses for Self-Inflicted Firearm Injuries in Denver, 1/1/2011-3/31/2017 (N=109)

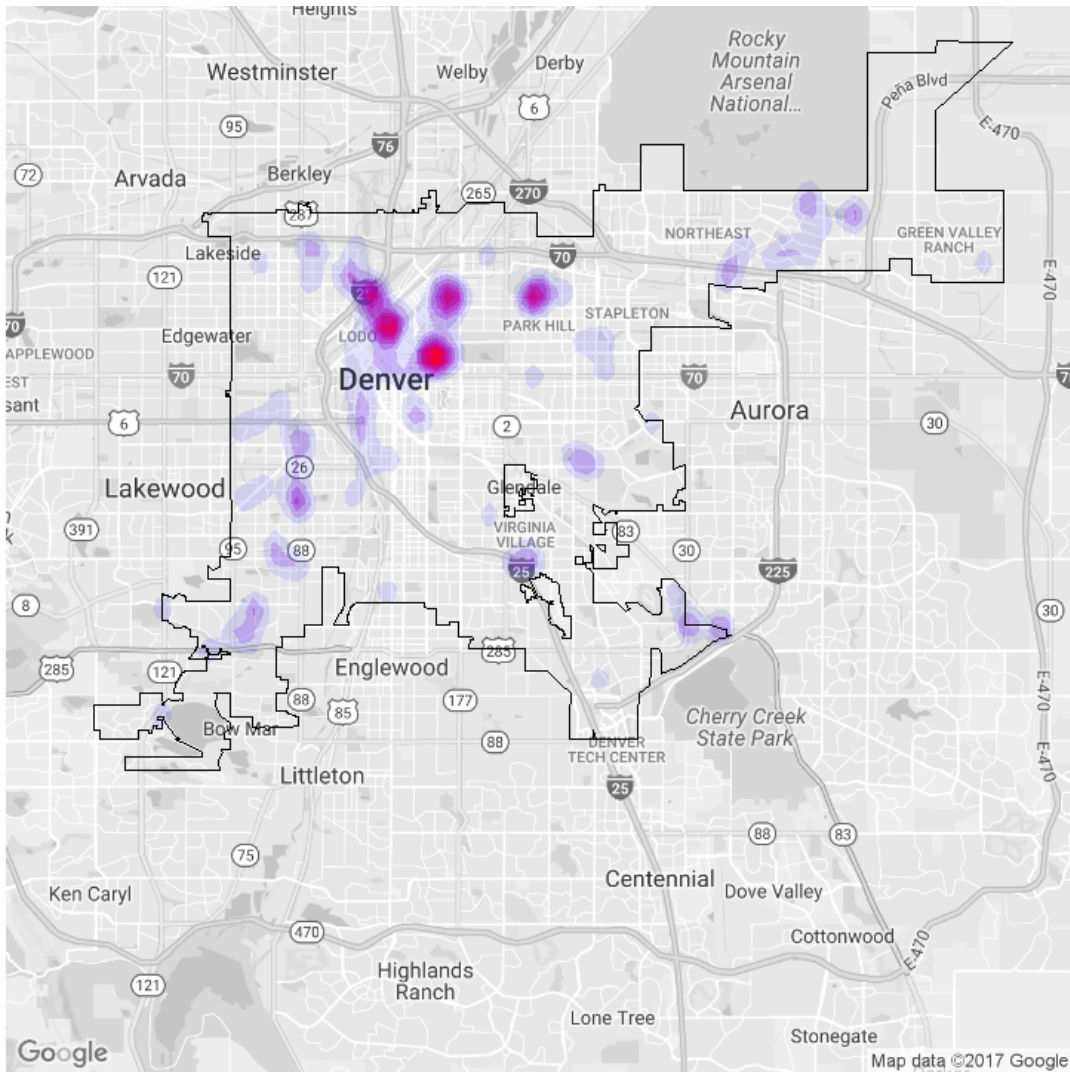


Figure 4: Geographic Distribution of Paramedic Responses for Unintentional Firearm Injuries in Denver, 1/1/2011-3/31/2017 (N=105)

