# Seasonal Variations in Mortality Rates Among Shelter Residents in Toronto: Is Winter the Deadliest Season?*

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This study explores Toronto winters' influence on the morality rates among sheltered residents. Using data on the number of sheltered deaths in each season from 2007 to 2024, I investigate how cold weather impacts those in shelters. I find that mortality rates in spring, summer, and fall are similar, while winter shows a slight increase compared to the other seasons. This finding suggests that while Toronto shelters offer protection from extreme weather, shelter residents remain vulnerable to cold temperatures, indicating that further measures should be taken to ensure their safety.

## 1 Introduction

Homelessness is a persistent issue in Canada, with Toronto fostering the largest population of homeless individuals in the country (Blair 2024). On any given night, an estimated 10,000 people in Toronto are without a permanent home (Blair 2024), with many relying on Toronto shelters for safety and warmth. Despite the city of Toronto providing shelters for these homeless people, sheltered residents still face many health risks.

Previous research has shown that homeless populations are at an increased risk of mortality from cold temperatures, particularly during the winter months (Romaszko and Cymes 2017). However, much of this existing research focuses on unsheltered individuals who are fully exposed to the cold. This leaves an important gap in our understanding of the well-being of sheltered homeless in winter.

To explore this, I utilized a dataset from Toronto Shelter & Support Services, which documents the number of deaths for sheltered or recently shelter residents between March 2007 and

*Code and data are available at: https://github.com/kevicai/toronto-sheltered-residents-deaths-analysis

February 2024. By comparing the death rate of each season and various trends in the data, I find that winter not only has the highest total death count but also consistently leads as the deadliest season across multiple years. This finding suggests that, although shelters provide essential services and are designed to protect homeless individuals from extreme weathers, they may not fully reduce the heightened risks associated with cold weather.

The remainder of this paper is structured as follows: Section 2 addresses the data used in the analysis, and Section 3 discusses my findings and limitations in the results.

# 2 Data

The data was extracted, cleaned, and analysed using the statistic programming software R (R Core Team 2024) and the R libaries `tidyverse` Wickham et al. (2019), `janitor` (Firke 2023), `citeKnitr` (Xie 2024), `ggplot2` (Wickham 2016). The data presentation and analysis methods used are from Telling Stories with Data (Alexander (2023)).

## 2.1 Overview of Dataset

To investigate the effect of winter on sheltered residents in Toronto, I investigate the dataset "Deaths of Shelter Residents" (2024), collected by the City of Toronto's Shelter and Support Services Division. This dataset is a part of Toronto's initiative to identify and respond quickly to issues that emerge in homeless shelters ("Deaths of Shelter Residents_2017" 2017). This dataset has been systematically documenting the deaths of residents in its shelters since 2007. The number of deaths is recorded for each month, and each death is reported within 24 hours of identifying the deceased ("Deaths of Shelter Residents_2017" 2017). These reports apply to both current and recent shelter residents and no sensitive privacy data that can identify the residents was recorded. The dataset measures deaths of male, female, and transgender/non-binary/two-Spirit sheltered residents.

I obtained the data using the OpenDataToronto R package (Gelfand 2022) from OpenData-Toronto. A sample of the cleaned dataset is shown in Table 1.

Table 1: Sample of Cleaned Deaths of Shelter Residents Data

| Year | Season | Deaths |
|---|---|---|
| 2007 | Fall | 6 |
| 2007 | Spring | 6 |
| 2007 | Summer | 7 |
| 2007 | Winter | 9 |
| 2008 | Fall | 3 |

The variable `deaths` includes the total count of deaths from all gender identities: male, female, transgender/non-binary/two-Spirit. Although the dataset tracks gender distinctions, for the purposes of this analysis, these were combined to focus on overall mortality trends rather than gender-specific mortality patterns. The variables `year` and `season` denote the year and season of death. The data originally contained the number of deaths for each month, but for the purpose of studying the effect of seasons, the months are merged into seasons. Winter of each year includes only December of the year and additionally January and February of the following year; Spring includes March, April and May; Summer includes June, July, and August; Fall includes September, October, and November. The dataset does not contain the exact date of death, so the four seasons are divided into three months rather than the exact days for each season in Toronto. The original dataset includes months from January 2007 to August 2024, but in the final dataset, only months from March 2007 to February 2024 are included to ensure that there are 17 occurrences of each season. Further, no invalid data was found in the original dataset and the cleaned dataset includes 68 rows.

Similiar datasets, such as general homelessness mortality of Toronto, could be used in the research. However, these datasets are less specific to the sheltered population and include individuals with different levels of exposure to shelters. For understanding the direct impact of shelters, the chosen dataset is ideal, allowing for a more precise analysis.

