An analysis of socioeconomic factors and fire inspection violations in Toronto highrises

Jessica Im

January 24, 2024

My abstract...

Table of contents

Introduction

The Ontario Fire Code is a regulation under the Fire Protection and Prevention Act of 1997, and helps guide Toronto Fire Services and building fire safety requirements (Toronto, n.d.a). Since 2016, TFS Fire Inspectors conduct fire safety inspections on residential highrises yearly (Services 2017). Results of these fire inspections can be found on OpenDataToronto, making fire safety accessible to the public.

According to Statistics Canada, residential fires accounted for 3 of 4 fire-related deaths. Homes without a functional smoke alarm also accounted for 74% of deaths (StatCan 2023). Unfortunately, from 2015 to 2021, only 37% of residential fires had a working smoke alarm. Fire-related injuries were also higher in homes with a functioning smoke alarm but no sprinkler protection. Statistics Canada explains this may be due to attempts by the residents to control the fires. Since the Covid-19 pandemic, fires have increased and the rise in deaths among seniors was highest; from 2019 to 2020 fire-related deaths among seniors doubled. In a cross-sectional

population-based study in British Columbia, Alberta, Manitoba, and Ontario, socioeconomic factors related to residential fire rates were investigated (Beaulieu et al. 2019). The report found an association between higher educational attainment and unemployment with increased fire incidents. Smaller households were also found to be at higher risk for fire casualties, especially for children.

While high-rises are designed with fire safety as a priority, because of the number of residents and size, a fire has potential for major incidents and can be challenging to respond to (Toronto, n.d.b). This paper will examine the relationship between fire regulation violations in highrises, which requirements failed to be met, and various socio-economic factors by walking through the following sections: Data, Results, Discussion, and Conclusion. In Data, I will discuss the spreadsheets on fire inspection violations in highrises and socio-economic information by Ward Profiles. I also detail the cleaning and analyzing process of these datasets. Results will reveal trends found in the analyses and the Discussion section highlights additional insights. Finally, in the Conclusion, I will summarize key takeaways.

Data

The two datasets used in this paper are from the city of Toronto's OpenDataToronto database (Gelfand 2022). To investigate the various socioeconomic variables and investigation violations in relation to highrises, two datasets were used: "Highrise Residential Fire Inspection Results" (OpenDataToronto 2024a) and "Ward Profiles (25-ward model) (OpenDataToronto 2024b). The data were cleaned and analyzed using open-source statistical programming language R (R Core Team 2023), alongside dplyr (Wickham, François, et al. 2023), tidyverse (Wickham 2023c), forcats (Wickham 2023a), ggplot2 (Wickham, Chang, et al. 2023), janitor (Firke 2023), knitr (Xie 2023), lubridate (Spinu, Grolemund, and Wickham 2023), purrr (Wickham and Henry 2023), readr (Wickham, Hester, and Bryan 2024), readxl (Wickham and Bryan 2023), stringr (Wickham 2023b), tibble (Müller and Wickham 2023), and tidyr (Wickham, Vaughan, and Girlich 2023).

Fire Inspection Results Data

The Highrise Residential Fire Inspection Results Data (OpenDataToronto 2024a) consists of properties with and without identified Ontario Fire Code violations. This dataset does not include ongoing inspections and only includes closed cases. The data includes building addresses, property wards, each fire code violated and a description, and the open and close date of each inspection. In this data, the property address, the property's ward, the fire code violated, and the number of violations at each property were key to uncovering patterns in fire investigations (see Table 1).

Table 1: Sample of Cleaned Fire Inspection Data

Property Address	Property Ward	Violation Fire Code	Number of Violations
90 Park Lawn Rd	3	2.2.3.2	5
90 Park Lawn Rd	3	6.3.1.2	5
4 Elsinore Path	3	1.1.2.3	9
4 Elsinore Path	3	1.1.2.3./2.7.3.3.(3)	9

Ward Profiles Data

For the second dataset, I used the Ward Profile dataset (OpenDataToronto 2024b). This data is gathered from the 2021 Statistics Canada Census of Population and includes demographic, economic, and social information based on the 25 Wards which geographically divide Toronto. While the entire dataset includes data from the 2016 and 2011 Census data, I only used the 2021 data. I focused solely on socioeconomic data like median household and individual income, as well as monthly shelter costs (see Table 2).