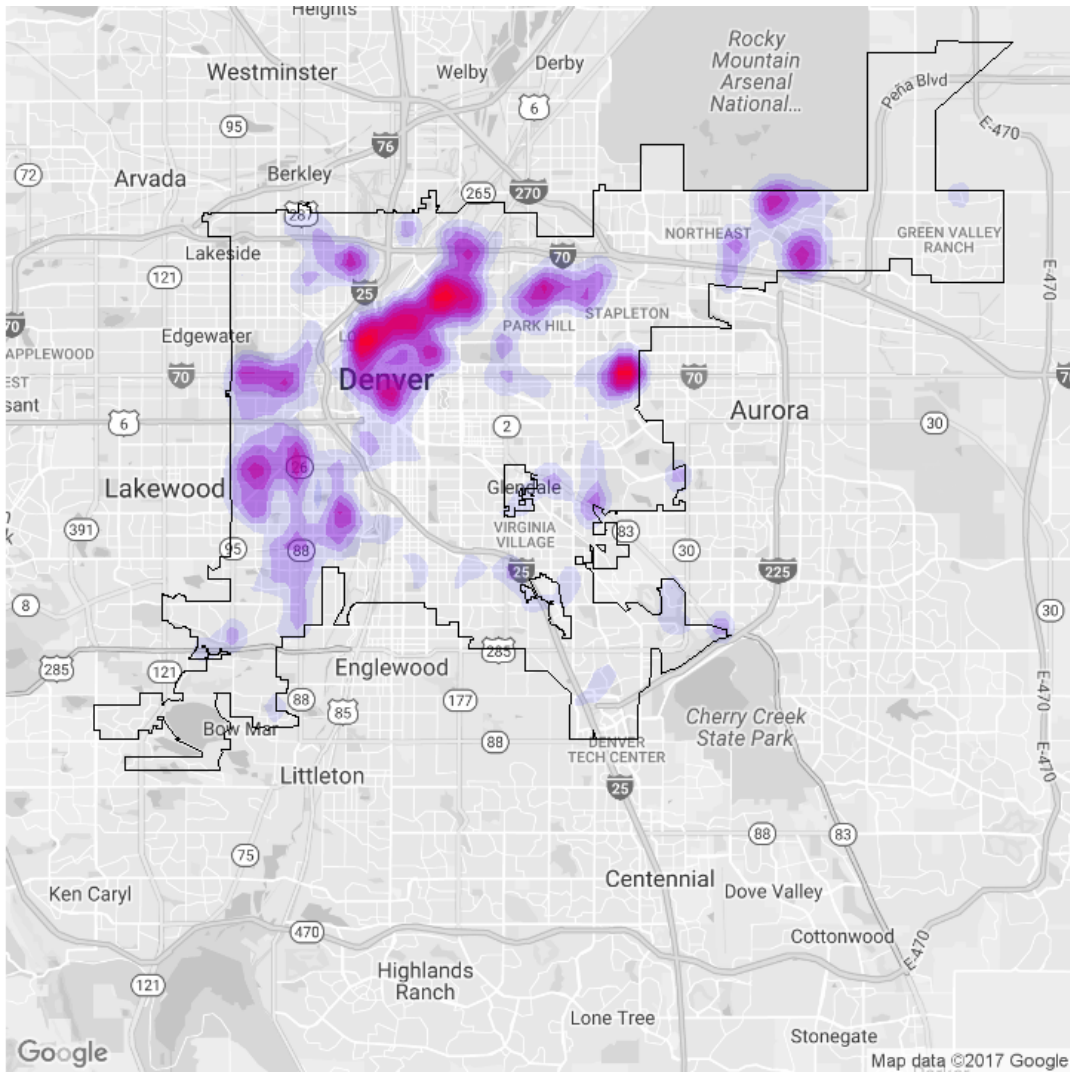


Figure 5: Geographic Distribution of Paramedic Responses for Firearm Injuries with Unknown Intent in Denver, 1/1/2011-3/31/2017 (N=404)

appear to occur throughout the city and county.

