Lower Income Wards Experience More Civilian Deaths from Fires *

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Using Toronto Fire Service data from OpenData Toronto and Toronto ward profiles, this paper found Toronto Centre is the ward in which the most civilian deaths from fires took place. There also appears to be a negative relationship between the median income of a ward and the number of civilian deaths from fires, with more people dying from fires in lower income wards.

Introduction

In 2021, nearly 200 people were killed and almost 900 were injured in a housefire (Canada 2017). While structure fires can be devastating for all those who experience them, news reports out of Hamilton, Ontario suggest fires are more severe and deadly in low income areas of Hamilton compared to affluent suburban areas (Buist and Moro 2017). Research out of the United Kingdom has also found various sociodemographic factors of disadvantage (Smith, Wright, and Solanki 2008) are linked to more destructive and deadly fires.

There were thousands of fire incidents in Toronto between 2018 and 2022. The Toronto Fire Service, (TFS) keeps records on all of the incidents for which they were called. The TFS is the largest fire service in Canada and the fifth-largest in North America (Toronto 2024b), with 85 fire stations and serving a population of nearly 3 million people in the City of Toronto. TFS and the Ontario Fire Marshall provide data about incidents in the city and including source, effects and response times and post the information on OpenData Toronto (Toronto 2024a).

Toronto is also separated into geographic areas known as wards. These are electoral areas in the city each with a population of roughly 100,000 people. The City of Toronto keeps records on demographic profiles of each of the city's 25 wards, including income metrics.

This paper will test the hypothesis that lower income areas have more dire outcomes from fires. First, it will explore the wards in which civilian casualties from TFS-reported fire incidents

*Code and data is available at: github.com/CarlyPenrose/Toronto_Fires

were greatest from years 2018 to 2022. It then examines median ward income according to ward profiles published by the City of Toronto to understand the relationship between median income and deaths from fires (Toronto 2024c).

Data

Data are from the OpenData Toronto portal through the library `opendatatoronto` (Gelfand 2022). Data were cleaned and analyzed using the open source statistical programming language R (R Core Team 2023). Libraries `tidyverse` (Wickham et al. 2019), `janitor` (Firke 2023), `knitr` (Xie 2022), `dplyr` (Wickham et al. 2023), and `lubridate` (Grolemund and Wickham 2011) were used for simulating, cleaning, running tests and creating graphics for the project. Graphs were made using `ggplot2` (**citeGG?**)

Fire Incidents data

Fire Incidents data are provided by the City of Toronto Fire Marshall and are updated on OpenData Toronto on an annual basis. The most recent data are from December 2022. The dataset tracks all fire incidents for which TFS was alerted, starting in 2011.

The dataset includes nearly 30,000 fire incidents over 11 years. It tracks the date of the incident, the location to the nearest intersection, the ward in which the incident took place, the time TFS was alerted to the fire and the time TFS arrived at the scene. It also records civilian casualties, TFS casualties, property lost (in dollars) and incident type.

Data were isolated for 2018 through 2022. In 2018, the City of Toronto switched from a 44-ward to a 25-ward model. Ward information recorded prior to 2018 would not match more recent data and could introduce errors into the analysis.

The columns chosen for this analysis were number of civilian casualties, TFS alarm time (which was used to identify the year), and the ward in which the incident took place. For the purposes of this analysis, other potentially relevant columns that were excluded were injuries from fire incidents and TFS firefighter casualties. TFS alarm time was used to isolate the "year" varaible because that data was more complete than the "incident time" data.

Ward demographics

The City of Toronto provides ward profiles for each of its 25 wards. This includes population, age, ethnic group, language spoken and median income. Median total household income is the amount of income a household makes after taxes and is most reflective of actual take home pay. The median was used rather than the average in this case because medians are widely recognized as a more accurate picture of the middlemost earners in an area becuase median is less sensitive to extremely high and extremely low incomes compared to average.s

The data for median income of each ward was collected from ward profiles based on the 2021 Statistics Canada census (Toronto 2024c). These data were then merged with the fire data for comparison.

Results

Fire incidents by year

There were, on average nearly 3,500 fires incidents per year from 2018 to 2022. The most fire incidents occurred in 2022, followed closely by 2020 Figure 1. The year with the fewest incidents was 2019, with just less than 3,000.

