Interpersonal Firearm Injury and Death in Portland, Oregon: 2018 through 2021

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Abstract

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Firearm related injuries and deaths have been increasing across the United States since the start of the COVID-19 pandemic in 2020. In Portland, Oregon non-fatal and fatal injuries from firearms have been higher since 2020 than at any year in the city's history. This descriptive study analyzed data from Gun Violence Archives from January 1, 2018 to December 31, 2021. It shows that incidents of firearm-related assault began to rise three months after the first COVID-19 case in Portland, with July 2020 having the most injuries from assault in the four-year study. Black men had the highest rate of fatalities, with more than ten-fold higher rate of firearm-associated injury than White men in the four years studied. Portland had a higher rate of total injuries and a markedly higher rate of fatalities from 2018 through 2021 compared with similar cities. Neighborhoods near Downtown and those on the Eastside of the city had the highest rates of interpersonal injuries and deaths from firearms. This study will help develop hypotheses for future public health research and interventions targeted at curbing this alarming rise in interpersonal firearm-associated injuries.

Introduction

Firearm-related assault has been rising in major cities across the United States for the last five years, with a marked increase since the COVID-19 pandemic started in 2020[1]. In Portland, Oregon the number of firearm-related crimes increased 225% from 2019 (388) to 2020 (891). And in 2021, the number of homicides and non-fatal injuries from firearm assault was the highest compared to any other year [2]. The injury and trauma from these events are a public health crisis that disproportionately affects young men of color. In a cross-sectional study published in 2019, Black people had six times the life expectancy loss from firearm injuries when compared to White people[3].

Many studies have investigated the rise of firearm associated interpersonal assaults during the pandemic[4,5]. Increased stress due unemployment and financial strain, especially in lower socioeconomic communities, is hypothesized to contribute to the rise of interpersonal firearm injuries during the COVID-19 pandemic[6]. In fact, unemployed men made up the largest portion of victims of violent penetrating injuries in a study at Boston Medical Center during the first year of the pandemic[7]. This study also showed that the increase in penetrating injuries was isolated to firearms, with no increase in stabbing wounds. Additionally, there has been an increase in alcohol and drug use since the start of the pandemic, which has been previously correlated with increased firearm assaults[6].

There has been limited research on interpersonal firearm violence specifically focused on Portland, Oregon and that include data covering the pandemic years. This study describes trends in interpersonal firearm-associated injuries and deaths in Portland to identify victim demographics, where gun violence is occurring and how these factors have changed over the last four years. As a descriptive study, the goal is to help develop hypotheses for future studies which

may focus on socioeconomic, geographic, and demographic factors influencing the rise in morbidity and mortality due to firearm assaults.

Methods

Data Collection:

This is a descriptive study that investigates the distribution and patterns of firearm-related assaults in Portland, Oregon from January 1, 2018 to December 31, 2021. No internal review board (IRB) was required because only publicly available datum were used. Gun Violence Archives (GVA) served as the primary data source[8]. GVA is an independent, non-profit organization that collects incidents of gun violence throughout the United States and makes them available for research purposes. They obtain their data from over 7,500 government, law enforcement, social media, and news sources. Each incident undergoes primary and secondary confirmation by GVA researchers to ensure validity[8]. Data on date, location (address block, geolocation, and State House District) and number of injured and killed in the city of Portland was pulled manually from GVA for each month of the study period. Primary source links were explored to obtain additional data such as victims' age, gender, and race. Geocodes were used to map incidents to neighborhoods.

Included in the definition of "assaults" are incidents that resulted in an injury or death from interpersonal violence and from law enforcement interventions. 26 incidents where the injury was associated with suicide or unintentional injury and 13 that occurred in the suburbs of Portland were excluded. GVA data for Seattle, Washington and San Francisco, California was acquired for comparison. Seattle and San Francisco were chosen for their similarity to Portland as major West Coast cities with comparable political and cultural environments. Only the

number injured and killed by firearms from 2018 through 2021 were analyzed from these comparison cities.

Starting in 2019, Portland Police Bureau (PPB) made data publicly available on shooting incident location, date and whether there were injuries[2]. This data set was used to fill in locations of incidents when it was not identified in GVA. PPB does not make person-level data or the number of injuries or deaths available to the public. US Census Bureau[9] was the source for population data, to include total population by study year, as well as estimates of race and age distribution for each year.

Data Analysis:

Data analysis was conducted using R programming language in R Studio, and the codes for this are listed in *Appendix B*. Incidents with lethal injuries were analyzed separately from the total incidents (which includes both non-fatal and fatal injuries). This was done after exploring the "missingness" feature on R and finding that incidents with lethal injures had more consistent person-level data than those that were not lethal. Incidents were analyzed by year from January 1, 2018 to December 31, 2021. Population age data was available from the 2020 census and this was used to estimate annual average rates for each year[9]. Counts and percentages of injuries and deaths that were associated with legal interventions were included in the total incident analysis, as were the number of mass shootings per year, (defined as more than three victims)[10]. The number of injuries and deaths from firearms in Seattle and San Francisco were tabulated from GVA for each year to provide context to the Portland data. The Excel graphing feature was used to display data analyzed in R-Studio.

The geocode identifying the location where each incident occurred was mapped to distinct neighborhoods (recognized by established neighborhood associations) of Portland. Rates of total incidents and fatal incidents were obtained using neighborhood population estimates

from 2019[11] to get an annual average rate. Using the Oregon Health Authority's Health Promotion and Chronic Disease Prevention Guidelines for Reporting Reliable Numbers[12], neighborhoods that had less than five incidents were excluded from location analysis. The simple features package in R was used to perform a spatial join between GPS coordinates in GVA data and neighborhoods/district coalitions downloaded from the City of Portland Maps[13]. During spatial analysis, it was noted that some incident locations identified within Portland by GVA were outside the boundaries according to the city of Portland maps. These incidents are included in the total data analysis but not in neighborhood analysis.

Results

A total of 521 firearm-associated assaults from GVA were analyzed. Of these, 71 involved multiple injuries or deaths, totaling 605 persons injured or killed in the four-year study period. Non-fatal and total assaults decreased from 2018 to 2019, then increased in 2020 and 2021 (*Appendix A* Table 1). July 2020 had the most injuries from firearm-associated assaults in the four years that were studied (*Appendix A* Figure 1). The largest increase in the total number of incidents occurred between 2019 and 2020 (*Appendix A* Figure 2). The number of fatal incidents increased each year during the 2018 to 2021 period, with the largest increase in 2021 (*Appendix A* Figure 3). The percentage of incidents related to legal intervention was less than 10% each year. The number of mass shootings was at a low level from 2018 to 2020 but nearly tripled in 2021. There were three incidents in 2021 that involved five or more victims, one in the Downtown neighborhood that involved seven victims (six injured, one killed) and another in Madison South that involved six victims with two fatalities.

