Lower Income Wards Experience More Civilian Deaths from Fires *

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Fires can be devastating, and hunderds of Canadians die from fires each year, and some research suggests lower-income areas experience more deadly outcomes. 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, 202 people were killed in and 999 were injured in fires in Canada (Canada 2017). While structure fires can be devastating for all those who experience them, news reports out of Hamilton, Ontario suggest fires are more deadly in low income areas compared to affluent suburban areas (Buist and Moro 2017). A study in the United Kingdom also found that low-income people were more likely to experience deadly fires (Smith, Wright, and Solanki 2008).

In Toront, 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.

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

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 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` (Wickham 2016)

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.

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. Therefore, any incidents reported before Jan. 1, 2018 was excluded from this analysis.

The columns chosen for this analysis were number of civilian casualties, TFS alarm time (used to identify the year of the incident), and the indicent ward. 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" variable 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, based on census data. This includes population, age, ethnic group, language spoken and median income of ward residents. Median total household income is the amount of income a household makes before taxes. The

median was used because it is less sensitive to extremely high and extremely low incomes compared to average.

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 to plot the values.

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.
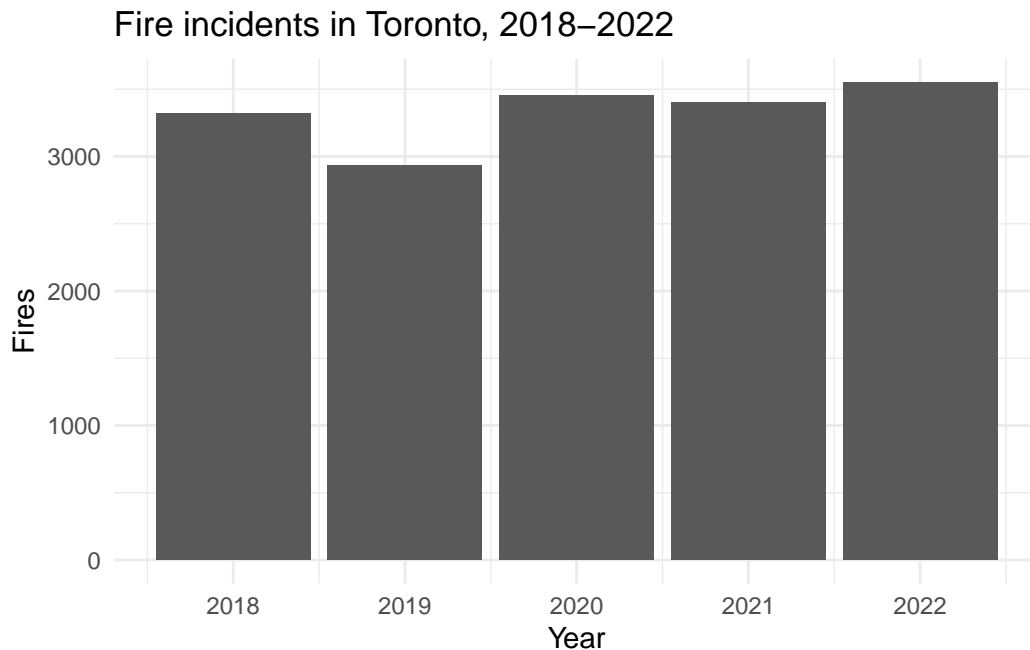

Figure 1: Number of fire incidents in Toronto, by year, from 2018-2022

Despite the higher number of fires in 2022 and 2020, the greatest number of civilian deaths from fires happened in 2018 Figure 2
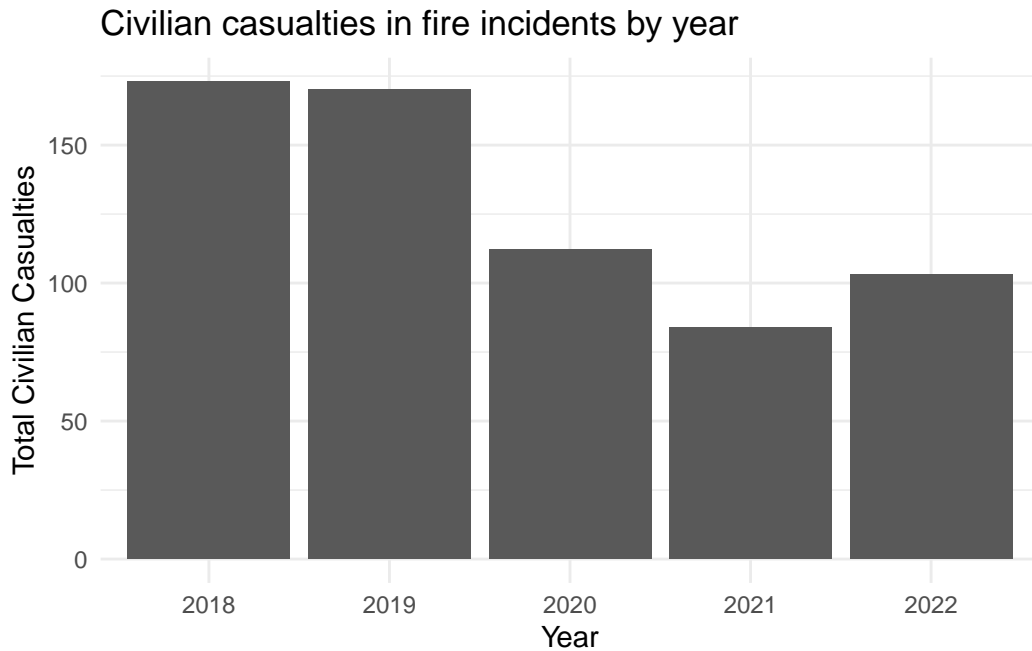
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Civilian casualties in fire incidents by year

