Analysis of Death register statistics in Toronto*

with civic centre and location

Ruiying Li

September 27, 2024

This study analyzed death registration statistics in Toronto to understand mortality patterns and distributions in different city centers and locations. We found that the majority of deaths occur within urban areas, with significant differences between city centers highlighting differences in health outcomes and population density. This study provides valuable insights into how geographic and seasonal factors affect mortality trends in Toronto, which is crucial for public health planning and observing population mobility. By identifying these trends, our research findings can provide strategic basis for improving healthcare services and meeting the needs of different populations in urban environments.

1 Introduction

understand morality trend is important for public health, particularly in urban area with huge and diverse population with different health conditions like Toronto. Death Registry serves is a type of crucial resources to track this trend,revealing the factors leading to deaths in different citizen centers. This paper aims to analysis the geographic distribution of deaths in Toronto,by examining death registry statistics, exploring the morality pattern and distribution in different civic center in Toronto,and how seasonal change affect the death registry statistics.We conducted a detailed analysis of the number of deaths registered from 2020 to 2024,investigating how factors such as location affect mortality.Through analyzing data,we attempt to uncover trends that can provide information for public health strategies and observing population mobility.Our studies indicate that the majority of deaths occur within the Toronto metropolitan area, with significant differences between each center.This study not only emphasizes the differences in mortality based on location, but also highlights the importance of addressing these differences in public health planning.Understanding the location and time of death can guide policy makers in developing targeted interventions to improve the health status of vulnerable

*Code and data are available at: https://github.com/Liruiying0414/death-count

Table 1: **?(caption)**

```
# A tibble: 6 x 6
   ...1 number_of_death location            civic_centre  year season
  <dbl>           <dbl> <chr>               <chr>        <dbl> <chr>
1     1              47 Toronto             TO            2020 Winter
2     2              51 Outside city limits NY            2020 Winter
3     3              64 Toronto             NY            2020 Spring
4     4              60 Toronto             NY            2020 Spring
5     5              48 Outside city limits SC            2020 Spring
6     6              41 Outside city limits SC            2020 Summer
```

groups.The structure of the paper is as follow the data part outlines the data sources and how we analyze these data, the result section examines the main finding of morality trends by using the dataset we analyze above, and mention their effect on public health and tracking the population mobility, with discussing the limitations the dataset may have.Finally,the conclusion section would summarizes the main insights of this article and provides suggestions for future research direction.

2 Data

2.1 Data background

Understanding the mortality trends in urban environments is crucial for public health policies and resource allocation,especially for a city characterized by population diversity and varying health conditions across different regions like Toronto.This paper uses data from Toronto's death registration statistics,which provided by 'opendatatoronto'(**rOpenDataToronto?**) to capture important information on the number of deaths recorded during a specific dates in Toronto.This dataset includes death records classified by various municipal civic centers, death locations, and registration dates for these deaths.The raw data covers the period from 2011 to 2024,we only choose the data from 2020 to 2024 for analysis.The data underwent cleaning and analysis through R programming language (R Core Team 2024). Cleaning was performed through 'tidyverse' package (**rTidyverse?**) ,'janitor' package(Firke 2021),and 'dplyr' package(**rDplyr?**),removing the unnecessary columns for analysis, and arrange data in the order of specific season period. Then install ggplot2 package (**rGgplot2?**) to visualize dataset,providing insights into the demographic and geographic factors influencing death rates in Toronto.

2.2 Data Examination

?@tbl-data provides a sample of the dataset structure and key variables. The dataset includes the above key varaibles: Dates:Register the specific month and year of death for time series analysis of mortality trends,where I divided into specific year and season in cleaning data.

number of death: This variable represents the total number of deaths recorded each month and is the primary response variable for our analysis.

location:This variable classifies deaths as occurring either within Toronto city limits or outside, and crucial for analyzing urban vs. suburban mortality patterns.

civic centre:The code representing the citizen center for death registration,which can indicate the impact of administrative regions on mortality rates.

While there actually are some similar dataset like national morality data provided by Statistics Canada, the dataset we choose has specificity to city Toronto, allowing us focus on more localized and detailed analysis of urban mortality pattern and public health interventions specific to urban environments.

