

Shooting Occurrences Across the City of Toronto Increased in the Six-Year Period From 2014 to 2019

Talia Fabregas

January 25, 2024

In 2005, Canada's largest city, Toronto saw unprecedented levels of gun violence Siciliano (2005). More than a decade later, the number of yearly shooting occurrences across Toronto continued to rise. Using data from the City of Toronto Open Data Portal, this paper investigates trends in the number of shooting occurrences in different divisions of Toronto, from 2014 to 2019, inclusive. This paper shows that across the City of Toronto, shooting occurrences steadily increased in the six-year period from 2014 to 2019, with the number of shooting occurrences in Toronto in 2019 being more than triple what it was in 2014.

Table of Contents

1. Introduction
2. Data
3. Analysis and Results
4. Conclusion

1 Introduction

Although Canada's gun violence numbers are not as high as those of the United States, its largest city, Toronto, saw three times more shooting occurrences in 2019 than in 2014. Canada has the fifth-highest rate of gun fatalities in the world among high-income countries, and between 2008 and 2012, firearms caused more deaths in young men ages 18-24 than cancer, falls, drowning, and fires combined Owens (2019). These alarming statistics shed light on Canada's gun violence epidemic. This research paper aims to explore what the numbers

can tell us about the increase in gun violence that Toronto saw in the six-year period from 2014 to 2019, and where critical violence and crime-reduction resources such as social services, mental health care, community programs, and additional policing might be needed Siciliano (2005).

This research paper used a data set from the City of Toronto’s Open Data Portal, published by Toronto Police, titled “Shooting Occurrences (2014-2019).” This paper explores one thing and one thing only: the data. Due to the data set’s limited nature, information about the specific locations of each division, race, demographics, income, poverty, homelessness, education, and other socioeconomic factors are not included in the Shooting Occurrences Data. Details about the specific shootings, including whether they were targeted, domestic violence-related, gang-related, or random is also not included in the data set. This makes it impossible to draw conclusions about *why* gun violence in Toronto increased between 2014 and 2019, and why there are variations between different geographical divisions. However, this can virtually eliminate racial and socioeconomic bias in the study, and force us to focus only on what the numbers tell us about gun violence across the City of Toronto and within its different geographic divisions during this time period.

The code and data that were used for this analysis paper are available via GitHub. [^1]

[^1] <https://github.com/taliafabs/TorontoDataPaper.git>

2 Data

The data used throughout this paper was obtained through the City of Toronto’s Open Data Portal, OpenDataToronto. Gelfand (2022) OpenDataToronto is a publicly-funded, widely accessible data portal, with data relating to various topics including, but not limited to, social services, public services, elections, public safety, policing, education, and public health. Data was collected, cleaned, and analyzed using statistical programming language R R Core Team (2022). Additionally, tidyverse Wickham et al. (2019), dplyr Wickham et al. (2023), janitor Firke (2023), ggplot2 Wickham (2016), and knitr Xie (2014) were used for the data analysis and visualizations.

The data set used in this paper is titled “Shooting Occurrences (2014-2019).” It includes all shooting-related events reported to Toronto Police Service from 2014 to 2019 Gelfand (2022). The data is divided between Toronto’s police divisions. The data set contains 96 rows; one row for each of Toronto’s geographical divisions for each of the six years from 2014 to 2019 inclusive. Further information about the individual shooting incidents is not provided. More specifically, each row in the data set contains the number of shooting occurrences in each geographical division each year from 2014 to 2019. The precise location, date, time, injury levels, and resulting charges of each shooting are not included in this data set. The data set provides only very high-level data: the general area of where the shootings occurred and how many shootings occurred.

The raw data includes the following column variables: a unique row identifier “__id”, year the shootings occurred “occurred_year”, the geographical division “geo_division”, and “count”, the number of shootings that occurred in the respective geographical division that year. My data cleaning process was very simple and straightforward. Additionally, I used the dplyr package select function, Wickham et al. (2023) to remove columns that are not relevant for the purposes of my data analysis. My cleaned data includes the following column variables: occurred_year, geo_division, category, and count.