The fatal assault rate doubled from 2020 to 2021 (*Appendix A* Table 2). Men were the victims of most firearm fatalities over the four years that were studied, comprising approximately

90% of deaths each year. In 2021, nine women were killed by firearms in Portland. While the number of fatalities where the victim was White was roughly equal to when the victim was Black, the rate of fatalities per 100,000 by race was markedly higher for Black individuals (*Appendix A* Table 3). In 2018, Black people were killed at 11.5 times the rate of Whites (28.2 versus 2.5 per 100,000). The rate was 12.8 times as high for Blacks in 2019, 13.3 times as high in 2020 and 12.3 times as high in 2021. The number of fatalities for victims of Asian and Hispanic ethnicity increased each year, but low numbers make interpretation difficult. The victim's race was unknown in 6% of the fatal incidents that were analyzed. People aged 20-29 had the highest rate of fatal injury from firearms (11.7 per 100,000) followed by people 30-39 years old (*Appendix A* Table 4, Figure 5).

In 2018 and 2019, Portland had rates of injuries and deaths from firearms similar to those of Seattle, Washington and San Francisco, California (*Appendix A* Figure 5). There was a greater rise in Portland of both fatal and non-fatal firearm incidents in 2020 and 2021. In 2020, Portland had a rate of injuries from firearm assault of 20.8 per 100,000 people compared with 9.9 in Seattle and 10.1 in San Francisco (*Appendix A* Table 4). The non-fatal injury rate jumped in both Portland and Seattle in 2021 (to 27.6 and 22.0 respectively), where the rate in San Francisco remained roughly the same (10.1 to 11.0 per 100,000 people, respectively). Portland had a higher fatal injury rate than both Seattle and San Francisco for all study years. In 2021 the fatal injury rate in Portland was 2.4 times that in Seattle and San Francisco (11.1 versus 4.6 and 4.3 respectively).

There are 94 neighborhoods in Portland, Oregon as recognized by established neighborhood associations[14], and 63 of these had one or more firearm associated assaults during the study period. Portland is also divided geographically into seven district coalitions – Neighborhoods West/Northwest (NWNW), Southwest Neighbors (SNI), North Portland

Neighborhood Services (NPNS), Northeast Coalition of Neighbors (NECN), Central Northeast Neighbors (CNN), Southeast Uplift Neighborhoods (SEUL), and East Portland Community Office (EPCO)[14]. The neighborhoods of East Columbia, Old Town, Lloyd District and Parkrose had highest rate of firearm-related injury or death per 100,000 people (*Appendix A* Figure 7 and 8). The geographical coalitions with the highest rate of firearm associated assaults per 100,000 people were EPCO, followed by NWNW and CNN (*Appendix A* Figure 9). The Southwest Neighbors (SNI) district had only five total incidents in all four years studied. EPCO had the most injuries from firearm assaults in all study periods, whereas NWNW, which includes Old Town and Downtown neighborhoods, had the greatest increase in firearm injuries from 2020 to 2021 (*Appendix A*, Figure 10).

Discussion

This data demonstrates a rise in firearm-associated assaults in Portland starting after the beginning of the COVID-19 pandemic in early 2020. It shows that, like other urban areas of the United States, Black men in Portland have markedly higher rate of interpersonal injuries and deaths from firearms. When compared to other similar cities, Portland's rate of injuries and fatalities from firearm assault is higher, and certain neighborhoods are more affected.

The first COVID-19 case was confirmed in Portland at the end of February 2020 and Oregon initiated isolation measures starting in mid-March of the same year, including closure of schools and non-essential businesses. The trends in firearm associated assaults declined during the first 3 months of the pandemic but rose steeply beginning in June of 2020. George Floyd was murdered by a Minneapolis police officer on May 25, 2020, setting off protests nationwide, and which began occurring on a nightly basis in Portland starting on May 28, 2020. There were only four incidents (one fatal) identified in GVA as directly related to racial justice protests. This

figure, however, understates the violence that occurred during this time as it only included firearm associated assaults. A rise in community tension from the racial justice reckoning, compounded by economic insecurity brought on by pandemic-related job loss and loss of essential social structures could have contributed to the rise of firearm-related assaults that began in the summer of 2020.

The burden of lethal firearm assaults that occurred in Portland from 2018 to 2021 predominantly affected men of color, with Black individuals dying at more than ten times the frequency of Whites in every study year. Previous studies have shown an association between racists practices such as redlining[15] and segregation in Northern cities[16] with higher rates of neighborhood gun violence. And while Portland has a small Black population, it is not immune to racist policies and discrimination. A study from Portland State University in 2014 showed that not only do Black people in Portland trail behind White people economically and in health outcomes, but they also have lower socioeconomic stability than Black people in other similar sized cities[17]. This may explain the disparate rates of firearm assaults seen in Portland compared to Seattle and San Francisco. The increase in homicide rate involving Asian individuals in Portland may coincide with a rise in anti-Asian hate crime[18] during the pandemic that was propagated by the xenophobic language of political officials. A better understanding of how systemic racism influences violence in communities of color in Portland will help public health officials develop an anti-racist approach to addressing it.

The number of firearm-associated assaults was not equally distributed throughout Portland; certain neighborhoods were affected more, and the more highly impacted areas were clustered regionally. Although this study did not make formal associations, it is notable that the Southwest Neighborhood district, which has the highest median household income[19], had the fewest firearm injuries from assaults, with no change from pre to post pandemic years. Recent

studies have shown, however, the spatial impact of firearm violence is not entirely explained by a community's disadvantage[20]. More research needs to be directed at understanding the risk factors that lead to neighborhood vulnerability to interpersonal firearm injuries.

The study has several limitations. Gun Violence Archives obtains information on firearm incidents by internet searches on news, social media, and local law enforcement databases. It does not utilize hospital data or collaborate with police bureaus, and thus may underestimate the number of firearm-associated assaults. Neighborhood firearm assault rates calculated with counts between five to 11 were included in analysis but have potential for statistical instability. The study was of a single city and a discrete time, its application to the national gun violence crisis is limited.

As a descriptive study, the aim is to develop hypotheses to guide future public health research and interventions. Potential foci for future research include identifying the socioeconomic structures impacted by the pandemic and how these may have contributed to the rise in violence, examining the influence of systemic racism to explain the disproportionate toll from firearm injuries in communities of color, and enhancing understanding of the geographical associations to explain the clustering of interpersonal firearm injuries.

