

Motor Vehicle Collisions Reduced Across Toronto During and After the Beginning of the COVID-19 Pandemic*

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23 January 2024

As one of the fastest growing cities and densest cities in Canada, road and pedestrian safety are growing concerns in Toronto especially after the COVID-19 Pandemic. This paper looks at trends of collisions from 2017 to 2023 in Toronto neighbourhoods and wards, types of collisions, and the number of pedestrians involved. The results show that motor vehicle collisions and pedestrian involvement in them have decreased after the pandemic. However, further investigation is needed on the demographics of Toronto areas with high number of motor vehicle collisions.

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*Data and code are available at: <https://github.com/moonsdust/toronto-collisions>

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1 Introduction

As of 2024, Toronto was reported to have one of the worst traffic congestion in North America (Callan January 11 2024). As Toronto's population increased over the years, congestion on the road increased and road and pedestrian safety is a growing concern for many. Some also believe that roads have gotten unsafe after the pandemic. In order to reduce major injuries and traffic collision fatalities, the city of Toronto created the Vision Zero Safety Plan in 2016, which contains over 50 safety measures with the ultimate goal of eliminating fatalities on roads all together (Toronto, n.d.). An ambitious goal however it raises the following question: how does motor vehicle collisions (MVC) compare from the early years of the plan to the present following the outbreak of the COVID-19 pandemic in 2020?

In this paper, I analyzed collisions trends from 2017 to 2023 specifically into collisions in Toronto neighbourhoods and wards, the types of collisions that occurred, and the number of pedestrians involved. In my findings, from 2020 onwards, there was a decline in collisions...

By understanding collision trends across Toronto and over the years, it can help improved safety plans for strategies like Vision Zero for instance for pedestrians in specific areas of Toronto.

2 Data

The data used by the paper are **City Wards** (“City Wards” 2024), **Ward Profiles (25-Ward Model)** (“Ward Profiles (25-Ward Model)” 2024), and **Police Annual Statistical Report - Traffic Collisions** (“Police Annual Statistical Report - Traffic Collisions” 2023) datasets, which were sourced from Open Data Toronto Portal. These datasets were accessed using the `opendatatoronto` library (Gelfand 2022). Another dataset that could have been used but was not was the **About Motor Vehicle Collisions involving Killed or Seriously Injured Persons** dataset from Open Data Toronto Portal. However, this dataset’s most current record was in 2022 and is outdated for our purposes.

The datasets were cleaned and analyzed using `tidyverse` (Wickham et al. 2019), `knitr` (Xie 2014), `janitor`(Firke 2023), `dplyr` (Wickham et al. 2023), `ggplot2` (Wickham 2016), and `sf` (Pebesma and Bivand 2023). Some of the datasets used for the data analysis combined the **Ward Profiles (25-Ward Model)** and **Police Annual Statistical Report - Traffic Collisions** in order to create datasets with the following variables: `collision_type`, `num_of_collisions`, `num_of_pedestrians`, `yearly_collision_num`, and `total_collisions_2017_2023`. These variables were formed by mostly created

group existing columns and counting the number of rows with certain column variables. The Toronto Police Services has defined MVC under 4 different categories: Fatal, Personal Injury, Fail to Remain, and Property Damage (“Police Annual Statistical Report - Traffic Collisions” 2023). Fatal means that a person was killed during the vehicle collision, personal injury indicates a person was injured during the collision, fail to remain means that the person left the scene before after information was provided regarding the collision, and property damage indicates that property has been damaged during the collision. With this, the 4 types are possible values under the variable `collision_type`. `num_of_collisions` represents the number of collisions that occurred in either a neighbourhood in a specific year or the number of collisions of a certain type of a certain year depending on the context. `num_of_pedestrians` represents the number of pedestrians that were hit in the vehicle collision. `yearly_collision_num` and `total_collisions_2017_2023` are the count of collisions in a specific year and the total number of collisions from 2017 to 2023 for each Toronto neighbourhood mentioned in the Police Annual Statistical Report - Traffic Collisions dataset. For the dataset regarding Toronto ward profiles, the following variables were created: `ward_name` (indicates the name of the Toronto ward), `pop_num` (represents the population size of Toronto wards as of 2020), and `avg_income` (signifies the average household income of each ward as of 2020).

