

# The Impact of Seasonal Changes on Mortality Rates in Toronto\*

Death Registry Statistics in Toronto

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This paper analyzes death toll data across four civic centers (Scarborough, North York, Toronto and Etobicoke)) from 2011 to 2023, with the goal of identifying seasonal patterns and regional differences in mortality, which is made available to the public from Open Data Toronto. Utilizing death registry data, we categorized the deaths by season—Winter, Spring, Summer, and Fall—and aggregated the death tolls across the years for each region. The analysis revealed notable variations in mortality trends across both seasons and civic centers. The results show that Winter consistently reported higher death tolls compared to other seasons across most regions. Using visual representations generated through ggplot2, the findings highlight significant regional disparities, which suggest possible influences of environmental or socio-economic factors contributing to seasonal mortality trends.

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\*Code and data are available at: <https://github.com/Wang20030509/Sta304-Term-Paper-1>

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# 1 Introduction

Seasonal variations in mortality have been a focus of public health research for many years, driven by fluctuations in temperature, disease prevalence, and environmental factors. In colder regions, such as Toronto, winter months often coincide with increased mortality, particularly among vulnerable populations like the elderly or homeless. Numerous studies have linked these seasonal changes to temperature variations, with colder months typically showing elevated mortality rates (Madaniyazi, Chung, et al. 2021) (Madaniyazi, Armstrong, et al. 2021)

This study examines the impact of seasonal changes on death tolls in Toronto between 2011 and 2023, utilizing death registry data from Open Data Toronto. By categorizing deaths by season—Winter, Spring, Summer, and Fall—and analyzing regional variations across the city’s four civic centers (Scarborough, North York, Toronto, and Etobicoke), the paper aims to uncover significant trends in mortality rates throughout the year. Previous studies have shown that temperature plays a significant role in seasonal mortality (Martin et al. 2012) (Zhang et al. 2024), with cold winters and heat waves contributing to an increased death toll, but the exact influence of socio-economic and environmental factors at the local level remains under-explored (Madaniyazi, Chung, et al. 2021) (Madaniyazi, Armstrong, et al. 2021).

Past research has focused heavily on the role of extreme weather events and temperature variability in driving mortality rates. Findings suggest that colder months are associated with higher mortality, particularly due to cardiovascular and respiratory issues exacerbated by low temperatures (Madaniyazi, Chung, et al. 2021). This paper builds on those findings by exploring how these seasonal dynamics manifest in a large urban environment like Toronto, where varying environmental and socio-economic conditions across different neighborhoods might influence mortality outcomes (Martin et al. 2012).

The results of this study will offer new insights into seasonal mortality trends within Toronto and inform public health initiatives aimed at mitigating mortality spikes during colder months. Understanding these patterns is crucial for guiding policy decisions and healthcare resource allocation during high-risk periods (Zhang et al. 2024).

The remainder of this paper is structured as follows. Section 2 describes the dataset and cleaning methods used in the analysis. Section 3 presents the results and key findings, and Section 4 offers a discussion of the implications of these results as well as limitations and potential next steps.

## 2 Data

Some of our data is of deaths (Figure 1), from City of Toronto Open Data Team (2024).

### 2.1 Overview Data

Table 1: Sample Data

_id	CIVIC_CENTRE	DEATH_LICENSES	PLACE_OF_DEATH	TIME_PERIOD
27767	ET	69	Outside City Limits	2011-01
27768	ET	341	Toronto	2011-01
27769	NY	141	Outside City Limits	2011-01
27770	NY	540	Toronto	2011-01
27771	SC	129	Outside City Limits	2011-01
27772	SC	545	Toronto	2011-01

### 2.2 Cleaned Data

Table 2: Sample Cleaned Data

ID	Civic Centre	Death Toll	Place of Death	Year	Month	Season
27767	ET	69	Outside City Limits	2011	Jan	Winter
27768	ET	341	Toronto	2011	Jan	Winter
27769	NY	141	Outside City Limits	2011	Jan	Winter
27770	NY	540	Toronto	2011	Jan	Winter
27771	SC	129	Outside City Limits	2011	Jan	Winter

### 2.3 Summarized Data

And also planes (?@fig-planes). (You can change the height and width, but don't worry about doing that until you have finished every other aspect of the paper - Quarto will try to make it look nice and the defaults usually work well once you have enough text.)