Table 1: Sample from the Data

occurred_year	geo_division	category	count
2014	D11	Shooting Occurrence	2
2014	D12	Shooting Occurrence	20
2014	D13	Shooting Occurrence	2
2014	D14	Shooting Occurrence	7
2014	D22	Shooting Occurrence	8
2014	D23	Shooting Occurrence	18

Table 1 shows the first few rows of my cleaned data. The data set is reliable and rows are easily identifiable without the unique row identifier. The unique row identifiers present in the raw data were not necessary because each (occurred_year, geo_division) pair occurs only once in this data set. In the context of the relational model of database design and SQL, (occurred_year, division) would be a super key because it must be unique and cannot be NA.

The analysis will examine trends in the data, as well as the relationship between the independent variables, occurred_year and geo_division, and the dependent variable, count.

3 Analysis and Results

The data analysis component of this paper explores the details of shooting occurrence trends across all geographical divisions of the City of Toronto from 2014 to 2019. It examines trends in the number of shooting occurrences across the City of Toronto and within each geographical division from 2014 to 2019. Additionally, variation in the number of shooting occurrences between geographical divisions each year from 2014 to 2019 will be analyzed and illustrated by the visualizations below.

3.1 Annual Shooting Occurrence Trends

Table 2: Total Annual Shooting Occurrences Across Toronto, 2014-2019

Year	Total
2014	177
2015	288
2016	407
2017	392
2018	427
2019	492

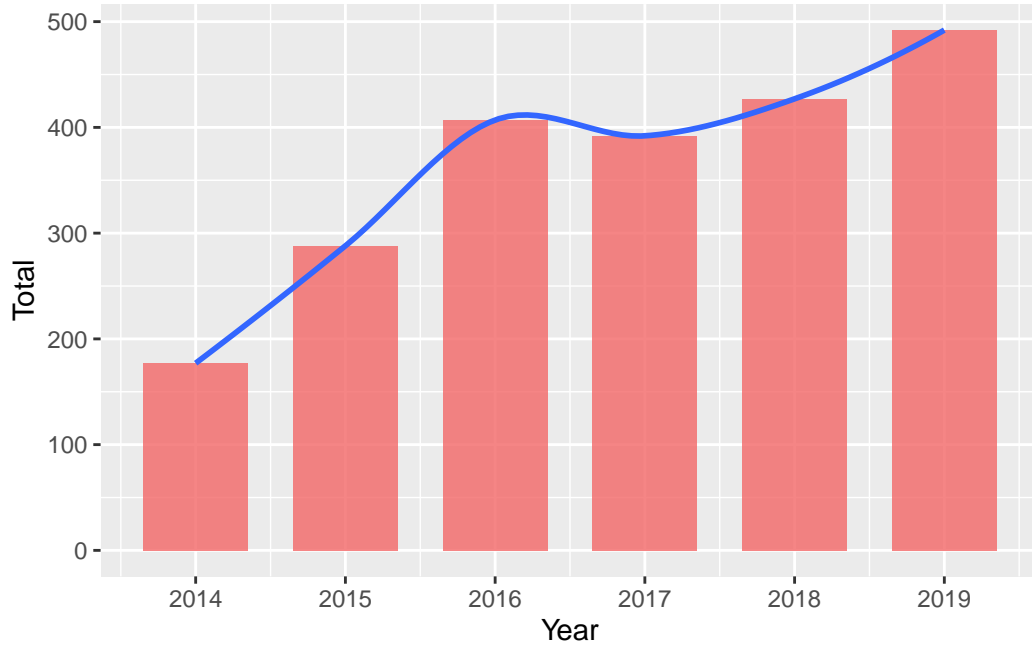


Figure 1: Annual Shooting Occurrences Across Toronto, 2014-2019

The number of shooting occurrences across the City of Toronto increased between 2014 and 2019, inclusive. Figure 1 clearly illustrates this trend. The red bars on the histogram illustrate the total number of shooting occurrences across all geographical divisions in the City of Toronto per year and the blue smoothing line illustrates the trend in the number of annual shooting occurrences during this time period. The blue smoothing line makes it evident that there was a consistent upward trend in the number of shooting occurrences in the City of Toronto between 2014 and 2019, inclusive. Refer to Table 2 for the exact number of shooting occurrences across the City of Toronto each year.

We can see that the steepest increase was between 177 in 2014 and 407 in 2017, where that number more than doubled Table 2. The number of shooting occurrences decreased very

slightly between 2016 and 2017, and then increased every year from 2017 to 2019, but at a slower rate than the period from 2014 to 2016. Although the rate at which the annual number of shooting occurrences across the City of Toronto increased slowed down after 2016, the trend illustrated by Figure 1 is still extremely concerning. The number of annual shooting occurrences across the city in 2019 (492) was more than triple what it was in 2014 (177).