References:

1. CDC. Injury Prevention and Control, Web-based Injury Statistics and Reporting Service (WISQARS) https://www.cdc.gov/injury/wisqars/fatal.html. February 2022
2. Portland Police Bureau. *Shooting Incident Statistics* https://www.portlandoregon.gov/police/81203 © 2022
3. Kalesan B, Vyliparambil M, Zuo Y, et al. *Cross-sectional study of loss of life expectancy at different ages related to firearm deaths among black and white Americans*, Evid Based Med. April 2019. https://pubmed.ncbi.nlm.nih.gov/30514715/
4. Abdallah B, Zhao C, Kaufman E, et al. *Increase in Firearm Injury During the COVID-19 Pandemic: A Hidden Urban Burden*, Journal Amer College Surg. February 2021. https://pubmed.ncbi.nlm.nih.gov/33166665/

5. Scenting P, Frontier C, Scenting A, et al. *Gun violence incidence during the COVID-19 pandemic is higher than before the pandemic in the United States*, Scientific Reports 21 October 2021. https://www.nature.com/articles/s41598-021-98813-z
6. Sutherland M, McKenney M. *Gun violence during COVID-19 pandemic: Paradoxical trends in New York City, Chicago, Los Angeles, and Baltimore*. Amer Jour Emer Med. January 2021. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7204738/
7. Pino EC, Gebo E, Dungan E, et al. *Trends in Violent Penetrating Injuries During the First Year of the COVID-19 Pandemic*. JAMA Public Health. February 2022. https://jamanetwork.com/journals/jamanetworkopen/fullarticle/2788842
8. Gun Violence Archives https://www.gunviolencearchive.org/about © 2022
9. Census Reporter. *Profiles: Portland, Oregon*. *American Community Survey* 2020 https://censusreporter.org/profiles/16000US4159000-portland-or/
10. Text - H.R.2076 - 112th Congress (2011-2012): Investigative Assistance for Violent Crimes Act of 2012. www.congress.gov. Jan 2013
11. Portland Monthly. *Portland Neighborhoods by the Numbers: 2020: The City*. https://www.pdxmonthly.com/home-and-real-estate/portland-neighborhoods-by-the-numbers-2020-the-city May 28, 2020.
12. OHA HPCDP Guidelines for Reporting Reliable Numbers. Version 2, March 7, 2018
13. PortlandMaps – Open Data. https://gis-pdx.opendata.arcgis.com/
14. The City of Portland. Community & Civic Life. https://www.portlandoregon.gov/civic/index.cfm?c=28385
15. Benns M, Ruther M, Nash N, et al. *The impact of historical racism on modern gun violence: Redlining in the city of Louisville, KY.* Injury. Volume 51, Issue 10, October 2020. https://doi.org/10.1016/j.injury.2020.06.042
16. Jacoby SF, Dong B, Beard JH, et al. *The enduring impact of historical and structural racism on urban violence in Philadelphia*. Social Science & Medicine. February, 2018 https://doi.org/10.1016/j.socscimed.2017.05.038
17. Bates, L., Curry-Stevens, A. & Coalition of Communities of Color (2014). *The African-American Community in Multnomah County: An Unsettling Profile*. Portland, OR: Portland State University. https://pdxscholar.library.pdx.edu/socwork_fac/135/
18. Nguyen T, Criss S, Dwivedi P, et al. *Exploring U.S. Shifts in Anti-Asian Sentiment with the Emergence of COVID-19.* Int J. Environ Public Health. 2020 https://doi.org/10.3390/ijerph17197032
19. The Portland Plan. *Income by District Coalition*. https://www.portlandonline.com/portlandplan/index.cfm?a=288108&c=52257 © 2022
20. Dalve, K., Gause, E., Mills, B. et al. *Neighborhood disadvantage and firearm injury: does shooting location matter?* Inj. Epidemiol. March 2021. https://doi.org/10.1186/s40621-021-00304-2

APPENDIX A: Tables and Figures

Table 1: Total injury from assault (non-fatal and fatal) characteristics in Portland from 2018 through 2021

	2018	**2019**	**2020**	**2021**
Total incidents	100	79	172	254
Non-fatal, n (%)	76 (76%)	51 (64%)	136 (79%)	181 (71%)
Fatal, n (%)	24 (24%)	28 (35%)	35 (20%)	73 (28%)
Rate (per 100000)	15.64	12.24	26.32	38.71
Non-fatal rate	11.26	7.90	20.81	27.58
Fatal rate	3.75	4.34	5.36	11.12
Officer involved n, %	9 (9 %)	7 (8.8%)	7 (4.1%)	10 (3.9%)
°Number of mass shootings	2	2	3	11

° More than 3 victims[10]