2.3 Trend of death toll changes over different time periods

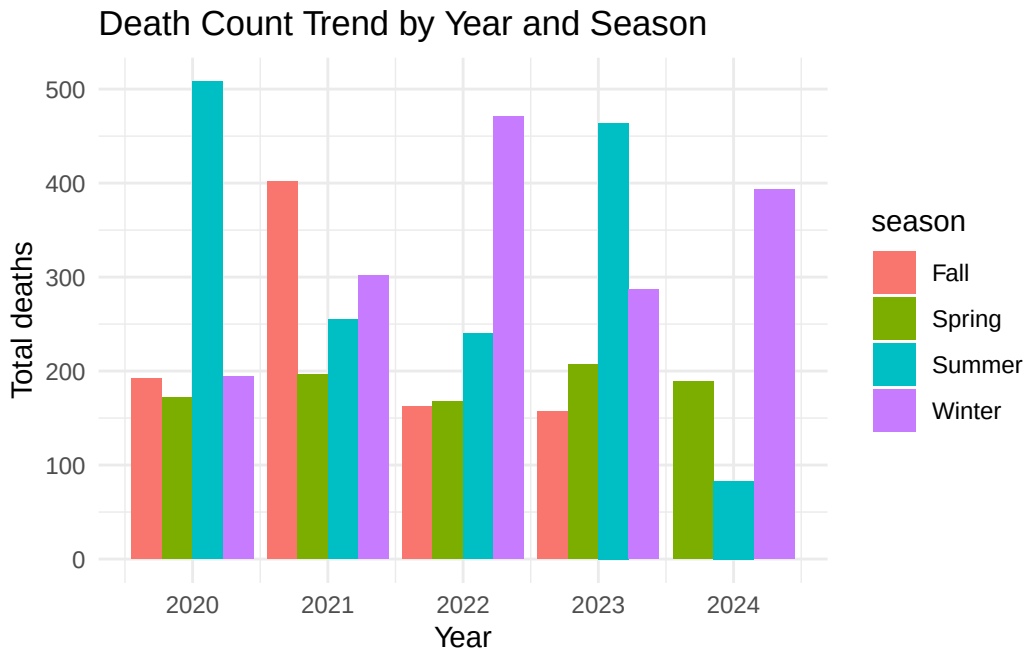

Figure 1: Toronto all season death registry trend From 2020 Spring to 2024 Summer

Based on the results of Figure 1,sorting the death toll by four seansons over the past four years, which green represents 'Spring', blue represents 'Summer' and red represents 'Fall', purple for 'winter'. Although the total deaths in different years and seasons shows complex fluctuations in the data from 2020 to 2024,the number of deaths in summer and winter is more prominent than in other seasons,we found out that the death toll in winter (Dec ~ Feb)was significantly higher than the other season, and show an increasing trend through these four years,this trend may be related to the cold weather and flu season in Toronto. In addition, the death tons in Summer(May-August) also very high, which we consider this might be related to the extreme seasonal change may exacerbate specific health problems, such as cardiovascular and respiratory diseases, and the population flow after school break and reopen would also be a assumption for death number increasing. As we know, Canada is known as a immigrant country with multi-culture.

Through the bar graph,we also found out the death number in Fall 2021 is unusually and extremely higher than other years,back to review the information, we found that the Fall of 2021 coincided with a major outbreak of the pandemic,we assume that the medical burden during Pandemic period may lead to fluctuations in mortality rate.

Moreover,The peak periods of winter and summer vary in different years, with winter becoming the main season with the highest number of deaths, especially in the later years.