Table 2: Sample of Cleaned Average Rent Ward Data

Data Type	Ward 1	Ward 2	Ward 3	Ward 4	Ward 5
Avg household income	95200	146600	127200	127200	88700
Avg monthly rented shelter cost	1328	1574	1592	1492	1196
Avg monthly owned shelter cost	1664	1930	2108	2280	1660
Med indv income	32400	44400	47600	46800	34800

Violations per Ward

The number of violations was highest in Ward 13, at 2662 violations (see Figure 1). Ward 25 had the lowest number of highrise violations at 134. These numbers are most likely influenced by the total number of highrises in the wards since Ward 13 is Toronto Centre and Ward 25 is the Scarborough-Rouge Park area.

```
Warning: Removed 1 rows containing missing values (`position_stack()`).
```

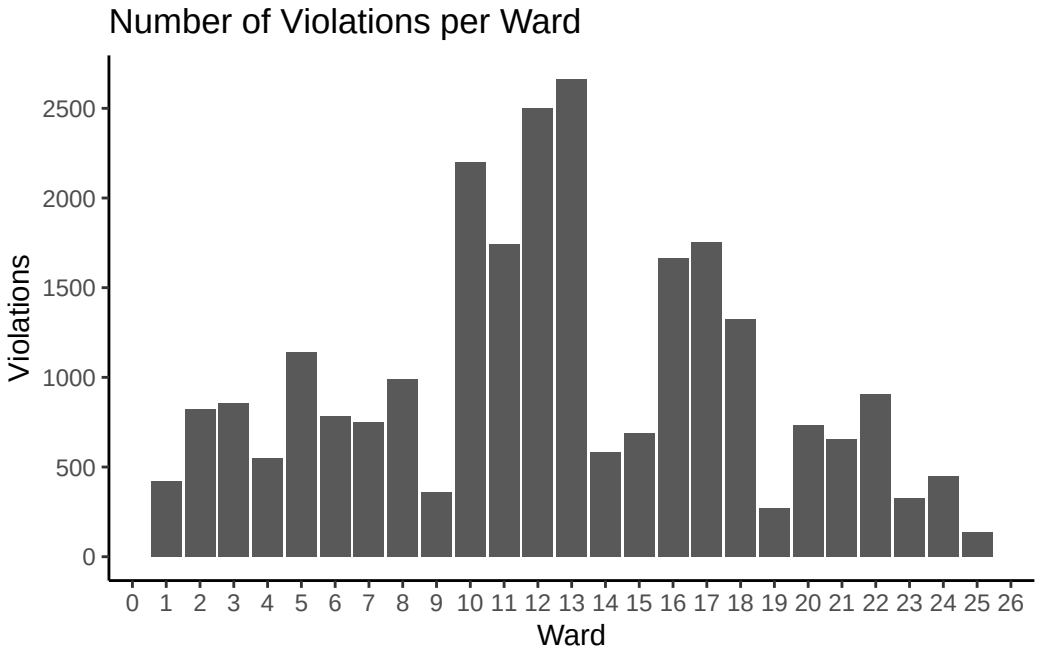

Figure 1: Violations per Ward

Appendix

Data Cleaning

To clean the Fire Investigation data, I removed variables irrelevant to the intended scope of investigation. For example, date of inspections and buildings without fire code violations were removed (OpenDataToronto 2024a). Originally, I wanted to explore the relationship between the number of fire code violations in a ward with socioeconomic data of the same ward, but I had a really hard time adjusting the number of violations with the number of highrises in the ward, so I had to change and limit the scope of my paper. Attempts to do this can be found at (n.d.)

References

n.d. https://github.com/jimessica/fire_inspection_violations/blob/main/inputs/Fire_investigation_adjustment_attempt.qmd.