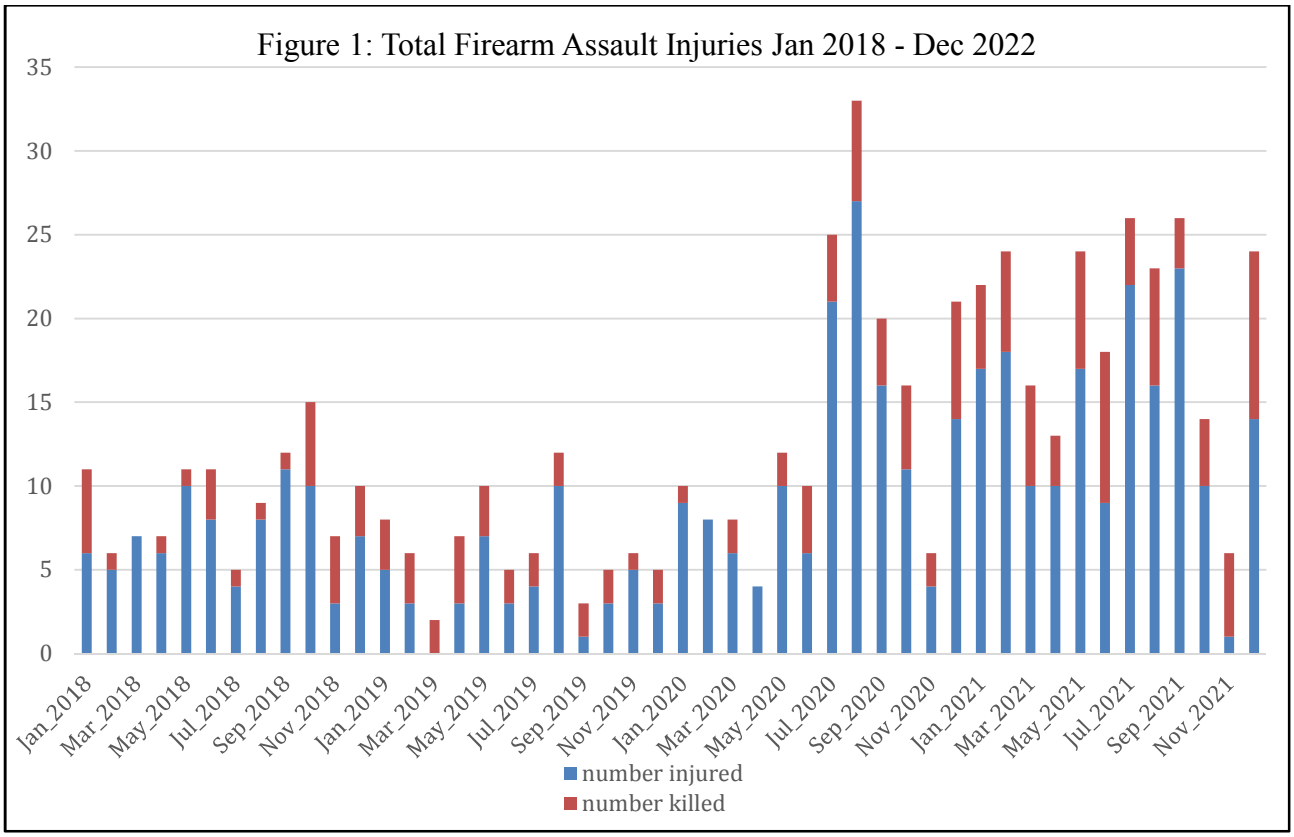

Figure 1: Number of victims injured, and number killed by firearm assault in Portland, OR by month from January 2018 through December 2021

Table 2: Fatal injury from firearm assault characteristics in Portland, OR 2018 through 2021

Characteristic	**2018**	**2019**	**2020**	**2021**
Fatal injury #	24	28	35	73
Rate (per 100000)	3.75	4.34	5.36	11.12
*Sex, m, n (%)	22 (91.7%)	26 (92.9%)	32 (91.4%)	64 (87.7%)
° Age (mean)	36.95	36.04	31.94	33.54
Officer involved n, (%)	3 (3.8%)	5 (2.5%)	1 (2.8%)	4 (1.4%)
Arrest made n, %	14 (58.3%)	12 (42.9%)	10 (28.5%)	22 (30%)

** Sex - male/female null = male*
° Age - in years

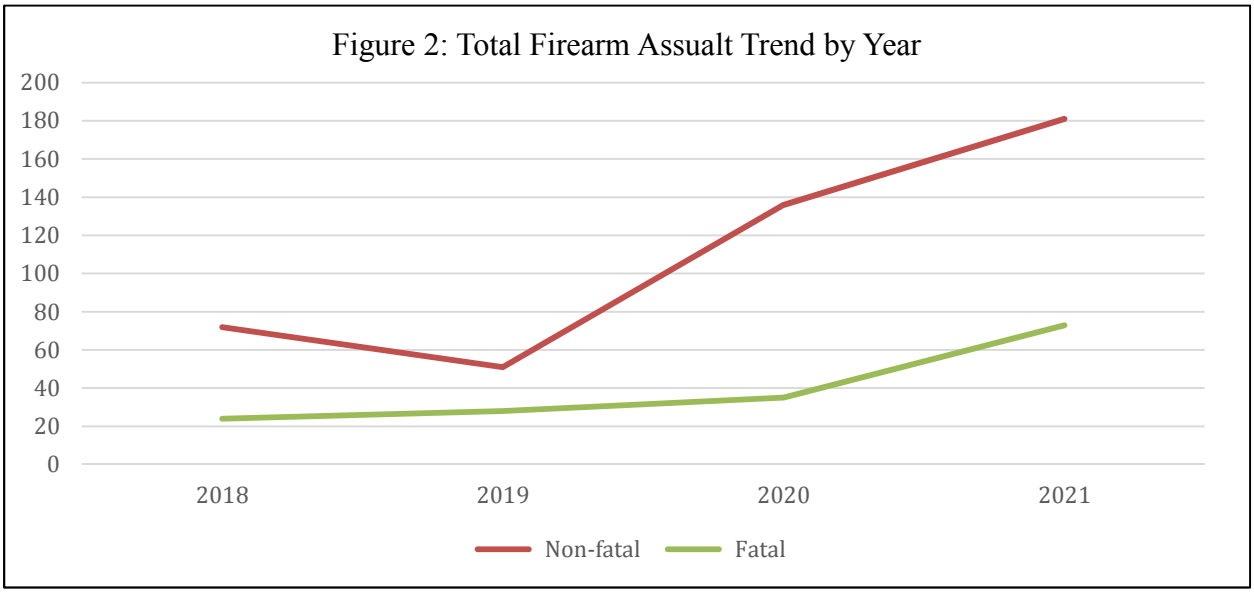

Figure 2: Non-fatal and fatal injuries from firearm assault, trends in Portland, OR from 2018 through 2021

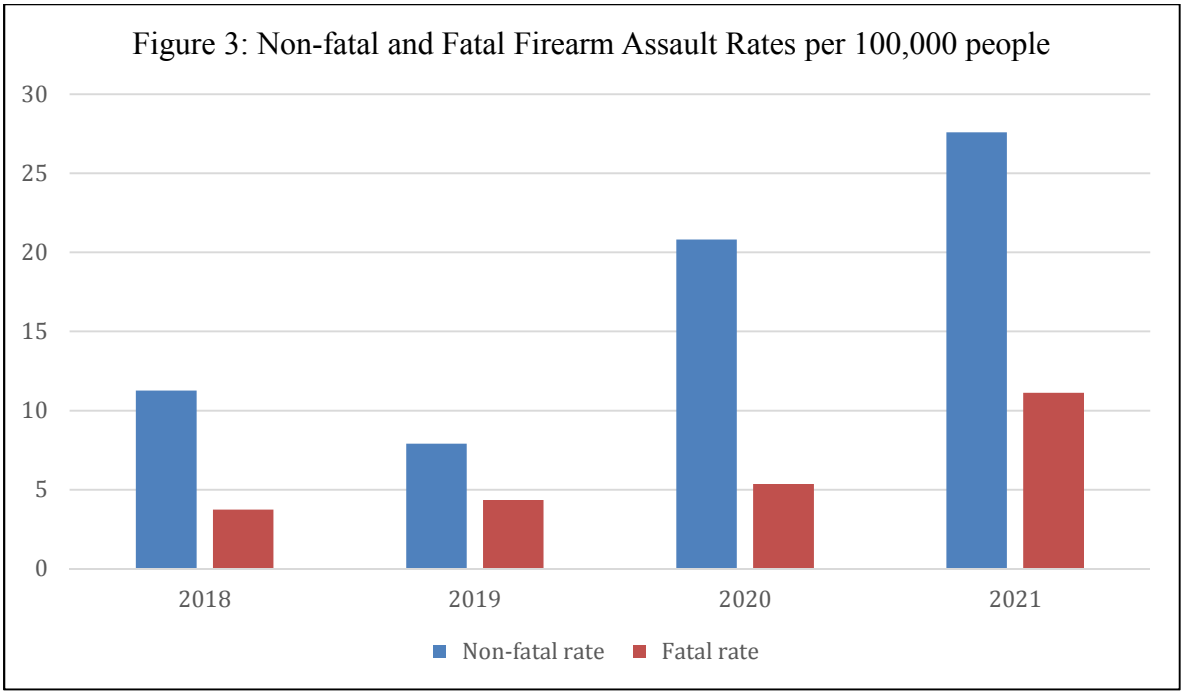

Figure 3: Non-fatal and fatal injury rates from firearm-related assault per 100,000 people in Portland, OR by year, 2018 through 2021

