Firearm availability and sex-specific mortality rates in Europe

Peter GREGORY
University of the People
Pasadena, United States
peter.andrew.gregory@gmail.com

Abstract. *Compared to the number of studies focusing on the United States, studies of gun violence in Europe are relatively few in number. Those studies that do touch on Europe have generally failed to exclusively utilize European data and to incorporate data from all possible countries across the continent. Studies in Europe have also tended to examine only aggregated outcomes, thereby failing to account for possible differences in how gun violence affects different groups. This study begins the process of filling these gaps by utilizing OLS regression and a cross-section of data from 40 European countries to determine how firearm availability across Europe affects mortality rates among men and women. Results indicate that firearm availability is positively associated with multiple measures of mortality among European men and women. Policymakers seeking to prevent violence in their respective countries should view the prevention of gun violence and the regulation of civilian-owned firearms as key priorities.*

Keywords: *Gun violence, Firearms, Homicide, Suicide.*

JEL: C31, H83, K14.

1. Introduction

Gun violence is a public policy problem that affects people and governments on every inhabited continent. Indeed, according to Naghavi et al. (2018), there were more than a quarter-million firearm deaths globally in 2016 alone, with victims in every one of the 195 countries and territories included in the study. While gun violence is a global problem, however, gun violence research has tended overwhelmingly to focus on the occurrence and prevention of gun violence in the United States (US). To some extent, this focus is understandable as the US is a well-known "gun violence outlier among nations" (Branas et al., 2021, p. 243), but it has meant in practice that gun violence in other parts of the world has comparatively received only little attention.

As it pertains to research on gun violence in European countries, Krüsselmann et al. (2021) note that, "Empirical research exclusively using European data is still lacking" (p. 1). Existing studies on gun violence in Europe tend to focus on just one or a handful of developed countries and have tended to report only on aggregated firearm mortality rates. Said differently, the limited existing gun violence research that involves European countries has tended to exclude data from smaller, less developed European nations and has, with few exceptions, failed to distinguish between outcomes that occur between various demographic groups within and across countries. These groups include men and women, members of different racial groups, and members of different economic classes, to name a few.

In light of the failings discussed above, this study contributes to the literature on gun violence in three ways. First, it adds to the body of gun violence research that focuses on countries other than the US. Second, it utilizes data from 40 European countries, including several smaller and less-developed nations that are frequently absent from analyses conducted by other researchers. Outside of global studies such as the work of Naghavi et al. (2018), this study is among the first to incorporate data from all possible European countries when examining gun violence. Finally, this study contributes to the literature on gun violence by examining how firearm availability among civilians across Europe is related to both male- and female-specific firearm mortality rates and total male- and female-specific mortality rates from homicide and suicide. Understanding if and how gun violence affects men and women separately is vital for helping policymakers tailor policy solutions to gun violence for maximum effectiveness.

2. Literature Review

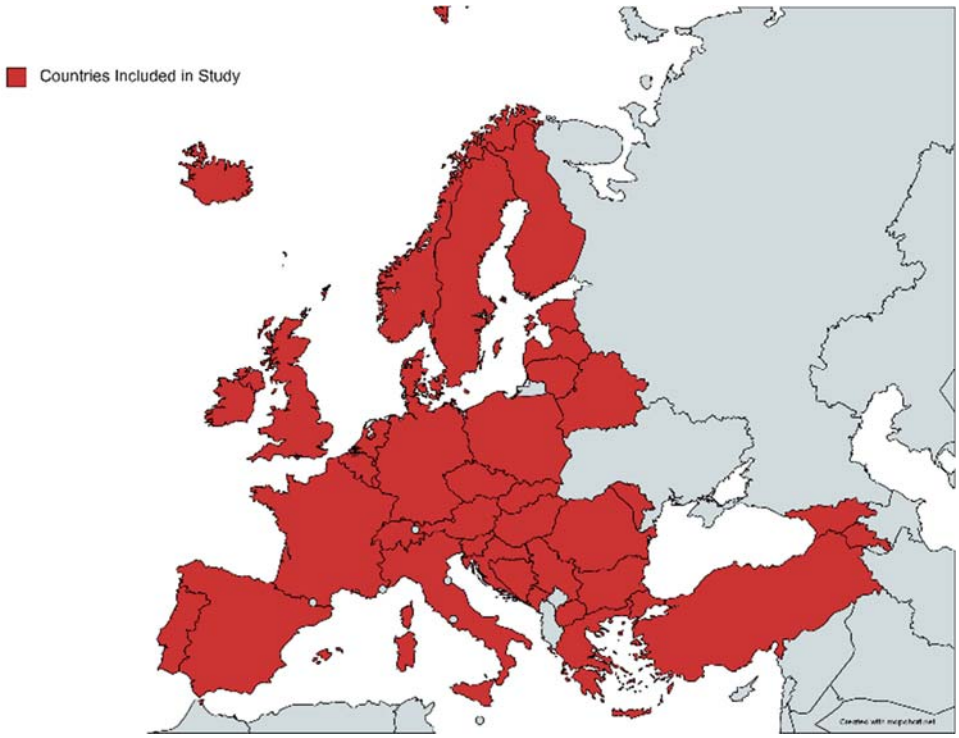
Gun violence cannot occur without a gun. Accordingly, it should come as little surprise that previous research has repeatedly found a robust link between firearm availability and gun violence outcomes. In the US context, for instance, positive associations have been found between civilian gun ownership and firearm homicide rates (Siegel et al., 2014; Siegel et al., 2013); firearm suicide rates (Siegel & Rothman, 2016); and rates of unintentional firearm deaths (Levine & McKnight, 2017; Miller et al., 2001). Likewise, positive associations have been found between civilian gun ownership levels and total homicide rates (Gius, 2009; Miller et al., 2007; Siegel et al., 2014); total suicide rates (Anestis & Houtsma, 2018), and total violent death rates (Hamilton & Kposowa, 2015). Evidence from the US suggests, moreover, that gun ownership rates within a given area are positively associated with gun carrying among youth (Cook & Ludwig, 2004); mass shooting rates (Fridel, 2021; Reeping et al., 2019); homicide death rates among law enforcement officers (Swedler et al., 2015); and rates of homicide committed by law enforcement officers (Hemenway et al., 2019).