Data Sources

The data summarized in this report comes from different sources. A true public health approach to addressing any issue starts with public health surveillance. A bona fide public health surveillance system, like the Colorado Violent Death Reporting System described below, involves considerable time, energy and resources to administer. All cases that meet a particular case definition are enumerated. Additional data on the contributing factors are collected and validated systematically. The system, then, can provide a “snapshot” of the problem and, as importantly, track trends over time to assess whether the problem is getting better or worse.

The Violent Death Reporting System, however, does not capture data on non-fatal violent injuries. Therefore, to characterize how commonly those types of injuries are occurring in Denver, we relied on other sources of data. Each source of data is collected for a different purpose and has particular idiosyncracies that influence how we understand what the data “mean.”

The sources of data include:

- **Vital Records** Vital records include formal determination of the cause of death. Denver Public Health maintains vital records for the City and County of Denver including certified death certificates for individuals who die in Denver. The Colorado Department of Public Health and Environment (CDPHE) collects vital records from across the state. Data are available in aggregate at the following website: <http://www.cohid.dphe.state.co.us/deathmenu.html>.
- **Colorado Violent Death Reporting System** The Colorado Violent Death Reporting System (COVDRS) is one of 42 state-based surveillance systems that together comprise the National Violent Death Reporting System (NVDRS). COVDRS is based at the Colorado Department of Public Health and Environment (CDPHE) and supported through a grant from the Centers for Disease Control and Prevention (CDC) to collect detailed information on the individuals and circumstances involved in suicides, homicides, deaths of undetermined intent and unintentional firearm-related deaths. All death certificates with a relevant cause of death are enhanced with data from the following sources: coroner reports, law enforcement investigations, the Supplemental Homicide Report, Child Fatality Review, the state crime lab, and newspaper articles. Data are abstracted and entered into a standardized electronic database prepared by the CDC. On a daily basis, a de-identified limited subset of the data is submitted to the national database. Data at the state level are available for analysis and local use. The data reviewed for this report included only patients with a Denver residence zip code and who died by firearm from 2011-2015.
- **Colorado Trauma Registry** The Colorado statewide trauma registry is established by the Code of Colorado Regulations (6 CCR 1015-4) and maintained by the Colorado Department of Public Health and Environment (CDPHE). According to the establishing statute, the registry is a “data base of information concerning injured persons and licensed facilities receiving injured persons, which information is used to

evaluate and improve the quality of patient management and care and the quality of trauma education, research and injury prevention programs. The database integrates medical and trauma systems information related to patient diagnosis and provision of care. Such information includes epidemiologic and demographic information.” The data reviewed for this report included only patients with a Denver residence zip code, injured by a firearm anywhere in the state who were alive at discharge from the hospital and were recorded in a level I, II or III trauma registry. Firearm injuries were determined by selecting patients with E-codes of: E955.0, E955.1, E955.2, E955.3, E955.4 (Self-Inflicted Firearm Injuries); E965.0, E965.1, E965.2, E965.3, E965.4 (Firearm Assaults); E922.0, E922.1, E922.2, E922.3, E922.8, E922.9, E985.0, E985.1, E985.2, E985.3, E985.4, E979.4, E970 (Other Firearm Injuries).

