Time Trends in Deaths of Shelter Residents in Toronto*

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The number of deaths among shelter residents in Toronto is a good index assessing the living conditions and health risks faced by homeless populations. We visualized the data to examine time trends, pandemic impacts, and gender differences in shelter deaths. Our findings suggest that winter may have the highest number of deaths and that COVID-19 increased the death count by three times. This analysis draws the attention of policymakers and encourages further statistical examination to reach significant conclusions.

1 Introduction

In examining urban social issues, the living conditions and health risks faced by homeless populations have long been a central concern. According to the latest report from Trillium, Toronto's shelter system has the capacity to house around 10,000 individuals at a time. This number highlights the seriousness of the city's homelessness challenge and reflects society's ongoing efforts to address the basic needs of this vulnerable group[1]. Despite this capacity, conditions for homeless individuals remain challenging. Data from Fred Victor shows that the daily shelter occupancy rate consistently hovers at approximately 98%[2]. This high utilization indicates not only the pressing demand but also the strain on shelter resources and management.

Behind this high occupancy rate lies a concerning mortality rate among homeless individuals. On average, three homeless people die each week in or near shelters—a rate significantly higher than that of the general population. This increase in mortality reflects the heightened health risks faced by this group and poses a significant challenge to urban society's commitment to public welfare.

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*Code and data are available at: https://github.com/RohanAlexander/starter_folder.

Additional statistics from Toronto.ca reinforce the gravity of the situation, showing that homeless individuals experience not only a higher incidence of illness but also an unusually elevated rate of unnatural deaths[3]. In response, the Toronto government has committed to enhancing its emergency response protocols within shelters, demonstrating its commitment to safeguarding the health of this population. These measures are an essential component of efforts to create a more inclusive and resilient city.

However, reducing the mortality rate among homeless individuals requires more than emergency responses. There is a need to examine the patterns and underlying causes of medical emergencies in shelters, which could help optimize emergency response strategies into preventing these tragic outcomes. Analyzing the time trends and possible contributing factors behind these deaths is essential for developing effective prevention strategies.

Against this backdrop, this paper aims to analyze the temporal patterns of deaths within Toronto's shelter system and investigate the factors that may influence mortality rates. The specific objectives are as follows:

Examine the time trends in shelter death rates since 2007. Identify periods of higher and lower mortality rates. Assess the impact of external events, such as COVID-19, on shelter deaths. Explore gender differences in shelter mortality. Through this analysis, we hope to provide data-driven recommendations that can inform more targeted, timely policies. Ultimately, the goal is to contribute to a more just, healthy, and inclusive society where every life is respected and protected.

The remainder of this paper is structured as follows: Section 2 describes the data source and analysis methods, Section 3 presents analytical results, and Section 4 discusses with strength and limitations of the research as well as policy recommendations.

2 Data

The dataset used in this study was obtained from Open Data Toronto, offering monthly records of deaths in Toronto shelter since 2007. Data were stratified by genders.

The raw dataset comprises the following key fields:

- **Year** and **Month**: Time of records.

- **Total decedents** : Total number of deaths in Toronto shelters.

- **Male** , **Female** and **Transgender/Non-binary/Two-Spirit**: Detailed number of deaths by genders.

We used R 4.3 for analysis and followed a public template[45]. and a collection of R packages were used in this study:

- tidyverse[6]

- here[7]
- lubridate[8]
- ggplot2[9]
- scales[10]
- knitr[11]

Data cleaning steps are described in the Appendix. A sample of the cleaned data is presented in Table 1.

Table 1: Sample of Monthly Death Data

Year	Month	Total_Death	Male	Female	Time
2007	Jan	0	0	0	2007-01-01
2007	Feb	3	3	0	2007-02-01
2007	Mar	3	2	1	2007-03-01
2007	Apr	1	1	0	2007-04-01
2007	May	2	2	0	2007-05-01
2007	Jun	3	3	0	2007-06-01

3 Analysis

3.1 Data overview

Figure 1 shows the overall trend of deaths in Toronto shelters. The numbers of monthly deaths fluctuate over time and increases slightly before the COVID-19 period. There is an outbreak of death during COVID period. After COVID-19, the numbers of death dropped down but the still showed an overall increase.