Evidence from Europe largely coincides with that from the US. Evidence from Austria (Etzersdorfer et al. 2006), the United Kingdom (Haw et al., 2004), Sweden (Henriksson et al., 1992), and Switzerland (Ajdacic-Gross et al., 2010; Balestra, 2018), for example, indicates that gun ownership is positively associated to rates of firearm suicide. Evidence from Switzerland also suggests that gun ownership is positively associated with total suicide rates (Balestra, 2018). Evidence from Austria indicates that legislation that effectively limited firearm availability simultaneously reduced both firearm suicide and firearm homicide rates in the country (Kaputsa et al., 2007). Evidence from Croatia (Cengija et al., 2012), Switzerland (Grabherr et al., 2010), and a meta-analysis of 27 studies covering eight countries (four of which were European) (Panczak et al., 2013) indicates that gun ownership is positively associated with firearm use in instances of homicide-suicide. In an analysis of 27 developed countries (21 of which were European), Bangalore and Messerli (2013) found that the number of guns per capita in each country was positively associated with total rates of firearm-related death. Finally, in an analysis of 25 high-income countries (17 of which were European), Hemenway et al., (2002) found that more women are victims of homicide in countries where firearms are more available.

3. Data and Methods

This study utilizes STATA to conduct OLS multiple regression modeling of cross-sectional data from 40 European countries (see *Figure 1*). OLS regression is a tool that is well-suited to examining multiple variables and determining whether and to what extent a change in one variable is likely to predict a change in another variable (Kumari & Yadav, 2018; Verbeek, 2017). It offers the least biased linear estimator when its assumptions are met (Kennedy, 2008, p. 43), and it works well even if a model is not perfectly specified (Verbeek, 2017, p. 1).

Figure 1: *Included Countries*[*), ^)]



[*)] Figure created with https://mapchart.net/europe.html

[^)] Albania, Azerbaijan, Kosovo, Russia, and Ukraine were excluded due to lack of sex-specific mortality data. Microstates such as the Vatican City were also excluded.

3.1. Dependent Variables

There are four dependent variables assessed in this study. The first is the total female firearm death rate in each of the 40 European countries included in the

analysis. The second is the total male firearm death rate for the same countries. The third is the total combined homicide and suicide rate for women, and the fourth is the total combined homicide and suicide rate for men. All variables are measured in a "rate per 100,000" format. Data for these variables was collected from gunpolicy.org, a website that collects and publishes data on gun-related measures from countries around the world. Gunpolicy.org is hosted by the Sydney School of Public Health at the University of Sydney and is supported by the United Nations Trust Facility Supporting Cooperation on Arms Regulation (UNSCAR). One regression model was run for each of the main dependent variables – four models in total.

3.2. Independent Variables

The main independent variable in this study is civilian gun ownership. There are only a few possible options for accessing data that directly measure the prevalence of civilian owned guns in Europe. One option is the International Crime Victimization Surveys (ICVS). As Killias and Markwalder (2012) note, these surveys collected data on gun ownership in five different waves across the years 1989, 1992, 1996, 2000, and 2005, ultimately resulting on gun ownership data being gathered for more than 30 countries (p. 262). Specifically, these data measured "how many households (and individuals) in any given country have access to at least one gun" (p.262). Notably, measures of gun ownership derived from the surveys were correlated with both homicide and suicide rates in countries where these data were also available for comparison (p.262). The ICVS, however, was discontinued after 2005, meaning that even the most recent of the data it collected on gun ownership in various countries is nearly two decades old. Accordingly, gun ownership in this study is measured using data from the Small Arms Survey, which measures the number of civilian owned guns per 100 people in countries across the world (Karp, 2018). The most recent data available are for the year 2017.

