Navigating Toronto's Homelessness Landscape: A Comprehensive Data Analysis of Trends, Compositional Shifts, and Projections for the City's Homeless Population Dynamics (2018-2023)

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Against the backdrop of economic challenges and the ramifications of the pandemic, this analysis offers an intricate exploration of Toronto's shelter system from 2018 to 2023. Unveiling nuanced shifts in the homeless population's composition across single adults, families, genders, and age groups, the study scrutinizes population dynamics. It elucidates fluctuations in the actively homeless count and discerns patterns of return to homelessness. Notably, predictive modeling forecasts a concerning surge in homelessness, underscoring the urgency for proactive strategies. These findings illuminating the pressing need for expanded shelter infrastructure to meet the escalating challenges ahead.

Table of contents

1 Introduction **2**

2 Data **3**
2.1 Data Source 3
2.2 Features 3
2.3 Methodology 4

3 Result **5**
3.1 Trends in Homelessness Transitioning within the Toronto Shelter System 5
3.2 Composition of Homeless Population Groups and Correcponding Age Distribution 6

4 Discussion **8**
4.1 Weaknesses and next steps 9

bibliography **10**

1 Introduction [1]

Undoubtedly, homeless individuals in Toronto have been facing serious challenges in accessing nighttime accommodation in recent years. As early as 2020, the general manager of the city's shelter, support, and housing administration openly stated that an average of 72 people were being turned away from shelters due to overcrowding every day, a number that only continued to rise. 1 By the winter of 2022, this figure had surged to a staggering 168 people. 2 For residents living in Toronto, this reality is starkly apparent - despite shelter occupancy rates exceeding 98%, a significant number of individuals still resort to sleeping on the streets or in parks, a reality witnessed firsthand by residents and students alike.

Despite significant efforts to address homelessness, there remains a notable gap in our understanding of the changing trend in the composition of the homeless community in Toronto. While the overall number of homeless individuals is documented, the specific demographic shifts within this population, such as variations in age groups and gender distribution, have not been comprehensively explored. Understanding these trends is essential for developing targeted interventions and resource allocation strategies to effectively address the diverse needs of the homeless population in Toronto.

To do this, we seek to conduct an in-depth analysis and study of Toronto's homeless population, aiming to understand the recent trends in this community, including changes in overall numbers and demographic composition. Leveraging data obtained from the Toronto Open Database, we aim to delve into the complexity and evolving trends of Toronto's homeless community. We analyze the status and demographic composition of Toronto's homeless population from 2018 to 2023, focusing on changes in status, such as the number of homeless individuals transitioning between housing and shelters, and long-term use of the shelter system, as well as demographic characteristics including gender, age, and identity.

To address this gap, we present a series of structured analyses of our findings. We begin by examining the annual counts of transitions of homeless individuals between housing, shelters, and other status within the Toronto shelter system from 2018 to 2023. Following this, we delve into the composition of homeless population groups and the trend of age distribution within the homeless population. Similarly, the trend of gender composition across different population groups in the homeless community was also analyzed. Finally, we present the predictions from our linear model for future trends in the number of homeless individuals in Toronto.

[1] Please check https://github.com/kqlqkqlqF/Toronto-Shelter-System-Flow-between-2018-and-2023-with-Further-Predictions.git for more information.

Our analysis reveals several key findings. Firstly, the linear model we built suggests a steady increase in the number of homeless individuals in Toronto, indicating the need for expansion of the shelter system to accommodate more people. Additionally, our examination of the data through various figures provides insights into the nuanced dynamics of homelessness in the city. These figures include trends in the annual counts of homeless individuals transitioning within the Toronto shelter system, trends in the composition of homeless population groups and age distribution, and trends in gender composition across different population groups within the shelter system.

Understanding the trends and dynamics of homelessness in Toronto is of paramount importance, given its implications for public policy and social welfare. By shedding light on the challenges faced by the homeless population and providing evidence-based insights, our study aims to inform and guide policymakers and stakeholders in their efforts to address homelessness in the city.

2 Data

2.1 Data Source

The data for this analysis was collected from the shared Toronto Open Database (Shelter 2018-2023). This study utilizes and analyzes the dataset titled "About Toronto Shelter System Flow". The dataset contains a wealth of information on the movement of homeless individuals in Toronto shelters from January 2018 to January 2024, including gender, age, quantity, and group affiliation (such as refugees). Additionally, the dataset provides information on the number of people leaving and entering shelters. It is released by the Toronto Shelter, Support, and Housing Administration, updated monthly, and has a high level of credibility. Moreover, the dataset has received full marks for freshness, metadata, accessibility, completeness, and usability on the Opendatatoronto website. Therefore, we consider the content of this dataset to be highly credible and utilize it as the primary data source for this paper. However, due to the limited data available for January 2024, we did not include this portion in the data analysis, as the smaller dataset size for 2024 may lead to unexpected analysis results.

