# Violent death rates in the US compared to those of the other high-income countries, 2015

Erin Grinshteyn[a],[*], David Hemenway[b]

[a] Health Professions Department, School of Nursing and Health Professions, 2130 Fulton Street, San Francisco, CA 94177, United States of America
[b] Department of Health Policy and Management, Harvard T.H. Chan School of Public Health, 677 Huntington Avenue, Boston, MA 02115, United States of America

ARTICLE INFO

ABSTRACT

Violence is a serious public health issue in the U.S. This research compares the US and other high-income countries in terms of violent death. We used data from the World Health Organization for populous, high-income countries. Data from CDC's WISQARS and WONDER systems were used to assess mortality data among US white and non-white populations and in low-, medium-, and high-gun states in 2015. Death rates per 100,000 populations were calculated overall, by age, and by sex. Poisson and negative binomial regression were used to test for significance. The homicide rate in the US was 7.5 times higher than the homicide rate in the other high-income countries combined, which was largely attributable to a firearm homicide rate that was 24.9 times higher. The overall firearm death rate was 11.4 times higher in the US than in other high-income countries. In this dataset, 83.7% of all firearm deaths, 91.6% of women killed by guns, and 96.7% of all children aged 0–4 years killed by guns were from the US. Firearm homicide rates were 36 times higher in high-gun US states and 13.5 times higher in low-gun US states than the firearm homicide rate in other high-income countries combined. The firearm homicide rate among the US white population was 12 times higher than the firearm homicide rate in other high-income countries. The US firearm death rate increased between 2003 and 2015 and decreased in other high-income countries. The US continues to be an outlier among high-income countries with respect to firearm deaths.

## 1. Introduction

Injuries are a major public health problem in the United States, accounting for more potential years of life lost before age 65 than cancer and heart disease combined. Intentional injuries (i.e., suicide and homicide) accounted for 27% of all US injury deaths in 2016. Among 15–34 year-olds, suicide and homicide were the second and third leading cause of death from all causes (National Center for Injury Prevention and Control, 2016).

Compared to other high-income countries, the US is an average country in terms of non-fatal crime and violence, but has much higher rates of gun homicide, overall homicide, gun suicide, and accidental gun deaths (Zimring and Hawkins, 1997) (Hemenway, 2017). A recent study that examined firearm-related mortality data from 195 countries found that in terms of total numbers, the US had the second largest number firearm-related deaths in 2016 and, when combined with the country that had the largest number of firearm-related deaths (Brazil), accounted for 32% of firearm deaths worldwide (The Global Burden of Disease 2016 Injury Collaborators, 2018). The United States has many

more guns per capita than any other high-income country and the most permissive gun laws (Hemenway, 2017).

Previously, using data from 2003 and then from 2010, we compared violent death rates in the US—for all age groups stratified by sex—with rates in the other high-income countries (Richardson and Hemenway, 2011; Grinshteyn and Hemenway, 2016). The current article updates these previous studies with data from 2015, and expands upon the previous analyses by comparing the other high-income countries to subgroups within the US, both comparing violent death rates in low-, medium-, and high-gun US states with those of other high-income countries, and comparing violent death rates of US whites and nonwhites to rates in these other countries. While studies have found that rates of firearm-related violence in low-gun states are lower than rates of firearm violence in high-gun states (Miller et al., 2002a,b), we examine how safe residents of the low-gun US states do compared with residents of the other high-income countries. Research has also shown that firearm homicide rates among nonwhites in the US are much higher than rates of firearm homicides among whites (Riddell et al., 2018). This paper examines how rates for US Black and White

populations compare with rates in other high-income countries. We are thus able to determine the extent to which firearm homicide victimization is also a relative problem for whites in the US compared with residents of other developed countries.

## 2. Methods

### 2.1. Data source

The World Health Organization's (WHO) Mortality Database compiles numbers of deaths by cause using data from each country's national vital registration systems. Cause of death is classified using International Classification of Diseases, 10th Revision (ICD-10).

### 2.2. Study population

We investigated data for all populous (i.e., greater than one million inhabitants) countries defined as high income by the Organisation for Economic Co-operation and Development (OECD) for 2015 (OECD, 2015). There were 31 countries defined as high-income by OECD for 2015, the most recent year of data available for the majority of countries [Australia, Austria, Belgium, Canada, Chile, Czech Rep, Denmark, Estonia, Finland, France, Germany, Greece, Iceland, Ireland, Israel, Italy, Japan, the Republic of Korea, Luxembourg, Netherlands, New Zealand, Norway, Poland, Portugal, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, United Kingdom (inclusive of England and Wales, Northern Ireland and Scotland), and the United States]. Iceland and Luxembourg were excluded for having small populations (i.e., less than one million inhabitants). Since 2010, Chile and Estonia have been added to the list of high-income OECD countries. Data from 2015 were used for all countries except for six countries that did had not yet reported 2015 data. The most recent year of available data was 2014 for France, Ireland, Portugal, and Slovak Republic and 2013 for Canada and New Zealand.

Mortality data were organized into six mutually exclusive categories using ICD-10 codes to define mortality as firearm-related homicide (X93, X94, X95, U01.4), non-firearm-related homicide (X85, X86, X87, X88, X89, X90, X91, X92, X96, X97, X98, X99, Y00, Y01, Y02, Y03, Y04, Y05, Y06, Y07, Y08, Y09, U01.0, U01.2, U01.3, U01.5, U01.6, U01.7, U01.8, U01.9, U02), firearm-related suicide (X72, X73, X74), non-firearm-related suicide (X60, X61, X62, X63, X64, X65, X66, X67, X68, X69, X70, X71, X75, X76, X77, X79, X80, X81, X82, X83, X84, Y87.0, U03), unintentional firearm death (W32, W33, W34), and undetermined firearm death (Y22, Y23, Y24). All countries used detailed four-digit ICD-10 codes except for Estonia, Finland, the Republic of Korea, Slovenia, and Switzerland, which only use 3-character ICD-10 codes. As a result, 226 fatalities were removed from the analysis as it was not possible to determine whether the "Y87" coded deaths are Y87.0 (non-firearm-related suicide), Y87.1 (non-firearm-related homicide), or Y87.2–Y87.9, which are neither.