Table 3: Fatal assaults by race/ethnicity in Portland, OR 2018 through 2021

Race/Ethnicity	**2018**	**2019**	**2020**	**2021**
White, n (%), rate	11 (45.8%), 2.46	11 (39.2%), 2.42	15 (42.8%), 2.97	28 (38.3%), 5.91
Black, n (%), rate	11 (45.8%), 28.20	11 (39.2%), 30.99	15 (42.8%), 39.57	30 (41.1%), 72.57
*Hispanic, n (%), rate	0	2 (7.1%), 3.53	3 (9.3%), 4.73	7 (9.5%), 11.35
*Asian, n (%), rate	0	1 (3.6%), 1.91	1 (2.8%), 1.87	4 (5.4%), 8.59
Unknown, n (%)	2 (8.3%)	3 (10.7%)	1 (2.8%)	4 (5.4%)

* Low n precludes statistical reliability

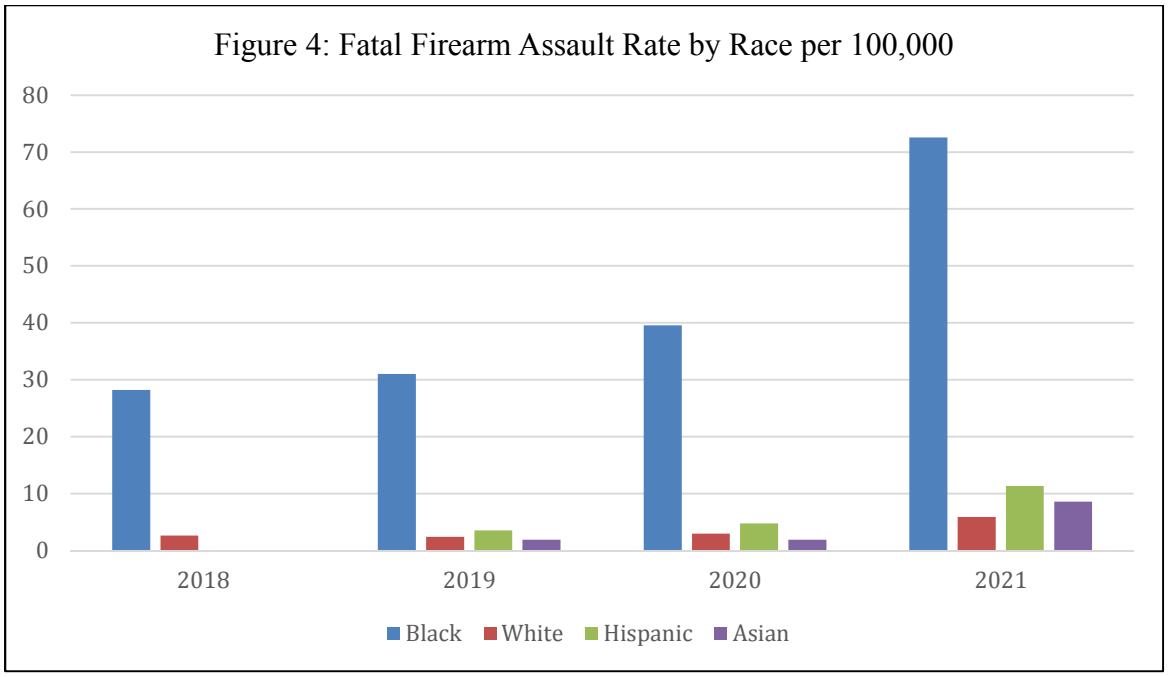

Figure 4: Fatal firearm injury from assualt rate per 100,000 people in Portland, OR by race/ethnicity

Table 4: Average age specific fatal assault rate per 100,000 in Portland, OR

Age	**Number**	**Age specific rate**
10-19	16	6.26
20-29	46	11.66
30-39	42	8.13
40-49	32	8.15
50-59	9	3.07
60-69	6	2.23
Older than 70	2	N/A
Unknown	7	N/A

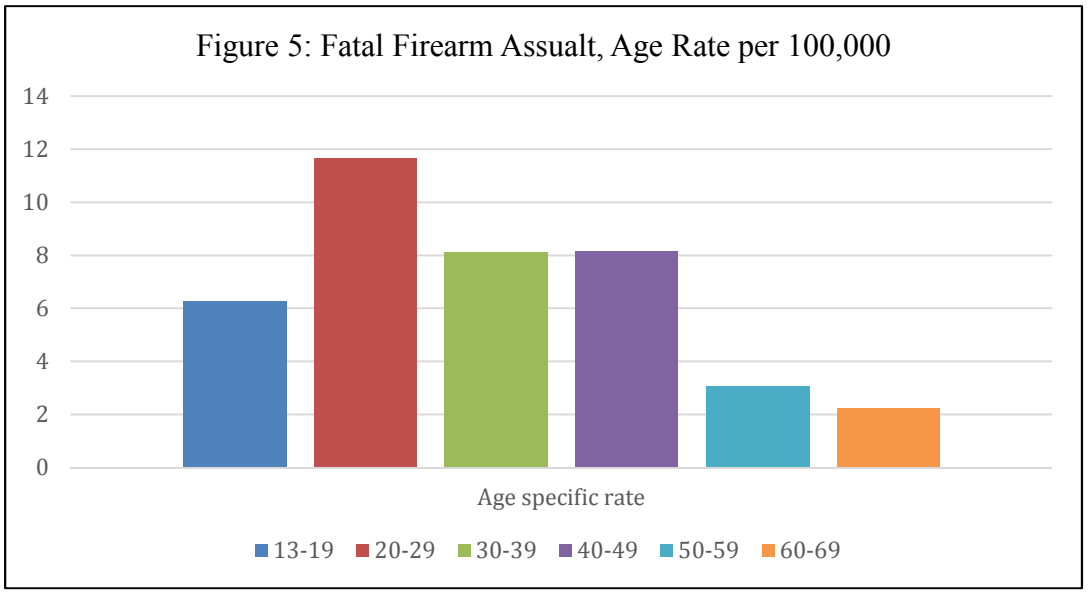

Figure 5: Firearm fatality rate by average age per 100,000 people from 2018 to 2021