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

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.

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

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.

In Toronto Centre, which has the lowest median income in the city at $65,000, 52 people died from fires between 2018 and 2022. The ward with the highest median household income was Ward 25, Scarborough-Rouge Park (median income $105,000), which includes the high-income Bridle Path neighbourhood. In that ward, only 11 civilians died in fires.

The ward where the fewest people died from fires was Scarborough North which has a median household income of $87,000. Only eight people died from fires over four years.
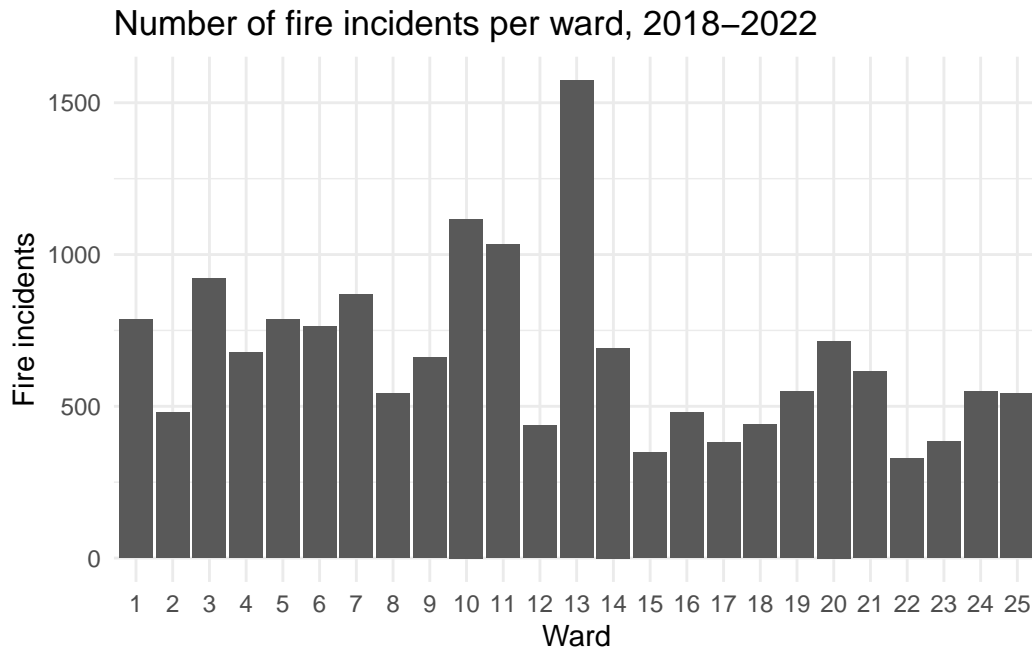
Number of fire incidents per ward, 2018–2022