2.1 Results

2.1.1 Collisions across Toronto neighbourhoods and Wards (2017-2023)

There are 25 wards and 158 neighbourhoods in the city of Toronto. The distribution of MVC across different neighbourhoods and wards was investigated and the following was obtained:

Table 1: Toronto Neighbourhoods with the most number of motor vehicle collisions from 2017 to 2023

Neighbourhood	Number of Motor Vehicle Collisions (2017 to 2023)
West Humber-Clairville (1)	2812
Wexford/Maryvale (119)	2075
South Riverdale (70)	1866
York University Heights (27)	1781
Clairlea-Birchmount (120)	1567
Etobicoke City Centre (159)	1519

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#| echo: false
#| warning: false
#| message: false
# Code snippet to add points to map is from https://stackoverflow.com/questions/58676661/g
```

```

# Code snippet to change colour of plots
# https://www.rdocumentation.org/packages/ggplot2/versions/2.2.1/topics/scale_colour_gradient
# Code snippet to change theme adapted from
# https://ggplot2.tidyverse.org/reference/theme.html
ggplot() +
  geom_point(data = cleaned_map_data,
    aes(color = num_of_collisions, geometry = geometry), alpha = 0.05,
    stat = "sf_coordinates"
  ) +
  facet_wrap(vars(year), ncol = 4) +
  # Change colours of the points
  scale_color_gradient(low = 'lightblue', high = 'darkblue', name = "Number of Collisions") -
  # Overlays a map of Toronto
  geom_sf(data = the_map, fill = "transparent") +
  # Add ward number labels
  geom_sf_text(data=the_map, aes(label = area_short_code), color = '#333333', size = 1.5) +
  # Changes the font of the title and removes the x and y axis
  theme(plot.title = element_text(size = 9, face = 'bold'), rect = element_blank(), axis.text.x =
    element_blank(), axis.text.y = element_blank(), axis.ticks = element_blank(), legend.position =
    'none') +
  labs(x = "Longitude",
    y = "Latitude",
    title="Number of Motor Vehicle Collisions Across Toronto Wards from 2017 to 2023") +
  theme(legend.position = c(0.9, 0.2))

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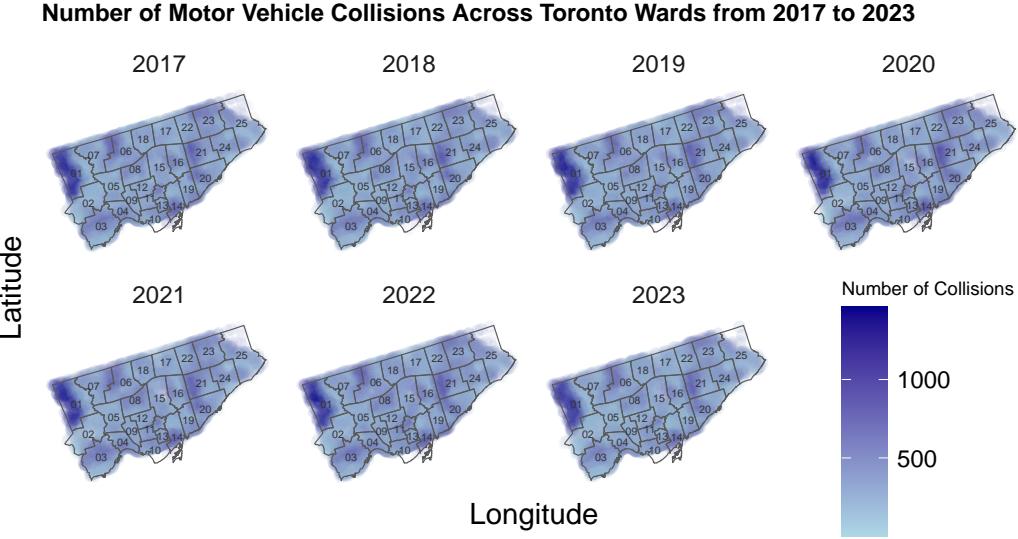


Figure 1: This figure shows separate maps of the number of motor vehicle collisions from 2017 to 2023 across different Toronto wards.

Table 2: Summary Statistics of Toronto Ward Profile in 2020

Population Number	Average Household Income
Min. : 94025	Min. :29545
1st Qu.:103690	1st Qu.:38345
Median :110095	Median :45345
Mean :110452	Mean :46436
3rd Qu.:115120	3rd Qu.:49440
Max. :139920	Max. :80730

In Table 1, West Humber-Clairville has the greatest number of collisions with 2812 MVC from 2017 to 2023. West Humber-Clairville is located in ward 1, which from Figure 1 is the region with the darkest shade of blue and is the most dense in terms of number of collisions ([citefinder?](#)). Following this is Wexford/Maryvale, which is located in ward 21 with 2075 collisions. From Table 6, something interesting to note is that ward 1's average household income is \$38,135 with a population of 115120 people and ward 21's average household income is \$40,565 with a population of 115120 people.

