

Does Weather Play a Part in an Increase in Homicide Statistics?*

An Analysis of the Toronto's Homicide Statistics from 2004 to 2023

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This research paper examines the impact of weather on Toronto killings. The study looks for possible links between weather patterns and criminal activity by studying homicide data in various seasons and temperatures across 20 years. Using data from OpenDataToronto, this paper shows that homicides are more likely to occur in warmer weather conditions as compared to colder weather conditions.

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*Code and data are available at: <https://github.com/aryamansuri/Toronto-Homicides>.

1 Introduction

A fascinating and important question that arises in the field of urban safety is how weather affects homicide rates. This question has implications for law enforcement tactics, resource allocation, policy formulation, community readiness, and criminology academic advancement.

The relationship between weather and homicides is complex and influenced by a number of indirect factors. Increased hostility and irritability have been associated with higher temperatures, which may make violent conflicts more likely. Seasonal differences in the weather can also affect outdoor activities. Unfavourable weather may discourage people from going outside, which would reduce the likelihood of conflicts. Seasonal variations in daylight availability have an impact on the visibility of crime and longer daylight hours may serve as a deterrent when criminal activity becomes more obvious. Social interactions are further affected by the possibility of confrontations that could turn violent due to the tendency of specific weather patterns to promote outdoor gatherings. Extended periods of unfavourable weather, including intense rain or extremely high temperatures, can also have a detrimental impact on mental health and criminal behaviour. Even though these correlations have been noted, it's important to recognize how complex the link is because a number of social, economic, and environmental elements work together to influence crime rates. Determining direct causality is still difficult and necessitates a sophisticated comprehension of the complex dynamics involved.

To examine the impact of weather on homicides, this paper is organized into the following sections: Data, Results, Discussion, and Conclusion. In the Data section, I discuss the nature of the spreadsheet obtained through the City of Toronto's OpenDataToronto Library (Gelfand 2022) and the steps I took to clean and analyze the data. The Results section highlights trends found during the analysis process, while the Discussion section further evaluates the trends and presents insight. Lastly, the Conclusion section summarizes the main findings from this paper.

2 Data

The data utilized throughout this paper was obtained through the City of Toronto's OpenDataToronto Library (Gelfand 2022). The data set used is entitled ' Police Annual Statistical Report - Homicides' (Data 2023). Data was collected and analyzed using the statistical programming software R (R Core Team 2023), with additional support from `tidyverse` (Wickham et al. 2019), `ggplot2` (Wickham 2016), `dplyr` (Wickham et al. 2023), `readr` (Wickham, Hester, and Bryan 2023), `tibble` (Müller and Wickham 2023), `janitor` (Firke 2023), `KableExtra` (Zhu 2021), `knitr` (Xie 2014), `ggbeeswarm` (Clarke and Sherrill-Mix 2023), `ggrepel` (Slowikowski 2023), and `here` (Müller and Bryan 2020). A further discussion of the data collection, cleaning, and analysis process can be found later on in this paper.

Table 1: Sample of Cleaned Homicide Statistics Data

Month	Homicide Data
April	101
August	127
December	126
February	106
January	110

Table 2: Sample of Cleaned Categorized Homicide Data

Homicide Category	Count
Other	352
Shooting	727
Stabbing	317

2.1 Toronto Homicide Statistics

This dataset, published by Toronto Police (Data 2023) outlines Homicide statistics in the city of Toronto. For each homicide, the data is divided into three types, which are: Shooting, Stabbing and Other. The data also shows the date on which these homicides were committed. For this study, I will be focusing on the broad month of the incident so we can use weather data (Diebel 2024) to classify the homicide as a warm weather homicide or a cold weather homicide.

Upon analysis, I only used columns that indicated homicide type and month of occurrence. All other columns were deemed beyond the scope of this paper. I conducted the first step of basic data cleaning to eliminate additional columns and simplify the names of retained columns and grouped the homicides by months. (see Table 1).