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

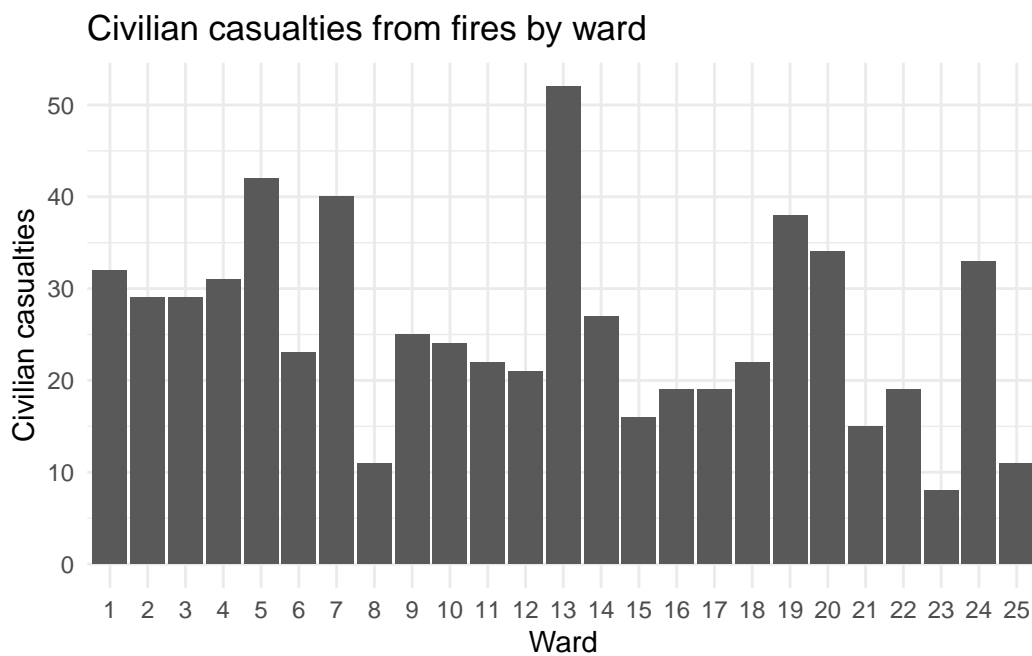## Civilian casualties from fires by ward

Figure 4: Number of civilian casualties from fire incidents by ward, 2018-2022
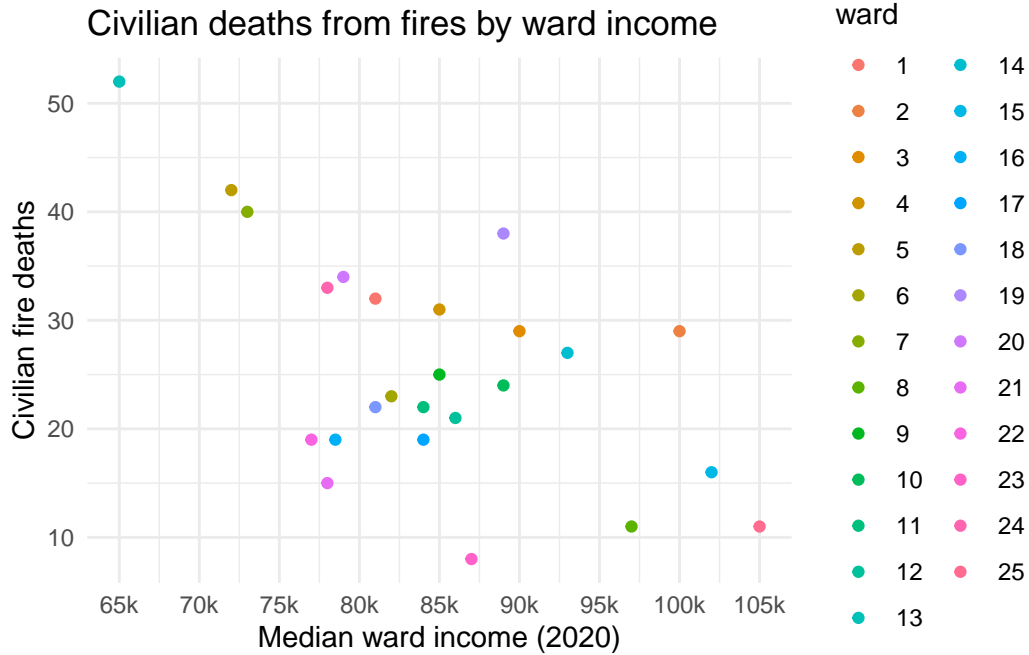
Figure 5: Number of civilian casualties from fires by median income of ward

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 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 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.

Further research looking at other demographic factors linked to lower-income due to systemic

bias and discrimination like ethic background or immigration status could be another dimension to study with these data.

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 save lives.

Limitations

Importantly, the TFS data should be verified for accuracy. According to the TFS fire incident data used, 173 people died from fires in 2018. However, according some Statistics Canada reports, only 161 people died from fires across the country. It would be important to compare the data collection methods for the TFS to the methods used by Statistics Canada to ensure the data are compiled correctly.

The TFS data were incomplete. For 144 incidents data had to be excluded from the analysis because they were incomplete. However, these data would have been unlikely to change the outcome of the analysis, as according to the Ontario Fire Marshall, incidents with incomplete data may be under investigation or is classified as a no loss outdoor fire, which would have resulted in no civilian casualties.

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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