How the COVID-19 pandemic influenced the Death of Homeless people in Toronto? Drugs became the major reason*

Examining Trends in Age, Gender, and Causes of Death Among Toronto's Homeless Population from 2017 to 2023

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By using 8 figures to analysis the data of homeless's death from 2017 to 2023, it was found that the major reason for increased death of homeless people during the Pandemic in Toronto was drug, instead of the COVID-19 itself. Only positioning the right problem enables us to take appropriate and efficient actions to help homeless people.

Table of contents

1 Introduction **2**

2 Data **3**

2.1 Data source and background 3

2.1.1 Variables of interest 3

2.1.2 Data processing 3

2.2 Sample of cleaned analysis data 4

2.3 Summarized analysis data 5

2.4 Visualization 7

2.4.1 Visual 1 7

2.4.2 Visual 2 8

2.4.3 Visual 3 9

3 Conclusion **11**

*Code and data are available at: https://github.com/Selinayichenji/2024-Data-collection.git.

References **12**

1 Introduction

In recent decades, Toronto has witnessed an increasingly visible homelessness issue, with individuals seeking refuge on city streets becoming a common sight. In 2013, homeless people took 0.19% (Gaetz et al. 2013) of total population in Toronto, ranked the 8th city in Canada. In 2021, there was 7,347 (Hub 2021) homeless people in toronto and the total population was 2,794,356 (Hub 2021). The percentage rose to 0.26%. This trend not only manifestated a growing societal challenge but also calling a critical need for action.

As (Gaetz et al. 2013) said, "The goal of ending homelessness is to ensure housing stability…and includes required services as needed (supportive), in addition to income and supports." In this paper, we are trying to figure out what caused the increase death of homeless people during pandemic and what social service they needed by using R (R Core Team 2022) to analysis a dataset from opendatatoronto (Gelfand 2022), named "Homeless deaths by cause". And there are some limitations of this data listed on the City of Toronto Website we must know before using the data: "1. This data reflects only deaths that are reported to TPH by SSHA, community partners and the Coroner's Office. 2. Cause of death is unknown or pending in approximately 25% of the reported deaths. 3. In 2019, TPH ceased reporting on location of death as this information is often unknown or unverified. 4. The data does not identify Indigenous status as this is reported as unknown or missing in 70% of the reported cases. With this high a percentage of missing information, accurate conclusions cannot be drawn, as such, it is standard epidemiological practice to suppress the release of data. 5. Cause of death for transgender people not shown due to small counts. 6. Cause of death is unknown in approximately 25% of the reports. To protect privacy, causes of death with less than 2% of the cases are included in the other category." (Toronto 2023)

Through tables, plot graphs and bar graphs, our findings reveal a huge increase in deaths attributed to drug use during the pandemic, overshadowing even COVID-19 as a direct cause of death. This suggests a secondary crisis unfolding within the pandemic period.The precise reasons behind this appearance remain ambiguous and subject to further professional research, several hypotheses have been proposed. Dr.Hwang observed, ' "The disruption caused by the lockdown and by the real lack of availability of services caused people to change where they spend time and thus where they use drugs," … "I think that contributed to people using in higher risk situations that would more likely result in death." '(Ireland 2023). The experience may prove beneficial for the charity's work with homeless individuals, particularly when critical times such as a pandemic come in the future.

The remainder of this paper is structured as follows: Section 2 introduces the data set, uses tables and figures to analysis it, and tells a story about homeless people's death during pandemic period. Section 3 concludes the findings of data and provide a consultation for further thinking.

2 Data

2.1 Data source and background

The data used through this paper was provided by the City of Toronto's OpenDataToronto Library, was a cvs file named "Homeless deaths by cause", under the category "Deaths of People Experiencing Homelessness". The homelessness is defined as "the situation of an individual or family without stable, permanent, appropriate housing, or the immediate prospect, means and ability of acquiring it"(Toronto 2023). We retrieved the data from R package opendatatoronto(Gelfand 2022).We downloaded the data, cleaned it and renamed it as "analysis_data" in output/datam folder.