2.2 Division of Homicides

The Toronto Homicide Statistics data set (Data 2023) divides the Homicides into 3 subcategories, which are: Shootings, Stabbings and Other. Consequently, I wrote a script using ‘group_by’ to see the total count of homicides for each subcategory (see Table 2). We now want to categorize the months as “warm” or “cold” to categorize a homicides that occurred in a warm month or a cold month. According to Toronto temperature history (Diebel 2024), Toronto has experienced cooler weather in the months of October through March and warm weather in the months April through September

Table 3: Homicide Data for Warm Months[April - September]

Homicide	Count
Other	189
Shooting	376
Stabbing	174

Table 4: Homicide Data for Cold Months[October - March]

Homicide	Count
Other	163
Shooting	351
Stabbing	143

2.3 Categorize Homicide by Temperature

Since I now had a basis and metric to classify how the warm weather homicides and cold weather homicides will be categorized, I cleaned the existing data and created a data table using “group_by” with homicides for the warm months(see Table 3) and repeated the process for the cold months(see Table 4).

3 Results

3.1 Monthly Homicide Data

As evident from the insights obtained in Table 5, notable patterns emerge. Referencing Diebel (2024), we can discern that July stands out as one of the hottest months in Toronto over the last two decades, while conversely, January registers as one of the coldest. Corroborating this meteorological data with homicide statistics reveals a corresponding trend, with July exhibiting a higher incidence of homicides, while January records a comparatively lower frequency. For a visual representation of these observations, please consult Figure 1, which encapsulates the physical manifestation of the data trends.

3.2 Affect of weather on Homicide Incidents

A detailed analysis of seasonal data is necessary to determine whether there is a relationship between weather and homicide incidents. A strong pattern emerges by comparing the analysis of Table 7, which represents the colder months of October to March, with Table 6, which includes homicide incidences from April to September between 2004 and 2023. There is a

Table 5: Homicide Data for Every Month across 20 years

Month	Homicides
April	101
August	127
December	126
February	106
January	110
July	148
June	101
March	92
May	113
November	97
October	126
September	149

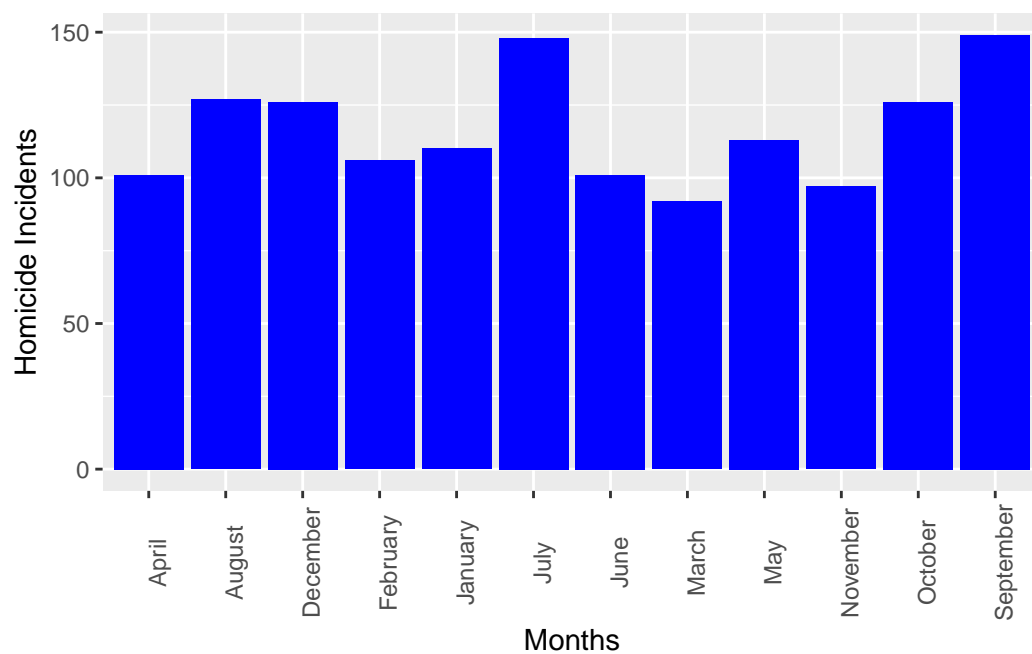


Figure 1: Number of Homicide Incidents per month from 2004 to 2023.