2.4 Death tolls change through civic centre

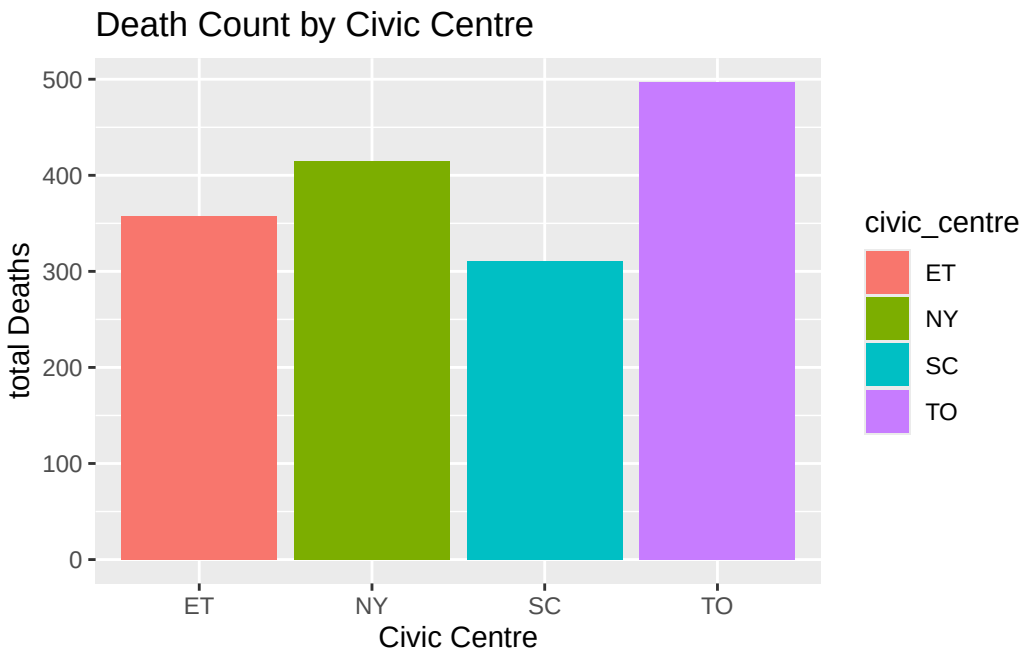

Figure 2: Total Death registry in different civic centre from 2020 to 2024

Figure 2 reveals the total death tolls in previous 4 years from 2020 to 2024, where red represents Etobicoke,green represents North York, blue represents Scarborough and purple represents Toronto. It is obvious that the death tolls in downtown Toronto is the highest, up to 500 deaths,followed by North York, which over 400 deaths,with no significant difference between the other two civic centers.

2.5 Death tolls in Difference civic centre change by Season

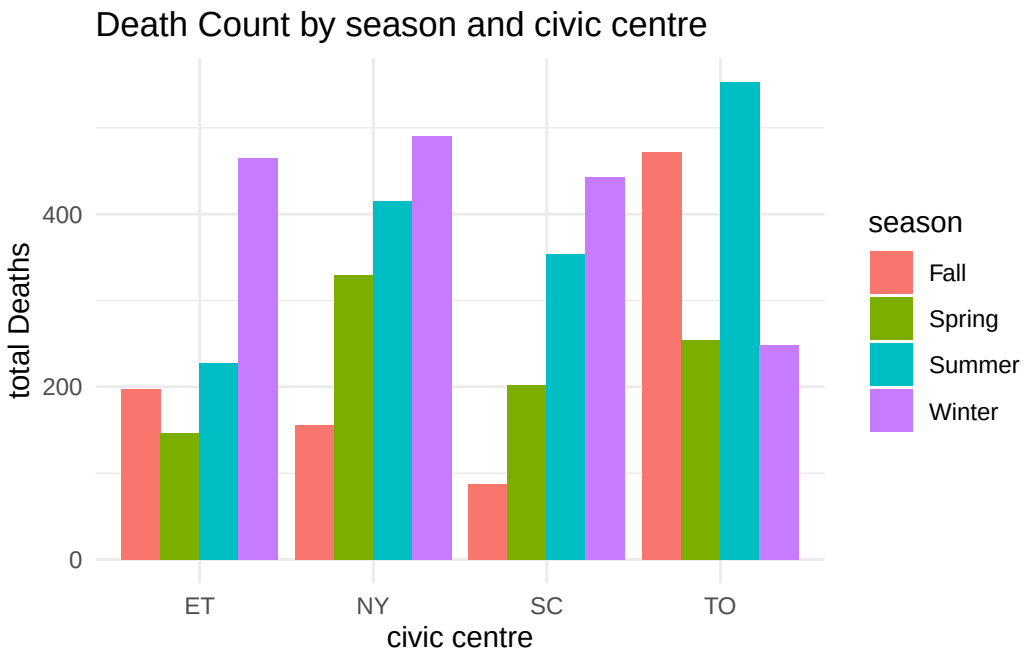

Figure 3: Different civic centre death registry in all season Toronto

Ae we can see from the bar chart Figure 3, where reveals the change death tolls in four different civic center, with the change of four season, where red represents Fall,green represents Spring, blue represents Summer and purple for Winter. Through this investigation of the seasonal changes in the number of deaths at different civic centers over a four-year period,we could tell by the result that the death toll in Downtown Toronto significantly increased during Fall and summer,while North York has the highest number of registered deaths in winter,and the other two city centers have a similar pattern, with the highest number of registered deaths in winter.

