

Motor Vehicle Collisions Decreased in Toronto During and After the Beginning of the COVID-19 Pandemic*

Emily Su

25 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 shows that motor vehicle collisions and pedestrian involvement in them have decreased after the pandemic but are still prevalent in more lower-income areas. Further investigation is needed on the demographics of Toronto areas with high number of motor vehicle collisions.

Table of contents

1	Introduction	1
2	Data	2
3	Results	3
3.0.1	Motor vehicle collisions across Toronto neighbourhoods and wards (2017-2023)	3
3.0.2	Types of motor vehicle collisions in Toronto (2017 - 2023)	5
3.0.3	Pedestrians involved in a motor vehicle collision (2017-2023)	7
4	Discussion	9
4.1	First discussion point	9
4.2	Second discussion point	9

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

4.3 Third discussion point	9
4.4 Weaknesses and next steps	9
Appendix	10
References	17

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 increases 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 unsafer in the years after the pandemic. In a 2023 study done by Ipsos surveying Canadians on road safety, they mentioned that concerns about road safety has increased to 65% in 2023 from 59% in 2021 (Cordeiro and Sethi, n.d.). In order to reduce traffic collision injuries and 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 (C. of Toronto, n.d.). An ambitious goal yet it raises the question how effective is this plan across Toronto over the years. We investigated this question and the following: how does motor vehicle collisions compare from the early years of the plan to the present following the outbreak of the COVID-19 pandemic in 2020?

In this paper, collisions trends were analyzed from 2017 to 2023 specifically into motor vehicle collisions in Toronto neighbourhoods and wards, the types of motor vehicle collisions that occurred, and the number of pedestrians involved in them. In our findings, there was a decline in motor vehicle collisions overall from 2020 onwards. However, we saw that the locations motor vehicle collisions occurred at stayed consistent over the years. We also found that the wards that make up a greater proportion of motor vehicle collisions had average household incomes that are below Toronto's overall average household income. By understanding collision trends over the years in Toronto, it can aid with identifying areas of improvement of current safety plans like Vision Zero and overall helping others feel safer in the city.

In the rest of this paper, the data section will cover the datasets used, define variables used by our tables and graphs, and briefly explain the data cleaning process. In the results section, we will reveal tables and graphs made on our datasets and explain what they show. In the discussion section, we will connect back to the real world and explain what the results could mean, the implication of our results, potential areas of improvement for the paper, and suggestions for future works. Finally, the appendix section will include the entire table of some of our results.

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 the City of Toronto’s Open Data Portal. These datasets were accessed using the `opendatatoronto` library (Gelfand 2022). Another dataset that could have been used 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 simulated, cleaned, analyzed, and tested using the R programming language (R Core Team 2023), `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`. `collision`. 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 motor vehicle collisions 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. Due to the complexity of motor vehicle collisions and the different combinations of ways they can be categorized, our analysis looked at collisions that were defined in only 1 of the 4 categories.

`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).

3 Results

3.0.1 Motor vehicle collisions across Toronto neighbourhoods and wards (2017-2023)

As of 2024, There are 25 wards and 158 neighbourhoods in the city of Toronto. The distribution of motor vehicle collisions 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 Name and Number	Number of Motor Vehicle Collisions (2017 to 2023)	Proportion of Motor Vehicle Collisions (2017 to 2023)
West	2812	0.02
Humber-Clairville (1)		
Wexford/Maryvale (119)	2075	0.02
South Riverdale (70)	1866	0.02
York University Heights (27)	1781	0.02
Clairlea-Birchmount (120)	1567	0.01
Etobicoke City Centre (159)	1519	0.01

Table 2: Minimum, quartiles, median, and maximum of population size and average household income across Toronto wards in 2020

Population Number	Average Household Income (CAD)
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

Table 1 reveals that the neighbourhood with the highest number of motor vehicle collisions and the approximately how many motor vehicle collisions from 2017 to 2023 occurred in