The data was measured and collected by Toronto Public Health (TPH), Support and Housing Administration (SSHA) and the Office of the Chief Coroner of Ontario (OCCO) since January 2017. The TPH tracked the deaths of homeless people to get accurate estimate of their number and causes of death. The TPH also leads the data collection, analysis and reporting. The SSHA and health and social service agencies that support homeless people share information about a death with TPH and the OCCO verifies some of the data. (Toronto 2023)

2.1.1 Variables of interest

Our population is divided by 4 categories: Year of death, Gender, Age group and Cause of death. The year of death covers form 2017 to 2023. The gender category has 3 types: Female, Male and Unknown. Age groups are divided as below: Under 20, 20-39,40-59,60+ and Unknown.Causes of death includes 10 types below: Accident, Cancer, Cardiovascular Disease, COVID-19, Drug Toxicity, Homicide, Other, Pneumonia, Suicide and Unknown/Pending.

2.1.2 Data processing

We used `R`(R Core Team 2022) to process the whole paper, packages include `tidyverse`(Wickham et al. 2019), `dplyr`(Wickham et al. 2023), `tidyr`(Wickham, Vaughan, and Girlich 2023), `knitr`(Xie 2023), `kableExtra`(Zhu 2021) and `ggplot2`(Wickham 2016).

We cleaned the data by cancelling the Count column, which represents the number of deaths in the specified category(Toronto 2023). For the convenience of counting specific population group, we copied the particular line a couple of times according to the number in the count. And all characters in columns' names were transformed into lowcase.

2.2 Sample of cleaned analysis data

Here is the sample of cleaned data.

Table 1: Sample of Data

id	year_of_death	cause_of_death	age_group	gender
1	2017	Accident	40-59	Male
2	2017	Accident	40-59	Male
3	2017	Accident	60+	Male
4	2017	Accident	60+	Male
5	2017	Accident	60+	Male
6	2017	Cancer	60+	Female
7	2017	Cancer	40-59	Female
8	2017	Cancer	40-59	Female
9	2017	Cancer	40-59	Male
10	2017	Cancer	40-59	Male

2.3 Summarized analysis data

Then there are basic distributions of population in gender, age and causes of death.

Table 2: Gender Distribution by Year

year_of_death	Female	Male	Unknown	Sum
2017	25	75	0	100
2018	21	73	0	94
2019	34	92	1	127
2020	28	115	0	143
2021	50	161	6	217
2022	39	146	4	189
2023	9	69	1	79
Total	206	731	12	949

The table referenced as Table 2 presents the distribution of deaths by gender among the homeless population among seven years. The 'Sum' column represents the annual total of deaths, aggregating the figures across all gender categories. According to Table 2, males was the majority of the recorded deaths, with a total of 731 instances, which is approximately 78% of the aggregate mortality count for the period in question. In contrast, the female death toll is roughly a third of the male figure. The data also include the Unknown category, amounting to only 12, which is negligible in the overall context.

Table 3: Age Distribution by Year

year_of_death	20-39	40-59	60+	Unknown	<20
2017	20	47	26	7	0
2018	21	44	23	6	0
2019	29	54	38	4	2
2020	36	53	48	5	1
2021	70	90	45	9	3
2022	45	64	60	17	3
2023	19	35	20	5	0
Total	240	387	260	53	9

The data outlined in Table 3 indicates that individuals aged 40-59 accounted for the highest number of deaths, totaling 387 cases. The group of individuals under 20 years old experienced the fewest deaths, with only 9 reported cases. The death counts for the age groups "20-39" and "60+" were comparable, with 240 and 260 deaths respectively. Both the "20-39" and

"40-59" age groups saw their highest death number in 2021, while the "60+" and "Unknown" age categories reached their peak in 2022. As for the youngest group, those under 20 years old, there were equally high numbers of deaths in both 2021 and 2022, with each year only 3 instances.

By analyzing sum column in Table 2, we can see a clear trend in 7 years. The death number decreased one year from 2017 to 2018, then quickly increasing from 2018 to 2022 and peaked at 2022, the yearly death observations went over 200, and then started to fall down to under 80 in 2023.