3.2 Annual Shooting Occurrence Trends and Variation Across Different Geographical Divisions

Shooting occurrence trends during this period and yearly totals varied across Toronto’s geographical divisions. Factors such as poverty, education, unemployment, mental health, homelessness, policing, and access to social services can affect crime rates Siciliano (2005). Further research into these factors as well as the historical crime statistics and socioeconomic statistics of each division will be necessary to explain the variation. However, this data clearly shows that shooting occurrences are disproportionately high in some geographical divisions of Toronto, while other geographical divisions have had fewer shooting occurrences that increased at a slower rate than the City of Toronto overall between 2014 and 2019.

Table 3: Proportion of Shooting Occurrences in Each Geographical Division, 2017

GeoDivision	Count	Proportion
D11	18	0.0459184
D12	25	0.0637755
D13	14	0.0357143
D14	23	0.0586735
D22	15	0.0382653
D23	44	0.1122449
D31	68	0.1734694
D32	11	0.0280612
D33	11	0.0280612
D41	27	0.0688776
D42	35	0.0892857
D43	30	0.0765306
D51	24	0.0612245
D52	10	0.0255102
D53	6	0.0153061
D54/D55	31	0.0790816

D12, D23, and D31 consistently had more shooting occurrences than other geographical divisions. On the contrary, D52 and D53 consistently had fewer shooting occurrences than other geographical divisions. As shown in Table 3, D23 and D31 alone accounted for approximately

28.5% of the city’s shooting occurrences in 2017. It is evident that the proportions of total yearly shooting occurrences in the City of Toronto are not evenly distributed across the different geographical divisions.



Figure 2: Number of Shooting Occurrences Per Geographical Division, 2014-2019

Figure 2 illustrates the number of shootings per geographical division for each year from 2014 to 2019. It is clear that geographical divisions D31 and D23 have the two highest numbers of shooting occurrences each year, while D52 and D53 have had the fewest. This is critical information. Understanding the pattern of where the gun violence is occurring the most can inform policy-makers, experts, and police where resources to reduce gun violence are most needed Siciliano (2005).

The rate at which shooting occurrences have increased each year in each geographic division of Toronto is alarming, even in divisions that have not accounted for a high proportion of shootings each year. Figure 3 clearly illustrates this trend. It is similar to Figure 1, except it is grouped by geographic division. The need to conduct this portion of the analysis was highlighted by Table 3 and Figure 2, which made it evident that the number of shooting occurrences is not evenly distributed across all geographic divisions. Thus, each geographic division should also be analyzed relative to itself, and not the City of Toronto as a whole.

This figure was created using `facet_wrap`, `histogram`, and a smoothing line Wickham (2016). The red histogram bars represent the number of shooting occurrences per year from 2014 to 2019 in the respective geographic division, which is indicated at the top of each plot. Blue