2.2 Features

Upon entering shelters, individuals utilizing shelter services are required to provide their name, age, gender, and group affiliation, which are recorded in the database. It is important to note that this dataset only records homeless individuals using overnight shelter services and does not include those utilizing other welfare policies, such as receiving free food or vaccinations.In the data, homeless individuals are divided into five age groups: under 16, 16 to 24, 25 to 44, 45 to 64, and over 65. Gender is categorized as male, female, and non-binary. Group affiliation includes chronic, refugees, families, youth, single adult, non-refugee, and indigenous.

It is noteworthy that the indigenous group was only included in the statistics starting from January 2022, as the authors of the dataset stated their intention to collect more detailed data, hence adding the subdivision. Here, Chronic refers to homeless individuals who have continuously used shelter services for more than 180 days. Additionally, by dividing the specific group's number of a given month by the total number of people using shelter services overnight, the dataset also records the percentage of each group in the overall population. Regarding the documentation of homeless transitions, the dataset provides six data points: new identified, return from housing, return to shelter, moved to housing, became inactive, and actively homeless. Newly Identified refers to people who entered the shelter system for the first time; Returned from Permanent Housing refers to people who previously used the shelter system, then moved to permanent housing, and have now returned; Returned to Shelter refers to people who were previously using the shelter system, then did not use the system for 3 months or longer, and have now returned; Moved to Permanent Housing refers to people who were using the shelter system and have moved to permanent housing; Became Inactive refers to people who last accessed shelter services three months ago; Actively Homeless refers to people who have used shelter services at least one time in the past three months and have not moved to permanent housing.

2.3 Methodology

The cleaned data were analyzed and performed using R (R Core Team 2022) with `tidyverse` (**citeTidyverse?**), `here` (**citeHere?**), `rstanarm` (**citeRstanarm?**), `modelsummary` (**citeModleSummary?**), `ggplot2` (**citeGgplot2?**), `knitr` (**citeKnitr?**), `marginaleffects` (**citeMarginalEffects?**), `plotly` (**citePlotly?**), `tibble` (**citeTibble?**), `margins` (**citeMargins?**), `testthat` (**citetestthat?**) and `kableExtra` (**citeKableExtra?**).

Due to the clarity of the data itself, our data cleaning process primarily focused on converting the raw data dates into the yyyy-mm-dd format, without making extensive changes to the overall dataset. Following the completion of general data cleaning, we performed separate data cleaning for each chart to ensure code were organized and minimize the amount of code in the final QMD file. For the first chart, intended to reveal Trends in the Annual Counts of Homeless Individuals Transitioning within the Toronto Shelter System between 2018 and 2023, we retained only a portion of the data for the six transition status categories from monthly data and aggregated data within the same year for ease of subsequent chart generation. For the second chart, aimed at revealing Trends in Composition of Homeless Population Groups and Age Distribution within the Toronto Shelter System between 2018 and 2023, we removed all data except for age and group affiliation. Similarly, for the third chart, which aimed to reveal Trends in Gender Composition of Homeless Population Across Different Population Groups within the Toronto Shelter System between 2018 and 2023, we retained only gender and group affiliation data. The final linear model utilized the overall dataset after data cleaning, and no additional cleaning was performed. It is important to note that we excluded data from January 2024 in all chart data to avoid errors.

3 Result

3.1 Trends in Homelessness Transitioning within the Toronto Shelter System

Year	Returned from Housing	Returned to Shelter	Newly Identified	Moved to Housing	Became Inactive	Actively Homeless
2018	776	6055	14442	8135	10420	110052
2019	873	6175	13124	8293	11037	117078
2020	891	5308	7617	6094	9302	99777
2021	989	5024	8297	3409	8690	99580
2022	940	4116	9795	4385	8738	117222

Figure 1: Number of Homeless Individuals Transitioning between Housing, Shelters, and Other Status Within the Toronto Shelter System between 2018 and 2023