Table 5: West Coast city comparison of non-fatal and fatal injury rates per 100,000 people from 2018 through 2021

	2018	**2019**	**2020**	**2021**
Non-fatal rate				
Portland	11.26	7.9	20.81	27.58
Seattle*	8.29	10.48	9.91	22.02
San Francisco*	9.31	8.25	10.09	10.98
Fatal rate				
Portland	3.75	4.34	5.36	11.12
Seattle*	3.21	3.84	3.53	4.64
San Francisco*	3.29	2.61	3.85	4.3

* Rates for Seattle and San Francisco include all injuries and deaths from firearms, those from suicide and those that were unintentional were not excluded

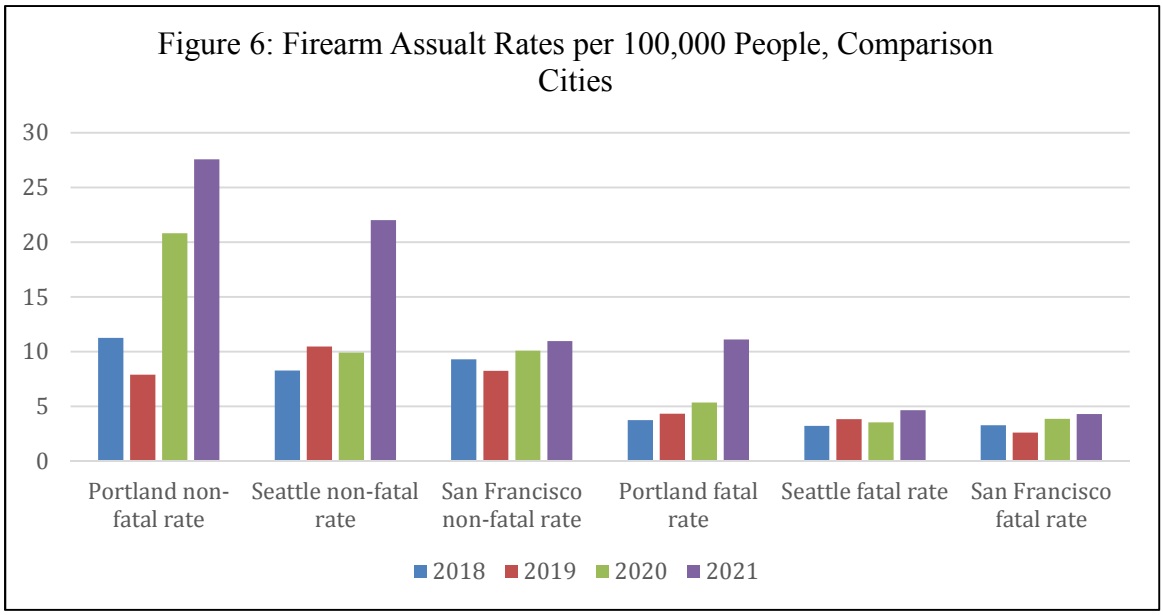

Figure 6: Non-fatal and fatal firearm injury rates in Portland, OR, Seattle, WA and San Francisco, CA in 2018 through 2021

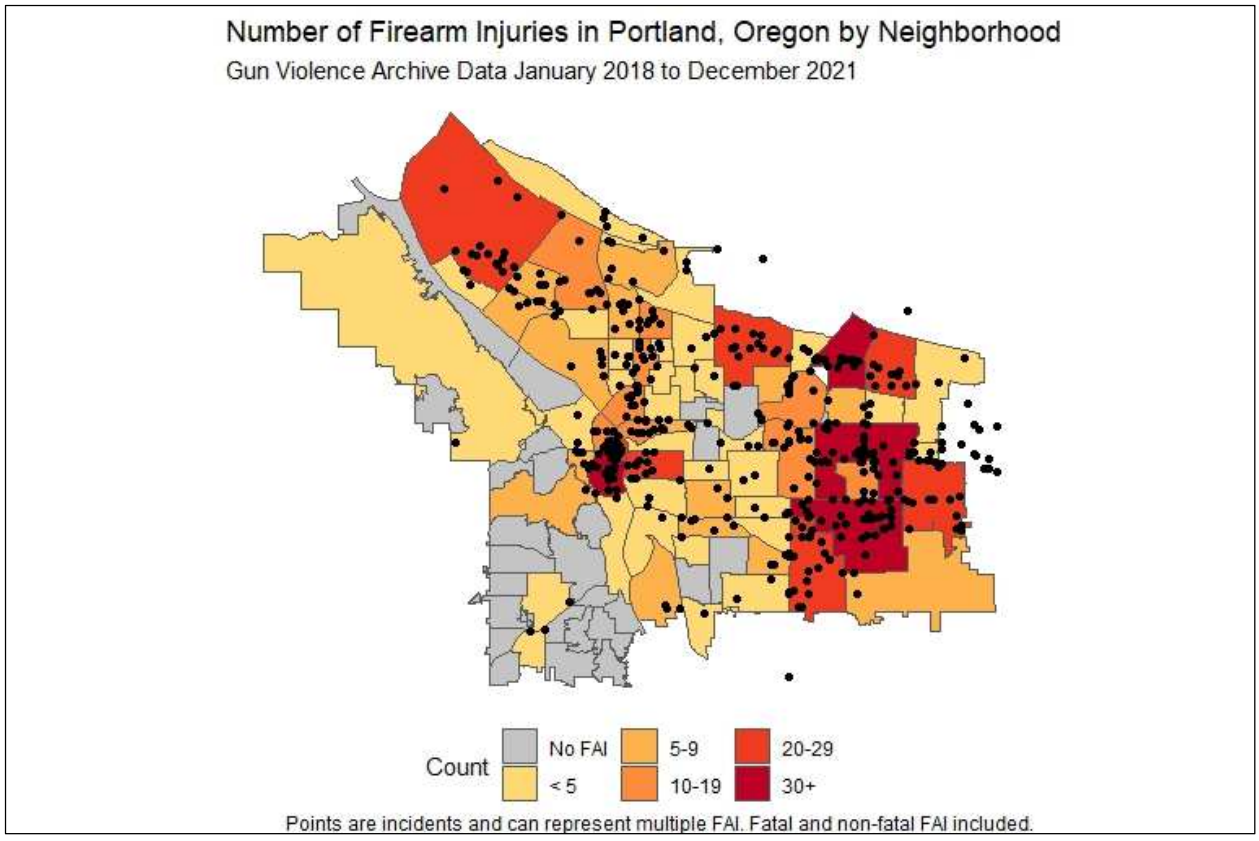

Figure 7: Number of non-fatal and fatal injuries from firearm assaults by neighborhood. Single points may include multiple firearm-associated injuries