The timeline in Table 2 and Table 3 overlaps time range of COVID-19. Since age and gender did not seem to influence the death number a lot, We can conjecture that maybe the death of homeless lead by the COVID-19 pandemic. To check our hypothesis, we need to look the statistics of trend of causes of death.

Table 4: Death Causes Distribution by Year - first half

year_of_death	Accident	Cancer	Cardiovascular Disease	Drug Toxicity
2017	5	9	14	32
2018	5	1	14	33
2019	9	9	15	39
2020	1	3	14	75
2021	9	7	15	127
2022	6	10	22	90
2023	2	4	1	36
Total	37	43	95	432

Table 5: Death Causes Distribution by Year - second half

year_of_death	Homicide	Other	Pneumonia	Suicide	Unknown/Pending	COVID-19
2017	1	8	3	3	25	0
2018	5	10	4	4	18	0
2019	7	11	8	2	27	0
2020	4	9	2	4	27	4
2021	1	12	2	7	34	3
2022	1	4	1	7	47	1
2023	1	2	1	2	30	0
Total	20	56	21	29	208	8

As indicated by Table 4 and Table 5, drug toxicity emerged as the predominant cause of death among the homeless, accounting for nearly half of all homeless people. The highest data was

recorded in 2021. Within a total of 949 cases, the causes of death for approximately 20%, or 208 individuals, remained unknown. Cardiovascular diseases ranked third with 95 deaths, experiencing a sharp increase to a peak of 22 in 2022, before dramatically dropping to just one in 2023. The least homeless people death were attributed to COVID-19, with only 8 cases, half of which occurred at the pandemic's outset in 2020. Other causes resulted in the deaths of 20 to 60 individuals.

These findings suggest that COVID-19 was not the direct cause of the marked increase in homeless deaths; it may have indirectly influenced death rates through a rise in drug toxicity and cardiovascular disease-related deaths. To evaluate the secondary hypothesis regarding other variables that could affect causes of death, it is necessary to examine the correlations between gender, age, and causes of death through visual analysis.