Variables used as controls to decrease the possibility of omitted variable bias include country-level estimates of GDP per capita, unemployment rates, and alcohol consumption per capita. GDP per capita was measured using World Bank data for the year 2017, with measurement in constant 2015 USD. Unemployment rates were also measured using World Bank data. Alcohol consumption per capita was measured in liters using data compiled by the World Health Organization (2018) for 2016.

4. Results

Full results of the four regression models can be seen in *Table 2*. Results indicate that firearms availability is positively associated with total firearm death rates for both men (p<.01) and women (p<.01). Results further indicate that firearms availability is positively associated with the combined total homicide and suicide rate for both men (p<.05) and women (p<.01). Although these results cannot be taken to be causal, they suggest that firearm availability plays a meaningful role in the predictability of mortality rates of men and women across Europe and are consistent with the conclusion that more guns in the hands of civilians lead to higher rates of combined homicide and suicide mortality among members of both sexes.

Table 2: *OLS Regression Model Results*

	Total Gun Death Rate (Women)	Total Gun Death Rate (Men)	Homicide + Suicide Rate (Women)	Homicide + Suicide Rate (Men)
Gun Availability	.02 (.01)**	.17 (.04)**	.12 (.03)**	.32 (.12)*
GDP Per Capita	-.00 (.00)	-.00 (.00)	-.00 (.00)	-.00 (.00)**
Unemployment	-.01 (.02)	-.14 (.12)	-.22 (.09)*	-.89 (.29)**
Alcohol Consumption Per Capita	-.03 (.03)	-.05 (.17)	.07 (.14)	.92 (.48)

Standard errors in parentheses.
*p<.05, **p<.01, ***p<.001

5. Discussion

As noted above, the results of this study are insufficient to claim a causal relationship between firearm availability and mortality rates among men and women in European countries. That said, there are at least two reasons to believe this may well be the case. First of all, there is a significant body of evidence suggesting that firearms are significantly more lethal than other weapons (e.g., knives or clubs). In one review of studies on the lethality of firearms relative to other weapons, for example, the authors conclude that, "Studies on the lethality of guns, the likelihood of injury by weapon type, offender intent, and firearm availability provide considerable evidence that guns contribute to fatalities that would otherwise have been nonfatal assaults" (Braga et al., 2021, p. 147). These findings suggest, simply, that where there are more guns there are more homicides.

As it pertains to suicides, there is also evidence that more guns lead to more suicides than might otherwise be completed. In the US, for example, one analysis found that although firearms are used in less than one percent of all suicidal acts,

firearms are used in more than half of all suicide deaths (Vyrostek et al., 2004); and a review of studies on suicide modality found that the case fatality ratio in the US "is strongly related to the availability of household firearms" (Miller et al., 2012, p. 393). Although this evidence relies heavily on studies conducted in the US, there is no reason to think that guns are any less lethal in Europe than in the US. There is, similarly, no reason to think that other weapons or suicide modalities besides firearms are less lethal in the US than in Europe. All else being equal, it is reasonable to assume based on the available evidence that more guns lead to higher numbers of homicides and suicides, regardless of the countries they are used in.

The second reason to believe the results of this study are indicative of a causal effect between firearm availability and mortality rates among European men and women is that said results indicate, for both sexes, that firearm availability is associated with both gun-specific death rates and the combined homicide and suicide rates resulting from any cause or method. This finding is consistent with the evidence on firearm lethality and suggests it is unlikely that a substitution effect would have kept homicide and suicide rates at their observed levels in the absence of firearms.

Speaking broadly, it is fair to claim that gun laws in Europe are significantly more "harsh and restrictive" than those found in the US (Kagan, 2006, p. 37), possibly as the result of differing world views (Müller, 2015). Even so, gun laws vary considerably across European countries. Policymakers who seek to reduce violence in their respective countries should view the prevention of gun violence and the regulation of civilian-owned firearms as key priorities. In seeking to prevent gun violence, policymakers should also make a deliberate effort to fund and promote research that assesses the effects of firearm availability and firearm legislation across the whole of the European continent. This research should, in addition to incorporating data from all possible countries, attempt to determine the relative size of the burdens that gun violence places on different groups and any differences in which groups benefit most from violence prevention efforts. Doing so will doubtlessly generate important findings that will allow policymakers to more effectively tailor and target their efforts.

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