2.6 Death tolls change by location

Figure 4 shows the change of four civic center registered death tolls in different locations, that red represent ET,green represents NY,blue represents SC and purple represents TO. This bar

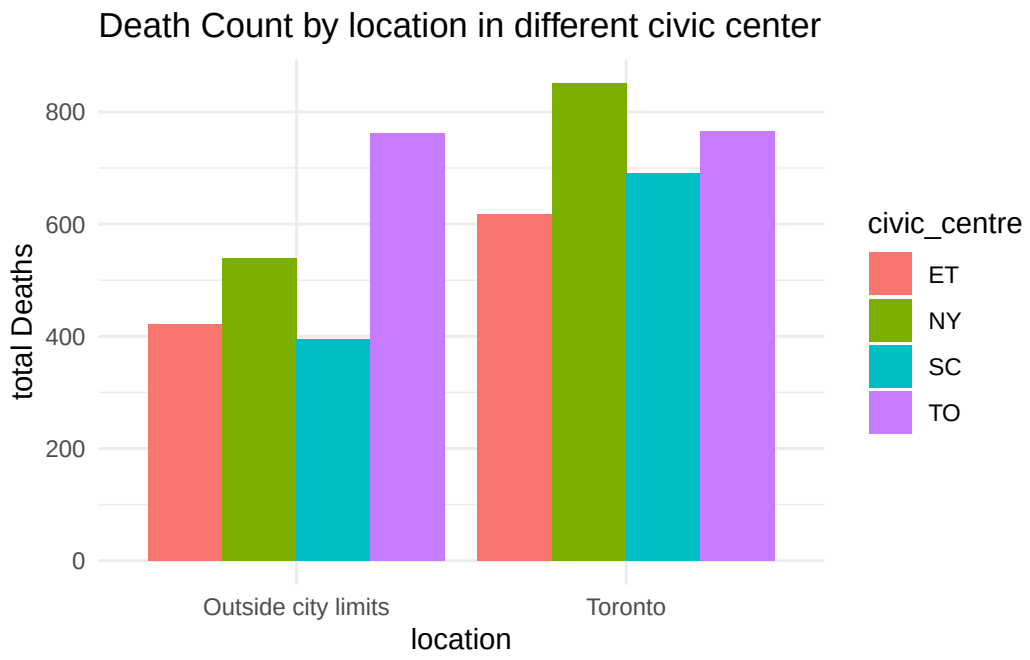

Figure 4: death registry change with location

chart indicates that the majority of deaths occur locally in Toronto, except for the dead who registered in downtown Toronto, the number of deaths occurs nearly the same inside or outside city Toronto,both nearly 750,which we could tell by the data that the population flow in the center of Toronto is frequent and rapid,with strong population mobility, a large number of outsiders,and a large population base, resulting in a high mortality rate

Apart from that,the number of deaths in North York locally far exceeds those outside the city, and even the local death toll is higher than that in downtown Toronto, which death tolls over 800.Firstly, this indicates that their population mobility is relatively inactive compared to downtown Toronto, but they have high population density and gatherings. At the same time, there may be more high-risk events and higher crime rates, which may also lead to higher mortality rates. Both Scarborough and ET had a higher number of deaths locally in Toronto, indicating their low population mobility, sparse population density, and limited human activities.

3 Result

This paper mainly uses bar chart to analyze the death registry statistics in Toronto,ans basically focus on finding how different civic centers,different death locations and the change of seasons would affect the death tolls in Toronto. Through@fig-season,we figure out in the past four years, the data has shown significant seasonal changes.Overall,summer and winter are the

seasons with the highest number of registered deaths. especially in 2022 and 2024,the number of deaths in winter was significantly higher than in other seasons, while 2020 and 2023 showed a peak in summer deaths. This trend may be related to the high incidence of winter diseases and extreme weather conditions in summer.Apart from that,the death number in Fall 2021 is unusually higher, so we assume that except for the extreme weather,the unexpected diseases and pandemic may also lead to increasing death rate.