2.4 Visualization

2.4.1 Visual 1

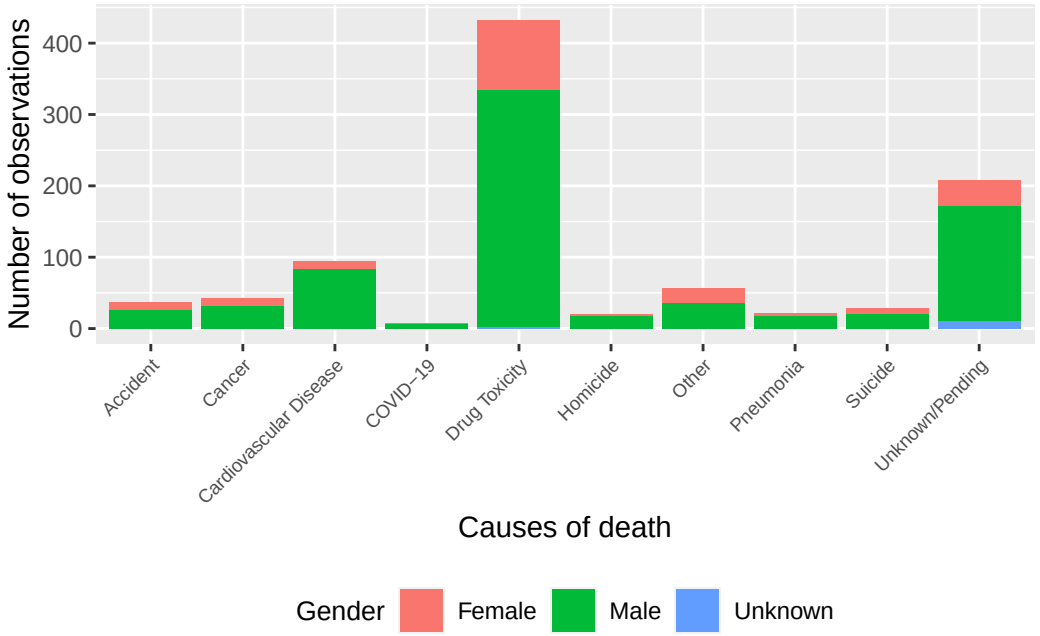

Figure 1: Correlation between gender and 10 causes of death

As depicted in Figure 1, the distribution of the three gender categories across 10 causes of death does not show a distinct pattern. Drug toxicity remains the leading cause for both genders, while COVID-19 has the least impact. For other causes, the ratio of female to male deaths remains at about 1:3, as shown on the Table 2.

2.4.2 Visual 2

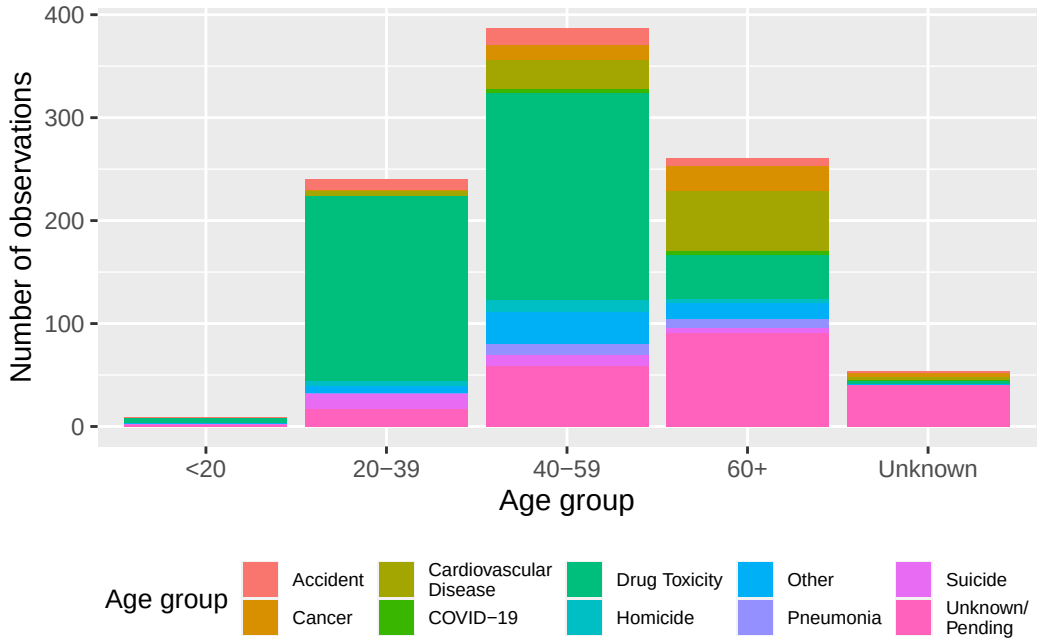

Figure 2: Correlation between age group and 10 causes of death

Figure 2 presents the relationship between age and causes of death. The under-20 age group is too small for meaningful analysis, and the unknown age group's data is inconclusive due to the absence of identifiable patterns between age and cause of death, with most causes also unidentified. Therefore, the analysis focuses on the age groups 20-39, 40-59, and 60+.

Notably, the distribution of death causes varies significantly across age groups. For those aged 20-39 and 40-59, drug toxicity is the main cause of death. In older age groups, an increased proportion of deaths is attributed to unspecified causes, cancer, and cardiovascular diseases, with the latter being the predominant cause of death among those over 60. The share of drug toxicity-related deaths in this group is less than 25%.

Comparing the correlations between age and cause of death to gender and cause of death, age appears to have a stronger correlation with death causes. Consequently, the analysis has shifted focus to the temporal trends across the three age categories.