The data provided in Figure 1 and Figure 2 offers a comprehensive insight into the dynamic changes in the homeless population within the Toronto shelter system from 2018 to 2023. It emphasizes the various transitions experienced by individuals reliant on shelter services and provides insights into the overall fluctuations in homelessness numbers. A notable trend observed is the fluctuation in the annual count of newly identified individuals entering the shelter system. Peaking in 2018 and gradually declining over the following years, the trend suggests a persistent need for shelter services, with a gradual increase observed from 2020 onwards. Another significant aspect of the data is the return of individuals from permanent housing to the shelter system. This phenomenon is concerning as it indicates potential housing instability for a portion of the population. Fortunately, the numbers have remained relatively stable from 2018 to 2023, and they are lower than those transitioning to permanent housing each year. However, the declining trend in individuals moving to stable housing from 2018 to 2021 is worrisome. Although there is a slight increase in 2022 and 2023, it remains below the 2018 levels, suggesting a decrease in individuals transitioning to permanent housing. The data also captures changes in individuals returning to shelters and those becoming inactive within the shelter system. While there is a gradual decline in the number of individuals becoming inactive homeless over the five years, the decrease is minimal, similar to the trend in individuals returning to shelters. Without further explanation, it's challenging to draw reliable conclusions on the decrease in the number of inactive homeless individuals or the reasons behind individuals returning to shelters since their experience after leaving the shelter system is unknown. They could be moving to other cities, finding housing, or dying. Therefore, if there's no further detail for the reason they left the shelter system, it is hard to understand the implications of the data fully, and no conclusion can be drawn. Lastly, individuals from the actively homeless category highlight the ongoing demand for shelter services and support. Although there was a decline in the number of actively homeless individuals in 2020 and 2021, it surged to new highs

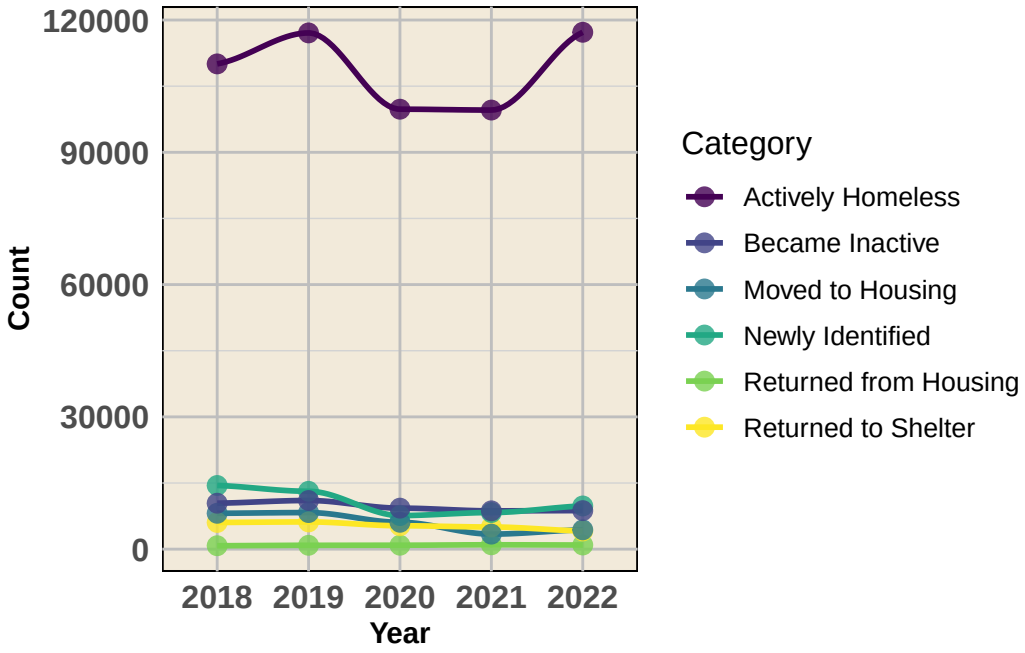

Figure 2: Trends in the Annual Counts of Homeless Individuals Transitioning within the Toronto Shelter System between 2018 and 2023

in 2022 and 2023. This suggests a significant increase in the number of individuals utilizing overnight shelter services in the past two years, indirectly indicating a potential increase in Toronto's homeless population from 2022 to 2023. In conclusion, these data paint a complex picture of homelessness within the Toronto shelter system, with a noticeable trend of increasing actively homeless individuals. This underscores the importance of continued efforts to provide comprehensive support and housing solutions to meet the diverse needs of this vulnerable population.