Population data were also derived from the WHO mortality database for the corresponding year of mortality data that was available for each country. In some cases (Canada, Chile, Finland, Ireland, Israel, the Republic of Korea, Switzerland, and the United States), population data were not available. For those countries, data from the United Nations Desa Population Division World Population Prospects were used for the corresponding year of mortality data that was available (UN, 2015). Age specific data were only available in either 2010 or 2015. Thus, for Canada and Ireland (whose years of data were 2013 and 2014, respectively), the 2010 and 2015 data were used to interpolate the age-specific population estimates in these years.

We used two databases from the CDC to compare subgroups in the US to the other high-income countries. Data from the Centers for Disease Control and Prevention's (CDC) Web-based Injury Statistics Query and Reporting System (WISQARS) were used to calculate mortality rates among white and non-white populations in the United States

(WISQARS, 2015) so that mortality rates in each of these groups could be compared with mortality rates in other high-income countries. Data from the CDC's Wide-ranging ONline Data for Epidemiologic Research (WONDER) was used to calculate mortality rates among high-gun, medium-gun, and low-gun states (WONDER, 2015) so that mortality rates in each of these three groups could be compared with mortality rates in other high-income countries. To determine which states were low-, medium-, or high-gun states we used a previously validated proxy for state-level household firearm ownership, which is the fraction of all suicides that involve a firearm (Azrael et al., 2004; Kleck, 2004). Using the fraction of all suicides that involve a firearm in each state, states have been designated as high- (Alaska, Georgia, Idaho, Kentucky, Louisiana, Missouri, Montana, Oklahoma, South Carolina, and West Virginia) and low-gun (Connecticut, Hawaii, Massachusetts, New Jersey, and New York) in a recent study for 2015–16 (Hemenway et al., 2018). Hemenway et al. (2018) selected the states with the highest proportion of suicides that involved a firearm and states with the lowest proportion of suicides that involved a firearm, including enough states in each group so that the number or person-years in the high- and low-gun states were roughly the same. All states plus Washington D.C. that were not categorized as high- or low-gun were categorized as medium-gun states (n = 36). While there are no accurate measures of private gun ownership across the world, the best estimates show that every other high-income country has lower levels of private gun ownership than the US (Small Arms Survey, 2017).

### 2.3. Statistical analysis

We stratified the data into mutually exclusive age categories (0–4 years, 5–14 years, 15–24 years, 25–34 years, 35–64 years, and 65+ years) and by sex. Mortality rates per 100,000 population were calculated for the United States, for each other high-income country, and for the aggregation of the non-US countries, by age and sex and overall. In addition, we calculated the same rates for the US states that have the most guns (high-gun states), the US states that have the fewest guns (low-gun states), and all other states including Washington D.C. (medium-gun states). The high-gun states were Alaska, Georgia, Idaho, Kentucky, Louisiana, Missouri, Montana, Oklahoma, South Carolina, and West Virginia. The low-gun states were Connecticut, Hawaii, Massachusetts, New Jersey, and New York. All other states and Washington D.C. were included in the medium-gun states. Finally, these rates were calculated for US white and US non-white populations.

For totals, the numbers include a small number of deaths attributed to those of unknown age. We do not present a column for unknown since these numbers are tiny. Ratios were calculated comparing the United States with the aggregate of all non-US high-income OECD countries. Ratios were also calculated comparing the aggregate of these other countries to high-gun US states, medium-gun US states, and low-gun US states and to US white and US non-white populations.

Tests of significance were performed using Poisson and negative binomial techniques to assess the statistical significance of differences in mortality in the United States versus non-US countries. Negative binomial models were used when the dispersion parameter showed that the data were over-dispersed. All analyses were performed using Excel and Stata version 13.1 (StataCorp, 2013).

This research project was exempt from the Institutional Review Board approval and exempt from certification of exemption from the University of San Francisco.

## 3. Results

### 3.1. United States

In 2015, there were >17,000 homicides in the United States or 5.6 homicides per 100,000 US population (Table 1). Almost 73% of these homicides were firearm homicides. There were 9.4 firearm homicides