2.4.3 Visual 3

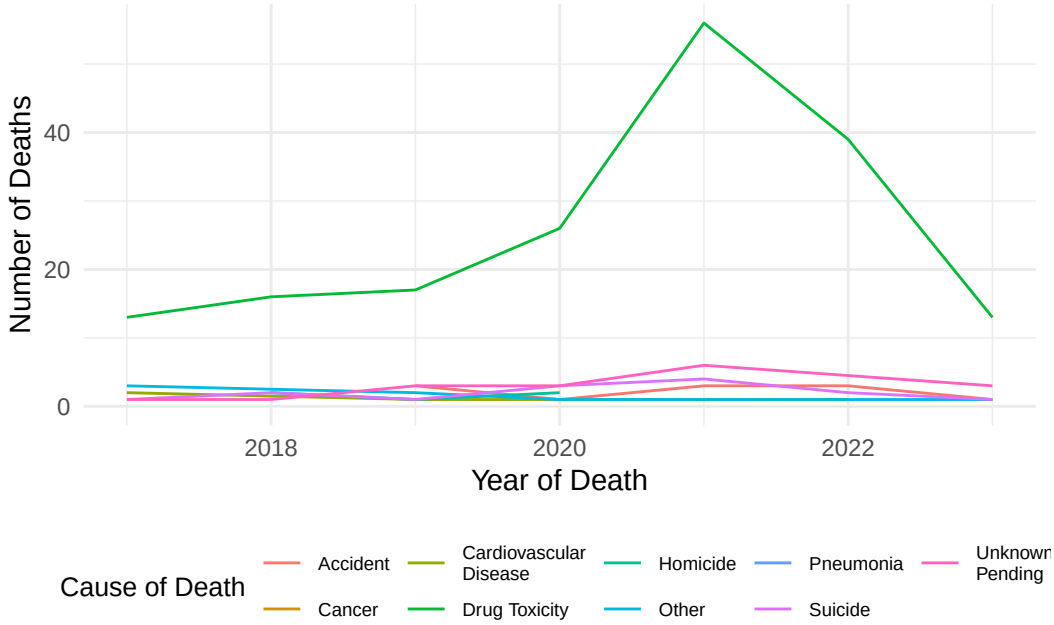

Figure 3: Correlation between age and 10 causes of death part1

Both Figure 3 and Figure 4 reveal a striking increase in deaths due to drug toxicity from 2017 to 2021, peaking in that year before declining. The peak figures for drug toxicity are roughly four to five times higher than those for other causes, with about 50 cases in the 20-39 age group and over 60 in the 40-59 age group, while other causes remained below 10 in 2021. A slight difference exists, with the 40-59 age group exhibiting a higher number of unknown causes deaths.

Oppositely, for those aged over 60, on the Figure 5, the number of deaths due to drug toxicity and unspecified causes decreased in 2021 but rose again in 2022. Deaths from cancer followed a similar pattern, peaking in 2022, thus forming an "M"-shaped trend. Cardiovascular disease-related deaths continued to rise, with the last count in 2022. Deaths from all other causes did not exceed five.