2.1.2 Type of Collisions in Toronto (2017 - 2023)

Table 3: Number of Motor Vehicle Collisions of Different Types Across Toronto from 2017 to 2023

Year	Collision Type	Number of Collisions	Proportion of Collisions (Per Year)
2017	Fail to Remain	11411	0.16
2017	Property Damage	50157	0.69
2017	Personal Injury	10868	0.15
2017	Fatal	60	0.00
2018	Personal Injury	9832	0.13
2018	Property Damage	55762	0.72
2018	Fail to Remain	11851	0.15
2018	Fatal	66	0.00
2019	Personal Injury	8774	0.11
2019	Property Damage	60865	0.77
2019	Fail to Remain	9504	0.12
2019	Fatal	62	0.00
2020	Property Damage	34056	0.79
2020	Fail to Remain	4251	0.10
2020	Personal Injury	4950	0.11
2020	Fatal	40	0.00
2021	Personal Injury	5211	0.12
2021	Fail to Remain	4430	0.11
2021	Property Damage	32053	0.77
2021	Fatal	55	0.00
2022	Personal Injury	5930	0.10
2022	Property Damage	47917	0.83
2022	Fail to Remain	3600	0.06
2022	Fatal	45	0.00
2023	Property Damage	34262	0.71
2023	Personal Injury	5831	0.12
2023	Fail to Remain	8408	0.17
2023	Fatal	28	0.00

Table 4: Summary Statistics of the Number of Motor Vehicle Collisions of Different Types Across Toronto from 2017 to 2023

Number of Collisions
Min. : 28
1st Qu.: 2716
Median : 7169
Mean : 15010
3rd Qu.: 16902
Max. : 60865

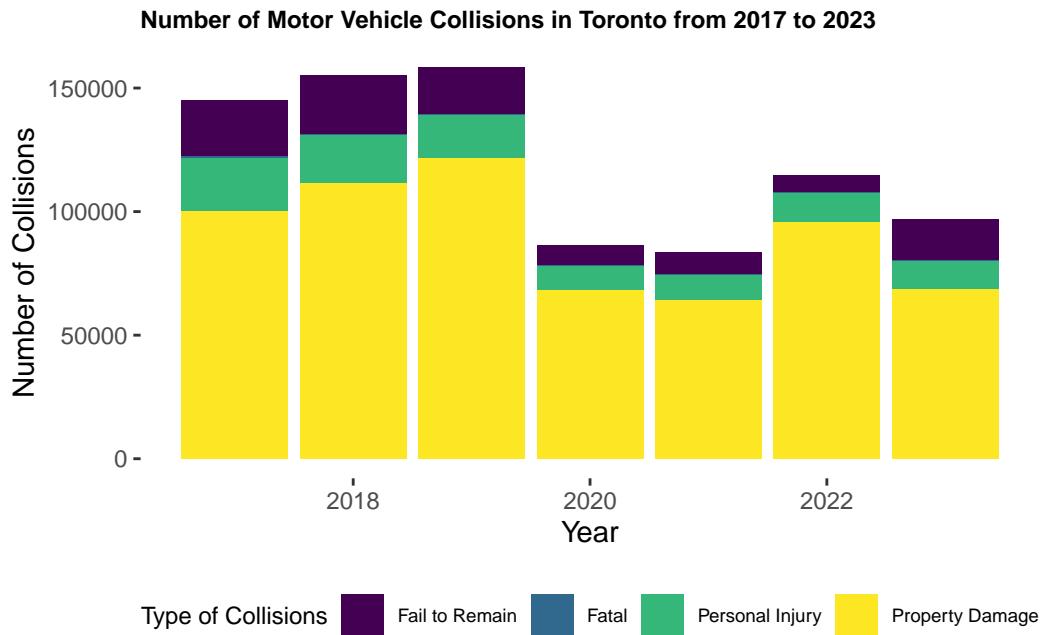


Figure 2: This histogram reveals the number of motor vehicle collisions from 2017 to 2023 across Toronto and the different types of motor vehicle collisions.

From Figure 2, when comparing the overall number of collisions before 2020 and 2020 onwards, there is an overall annual decrease with the overall number of collisions. However, collisions involving property damage remains the majority of collision cases over the years. We can see this decrease from 2019 and 2020 from about 79205 collisions to 43297 collisions. According to Table 4 and Table 3, the peak number of property damage collisions was at 60865 in 2019, which made up 77% of the collisions in that year. However property damage collisions in 2020 was up to 79% of collisions in 2020.