3.2 Composition of Homeless Population Groups and Correcponding Age Distribution

Before beginning the analysis of Figure 3, there are several points that need to be explained. Firstly, within the population groups depicted in this graph, apart from refugees and non-refugees, the other options are not mutually exclusive. This means that a person can simultaneously belong to the chronic, families, and refugee groups, but cannot be a refugee and a non-refugee at the same time. This explains why the total number of homeless individuals in these population groups exceeds the number represented by the "all population" category. Secondly, as mentioned earlier, the number of individuals in the indigenous group was only

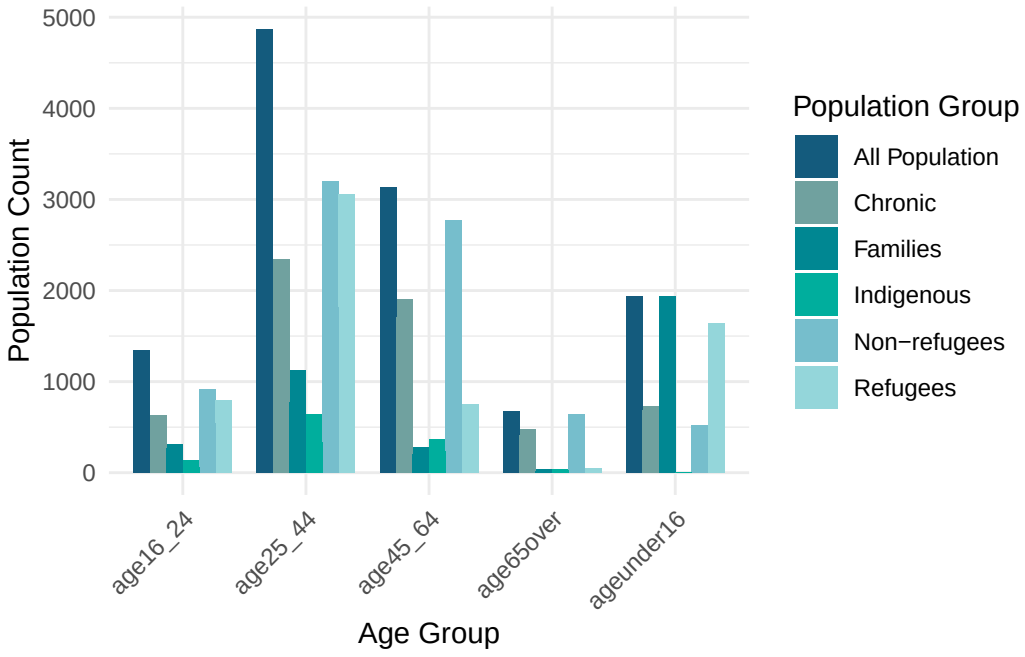

Figure 3: Composition of Homeless Population Groups and Age Distribution within the Toronto Shelter System between 2018 and 2023

recorded starting from 2020, so the actual number of indigenous individuals should be higher than what is shown in the graph.

We can see that individuals aged between 25 and 44 constitute the largest portion of the homeless population, while those aged between 45 and 64 represent the second largest group, and those aged 65 and above represent the smallest group. From the perspective of population groups, non-refugees constitute the largest group, followed by refugees and then chronic individuals, with indigenous individuals being the smallest group. From this distribution trend, we can infer the following information:

Firstly, except for the age group under 16, chronic individuals constitute a significant portion of the homeless population in other age groups, indicating that a considerable number of homeless individuals rely on overnight shelter services for an extended period and find it difficult to secure permanent housing, thus perpetuating their homelessness.

Secondly, although refugees constitute a smaller proportion of the homeless population compared to non-refugees overall, in the age group under 16, the number of refugees far exceeds the proportion of non-refugees. This suggests that there are a significant number of parenting teenagers or even younger children among the refugee population who are homeless. Additionally, we observe that the proportion of families in the age group under 16 also significantly increases, slightly surpassing the proportion of refugees and almost equaling the "all popula-

tion" category. This evidence confirms our previous conclusions and supports the notion that these young refugee homeless individuals are likely to be wandering alongside their refugee family members.

Thirdly, unlike refugees, homeless individuals categorized as non-refugees are mainly distributed in the age group of 25 and above. Particularly in the age group of 65 and above, the number of non-refugees is almost equivalent to the "all population" category.