- **Denver Health Trauma Registry** Denver Health and Hospital Authority, which is a safety net hospital that is also home to a Level I Trauma Center, collects, manages and submits trauma data per Colorado statewide trauma registry requirements. For the purposes of this report, the Denver Health trauma registry data can be viewed as a subset of the Colorado trauma registry data described above. The primary reason for including Denver Health trauma registry data in addition to data from the state trauma registry is timeliness. Because data are only submitted to the state periodically, there is a time lag between when the data are collected and when they are available for analysis. Denver Health trauma registry data are available in near real time. The data reviewed for this report included only patients with a Denver residence zip code, injured by a firearm anywhere in the state who were alive at discharge from the hospital and were treated at Denver Health. Firearm injuries were determined by selecting patients with ICD-9 E-codes of: E955.0, E955.1, E955.2, E955.3, E955.4 (Self-Inflicted Firearm Injuries); E965.0, E965.1, E965.2, E965.3, E965.4 (Firearm Assaults); E922.0, E922.1, E922.2, E922.3, E922.8, E922.9, E985.0, E985.1, E985.2, E985.3, E985.4, E979.4, E970 (Other Firearm Injuries) and ICD-10 Cause Codes W32-W34, X72-X74, X93-X95, Y22-Y24, Y35.0 and U01.4.
- **EMS trip reports completed by the Denver Health Paramedics Division** The Denver Health Paramedics Division is the primary provider of emergency medical services (EMS) for the City and County of Denver, handling about 95% of more than 100,000 911 responses in a given year. The Denver Health Paramedic Division manages trip report data electronically - in a system built and maintained by High Plains Information Systems, Inc. Each 911 call is assigned by the paramedic as either a “Medical” call or a “Trauma” call, depending on the nature of the incident. All “Trauma” calls are in response to some sort of injury. Injuries are also assigned categorical “cause” codes by the paramedics. The EMS data described in this report pertain to “Trauma” cases that were assigned as a “Firearm injury (GSW)” in the cause field between 1/1/2011 and 3/31/2017.

Additionally, the between-city comparisons were drawn from data published in a Morbidity and Mortality Weekly Report (MMWR) article titled “Violence-Related Firearm Deaths Among Residents of Metropolitan Areas and Cities - United States, 2006-2007.” The article, published on May 13, 2011 and authored by Scott R. Kegler, Joseph L. Annett, Marcie-jo

Kresnow and James A. Mercy, is freely available for download from the internet.

Limitations

This report is limited in a number of ways.

- These data capture a limited set of variables about the physical trauma associated with firearm injuries. There are factors that influence the occurrence of firearm injuries that are not captured in the available data sources. Furthermore, the *psychological* trauma that survivors and entire communities bear is only indirectly addressed in the pages that follow. Community assets that are currently acting to prevent firearm injuries are not accounted for in this document. After-school programs, mental health services, family and community support, employment opportunities and particular law enforcement strategies are helping keep the numbers lower than where they might otherwise be. And it is always important for public health practitioners to keep in mind that each statistic in this report represents real people with unique identities, families and friends.
- Several of the subgroup comparisons were limited by small sample sizes. For example, comparisons of fatal injury rates by race revealed differences between groups. Small numbers decreased the precision of the rate estimates and we could not reach clear conclusions whether the differences were meaningful or whether they were just due to chance.
- The data summarized in this report is limited to Denver residents. Injuries to residents of other jurisdictions that occurred in Denver are excluded from this report.
- Data from the Denver Health Trauma Registry and the Denver Health Paramedics Division may be missing data on eligible cases. The Denver Health Trauma Registry captures the majority (about 72%), but not all, of eligible trauma cases. The Denver Health Paramedics Division captures the majority (about 95%), but not all, of the eligible EMS responses. If the cases that are captured differ substantially from the cases that are not captured, the overall demographic and geographic trends may be different than the patterns described in this report.
- None of these data were originally collected with the explicit intent of conducting public health surveillance. Even the Violent Death Reporting System, which is the only true public health surveillance system used in this report, relies on data sources that were compiled for other purposes (e.g. law enforcement). The use of so-called “secondary data sources” has a number of implications:
 - Different information systems collect the same information using different methods, which could affect comparisons across data sources. For example, the Denver Health Trauma Registry categorizes firearm injuries using ICD-9 and ICD-10 codes, whereas the paramedics have a much shorter list of codes to indicate the cause of injury for a given case.
 - An individual involved in gun violence may face criminal prosecution. This could lead to bias in certain data sources. For example, whether an ambulance is called

to a scene (and thus get captured in the paramedic trip report data), could be influenced by an individual's concern about being arrested.

- There are potential risk and protective factors that are simply not collected in the available data systems. For instance, transgendered individuals may be at a higher or lower risk of a firearm-related injury than people who are not transgendered. Because information systems rarely distinguish between gender identity and sex, we cannot assess the absolute or relative risk of firearm injury among transgendered individuals in Denver.