**Table 1**
Death rates in the United States per 100,000 population, 2015.

|  | 0–4 y | 5–14 y | 15–24 y | 25–34 y | 35–64 y | 65 + y | Totals |
|---|---|---|---|---|---|---|---|
| Overall |  |  |  |  |  |  |  |
| Firearm homicide rate | 0.3 | 0.5 | 9.4 | 9.1 | 3.4 | 0.9 | 4.1 |
| Non-firearm homicide | 2.9 | 0.3 | 1.3 | 2.0 | 1.7 | 1.1 | 1.5 |
| Total homicide rate | 3.2 | 0.7 | 10.7 | 11.1 | 5.1 | 2.0 | 5.6 |
| Firearm suicide rate | 0.0 | 0.3 | 5.6 | 7.1 | 8.7 | 11.8 | 6.9 |
| Non-firearm suicide rate | 0.0 | 0.7 | 6.8 | 8.8 | 10.2 | 5.1 | 6.9 |
| Total suicide rate | 0.0 | 1.0 | 12.4 | 15.9 | 18.9 | 16.9 | 13.8 |
| Unintentional firearm death | 0.1 | 0.1 | 0.3 | 0.2 | 0.1 | 0.1 | 0.2 |
| Undetermined firearm death | 0.0 | 0.0 | 0.2 | 0.1 | 0.1 | 0.1 | 0.1 |
| Firearm death rates | 0.4 | 0.9 | 15.4 | 16.6 | 12.3 | 12.9 | 11.2 |
| Firearm deaths | 87 | 356 | 6798 | 7251 | 15,228 | 6039 | 35,759 |
| Males |  |  |  |  |  |  |  |
| Firearm homicide rate | 0.3 | 0.6 | 16.5 | 16.3 | 5.5 | 1.2 | 7.0 |
| Non-firearm homicide | 3.4 | 0.3 | 1.8 | 2.7 | 2.5 | 1.5 | 2.0 |
| Total homicide rate | 3.7 | 0.9 | 18.3 | 19.0 | 8.0 | 2.7 | 9.0 |
| Firearm suicide rate | 0.0 | 0.5 | 9.6 | 12.3 | 14.5 | 24.3 | 11.9 |
| Non-Firearm suicide rate | 0.0 | 0.7 | 9.7 | 13.2 | 13.7 | 7.3 | 9.5 |
| Total Suicide rate | 0.0 | 1.2 | 19.3 | 25.5 | 28.2 | 31.6 | 21.5 |
| Unintentional firearm death | 0.2 | 0.1 | 0.5 | 0.3 | 0.2 | 0.3 | 0.3 |
| Undetermined firearm death | 0.0 | 0.0 | 0.3 | 0.2 | 0.1 | 0.1 | 0.1 |
| Firearm death rates | 0.5 | 1.2 | 26.8 | 29.2 | 20.4 | 25.9 | 19.3 |
| Firearm deaths | 53 | 258 | 6070 | 6284 | 12,526 | 5367 | 30,558 |
| Females |  |  |  |  |  |  |  |
| Firearm homicide rate | 0.3 | 0.3 | 1.9 | 2.2 | 1.3 | 0.7 | 1.2 |
| Non-firearm homicide | 2.4 | 0.2 | 0.9 | 1.3 | 1.0 | 0.8 | 1.0 |
| Total homicide rate | 2.7 | 0.5 | 2.8 | 3.5 | 2.2 | 1.5 | 2.2 |
| Firearm suicide rate | 0.0 | 0.1 | 1.3 | 2.1 | 3.0 | 1.8 | 1.9 |
| Non-firearm suicide rate | 0.0 | 0.6 | 3.9 | 4.4 | 6.8 | 3.4 | 4.4 |
| Total suicide rate | 0.0 | 0.8 | 5.2 | 6.5 | 9.8 | 5.2 | 6.3 |
| Unintentional firearm death | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 |
| Undetermined firearm death | 0.0 | 0.0 | 0.1 | 0.1 | 0.0 | 0.0 | 0.0 |
| Firearm death rates | 0.4 | 0.5 | 3.4 | 4.4 | 4.3 | 2.6 | 3.2 |
| Firearm deaths | 34 | 98 | 728 | 967 | 2702 | 672 | 5201 |

and 9.1 firearm homicides per 100,000 population respectively for those aged 15–24 years and those aged 25–34 years. Results among the 15–24 years age category were also analyzed as two groups (15–20 years and 21–24 years) as those who are younger than 21 years of age are usually not allowed to either purchase a handgun in the US or purchase alcohol, which has been associated with firearm-related deaths. Among males and overall, the rates of firearm homicide and firearm suicide were approximately 70% higher in the 21–24 years of age group than they were in the 15–20 years of age group (results not shown). The overall suicide rate in the US was more than double the overall homicide rate in the US at 13.8 per 100,000 population; half of those suicides were firearm suicides. The firearm suicide rate increased with age. All violent death rates were much higher among men than among women. There were > 35,000 US firearm deaths in 2015 out of a population of 321 million persons —approximately 98 deaths per day.

### 3.2. Other high-income countries

There were 0.7 homicides per 100,000 population in the other high-income countries (Table 2). About 30% of these homicides were firearm homicides. There were 0.3 firearm homicides per 100,000 population both for those aged 15–24 years and those aged 25–34 years. The overall suicide rate was almost 20 times the homicide rate at 19.8 per 100,000 population; 5% of those suicides were firearm suicides. The firearm suicide rate was 0.7 per 100,000 population and increased with age for men, rising with age and then falling for women. Violent death rates were higher among men than among women. There were > 6958 firearm deaths in a population of 712,366,292 persons —approximately 19 deaths per day.

### 3.3. US Comparisons with the other high-income countries

The US homicide rate was 7.5 times higher than that of the other 28

high-income countries combined (Table 3). This was driven by a firearm homicide rate that was 24.9 times higher. The non-firearm homicide rate in the US was 2.6 times higher than in the other countries.

Overall suicide rates were similar between the US and the other high-income countries. The US firearm suicide rate was 9.8 times higher, the non-firearm suicide rate was half as high.

The overall firearm death rate in the US was 11.4 times higher than the firearm death rate in the other high-income countries. In the US, the total population for 2015 was 320 million people. There were more than twice as many people in the combined population of the other 28 countries (717 million people). Of all firearm deaths across the 29 countries, 83.7% occurred in the US, 91.6% of women killed by firearms were women in the US, and 96.7% of all children aged 0–4 and 92.0% of all young people aged 5–14 years killed by firearms were from the US.