## 3 Results

Our results are summarized in Figure 1 Something Something Something

Table 3: Summarized Data

(a) Total Death toll by Season (2011-2023)

Season	Civic Centre	Death Toll
Fall	ET	21827
Spring	ET	26261
Summer	ET	19696
Winter	ET	25173
Fall	NY	19565
Spring	NY	23605
Summer	NY	21262
Winter	NY	18923
Fall	SC	15428
Spring	SC	17055
Summer	SC	13422
Winter	SC	16744
Fall	TO	2666
Spring	TO	1900
Summer	TO	1866
Winter	TO	2074

(b) Average Deaths by Month (2011-2023)

Month	Mean of the Death Toll
Apr	280.0658
Aug	238.8049
Dec	215.2222
Feb	248.9630
Jan	336.4444
Jul	221.5570
Jun	233.6707
Mar	285.1000
May	297.9277
Nov	266.1299
Oct	252.1039
Sep	254.3117

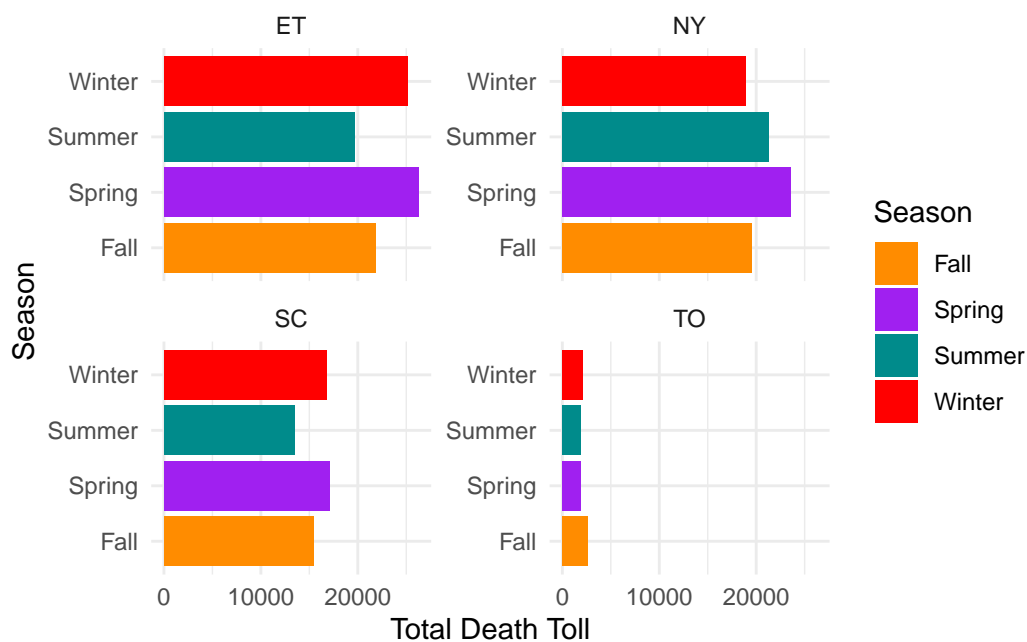


Figure 1: Total Death Toll by Season and Region (2011-2023)