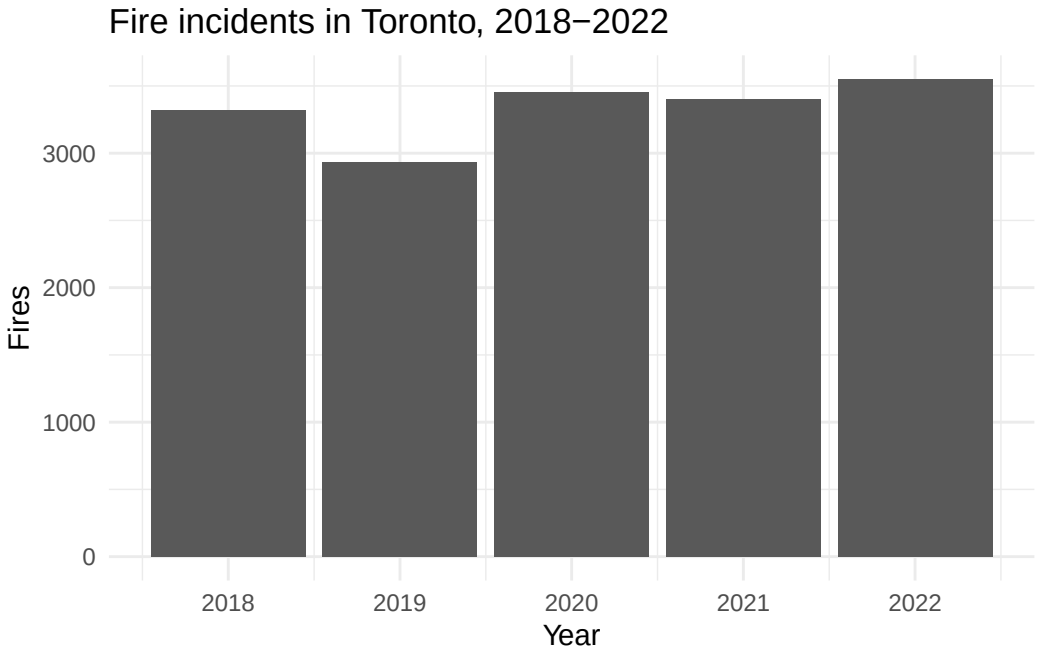

Figure 1: Number of fire incidents in Toronto, by year, from 2018-2022

Despite the higher number of fires in 2022 and 2020, the greatest number of civilian deaths from fires happened in 2018 Figure 2

Fire incidents by ward

Ward 13, Toronto Centre had the greatest number of fire incidents from 2018 to 2022. Ward 22, Scarborough Agincourt had the fewest fires Figure 3.