Among all the high-income countries, the US had the highest rates of firearm homicide, firearm suicide, and unintentional firearm deaths per 100,000 population (Table 4). The US firearm homicide rate was more than twice as large as the country with the next highest firearm homicide rate; the US rate was 4.0 per 100,000 population with Chile next with a rate of 1.9 per 100,000 population. No other country even approached one firearm homicide per 100,000 population. The firearm suicide rate in the US was 2.7 times larger than the country with the second highest firearm suicide rate. The firearm suicide rate in the US was 6.9 per 100,000 population; Switzerland was second with a firearm suicide rate of 2.5 per 100,000 population. The US had the eighth highest total suicide rate. The highest total suicide rate (53.5 per 100,000 population) was in the Republic of Korea and the second highest was in Slovenia (20.5 per 100,000 population).

**Table 2**
Death rates in non-US high-income countries per 100,000 population, 2015[a].

|  | 0–4 y | 5–14 y | 15–24 y | 25–34 y | 35–64 y | 65 + y | Totals |
|---|---|---|---|---|---|---|---|
| **Overall** | | | | | | | |
| Firearm homicide rate | 0.0 | 0.0 | 0.3 | 0.3 | 0.2 | 0.1 | 0.2 |
| Non-firearm homicide | 0.5 | 0.2 | 0.5 | 0.7 | 0.7 | 0.5 | 0.6 |
| Total homicide rate | 0.5 | 0.2 | 0.8 | 1.0 | 0.8 | 0.6 | 0.7 |
| Firearm suicide rate | 0.0 | 0.0 | 0.5 | 0.7 | 1.5 | 3.5 | 0.7 |
| Non-firearm suicide rate | 0.0 | 0.4 | 7.6 | 11.8 | 16.1 | 17.9 | 13.0 |
| Total suicide rate | 0.0 | 0.4 | 7.9 | 12.1 | 16.8 | 19.4 | 13.7 |
| Unintentional firearm death | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Undetermined Firearm Death | 0.0 | 0.0 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 |
| Firearm death rates | 0.0 | 0.0 | 0.7 | 0.8 | 1.0 | 1.8 | 1.0 |
| Firearm deaths | 3 | 31 | 552 | 707 | 3144 | 2528 | 6965 |
| **Males** | | | | | | | |
| Firearm homicide rate | 0.0 | 0.0 | 0.5 | 0.6 | 0.2 | 0.1 | 0.3 |
| Non-firearm homicide | 0.4 | 0.2 | 0.7 | 0.9 | 0.8 | 0.6 | 0.7 |
| Total homicide rate | 0.5 | 0.2 | 1.2 | 1.5 | 1.1 | 0.7 | 1.0 |
| Firearm suicide rate | 0.0 | 0.0 | 0.5 | 0.6 | 1.5 | 3.4 | 1.3 |
| Non-firearm suicide rate | 0.0 | 0.4 | 10.9 | 18.0 | 24.0 | 28.3 | 18.5 |
| Total suicide rate | 0.0 | 0.5 | 11.4 | 18.6 | 25.5 | 31.7 | 19.8 |
| Unintentional firearm death | 0.0 | 0.0 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 |
| Undetermined firearm death | 0.0 | 0.0 | 0.1 | 0.1 | 0.1 | 0.3 | 0.1 |
| Firearm death rates | 0.0 | 0.0 | 1.2 | 1.4 | 1.9 | 3.9 | 1.8 |
| Firearm deaths | 1 | 17 | 513 | 635 | 2907 | 2413 | 6486 |
| **Females** | | | | | | | |
| Firearm homicide rate | 0.0 | 0.0 | 0.0 | 0.1 | 0.1 | 0.1 | 0.1 |
| Non-firearm homicide | 0.5 | 0.2 | 0.4 | 0.4 | 0.5 | 0.5 | 0.4 |
| Total homicide rate | 0.5 | 0.2 | 0.4 | 0.5 | 0.5 | 0.6 | 0.5 |
| Firearm suicide rate | 0.0 | 0.0 | 0.0 | 0.1 | 0.1 | 0.1 | 0.1 |
| Non-firearm suicide rate | 0.0 | 0.4 | 4.2 | 5.7 | 8.3 | 10.0 | 6.7 |
| Total suicide rate | 0.0 | 0.4 | 4.2 | 5.7 | 8.3 | 10.0 | 6.8 |
| Unintentional firearm death | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Undetermined firearm death | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Firearm death rates | 0.0 | 0.0 | 0.1 | 0.2 | 0.2 | 0.1 | 0.1 |
| Firearm deaths | 2 | 14 | 39 | 72 | 237 | 115 | 479 |

[a] 2015 were used for all except six countries as 2015 data were not available in these six cases. For these countries, we used the most recent data available. The countries and years of data that were used are as follows: Canada: 2013; France: 2014; Ireland: 2014, New Zealand: 2013; Portugal: 2014; Slovak Republic: 2014.

*3.4. Low- medium- and high-gun states compared with other countries*

In the high-gun US states, the firearm homicide rate (6.0 per 100,000 population) was 36 times higher than the firearm homicide rate in the other high-income countries combined (0.16 per 100,000 population) (Table 5). Even in the low-gun US states the firearm homicide rate (2.2 per 100,000 population) was 13.5 times the firearm homicide rate of other high-income countries. Non-firearm homicides were slightly higher in the high-gun states (1.8 per 100,000 population) than in the low-gun states (1.2 per 100,000 population); these rates were 2–3 times higher than the rate in the other high-income countries (0.6 per 100,000 population). The firearm suicide rate in high-gun states (10.3 per 100,000 population) was 14.7 times higher than the firearm suicide rate in the other high-income countries combined (0.7 per 100,000 population) and the firearm suicide rate in low-gun states (2.1 per 100,000 population) was 3 times higher. The non-firearm suicide rates in the low-, medium-, and high-gun states were similar (6.9, 7.0, and 6.4 per 100,000 population), about half as high as the non-firearm suicide rate of the other high-income countries.