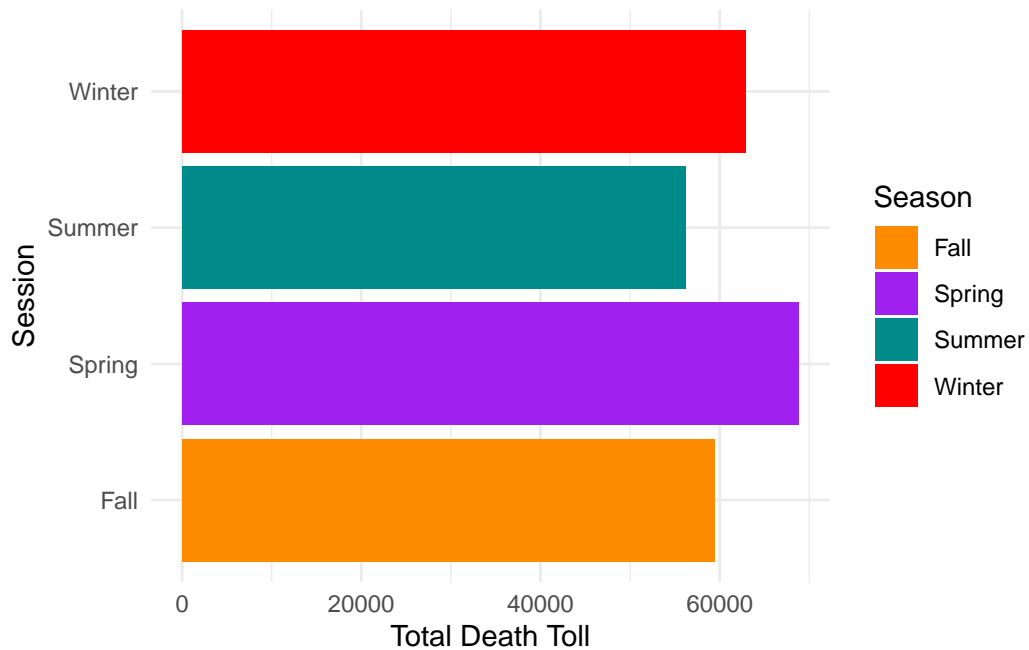


Figure 2: Total Death toll by Season (2011-2023)

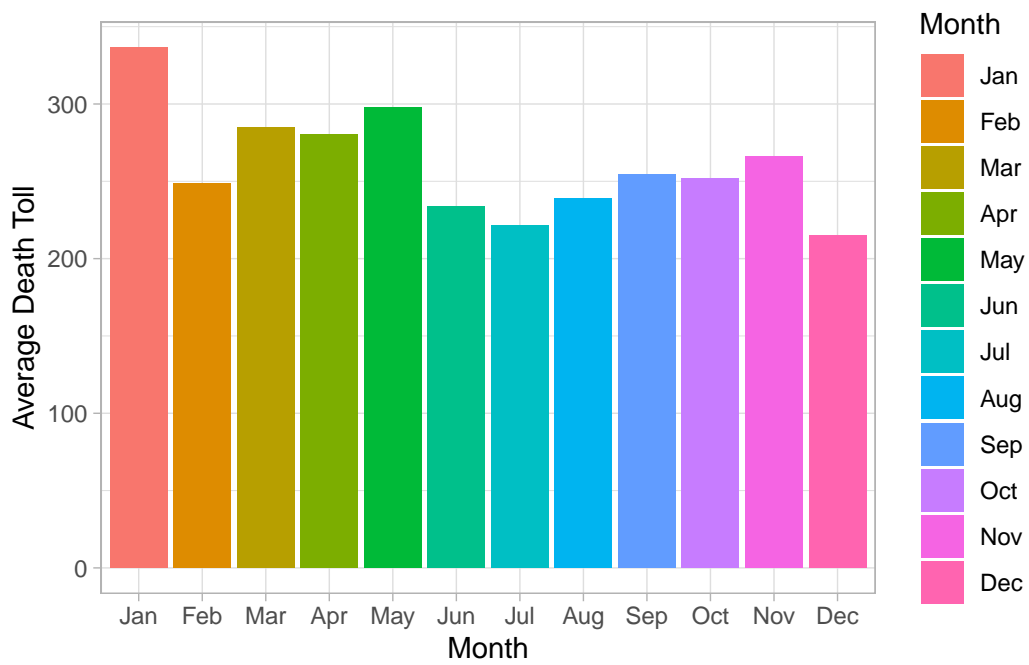


Figure 3: Average Death Toll by Month (2011-2023)

## **4 Discussion**

### **4.1 First discussion point**

If my paper were 10 pages, then should be at least 2.5 pages. The discussion is a chance to show off what you know and what you learnt from all this.

### **4.2 Second discussion point**

### **4.3 Third discussion point**

### **4.4 Weaknesses and next steps**

Weaknesses and next steps should also be included.

## Appendix

## References

- City of Toronto Open Data Team. 2024. *Death Registry Statistics Dataset*. City of Toronto. <https://open.toronto.ca/dataset/death-registry-statistics/>.
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- Martin, Sarah L., Christopher Alan Hebburn, Mary-Luyza Avramescu, and Neil Tremblay. 2012. “Climate change and future temperature-related mortality in 15 Canadian cities.” *International Journal of Biometeorology* 56 (4): 605–19. <https://doi.org/10.1007/s00484-011-0449-y>.
- Zhang, Yuqing, Kai Wang, Junjie Ren, Yixuan Liu, Fei Ma, Tenglong Li, Ying Chen, and Chengxiu Ling. 2024. “Bivariate extreme value analysis of extreme temperature and mortality in Canada, 2000-2020.” *BMC Public Health* 24 (1): 1344. <https://doi.org/10.1186/s12889-024-18785-3>.