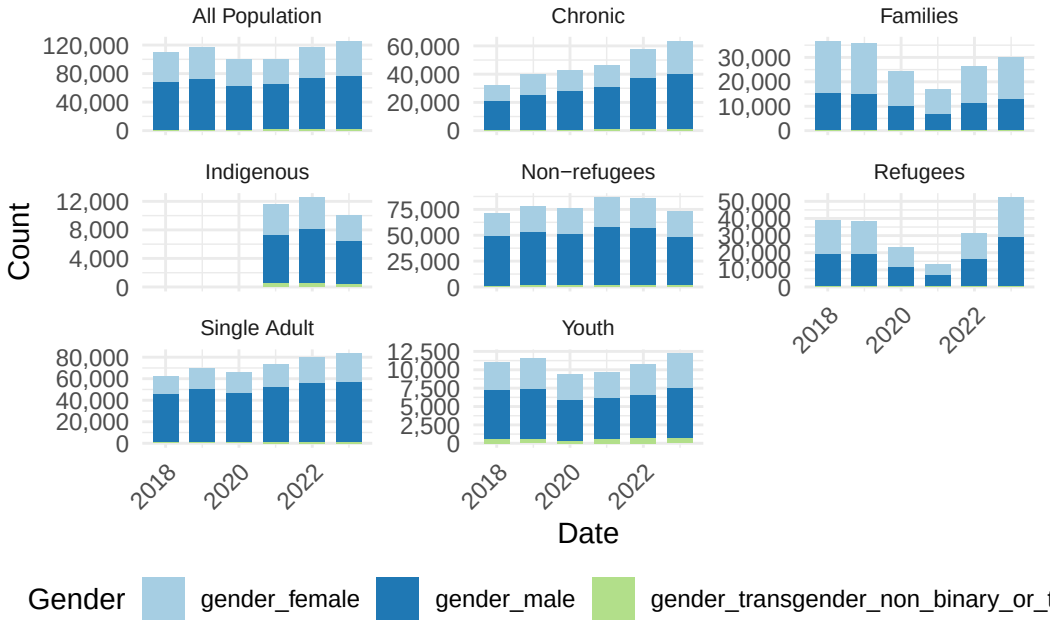

Figure 4: Trends in Gender Composition of Homeless Population Across Different Population Groups within the Toronto Shelter System between 2018 and 2023

4 Discussion

In the first section, we came up with the conclusion that there's no significant difference in the occupied rate of shelter in different seasons, and the main population of the homeless group consisted of people aged between 25 and 64, while people aged between 25 and 44 occupied the most. This conclusion seems reasonable since as we mentioned before, the occupancy rate of shelters in Toronto is already over 98% (Gilbert 2022), but there are still more than 9000 people who need to sleep outside. So, in a situation in which the shelters are full and cannot accept all of the homeless, the shelter will be fully occupied every day. As a result, the season and weather factors won't affect the occupancy rate of shelters largely.

In the second section, we found that the average number of people returning to shelters between 2018 and 2023 has decreased. Although the number of people returning to shelter decreased may suggest a good phenomenon, this also suggests a possibility that some of them died because of the pandemic so they cannot return. This idea came up with the result in the third section, in which we find that more people with chronic became inactive during these five years while all of the other population groups held a stable trend or decreasing trend. Considering people with chronic are more vulnerable to the COVID, we suspect that these results were caused by the death of chronically homeless people. However, this idea still needs more evidence to support it.

Also in the second section, we found that the number of homeless moved to housing has decreased between 2018 and 2023. This matched with the result shown in section three that the total amount of homeless became inactive decreased in the same period. Considering the result in section three also suggested that the total amount of homeless is rising, we can infer that things are getting worse because there are more new homeless people emerging, while fewer people are returning to housing. Most population groups have a similar trend with the overall homeless population, except for the chronic population mentioned before.

To sum up, these data demonstrated three facts: First, the homeless population was mainly composed of people aged between 25 and 44, and most of them were registered as non-refugees, single adults; Second: The weather and season did not affect the occupy rate of shelters; Third, the total population of homeless has increased between 2018 and 2023. This might be due to increasing house prices and the pandemic, but still a need for evidence to prove they are relevant.

4.1 Weaknesses and next steps

The weakness of this investigation mainly comes from the limitation of data. Firstly, shelter sites that do not use SMIS and that are funded by other levels of government are not included, meaning that it is not a comprehensive data set that includes all shelter data in Toronto. Second, this data reflects only people who have used an overnight service and does not include people using other homeless services. This potentially suggests that the homeless community is larger than the number shown in this dataset.

To investigate this question deeper, we can also look at the house pricing and COVID cases data between the same period, so that they can be matched up and compared with the data of shelter occupation. We shall also search for other datasets that contain the dataset for shelters not included in this dataset, and get a more comprehensive look at the homeless population in Toronto. Finally, we can compare the amount of shelters available and the size of the homeless population, to see how many homeless are still not able to stay in shelters. We believe these approaches could lead to a deeper understanding of the Toronto shelter system and homeless population.

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