*3.5. White and non-white mortality compared with other countries*

The firearm homicide rate among the white population in the US (2.0 per 100,000) was far lower than the firearm homicide rate among the US non-white population (11.5 per 100,000 population). Yet, the firearm homicide rate among the US white population was still over 12 times higher than the firearm homicide rate of the other high-income countries and the non-firearm homicide rate (0.2 per 100,000 population) was twice as high. The firearm suicide rate among the white population in the US (8.1 per 100,000) was three times higher than the firearm suicide rate among the non-white population in the US (2.4 per

100,000 population) and 11 times higher than that of the other high-income countries (0.7 per 100,000 population). Non-firearm suicide rates among the US white population were also higher (7.7 per 100,000 population) than in the US non-white population (3.9 per 100,000 population) but much lower than the non-firearm suicide rate in the other high-income countries (12.9 per 100,000 population).

**4. Discussion**

The US continues to be an outlier among high-income countries in terms of firearm deaths. Indeed, it has become more of an outlier in the 21st century. Between 2003 and 2015, the US firearm death rate increased from 10.2 to 11.2 (Richardson and Hemenway, 2011). During the same period, the firearm death rate of the other high-income countries declined, so that the relative situation in the US has worsened. In 2003 the firearm death rate was 7.5 times higher, in 2010 it was 10.0 times higher, and by 2015 it was 11.4 times higher than that of the other high-income countries (Richardson and Hemenway, 2011) (Grinshteyn and Hemenway, 2016). The relative firearm homicide rate in the US rose from 19.5 times higher in 2003 to 24.9 times higher in 2015; the firearm suicide rate rose from 5.8 times higher to 9.8 times higher (Richardson and Hemenway, 2011; Grinshteyn and Hemenway, 2016).

Not one of the other high-income countries compares to the US. The US accounts for 31% of the population of the OECD high-income countries, but in 2015, 92% of the women killed by guns, 96.7% of children aged 0–4 years and 92% of children aged 5–14 years killed by guns were from the US. These findings are consistent not only with previous analyses comparing the US to other high-income countries, but with recent papers examining a much bigger range of countries including both developing and developed nations (The Global Burden of

**Table 3**
Ratio of US death rates to death rates in other high-income countries, 2015[a].

| | 0–4 y | 5–14 y | 15–24 y | 25–34 y | 35–64 y | 65+ y | Totals |
|---|---|---|---|---|---|---|---|
| **Overall** | | | | | | | |
| Firearm homicide rate | 54.5 | 29.1 | 31.1** | 28.2** | 21.4** | 11.5 | 24.9** |
| Non-firearm homicide | 6.1** | 1.5 | 2.6 | 2.9 | 2.6 | 2.1 | 2.6 |
| Total homicide rate | 6.6** | 3.7 | 13.0** | 10.9** | 6.3** | 3.3 | 7.5** |
| Firearm suicide rate | – | 9.4 | 10.6** | 10.7** | 5.7** | 3.4** | 9.8** |
| Non-firearm suicide rate | – | 1.5 | 0.9 | 0.7 | 0.6 | 0.3 | 0.5 |
| Total suicide rate | – | 2.2 | 1.6 | 1.3 | 1.1 | 0.9 | 1.0 |
| Unintentional firearm death | – | 20.2 | 8.2 | 4.3 | 3.3 | 3.0 | 4.1 |
| Undetermined firearm death | 5.6 | 2.4 | 3.0 | 2.5 | 1.0 | 0.7 | 1.2 |
| Firearm death rates | 54.5 | 21.1** | 23.3** | 22.1** | 11.9** | 7.3** | 11.4** |
| Firearm deaths | 90 | 387 | 7350 | 7958 | 18,372 | 8567 | 42,724 |
| **Males** | | | | | | | |
| Firearm homicide rate | 58.5 | 28.8 | 30.2** | 28.0** | 22.2** | 13.1** | 26.7** |
| Non-firearm homicide | 7.5** | 2.1 | 2.7 | 2.8 | 2.9 | 2.5 | 2.9 |
| Total homicide rate | 8.1** | 5.1** | 15.0** | 12.4** | 7.3** | 3.9** | 9.4** |
| Firearm suicide rate | – | 34.1 | 19.6** | 20.3** | 10.0** | 7.1** | 9.0** |
| Non-firearm suicide rate | – | 1.5 | 0.9 | 0.7 | 0.6 | 0.3** | 0.5 |
| Total suicide rate | – | 2.6** | 1.7** | 1.4** | 1.1** | 1.0 | 1.1 |
| Unintentional firearm death | – | – | 7.9 | 4.2 | 3.1 | 2.5 | 3.9 |
| Undetermined firearm death | – | 1.8 | 2.9 | 2.0 | 0.8 | 0.5 | 1.0 |
| Firearm death rates | 99.9** | 28.0** | 22.5** | 21.4** | 10.6** | 6.6** | 10.8** |
| Firearm deaths | 54 | 275 | 6583 | 6919 | 15,433 | 7780 | 37,044 |
| **Females** | | | | | | | |
| Firearm homicide rate | 50.6 | 29.7 | 45.9** | 29.5** | 18.9** | 9.8 | 21.2** |
| Non-firearm homicide | 4.7** | 1.0 | 2.4 | 2.9 | 2.1 | 1.7 | 2.2 |
| Total homicide rate | 5.2** | 2.5** | 6.9** | 6.7** | 4.2** | 2.7** | 4.4 |
| Firearm suicide rate | – | 6.6 | 36.4** | 36.7** | 47.3** | 31.7** | 37.6** |
| Non-firearm suicide rate | – | 1.6 | 0.9 | 0.8 | 0.8 | 0.3 | 0.7 |
| Total suicide rate | – | 1.8** | 1.2** | 1.1** | 1.2** | 0.5 | 0.9 |
| Unintentional firearm death | – | 2.7 | 16.9 | 4.7 | 5.5 | 10.8 | 6.9 |
| Undetermined firearm death | – | – | 4.1 | 7.3 | 2.7 | 3.4 | 3.4 |
| Firearm death rates | 31.8** | 12.8** | 35.1** | 28.9** | 27.9** | 18.1** | 25.2** |
| Firearm deaths | 36 | 112 | 767 | 1039 | 2939 | 787 | 5680 |

[a] 2015 were used for all except six countries as 2015 data were not available in these six cases. For these countries, we used the most recent data available. The countries and years of data that were used are as follows: Canada: 2013; France: 2014; Ireland: 2014, New Zealand: 2013; Portugal: 2014; Slovak Republic: 2014.