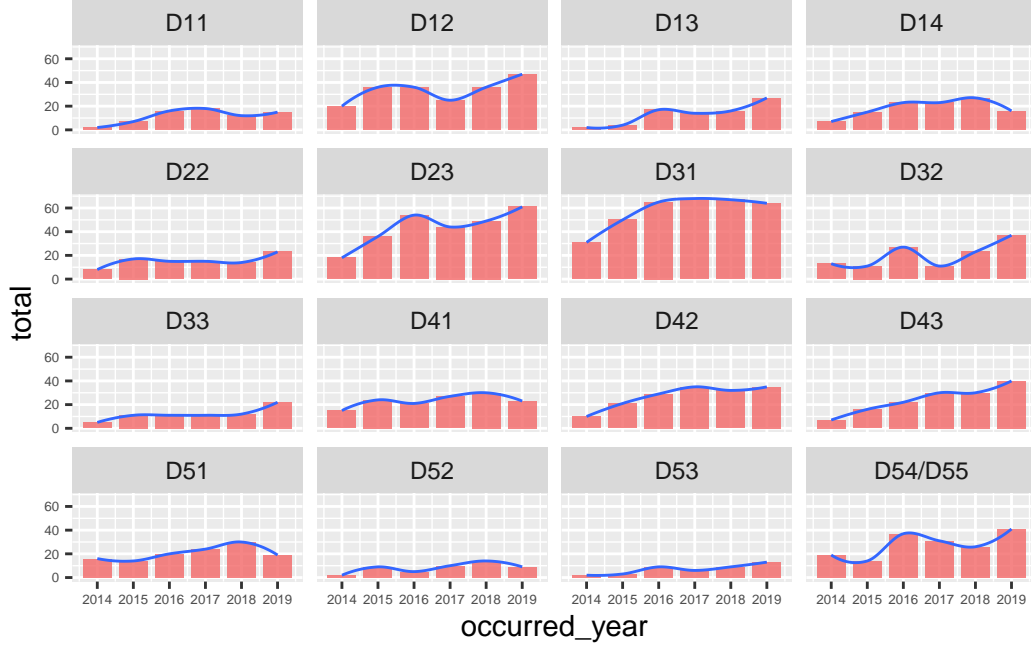


Figure 3: Annual Shooting Occurrences 2014-2019, by Toronto Police Division

smoothing lines have been added to illustrate the overall trend in the number of shooting occurrences each year in each respective geographic division.

D31, the geographic division that had the most shooting occurrences between 2014 and 2019, did not see the fastest rate of increase in gun violence. The number of yearly shooting occurrences in D31 increased consistently from 2014 to 2016, however appears to have plateaued from 2017 to 2019. On the contrary, D32, which has not accounted for a high proportion of Toronto’s shooting occurrences, saw its count increase sharply between 2017 and 2019. D43 shows an upward trend in its number of yearly shooting occurrences between 2014 and 2019. These alarming patterns are not immediately apparent when examining the overall trends in the number of shooting occurrences across the City of Toronto in Figure 1, or when comparing the number of shooting occurrences per division in any given year between 2014 and 2019, as seen in Figure 3.

4 Conclusion

This paper investigates how patterns in the number of shooting occurrences across Toronto changed between 2014 and 2019. While Canada’s rates of gun fatalities and gun violence are lower than those of the United States, these rates are still significantly higher than the United Kingdom, Australia, and New Zealand Owens (2019). The data clearly showed that while the

overall total number of shooting occurrences across the City of Toronto increased year-over-year between 2014 and 2019, this pattern varied between divisions. There are divisions that, despite accounting for a small proportion of Toronto’s total yearly shooting occurrences, have experienced consistent yearly increases in gun violence during this period. Further research and investigation will be required to gain a deeper understanding of *why* gun violence widely varies across Toronto’s different geographical divisions.

References

- Firke, Sam. 2023. *Janitor: Simple Tools for Examining and Cleaning Dirty Data*. <https://github.com/sfirke/janitor>.
- Gelfand, Sharla. 2022. *Opendatatoronto: Access the City of Toronto Open Data Portal*. <https://sharlagelfand.github.io/opendatatoronto/>.
- Owens, Brian. 2019. “Gun Violence Is an Epidemic and ‘We Solve Epidemics with Medicine, Not Politics’.” *Canadian Medical Association Journal* 191 (2). <https://doi.org/10.1503/cmaj.109-5700>.
- R Core Team. 2022. *R: A Language and Environment for Statistical Computing*. Vienna, Austria: R Foundation for Statistical Computing. <https://www.R-project.org/>.
- Siciliano, Amy Marie. 2005. *Olicing Poverty Race, Space and the Fear of Crime After the Year of the Gun*. <https://www.publicsafety.gc.ca/cnt/cntrng-crm/plcng/cnmcs-plcng/rsrch-prtl/dtls-en.aspx?d=PS&i=80215206>.
- Wickham, Hadley. 2016. *Ggplot2: Elegant Graphics for Data Analysis*. Springer-Verlag New York. <https://ggplot2.tidyverse.org>.
- Wickham, Hadley, Mara Averick, Jennifer Bryan, Winston Chang, Lucy D’Agostino McGowan, Romain François, Garrett Golemund, et al. 2019. “Welcome to the tidyverse.” *Journal of Open Source Software* 4 (43): 1686. <https://doi.org/10.21105/joss.01686>.
- Wickham, Hadley, Romain François, Lionel Henry, Kirill Müller, and Davis Vaughan. 2023. *Dplyr: A Grammar of Data Manipulation*. <https://dplyr.tidyverse.org>.
- Xie, Yihui. 2014. *Knitr: A Comprehensive Tool for Reproducible Research in r*.