In this case, we also observe how other factors may influence to the morality rate in Figure 2 and Figure 3,by observing the relationship between death number and different civic centers,under four seasons,we explored that there are significant differences in the number of registered deaths among different civic centers.Data shows that downtown Toronto have the highest number of registered deaths,especially in Fall and summer,where it the time for school reopen, and a golden time for traveling Toronto.For NorthYork,the death number have two peak times in Summer and Winter.In contrast, Scarborough and Etobicoke have fewer registered deaths, mainly concentrated during the winter season.This phenomenon indicates that not only the weather issue has a great impact on morality rate,especially in winter,but also population density and social group may have a significant impact on the number of registered deaths.

To explore more possibility for the relationship between population mobility and morality rate,here we also Analyzed the data between number of deaths in different civic centers and different death locations in Figure 4,and there are significant differences in the registered place of death in different civic centers.

In downtown Toronto,the number of deaths in both local and out of town areas is almost equal,so we considered this is because there are many outsiders,forming a huge population base in downtown Toronto and high level of resident mobility in this area. Surprisingly,Most of the death registered in North York occurs locally,even higher than the death tolls in Downtown Toronto,with relatively fewer deaths outside the city.So we considered their population mobility is relatively inactive compared to Toronto, but they have high population density and business gatherings,with higher crime rates.Scarborough and Etobicoke are more locally registered, with fewer deaths from outside Toronto city,as this two area known as residential district,and less business activity or flow population.

This research indicates that the mobility of residents in each civic center is closely related to the local death toll. Areas with strong liquidity, such as downtown Toronto, have higher death registration numbers outside of their city, while relatively stable areas, such as North York, are mainly registered locally,so we consider North York and Downtown Toronto has the biggest impact on the death tolls in Toronto city, and more close to downtown Toronto,the greater the population mobility is,then the morality rate seems higher.

4 Limitations

However,I also noticed that there are some limitations in our dataset.Firstly,our data only contains four variable,which is lack of important variables that may affect mortality rates, such as population age structure, health status, socioeconomic status.Therefore, it is not possible to delve into the impact of these factors on the number of deaths.

Secondly,the dataset only distinguishes whether the death occurred within or outside of Toronto,the specific geographic information is relatively vague.Without further subdividing the locations of death outside the city,it is impossible to explore the differences in mortality rates in different out of town regions. Apart from that,we are unable to distinguish the death of locals and immigrants,the registered deaths are either those of local residents or those of migrant populations.For example, deaths registered in downtown Toronto may include migrants,such as short-term workers, tourists, students,but this information is not included in the data,making it difficult to determine the difference in mortality rates and population mobility between local residents and migrants.

Thirdly,The lack of information on the cause of death in the data does not provide relevant information on the cause of death.Therefore,it is impossible to distinguish deaths caused by different reasons,such as illness, accidents, natural aging, which limits the analysis to the overall trend of the number of deaths and cannot explore the impact of specific health issues on mortality rates.

All of these limitations in data limit our ability to propose more feasible policies for future urban planning making it difficult to comprehensively analyze the relationship between population mobility and mortality rates in Toronto.This also means that for peak mortality rates or high mortality rates in specific regions,some potential impact factor of population mobility may not be fully considered.

5 Summary

This study analyzed death registration data from the city of Toronto and its surrounding areas over a four-year period,exploring the distribution of deaths in different Civic Centers and the impact of seasonal changes on death toll.

The research results show significant differences in death registration among different civic centers,with the highest number of registered deaths occurring in downtown Toronto and North York,where summer and winter often being the peak periods for death registration. Meanwhile,the registered deaths in Scarborough and Etobicoke are mainly concentrated during the winter season.

The analysis of the location of death shows that the local death registration in North York far exceeds that outside the city, while the number of deaths registered locally and outside the city in downtown Toronto is roughly equal.

Although this study revealed peaks in death registration in certain regions and seasons, there are limitations to the analysis. The lack of important variables such as population mobility and population density in the dataset limits our in-depth understanding of the relationship between population mobility and mortality rate. Future research can combine more detailed individual level mobility data and longer time span data to further explore the complex relationship between population mobility, population structure, and mortality rate.

Appendix

References

Firke, Sam. 2021. *Janitor: Simple Tools for Examining and Cleaning Dirty Data*. https://CRAN.R-project.org/package=janitor.

R Core Team. 2024. *R: A Language and Environment for Statistical Computing*. Vienna, Austria: R Foundation for Statistical Computing. https://www.R-project.org/.