** Significant differences at the $p \leq 0.05$ level between US and non-US countries are indicated by the double asterisk (**).

Disease 2016 Injury Collaborators, 2018). Our analyses add to that recent paper by allowing comparisons of the US compared to its peer countries in terms of overall homicide and overall suicide (and non-firearm homicide and suicide), and by gender and by age. In addition, we compare subgroups within the US (i.e., White and Black populations and high-, medium-, and low-gun states) to other high-income nations in terms of homicide and suicide (firearm and non-firearm).

US residents of low-gun states have much lower gun homicide death rates than those living in high-gun states. But even residents of the low-gun US states have over 13 times the gun homicide rate as residents of the other high-income countries, and a higher overall homicide rate compared to every one of these countries except Chile. While, it is much safer to live in the low-gun US states rather than the high-gun states, it would be safer still to live in almost any other high-income country. This may be due to the fact that all other high-income countries also have fewer firearms per capita than the US (Small Arms Survey, 2017). According to the Small Arms Survey (2017), while the US has approximately 120.5 firearms per 100 persons, the country in this analysis with the next highest rate of firearm ownership per capita is Canada with 34.7 firearms per 100 persons. While low-gun states in the US have substantially lower rates of firearm deaths compared to the high-gun states, these results indicate that it is still possible for US residents in low-gun states to be a great deal safer. Residents of virtually every other high-income country have lower rates of gun violence victimization than residents of the low-gun US states.

White individuals in the US have much lower firearm homicide rates than non-White individuals, but US Whites still have 12 times the firearm homicide rate of citizens (of all races) in the other high-income countries. No other high-income country has a firearm homicide rate as high as that of US Whites, and only one country (Chile) comes close.

While the firearm homicide problem in the US disproportionately affects non-Whites, it is also a problem among Whites.

What most differentiates the US is not the rate of non-gun violent deaths but the rate of gun violence. If the US could become an average OECD high-income country in terms of firearm homicide, 96% of our firearm homicides would be eliminated and 70% of our total homicides.

It might be inferred that the relatively high non-gun homicide rate shows that US residents are more violent than residents of other countries—that it is underlying violence rather than guns that explains much of the high homicide rate. An alternative hypothesis is that the non-gun homicide rate in the US is high in part because of the guns (Hepburn and Hemenway, 2004). One of the various arguments behind this hypothesis is that combatants appear to be more likely to use lethal violence if they anticipate their adversaries are armed. Research findings indicate that during assaults, offenders are more likely to kill adversaries who pose a greater threat (Felson and Messner, 1996) (Felson et al., 2014). The average non-gun non-lethal crime and violence rates is also suggestive evidence that the US is not an especially criminal nation (Dijk et al., 2007).

It might be inferred that the average overall suicide rate (for adults) in the US indicates close to complete substitution of methods, that availability of firearms affects the method but not the likelihood of suicide. An alternative explanation is that cultural differences are the most important explanation for the large differences in suicide across countries, but that the availability of lethal means affects suicide within countries. The evidence is overwhelming that gun availability increases the risk of suicide in the United States (Anglemyer et al., 2014) (Miller et al., 2012) (Miller et al., 2013) (Wintemute et al., 1999).

**Table 4**

Rates per 100,000 population of homicides, suicides, and unintentional gun deaths using WHO data, 2015[a].