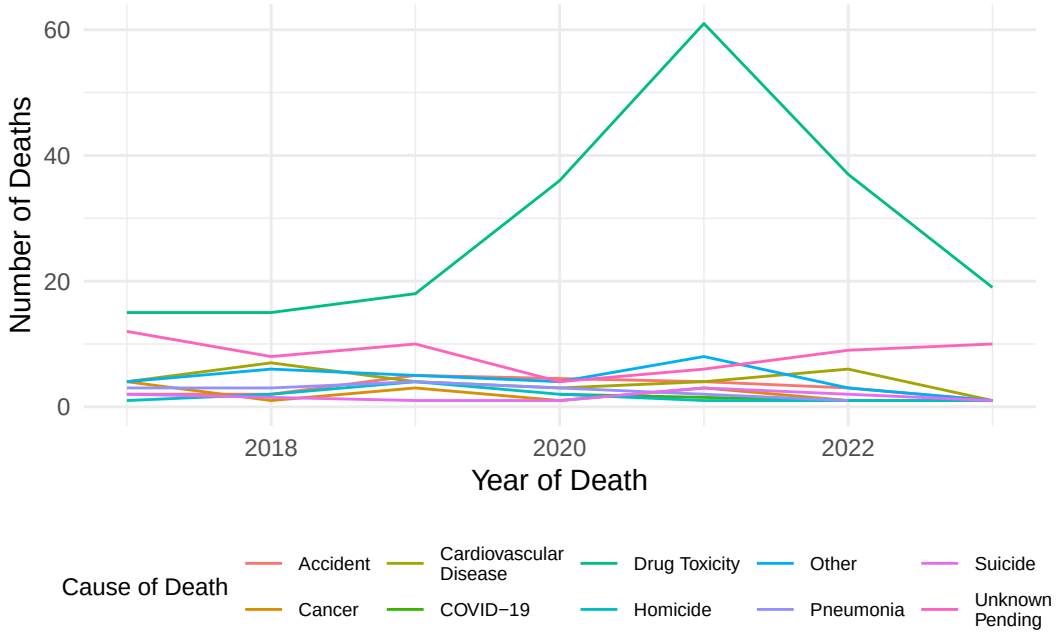

Figure 4: Correlation between age and 10 causes of death part2

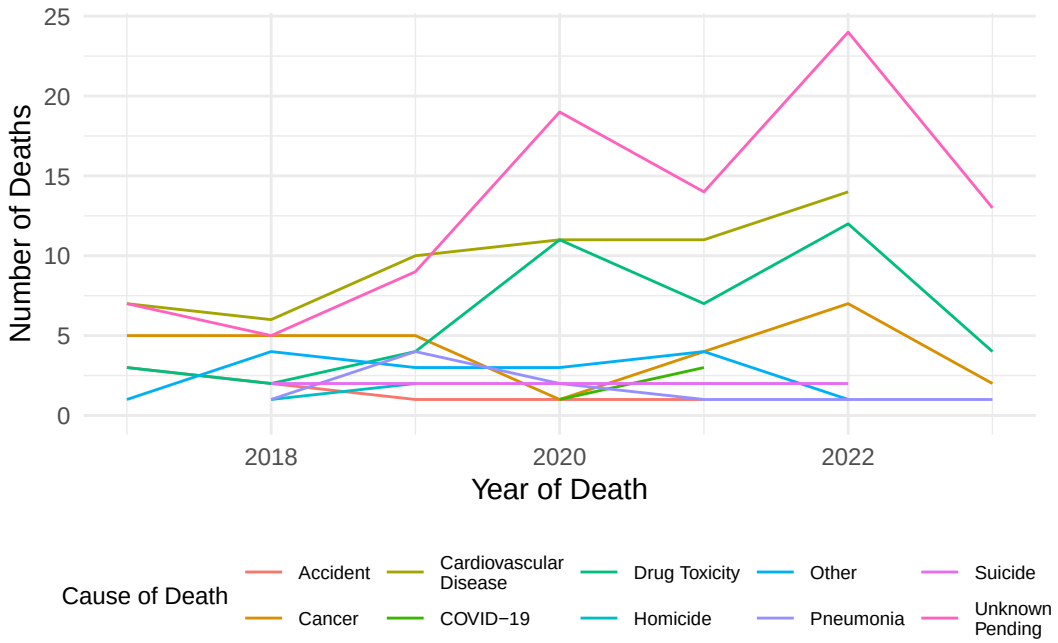

Figure 5: Correlation between age and 10 causes of death part3

3 Conclusion

In conclusion, our data analysis uncovers a distinct trend and points to potential factors behind the increase in drug toxicity-related deaths among Toronto's homeless population from 2017 to 2023. The evidence, drawn from Table 2, Figure 3, Figure 4, and Figure 5, shows a sharp rise in death among the young and middle-aged homeless segments. In contrast, the older homeless population appears to be less affected by drug-related issues, with cardiovascular disease being their leading cause of mortality. While our data does not provide evidence of the underlying causes of these trends, experts have speculated that the lockdowns may have compelled individuals to use drugs in risker and stranger circumstances, potentially leading to higher death number related to drug toxicity. (Ireland 2023)

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