Beaulieu, Emilie, Jennifer Smith, Alex Zheng, and Ian Pike. 2019. "Association Between Neighbourhood Socioeconomic Features and Residential Fire Incidence, Related Casualties and Children: A Cross-Sectional Population-Based Study in 4 Canadian Provinces." *CMAJ Open* 7 (3): E562–67. https://doi.org/10.9778/cmajo.20190079.

Firke, Sam. 2023. *Janitor: Simple Tools for Examining and Cleaning Dirty Data*. https://github.com/sfirke/janitor.

Gelfand, Sharla. 2022. *Opendatatoronto: Access the City of Toronto Open Data Portal*. https://sharlagelfand.github.io/opendatatoronto/.

Müller, Kirill, and Hadley Wickham. 2023. *Tibble: Simple Data Frames*. https://tibble.tidyverse.org/.

OpenDataToronto. 2024a. "Highrise Residential Fire Inspection Results." First Services. 2024. https://open.toronto.ca/dataset/highrise-residential-fire-inspection-results/.

———. 2024b. "Ward Profiles 25-Ward Model." City Planning. 2024. https://open.toronto.ca/dataset/ward-profiles-25-ward-model/.

R Core Team. 2023. *R: A Language and Environment for Statistical Computing*. Vienna, Austria: R Foundation for Statistical Computing. https://www.R-project.org/.

Services, Toronto Fire. 2017. "Fire Prevention in High-Rise Buildings." chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://www.toronto.ca/legdocs/mmis/2017/td/bgrd/backgroundfile-107853.pdf.

Spinu, Vitalie, Garrett Grolemund, and Hadley Wickham. 2023. *Lubridate: Make Dealing with Dates a Little Easier*. https://lubridate.tidyverse.org.

StatCan. 2023. "Fire Incidents Increase During the Pandemic." 2023. https://www150.statcan.gc.ca/n1/daily-quotidien/230608/dq230608a-eng.htm.

Toronto, City of. n.d.a. "Fire Inspection Results." https://www.toronto.ca/city-government/accountability-operations-customer-service/access-city-information-or-records/fire-inspection-results/#listing/eyJ0b3AiOjEwLCJza2lwIjowLCJxdWVyeVN0cmluZyI6IjcgR3JlbnZpbGxlIn0%3D/1.

———. n.d.b. "High-Rise Fire Safety." https://www.toronto.ca/community-people/public-safety-alerts/safety-tips-prevention/home-high-rise-school-workplace-safety/high-rise-fire-safety/.

Wickham, Hadley. 2023a. *Forcats: Tools for Working with Categorical Variables (Factors)*. https://forcats.tidyverse.org/.

———. 2023b. *Stringr: Simple, Consistent Wrappers for Common String Operations*. https://stringr.tidyverse.org.

———. 2023c. *Tidyverse: Easily Install and Load the Tidyverse*. https://tidyverse.tidyverse.org.

Wickham, Hadley, and Jennifer Bryan. 2023. *Readxl: Read Excel Files*. https://readxl.tidyverse.org.

Wickham, Hadley, Winston Chang, Lionel Henry, Thomas Lin Pedersen, Kohske Takahashi, Claus Wilke, Kara Woo, Hiroaki Yutani, and Dewey Dunnington. 2023. *Ggplot2: Create Elegant Data Visualisations Using the Grammar of Graphics*. https://ggplot2.tidyverse.org.

Wickham, Hadley, Romain François, Lionel Henry, Kirill Müller, and Davis Vaughan. 2023. *Dplyr: A Grammar of Data Manipulation*. https://dplyr.tidyverse.org.

Wickham, Hadley, and Lionel Henry. 2023. *Purrr: Functional Programming Tools*. https://purrr.tidyverse.org/.

Wickham, Hadley, Jim Hester, and Jennifer Bryan. 2024. *Readr: Read Rectangular Text Data*.

https://readr.tidyverse.org.

Wickham, Hadley, Davis Vaughan, and Maximilian Girlich. 2023. *Tidyr: Tidy Messy Data*. https://tidyr.tidyverse.org.

Xie, Yihui. 2023. *Knitr: A General-Purpose Package for Dynamic Report Generation in r*. https://yihui.org/knitr/.