| | Firearm homicide rate | Non-firearm homicide rate | Firearm suicide rate | Non-firearm suicide rate | Unintentional firearm death rate | Undetermined firearm death rate | Total firearm death rate |
|---|---|---|---|---|---|---|---|
| Country | | | | | | | |
| Australia | 0.1 | 1.0 | 0.7 | 12.0 | 0.0 | 0.0 | 0.9 |
| Austria | 0.1 | 0.5 | 2.5 | 12.0 | 0.0 | 0.1 | 2.7 |
| Belgium | 0.2 | 0.8 | 1.1 | 15.5 | 0.0 | 0.0 | 1.4 |
| Canada | 0.3 | 0.9 | 1.5 | 10.0 | 0.0 | 0.0 | 1.9 |
| Chile | 1.9 | 2.5 | 0.5 | 9.8 | 0.3 | 0.0 | 2.7 |
| Czech Republic | 0.1 | 0.7 | 1.5 | 11.7 | 0.1 | 0.1 | 1.8 |
| Denmark | 0.2 | 0.4 | 0.7 | 9.2 | 0.0 | 0.0 | 0.9 |
| Estonia | 0.0 | 3.2 | 1.1 | 13.7 | 0.0 | 0.2 | 1.3 |
| Finland | 0.2 | 1.1 | 2.2 | 11.1 | 0.0 | 0.0 | 2.4 |
| France | 0.1 | 0.3 | 1.7 | 12.2 | 0.0 | 0.6 | 2.4 |
| Germany | 0.1 | 0.5 | 0.9 | 11.4 | 0.0 | 0.1 | 1.0 |
| Greece | 0.2 | 0.7 | 1.0 | 3.9 | 0.1 | 0.0 | 1.3 |
| Ireland | 0.2 | 0.5 | 0.6 | 9.7 | 0.0 | 0.0 | 0.9 |
| Israel | 0.7 | 1.0 | 0.4 | 3.8 | 0.0 | 0.2 | 1.3 |
| Italy | 0.3 | 0.4 | 0.7 | 5.8 | 0.1 | 0.0 | 1.2 |
| Japan | 0.0 | 0.2 | 0.0 | 18.4 | 0.0 | 0.0 | 0.0 |
| The Republic of Korea | 0.1 | 2.0 | 0.0 | 53.5 | 0.0 | 0.0 | 0.1 |
| Netherlands | 0.2 | 0.4 | 0.3 | 10.8 | 0.0 | 0.0 | 0.5 |
| New Zealand | 0.2 | 1.0 | 1.1 | 10.5 | 0.0 | 0.0 | 1.3 |
| Norway | 0.1 | 0.3 | 1.4 | 10.0 | 0.0 | 0.0 | 1.5 |
| Poland | 0.0 | 0.7 | 0.1 | 14.2 | 0.0 | 0.0 | 0.2 |
| Portugal | 0.2 | 0.8 | 1.1 | 10.6 | 0.0 | 0.1 | 1.5 |
| Slovak Republic | 0.2 | 0.7 | 1.0 | 9.2 | 0.4 | 0.4 | 1.9 |
| Slovenia | 0.0 | 0.6 | 1.7 | 18.7 | 0.0 | 0.0 | 1.9 |
| Spain | 0.1 | 0.5 | 0.4 | 7.3 | 0.0 | 0.0 | 0.6 |
| Sweden | 0.3 | 0.7 | 1.2 | 10.9 | 0.0 | 0.0 | 1.6 |
| Switzerland | 0.2 | 0.3 | 2.5 | 10.4 | 0.0 | 0.0 | 2.8 |
| United Kingdom | 0.0 | 0.2 | 0.2 | 7.4 | 0.0 | 0.0 | 0.2 |
| United States | 4.1 | 1.5 | 6.9 | 6.9 | 0.2 | 0.1 | 11.2 |

[a] 2015 were used for all except six countries as 2015 data were not available in these six cases. For these countries, we used the most recent data available. The countries and years of data that were used are as follows: Canada: 2013; France: 2014; Ireland: 2014, New Zealand: 2013; Portugal: 2014; Slovak Republic: 2014.

### 4.1. Strengths and limitations

A strength of this paper is that the World Health Organization data are complete case reporting of all violent deaths occurring in each high-income country. The data are uniformly coded using ICD-10 codes that are universal. These countries are largely comparable to each other in terms of economic development, political stability, and democratic institutions. Other cross-national studies often include middle-income or developing countries (Felson et al., 2014) (Krug et al., 1998) (Polsby and Kates Jr., 1998) (Killias et al., 2001) (Altheimer and Boswell, 2012); it seems questionable to compare the United States with many middle income countries given the vast differences between the US and many of these nations in development, stability, and democratic institutions—as well as in the accuracy of the national data systems.

This study should not be used to infer causation since there are no control variables—the intent is to show some basic demographic data on violent death in high-income countries, focusing on firearm deaths

and comparing other countries with the United States. This paper is not trying to explain the variations in violent death across all these countries. In addition, when running large numbers of tests of association, one expects to sometimes find a statistically significant relationships when there is no true relationship. Nevertheless, we find that almost all firearm death comparisons between the US and the other high-income countries are statistically significant, and highly statistically significant. The age group 15–24 includes both those who are legally permitted to purchase a handgun and to purchase alcohol in the US (ages 21–24) and those who generally are not (ages 15–20). US rates for firearm homicide and firearm suicide are roughly 70% higher for the 21–24 year olds as for the 15–20 age group. In the tables, consistent with prior research, we provide 10 year groupings so that trends over time can be examined.

Although this study is purely cross-sectional, the data when combined with our previous papers using data from 2003 (Richardson and Hemenway, 2011) and 2010 (Grinshteyn and Hemenway, 2016) allows for some examination of the trends over a dozen years.

**Table 5**

Rates of deaths per 100,000 using WHO data, by subgroup, 2015[a].

| | Firearm homicide rate | Non-firearm homicide rate | Overall homicide rate | Firearm suicide rate | Non-firearm suicide rate | Overall suicide rate | Unintentional firearm death rate | Undetermined firearm death rate |
|---|---|---|---|---|---|---|---|---|
| Non-US Countries (reference) | 0.2 | 0.6 | 0.7 | 0.7 | 13.0 | 13.7 | 0.0 | 0.1 |
| United States | 4.1** | 1.5 | 5.6** | 6.9** | 6.9 | 13.8 | 0.2 | 0.1 |
| High Gun US States | 6.0** | 1.8 | 7.8** | 10.3** | 6.4 | 16.6 | 0.3 | 0.1 |
| Medium Gun US States | 4.0** | 1.5 | 5.5** | 7.1** | 7.0 | 14.1 | 0.2 | 0.1 |
| Low Gun US States | 2.2** | 1.2 | 3.3** | 2.1 | 6.9 | 9.0 | 0.0 | 0.0 |
| Whites | 2.0** | 1.2** | 3.2 | 8.1** | 7.7 | 15.8 | 0.2 | 0.1 |
| Non-Whites | 11.5** | 2.6** | 14.1** | 2.4** | 3.9 | 6.3 | 0.2 | 0.1 |

[a] 2015 were used for all except six countries as 2015 data were not available in these six cases. For these countries, we used the most recent data available. The countries and years of data that were used are as follows: Canada: 2013; France: 2014; Ireland: 2014, New Zealand: 2013; Portugal: 2014; Slovak Republic: 2014.