3.2 COVID-19 impact

We defined the COVID-19 period as spanning from January 2020 to May 2023 and used histogram to show the distribution of numbers of monthly deaths for both the COVID-19 and non-COVID periods, as shown in Figure 2. The numbers of monthly deaths during the COVID-19 period ranged from 0 to 18 and most values are between 5 to 15. The typical number of monthly deaths in non-COVID period was around 3. Visually COVID-19 resulted in a three-fold increase in monthly death.
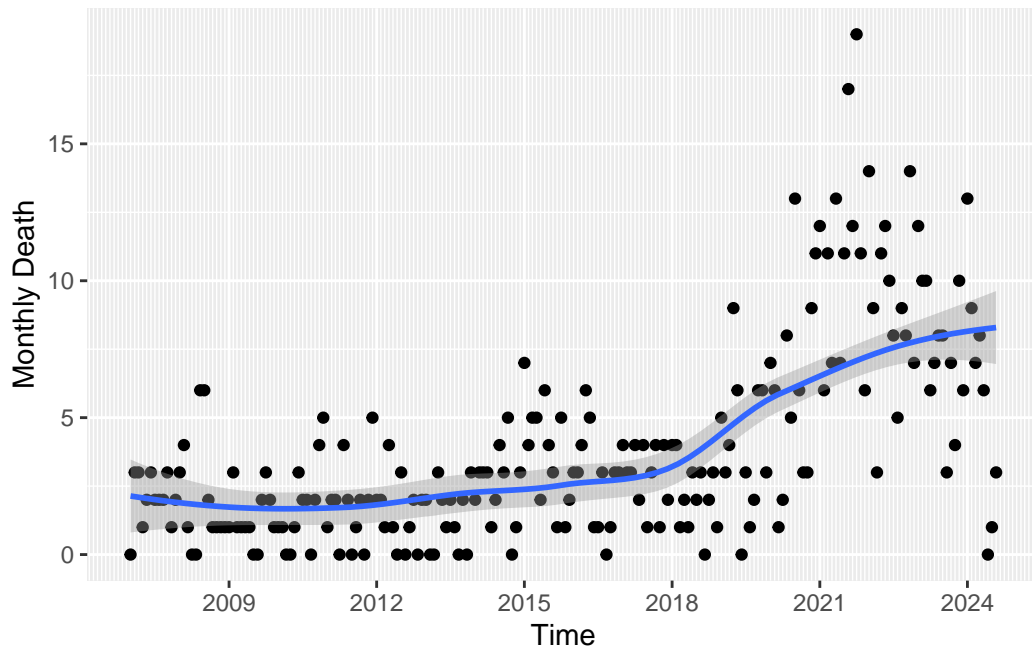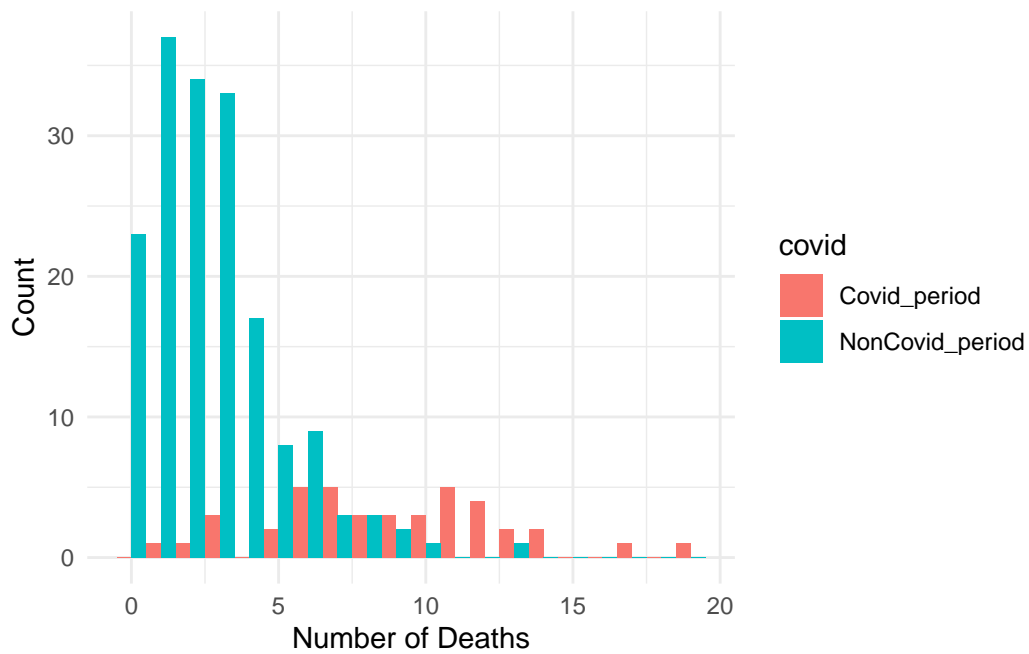
Figure 1: Monthly Death in Toronto Shelters Since 2007