Table 6: Homicide Incidents from April through September from 2004-2023

Homicide Subcategory	Incidents
Other	189
Shooting	376
Stabbing	174

Table 7: Homicide Incidents from October through March from 2004-2023

Homicide Subcategory	Incidents
Other	163
Shooting	351
Stabbing	143

distinct decrease in homicide events of all kinds (Shootings, Stabbings, Other) throughout the winter months, but a substantial increase during the hotter months. This glaring discrepancy suggests a direct link between rising homicide rates and warmer temperatures.

We now look at the homicide data from both types of weather side by side in Table 8 and can see that warm weather has an increase in all types of homicides. We can also see this graphically depicted in Figure 2

Table 8: Comparing Homicide Data for Warm Weather and Cold Weather

Homicide Type	Cold Weather	Warm Weather
Other	163	189
Shooting	351	376
Stabbing	143	174

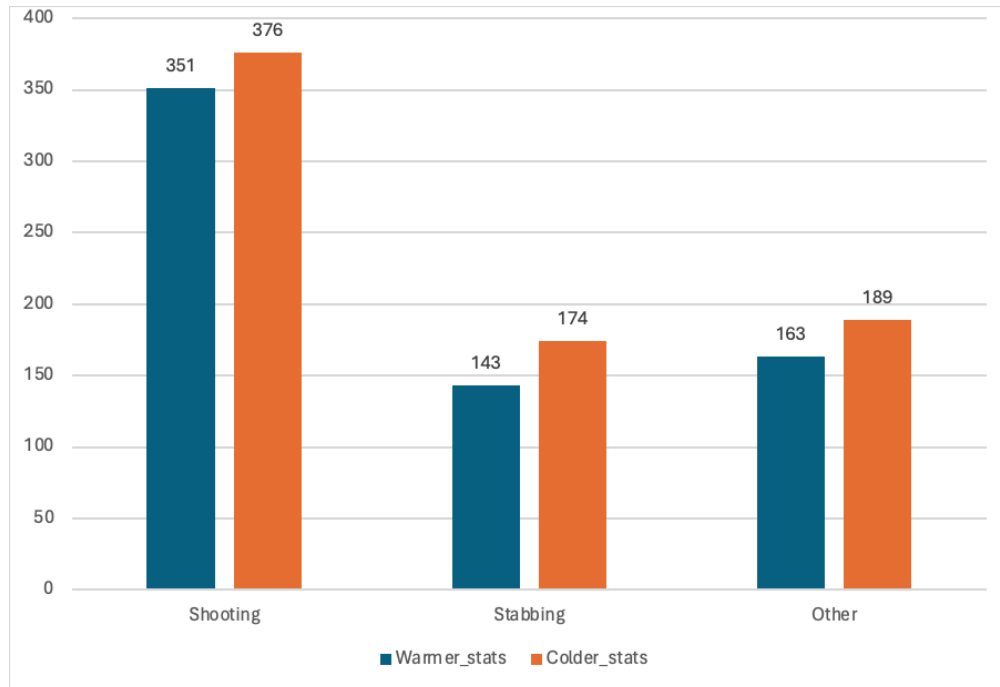


Figure 2: Graph depicting the impact of weather on all types of homicides

4 Conclusion

Our thorough examination of Toronto homicide statistics has revealed significant insights into the patterns of criminal behaviour in the city. One important finding is that warmer temperature correlates with a higher rate of homicides than cooler weather. While determining direct causation is difficult, this pattern is consistent with previous research indicating that higher temperatures may contribute to increased aggression and social tensions (Corcoran and Zahnow 2022). Furthermore, warmer weather frequently leads to more social contacts and outdoor activities, which can create situations that foster conflict and escalate into violent occurrences. These findings highlight the complex relationship between weather patterns and crime, stressing the significance of taking environmental elements into account when analyzing and managing urban safety issues.

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