2.1.3 Pedestrians Involved in a Motor Vehicle Collision (2017-2023)

Table 5: Number of Pedestrians Involved in a Motor Vehicle Collision from 2017 to 2023

Year	Number of pedestrians involved (Per Year)	Proportion of pedestrians involved (Per Year)
2017	1748	0.024
2018	1601	0.021
2019	1545	0.020
2020	1055	0.024
2021	990	0.024
2022	1241	0.022
2023	968	0.020

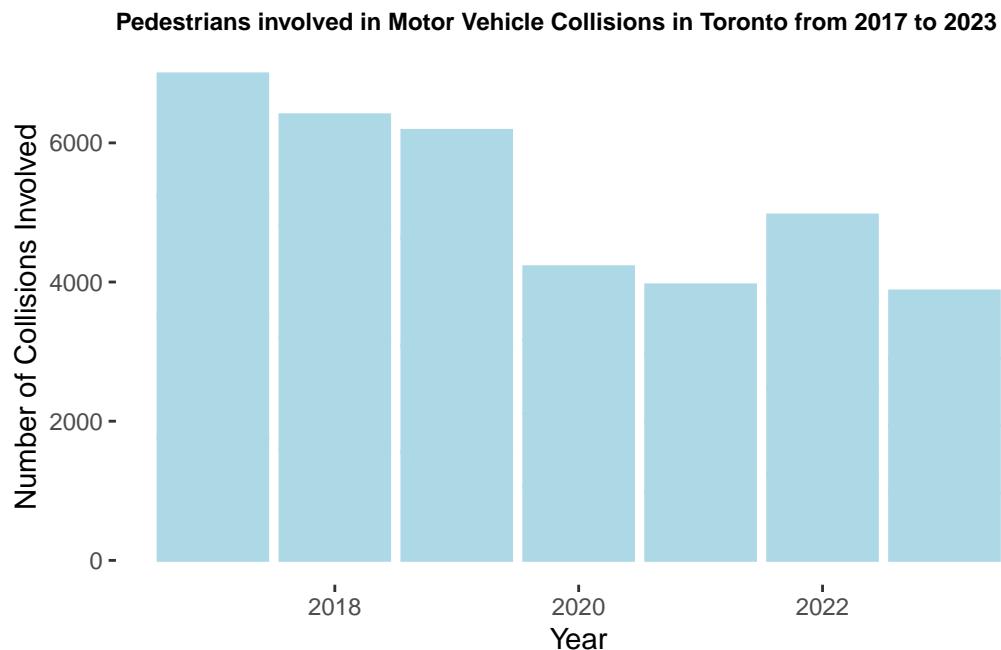


Figure 3: This histogram reveals the number of pedestrians involved in a motor vehicle collisions from 2017 to 2023 across Toronto.

3 Discussion

3.1 First discussion point

According to Table 2 and Section 2.1.1, ward 1 and ward 21's population number is above the mean of 110452 people (also known as average) however both wards are below the mean of \$46,436 in terms of average household income.

3.2 Second discussion point

3.3 Third discussion point

3.4 Weaknesses and next steps

Appendix

Table 6: Toronto Ward Profile in 2020

Ward Number	Ward Name	Population Number	Average Household Income
1	Etobicoke North	115120	38135
2	Etobicoke Centre	117200	45345
3	Etobicoke-Lakeshore	139920	65575
4	Parkdale-High Park	104715	49440
5	York South-Weston	115675	45055
6	York Centre	107355	41265
7	Humber River-Black Creek	111200	37675
8	Eglinton-Lawrence	114820	45915
9	Davenport	104730	45670
10	Spadina-Fort York	135400	80730
11	University-Rosedale	102385	53510
12	Toronto-St. Paul's	114095	58105
13	Toronto Centre	116930	68965
14	Toronto-Danforth	104555	46235
15	Don Valley West	101025	40030
16	Don Valley East	94335	38285
17	Don Valley North	112590	45785
18	Willowdale	117130	50550
19	Beaches-East York	108500	45705
20	Scarborough Southwest	110095	41905
21	Scarborough Centre	111560	40565
22	Scarborough-Agincourt	103690	38345
23	Scarborough North	94025	29545
24	Scarborough-Guildwood	102755	36245
25	Scarborough-Rouge Park	101485	32315

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