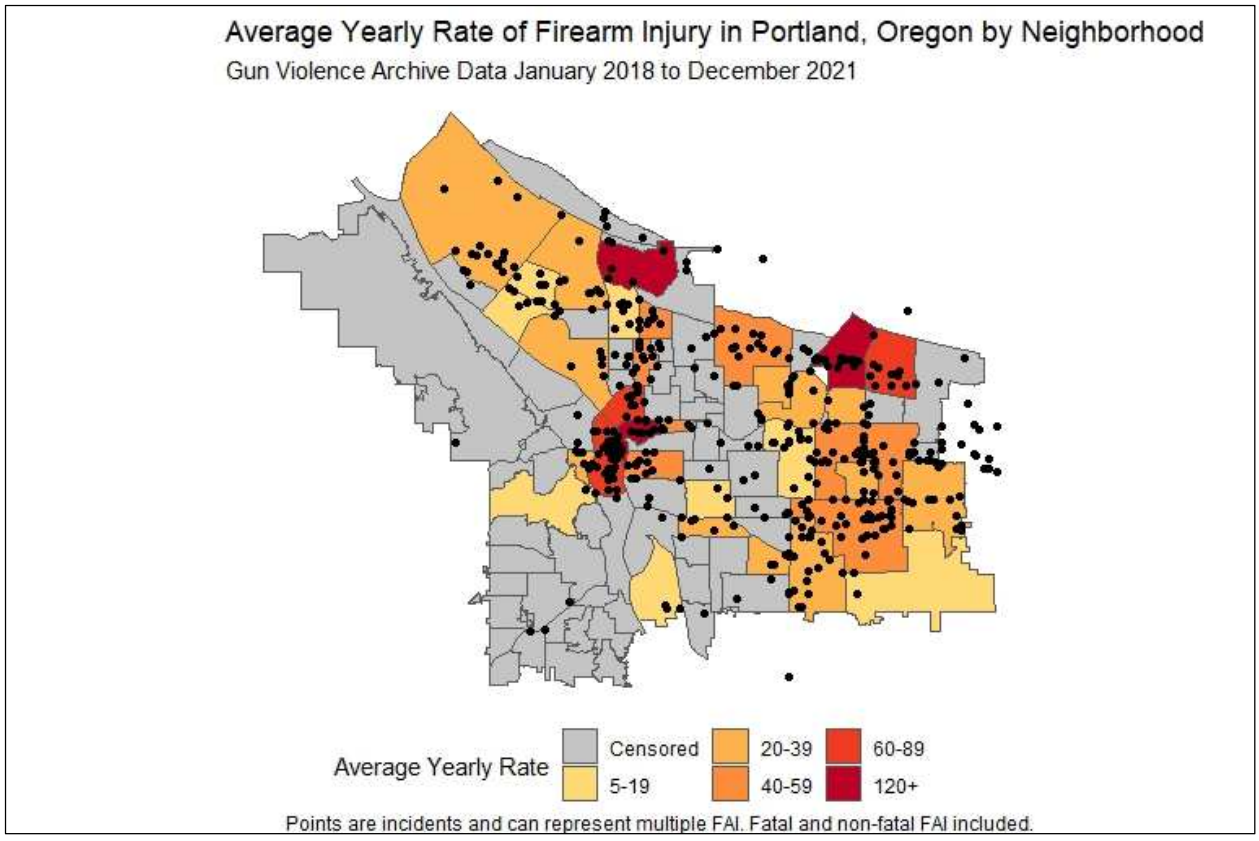

Figure 8: Average yearly rate of firearm-associated assault (non-fatal and fatal) per 100,000 people by neighborhoods

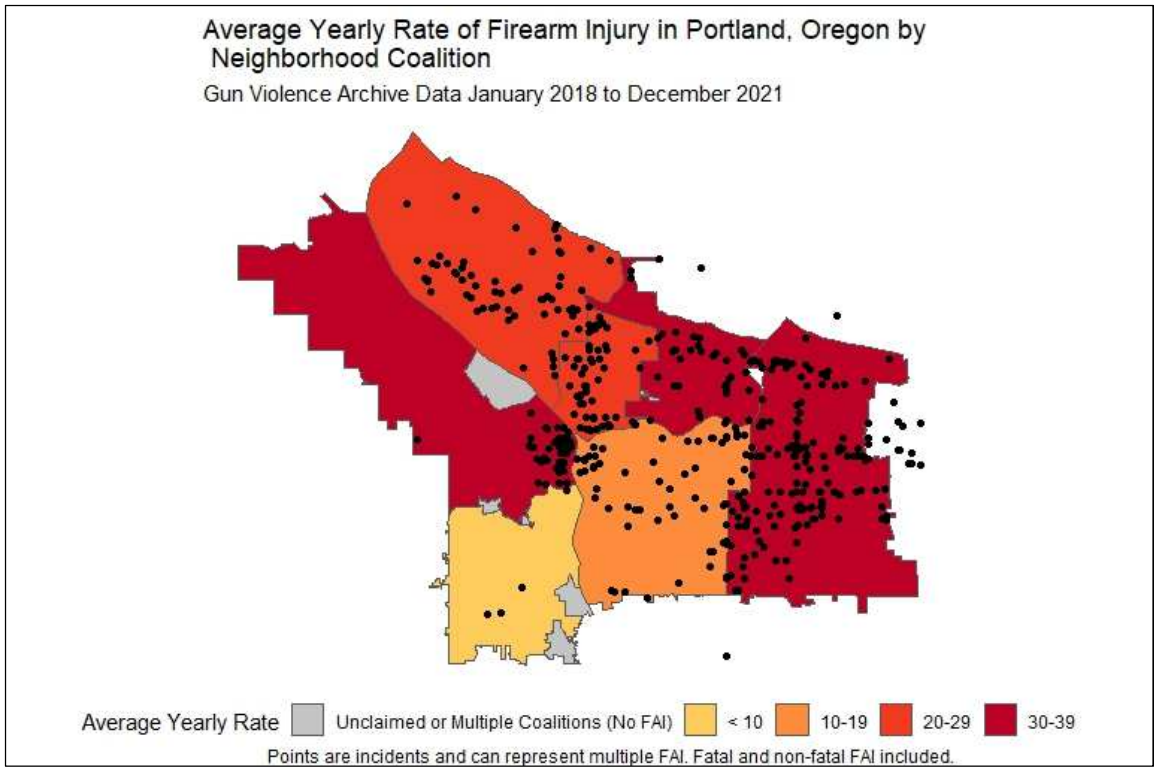

Figure 9: Average yearly rate of injury from firearm assault by geographical neighborhood coalitions in Portland, Oregon from 2018 through 2021