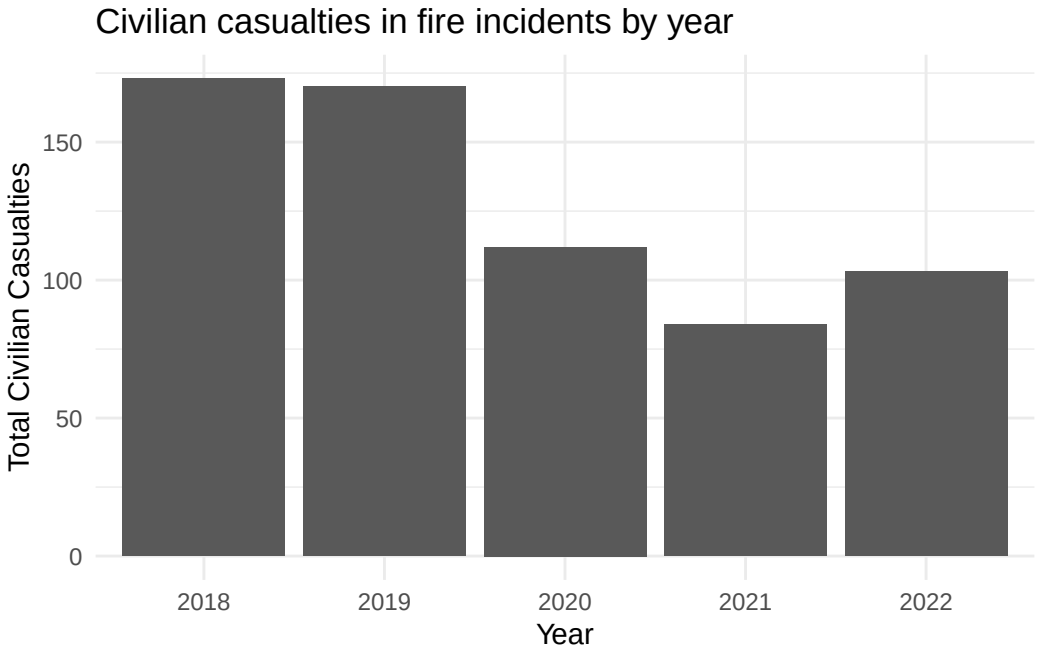

Figure 2: Number of civilian casualties from fire incidents by year, 2018-2022

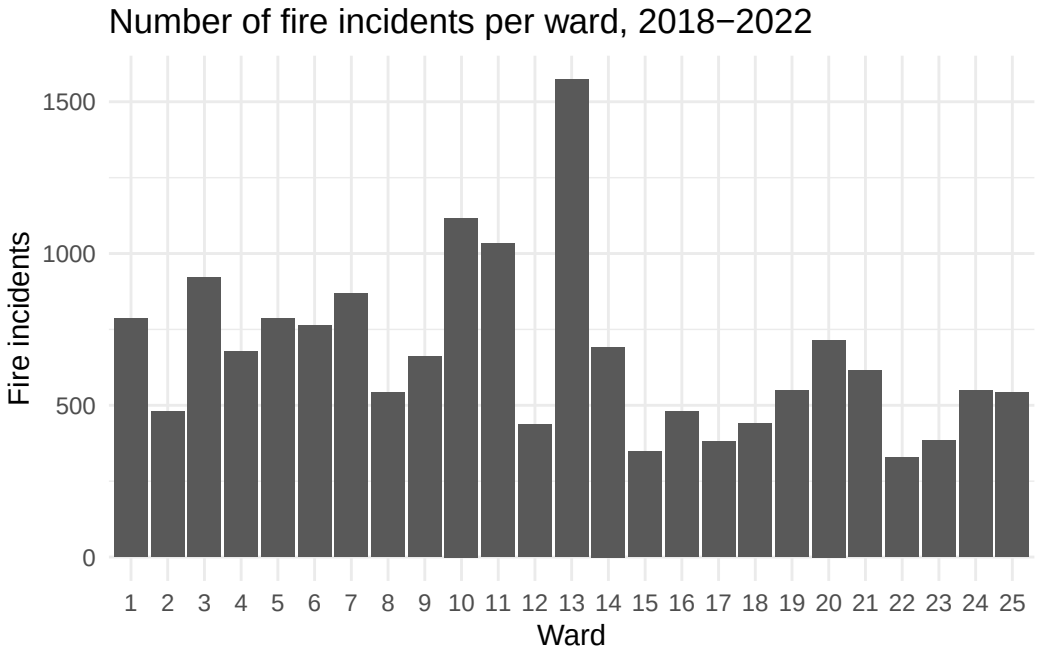

Figure 3: Number of fire incidents by ward, 2018-2022

Ward 13 also saw the most civilians die from fires, while Ward 23, Scarborough North had the fewest fire-related civilian casualties Figure 4.

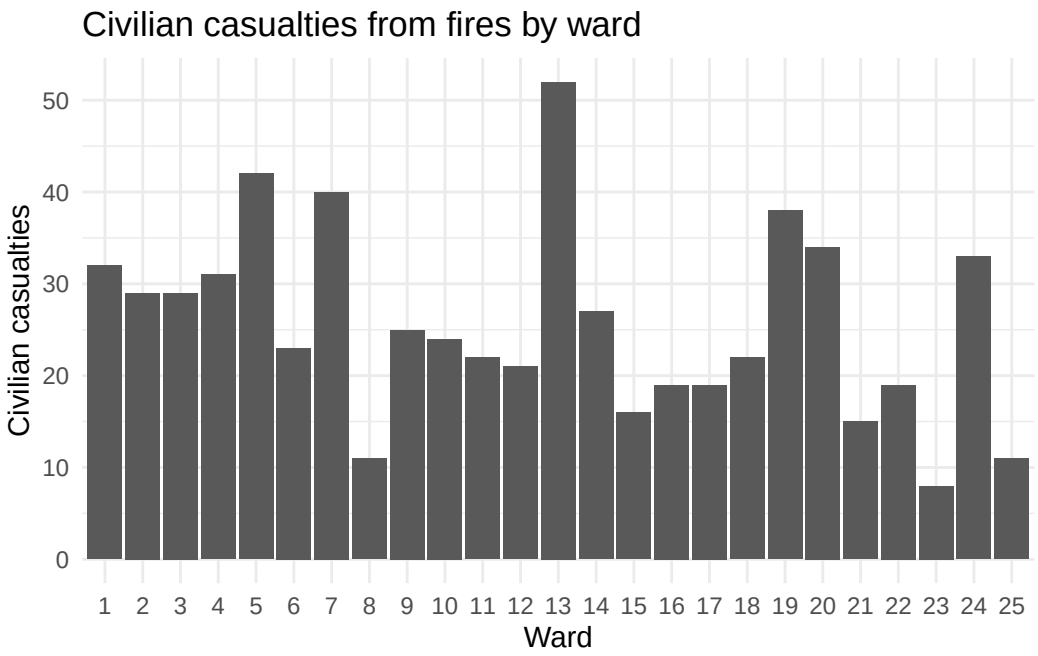

Figure 4: Number of civilian casualties from fire incidents by ward, 2018-2022

Fire incidents relationship to income

There appeared to be a negative relationship between median income in a ward and the number of civilian casualties from fires in Toronto. The higher the median income of a ward, the fewer civilian deaths occurred in that ward Figure 5.