## 2.2 Data Summary

Table 2: Summary of deaths of shelter residents in Toronto data

| Season | Total Deaths | Average Deaths |
|---|---|---|
| Fall | 185 | 10.88 |
| Spring | 185 | 10.88 |
| Summer | 187 | 11.00 |
| Winter | 228 | 13.41 |

Table 2 presents a summary of the total and average deaths by season. It shows that while mortality rates for fall, spring, and summer are relatively similar, winter experiences a noticeable increase in the number of deaths, indicating potentially higher mortality risks during this season.

Figure 1 presents the changes of sheltered mortality rates in the seasons of different years.

Figure 2 shows the number of times each season has the highest number of sheltered deaths in the respective year, winter clearly in the lead.

Figure 3 shows the boxplots of the number of deaths in each season.

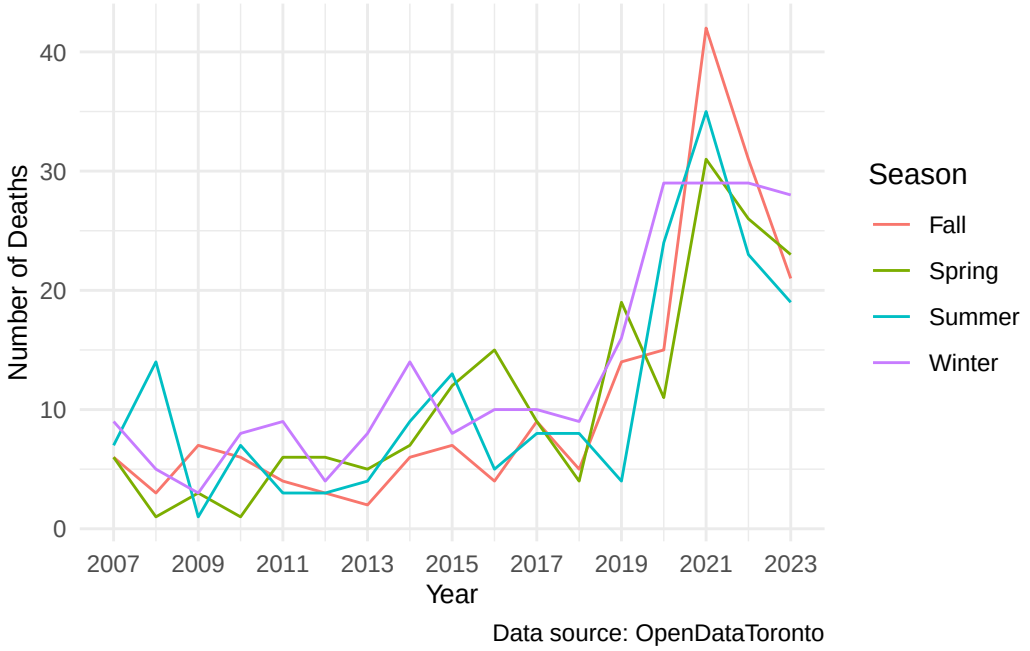


Figure 1: Toronto all seasons sheltered deaths changes, 2007-2024

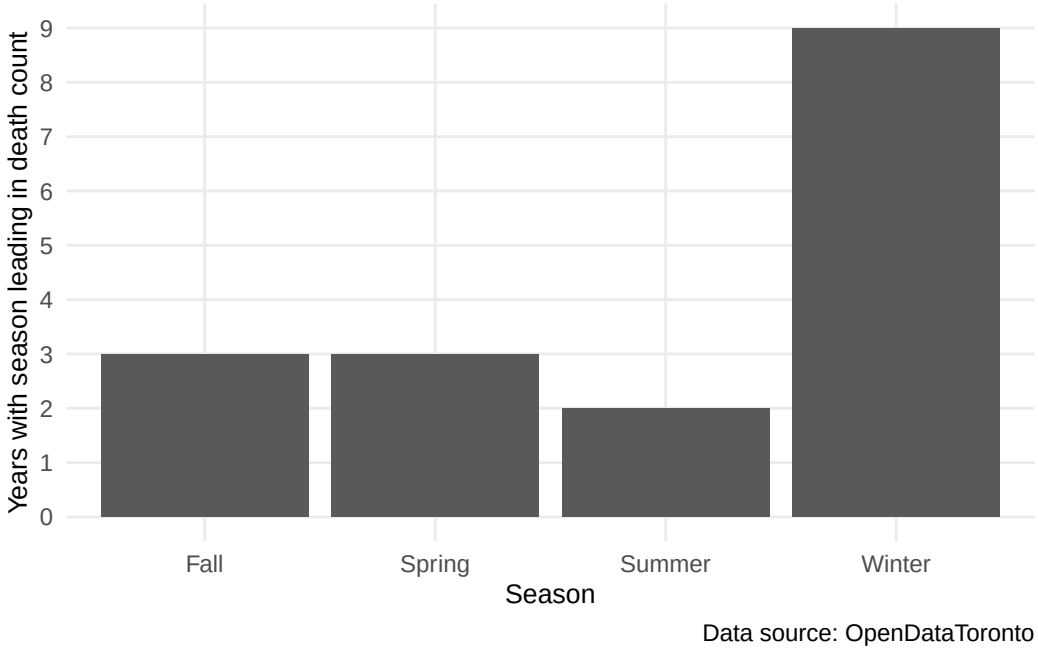


Figure 2: Toronto all seasons sheltered deaths changes, 2007-2024

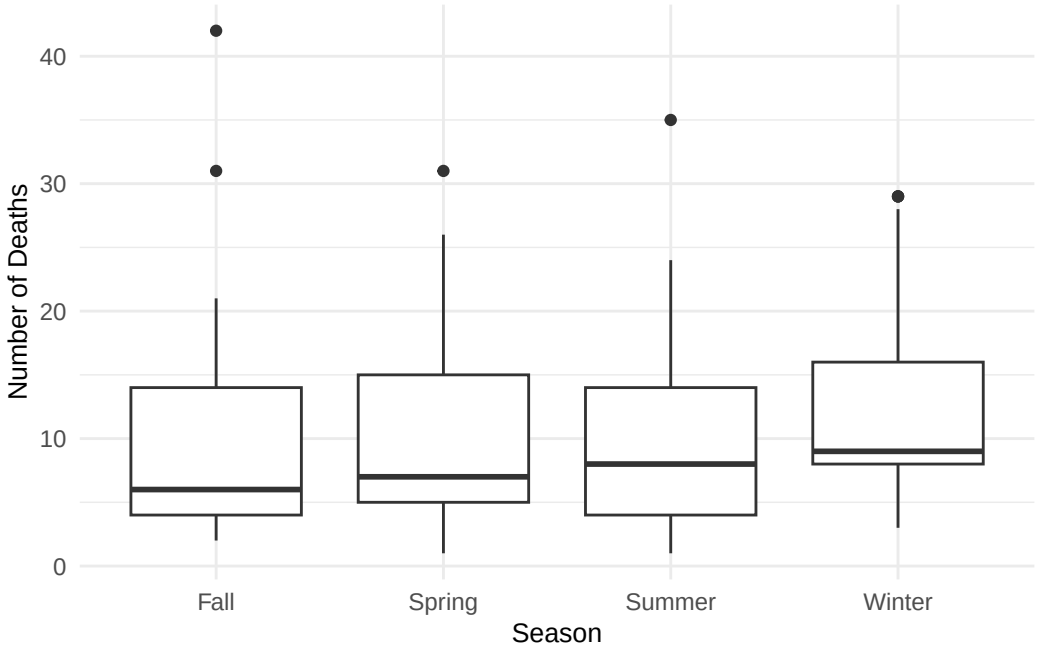


Figure 3: Boxplot of Deaths by Season

## 3 Discussion

A clear trend can be found in the mortality rates among sheltered residents. As seen in Figure 3, winter takes the lead in the number of deaths with the highest minimum, maximum, median, and quantile values. In addition, the data summarized in Table 2 shows that winter accounted for 228 deaths between 2007 and 2024, with an average of 13.41 deaths per winter season. This contrasts with spring, summer, and fall, which all average approximately 11 deaths per season. This data suggests that compared to other seasons, winter has a 21.91% increase in mortality rate. We can apply these statistics as a projection to future winters and estimate the amount of extra resources the shelters need to accommodate for the increased risk.

The histogram in Figure 2 also shows winter had the highest number of deaths, three times more than the second highest seasons with only. Also, winter leads in 9 out of the 17 years recorded, accounting for more than half of the years. This reinforces the idea that winter is the deadliest season.

Although winter leads to the death rate in most years, it is worth noting that winter is not always the deadliest season. In 2021 winter has the lowest death rate while fall leads with more than 10 deaths than winter, as illustrated in Figure 1. This anomaly could be due to factors beyond seasonal weather, such as Covid-19. It is important to further analyze the cause of

this increase in further research.

## 3.1 Limitations

There are two noticeable limitations to this study. First, the dataset only provides the season and year of death. This limits the ability to correlate deaths with the exact season, or extreme cold temperatures recorded. More precise insights and comparisons to daily temperature datasets could be made if the dataset includes weekly or daily data. Furthermore, the dataset does not report the shelter the deceased resided in. If we can consider the varying quality, capacity, or conditions of the shelters, a more detailed judgement on the effects of weather could be made since not all shelters provide the same level of protection from the cold.

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