Figure 2: Histogram of Monthly Deaths in Toronto Shelters for Covid and Non-Covid Periods

3.3 Season impact

We also explored the seasonal impact on the number of deaths. Figure 3 presents boxplots of deaths by season. Visually, the fall season showed a slightly lower mean number of deaths. The average number of deaths is similar for spring, summer, and winter, with winter showing the highest lower bound of the interquartile range. There are some outliers with extremely high death counts, likely caused by COVID-19.
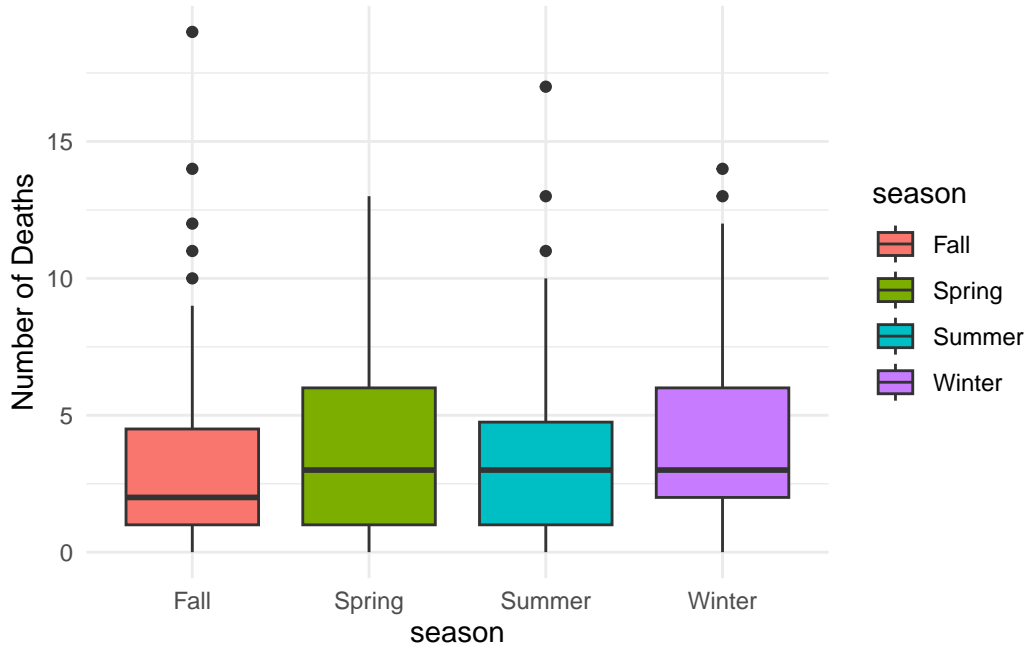