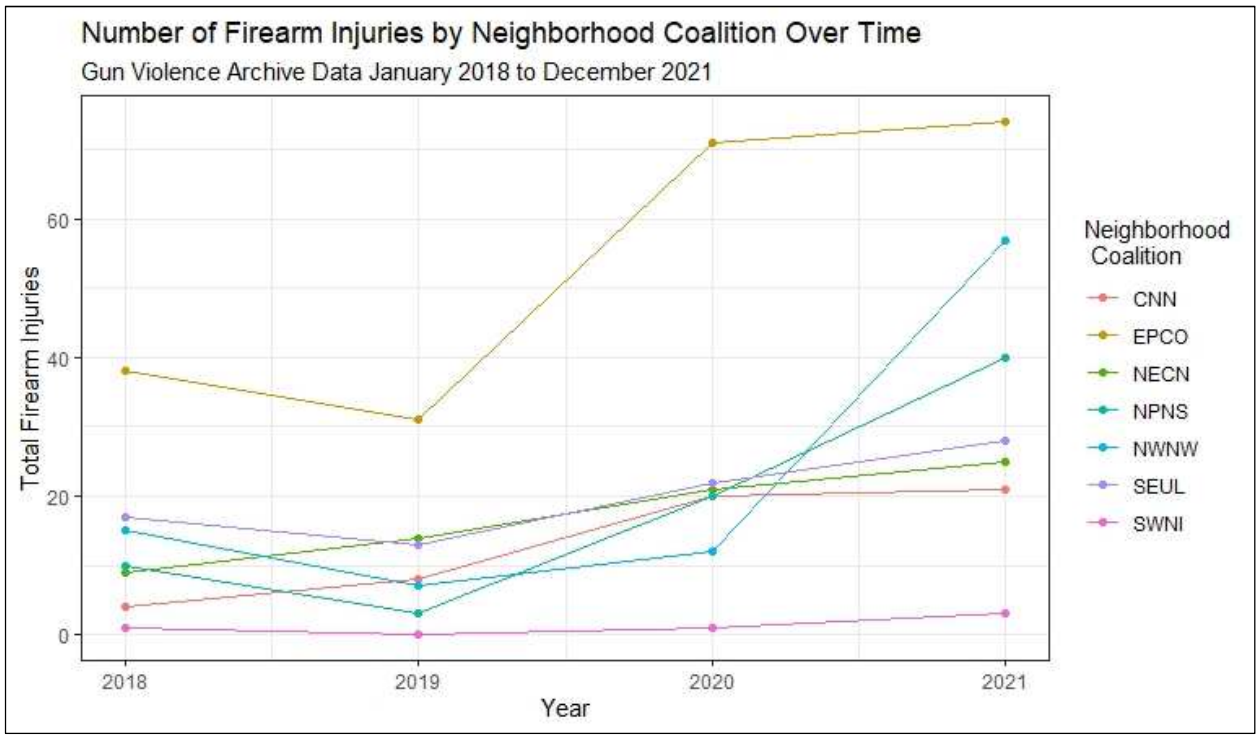

Figure 10: Trends in number of firearm injuries from assault by geographical neighborhood coalitions in Portland, OR from 2018 through 2021

APPENDIX B: R-code for data analysis

R-code for data analysis

```
# Population Year Table
year_count <- gva_data %>%   count(year) %>%  left_join(., pop_year, by = c("year" = "Year")) %>% mutate(pop_rate = round(n/Population*100000, 2),year = as.character(year))

# Population Victim Race and Year Table
year_race_count <- gva_data %>% count(year, victim_race) %>% mutate(victim_race = ifelse(is.na(victim_race), "Unknown", stringr::str_to_title(victim_race))) %>% left_join(., pop_race_year, by = c("year" = "Year", "victim_race" = "Race"))
 # Total fatal incident per year year_count_fatal <- gva_data %>% filter(victim_killed == "yes") %>% count(year)

 # Fatal rate by year
year_fatal_rate <- gva_data %>% filter(victim_killed == "yes") %>% count(year) %>% left_join(., pop_year, by = c("year" = "Year")) %>%   mutate(pop_rate = round(n/Population*100000, 2))

# Non-fatal rate by year
year_nonfatal_rate <- gva_data %>% filter(victim_killed == "no") %>% count(year) %>% left_join(., pop_year, by = c("year" = "Year")) %>%   mutate(pop_rate = round(n/Population*100000, 2))

# Officer involved total
officer_involved <- gva_data %>% count(officer_involved == "yes", year)

# Arrest made total
arrest_total <- gva_data %>% count(arrest_made == "yes", year)

# Officer Involved Fatal
officer_fatal <- gva_data %>% filter(victim_killed == "yes") %>% count(officer_involved == "yes", year)

# Arrest made fatal
arrest_fatal <- gva_data %>% filter(victim_killed == "yes") %>% count(arrest_made == "yes", year)

# Rate by neighborhood
rate_neighborhood <- gva_data %>% count(neighborhood) %>%
```

```
  left_join(., pop_neighbor, by = c("neighborhood" = "Neighborhood")) %>% mutate(pop_rate =
round(n/Population*100000, 2)) %>% mutate(avg_annual = round(pop_rate / 4, 2))
 # Fatal rate by neighborhood
rate_fatal_neighborhood <- gva_data %>% filter(victim_killed == "yes") %>%
  count(neighborhood) %>% left_join(., pop_neighbor, by = c("neighborhood" =
"Neighborhood")) %>% mutate(pop_rate = round(n/Population*100000, 2)) %>%
mutate(avg_annual = round(pop_rate / 4, 2))

 Fatal rate by race
rate_race_year <- gva_data %>% filter(victim_killed == "yes") %>% count(victim_race, year)
%>%  mutate(victim_race = ifelse(is.na(victim_race), "Unknown",
stringr::str_to_title(victim_race))) %>% left_join(., pop_race_year, by = c("victim_race" =
"Race", "year" = "Year")) %>%  mutate(pop_rate = round(n/Population*100000, 2))

# Fatal Injury Gender
gender_fatal <- gva_data %>% filter(victim_killed == "yes") %>% count(victim_gender, year)

# Fatal Injury Mean Age
mean_age_fatal <- gva_data %>% filter(victim_killed == "yes") %>% summarize(mean =
mean(victim_age, na.rm=TRUE))

# Fatal age rate
age_rate_fatal <- gva_data %>% filter(victim_killed == "yes") %>% mutate(victim_age_cat =
case_when(victim_age >= 60 & victim_age < 70 ~ "60-69", victim_age >= 70 ~ "70+", TRUE ~
victim_age_cat)) %>% count(victim_age_cat) %>% left_join(., pop_age, by =
c("victim_age_cat" = "Age")) %>% mutate(pop_rate = round(n/Population*100000, 2)) %>%
mutate(avg_annual = round(pop_rate / 4, 2))

# Neighborhood location data
 https://r-spatial.github.io/sf/index.html.
```