** Significant differences at the $p \leq 0.05$ level between each row and non-US countries are indicated by the double asterisk (**).

## 5. Conclusion

These results show that the United States suffers excessively from fatal firearm violence compared with other high-income countries—and that the US has become even more of an outlier since 2003. Even residents of the US low-gun states have far higher rates of firearm death than do residents of other high-income countries.

## Acknowledgments/funding

## References

Altheimer, I., Boswell, M., 2012. Reassessing the association between gun availability and homicide at the cross-national level. Am. J. Crim. Justice 37, 682–704.

Anglemyer, A., Horvath, T., Rutherforg, G., 2014. The accessibility of firearms and risk of suicide and homicide victimization among household members. Ann. Intern. Med. 101–110.

Azrael, D., Cook, P.J., Miller, M., 2004. State and local prevalence of firearms ownership measurement, structure, and trends. J. Quant. Criminol. 43–62.

Dijk, J., van Kesteren, J., & Smit, P. (2007). (2007). Criminal victimisation in international perspective. Boom Juridische Uitgevers.

Felson, R.B., Messner, S.F., 1996. To kill or not to kill? Lethal outcomes in injurious attacks. Criminology 201–227.

Felson, R.B., Messner, S.F., Rogers, M.L., 2014. Bring a gun to a gun fight: armed adversaries and violence across nations. Soc. Sci. Res. 79–90.

Grinshteyn, E.G., Hemenway, D., 2016. Violent death rates: the US compared with otherhigh-income OECD countries, 2010. Am. J. Med. 129 (3), 266–273.

Hemenway, D., 2017. Private Guns, Public Health. Ann Arbor, MI. University of Michigan Press.

Hemenway, D., Azrael, D., Conner, A., Miller, M., 2018. Variation in rates of fatal police shootings across US states: the role of firearm availability. J. Urban Health. https://doi.org/10.1007/s11524-018-0313-z.

Hepburn, L.M., Hemenway, D., 2004. Firearm availability and homicide: a review of the literature. Aggress. Violent Behav. 417–440.

Killias, M., Van Kesteren, J., Rindlisbacher, M., 2001. Guns, violent crime and suicide in twenty-one countries. Can. J. Criminol. 156, 429–448.

Kleck, G., 2004. Measures of gun ownership levels for macro-level crime and violence research. J. Res. Crime Delinq. 3–36.

Krug, E.G., Powell, K.E., Dahlberg, L.L., 1998. Firearm-related deaths in the United States and thirty-five other high- and upper-middle-income countries. Int. J. Epidemiol. 27, 214–221.

Miller, M., Azrael, D., Hemenway, D., 2002a. Firearm availability and suicide, homicide, and unintentional firearm deaths among women. J. Urban Health 26–38.

Miller, M., Azrael, D., Hemenway, D., 2002b. Firearm availability and unintentional firearm deaths, suicide, and homicide among 5–14 year olds. J. Trauma Acute Care Surg. 267–275.

Miller, M., Azrael, D., Barber, C., 2012. Suicide mortality in the United States: the importance of attending to method in understanding population-level disparities in the burden of suicide. Annu. Rev. Public Health 393–408.

Miller, M., Barber, C., White, R.A., Azrael, D., 2013. Firearms and suicide in the United States: Is risk independent of underlying suicidal behavior? Am. J. Epidemiol. 946–955.

National Center for Injury Prevention and Control, C. (2016). 10 Leading Causes of Death by Age Group, United States - 2016. Retrieved from Ten Leading Causes of Death and Injury: https://www.cdc.gov/injury/images/lc-charts/leading_causes_of_death_age_group_2016_1056w814h.gif

OECD. (2015). Country Classification for aid and repayment terms. Retrieved from The Organisation for Economic Co-operation and Development (OECD): https://www.oecd.org/trade/xcred/2015-ctryclass-as-of-16-july-2015.pdf

Polsby, D.D., Kates Jr., D.B., 1998. Causes and correlations of lethal violence in America: American homicide exceptionalism. Univ. Colo. Law Rev. 69, 969–1008.

Richardson, E.G., Hemenway, D., 2011. Homicide, suicide and unintentional firearm fatality: comparing the United States with other high-income countries. J. Trauma 70 (238–243).

Riddell, C.A., Harper, S., Cerda, M., Kaufman, J.S., 2018. Comparison of rates of firearm and nonfirearm homicide and suicide in black and white Non-Hispanic Men, by U.S. state. Ann. Intern. Med. 712–720.

Small Arms Survey, 2017. Global Firearms Holdings. Retrieved from Small Arms Survey. http://www.smallarmssurvey.org/weapons-and-markets/tools/global-firearms-holdings.html.

StataCorp. (2013). Stata Statistical Software: Release 13. College Station, TX: StataCorp LLC.

The Global Burden of Disease 2016 Injury Collaborators, 2018. Global mortality from firearms, 1990–2016. JAMA 792–814.

UN, 2015. United Nations DESA/Population Division. Retrieved from Population Indicators. https://population.un.org/wpp/Download/Standard/Population/.

Wintemute, G.J., Parham, C.A., Beaumont, J.J., Wright, M., Drake, C., 1999. Mortality among recent purchasers of handguns. N. Engl. J. Med. 1583–1589.

WISQARS, C., 2015. Fatal injury data. In: Retrieved from Web-based Injury Statistics Query and Reporting System (WISQARS), . https://www.cdc.gov/injury/wisqars/fatal.html.

WONDER, C., 2015. Underlying cause of death, 1999–2016. In: Retrieved from Wide-ranging ONline Data for Epidemiologic Research (WONDER), . https://wonder.cdc.gov/ucd-icd10.html.

Zimring, F.E., Hawkins, G., 1997. Crime is not the Problem: Lethal Violence in America. Oxford University Press, New York, NY.