The wards with the highest incomes, including Ward 25, Scarborough-Rouge Park (median income $105,000), which includes the high-income Bridle Path neighbourhood, as well

Conclusion

This paper investigated the wards in which the most civilians died from structure fires, according to TFS data from the Ontario Fire Marshal retrieved from OpenData Toronto. Results show that more civilians died from fires in Toronto Centre than any other ward over the years of 2018-2022. The fewest civilians died from fires in Scarborough North. There appeared to be a negative relationship between number of civilian casualties from fires and the median

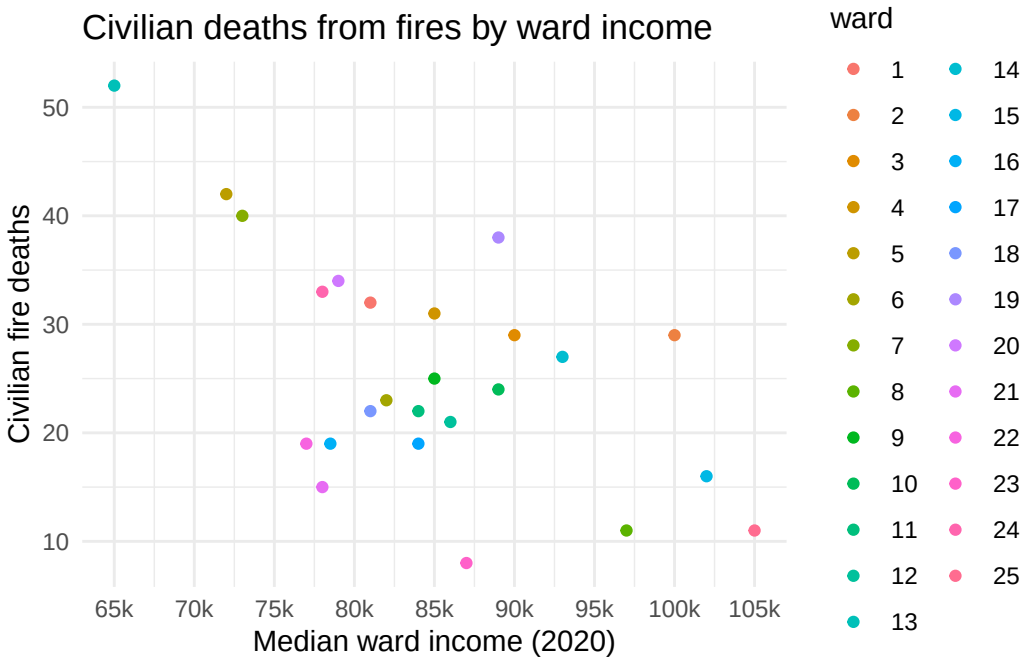

Figure 5: Number of civilian casualties from fires by median income of ward

income of a ward, with a lower-median income correlating to a more civilian casualties from fires.

It is possible this relationship could be explained by other factors such as density of housing units, traffic. There is also research to suggest that more affordable housing may be more likely to lack updated fire safety standards for tenants (Shokouhi et al. 2019). More research should be done to clarify the nature of the relationship between income and civilian risk of death in a structure fire.

It is also possible that other factors, like TFS response time are correlated to more deaths. This dataset provides the time TFS was called as well as the time they arrived on site. Examining how the length of time to response is related to casualties, and how that relates to median income could also further this research.

These findings could help inform policy outside of just education, that could inform public safety steps local governments could take to ensure people in lower income areas have the same protections and access to quick TFS services, which could potentially save lives.

Limitations

The TFS data were incomplete,there were _____ instances of incomplete data which were excluded. According to the Ontario Fire Marshall, incomplete data could be the result of...

Additionally, for the scope and purposes of this analysis, the only factor to measure the severity of fires used was civilian deaths. But TFS data includes other variables including injuries. An analysis which includes this variable could also be an important measure of the severity of fires.

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