Figure 3: Boxplots of Monthly Deaths in Toronto Shelters by Seasons

3.4 Gender impact

Figure 4 shows that the total number of deaths among males is significantly higher than that among females since 2007. However, we cannot conclude that males are at a higher risk than females, as we do not have detailed information on the total number of male and female residents in Toronto shelters. Further analysis will be required once additional data is collected.
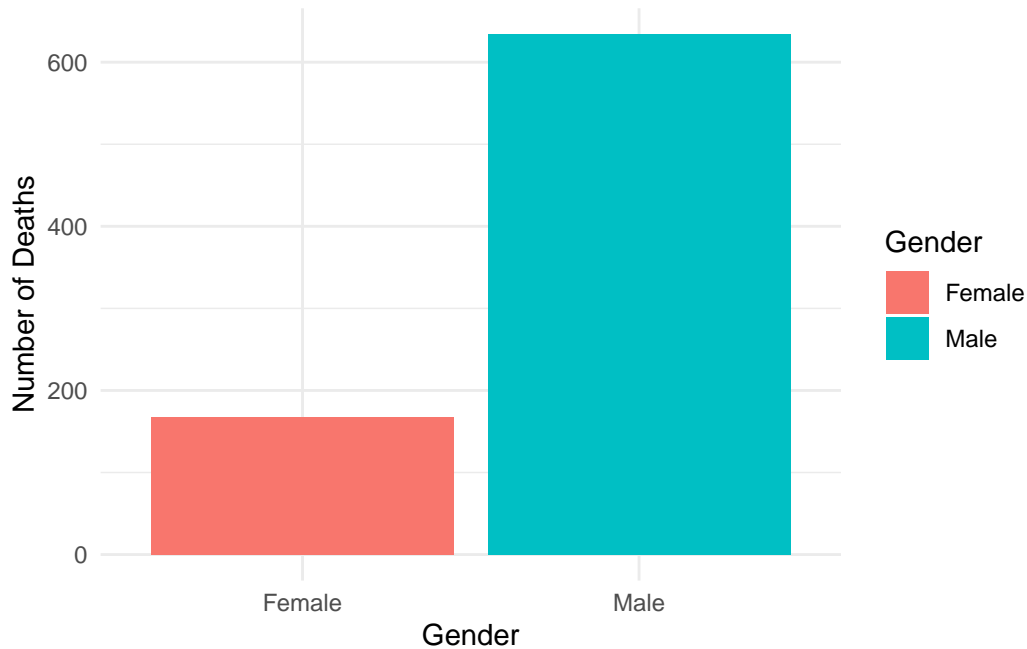
Figure 4: Barplots of Monthly Deaths in Toronto Shelters by Gender

4 Discussion

4.1 Summary of findings

In this paper, we analyzed data on the number of shelter deaths in the Toronto area. From our analysis, we identified the following key points: 1. The number of deaths in Toronto shelters has increased slightly each year since 2007, despite the impact of COVID-19; 2. COVID-19 significantly increased the number of deaths by three times; 3. Seasonal impacts exist but are not visually significant regarding the number of deaths; 4. The majority of deaths in shelters are among males.

4.2 Strength and Limitations

We analyzed variations in the number of deaths from different perspectives. We used plots to visualize temporal trends, which may provide some statistical support for policymakers.

However, we did not employ statistical methods to test whether various impacts are significant. Since we did not use modeling, we cannot provide statistical meaningful conclusions. We need to incorporate statistical modeling in future research. Additionally, we need to collect further data; for example, when exploring the gender effect, we did not have the total number of

sheltered males and females, so we cannot calculate the death rate and cannot draw a clear conclusion.

4.3 Conclusion and Support to Policy Making

We identified potential timely trends in deaths, such as seasonal impacts and pandemic effects. However, we lack statistical modeling, so we are unable to make statistically significant conclusions. On a positive note, we have provided policymakers with some visual results that may help attract more attention and interest in further analyzing this data.

Appendix

Data Cleaning Steps

Raw data from Open Data Toronto were prepared, so we did not need to perform many cleaning steps. A few cleaning steps are as follows:

- Recode missing values for genders other than male or female.
- Standardize column names.
- After realizing that there were too many missing values for other genders (over 90%), we dropped that variable.
- Create a new Time variable to represent the first day of each recorded month in date format.

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