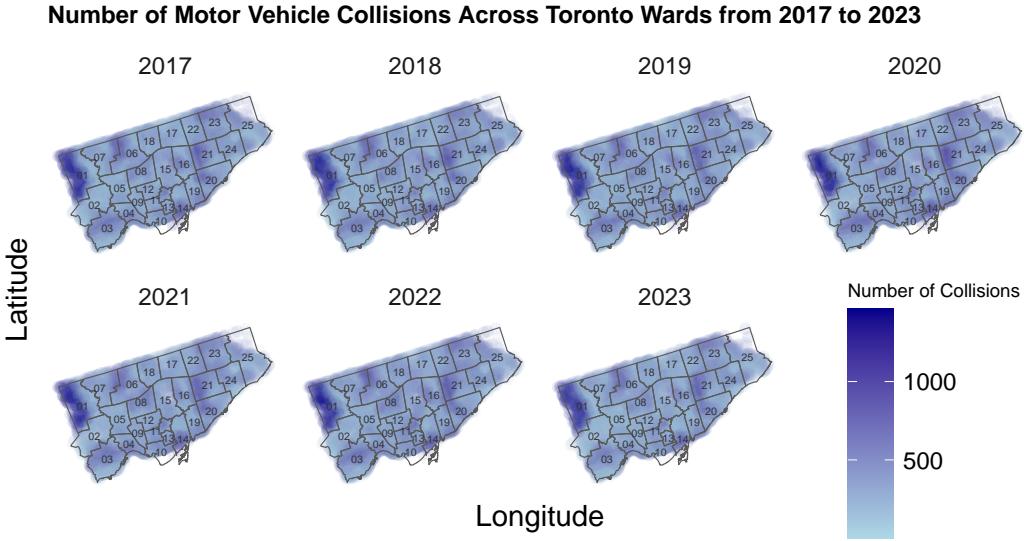


Figure 1: Number of motor vehicle collisions from 2017 to 2023 across different Toronto wards.

each neighbourhood. The neighbourhoods with a high number of collisions are the following: West Humber-Clairville (approximately 2%), Wexford/Maryvale (approximately 2%), South Riverdale (approximately 2%), York University Heights (approximately 2%), Clairlea-Birchmount (approximately 2%), Birchmount (approximately 1%), and Etobicoke City Centre (approximately 1%). The full table of Table 1 can be found here Table 7 in the Appendix section with the rest of the neighbourhoods making up approximately 1% of collisions or less.

In Table 1, West Humber-Clairville has the largest amount of collisions with 2812 motor vehicle collisions 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 has the highest density of points (Toronto, n.d.). Following this is Wexford/Maryvale, which is located in ward 21 with 2075 collisions (Toronto, n.d.). The rest of the neighbourhood are in the following wards based on Toronto (n.d.): South Riverdale is in Ward 14, York University Heights is in Ward 7, Clairlea-Birchmount is in Ward 20, and Etobicoke City Centre is in Ward 2.

Table 2 reveals that the mean (also known as the average) population size per ward in Toronto is 110452 people with a standard deviation of 10594 people and the mean for the average household income per ward is \$46,436 with a standard deviation of \$11,647.51. It also indicates that the median for the population size per ward is 110095 people and the median for average household income per ward is \$45,345. From Table 6, 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. For ward 14, 7, 20, and 2, the average households incomes

are \$46,235, \$37,675, \$41,905, and \$45,345, respectively and the population sizes are 104555, 111200, 110095, and 117200 people, respectively.

When comparing the density of collisions in Toronto for each year with Figure 1, the density stays the same from 2017 to 2023 with ward 1 having the largest amount of collisions. According to Table 2 and Section 3.0.1, when comparing the the average household incomes for the wards each neighbourhood that make up 2% of motor vehicle collisions with the mean and median for average income per ward, the incomes are below the mean and median. The wards of the other 2 neighbourhoods from Table 2 have incomes that are below the mean and either equal to or below the median. However for population sizes, the wards of West Humber-Clairville, York University Heights, Wexford/Maryvale, and Etobicoke City Centre are above the mean population size per ward while the rest in Table 2 are below it.

3.0.2 Types of motor vehicle collisions in Toronto (2017 - 2023)

Table 3: Motor vehicle collisions of different types in Toronto from 2017 to 2023

Year	Motor Vehicle Collision Type	Number of Collisions	Proportion of Motor Vehicle 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

Table 3: Motor vehicle collisions of different types in Toronto from 2017 to 2023

Year	Motor Vehicle Collision Type	Number of Collisions	Proportion of Motor Vehicle Collisions (Per Year)
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: Minimum, quartiles, median, and maximum of motor vehicle collisions of different types in Toronto from 2017 to 2023

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

From Figure 2, when comparing the overall number of collisions before 2020 and 2020 onwards, there is a 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.

3.0.3 Pedestrians involved in a motor vehicle collision (2017-2023)

Table 5: Number of pedestrians involved in motor vehicle collisions in Toronto 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

Table 5: Number of pedestrians involved in motor vehicle collisions in Toronto from 2017 to 2023

Year	Number of pedestrians involved (Per Year)	Proportion of pedestrians involved (Per Year)
2020	1055	0.024
2021	990	0.024
2022	1241	0.022
2023	968	0.020

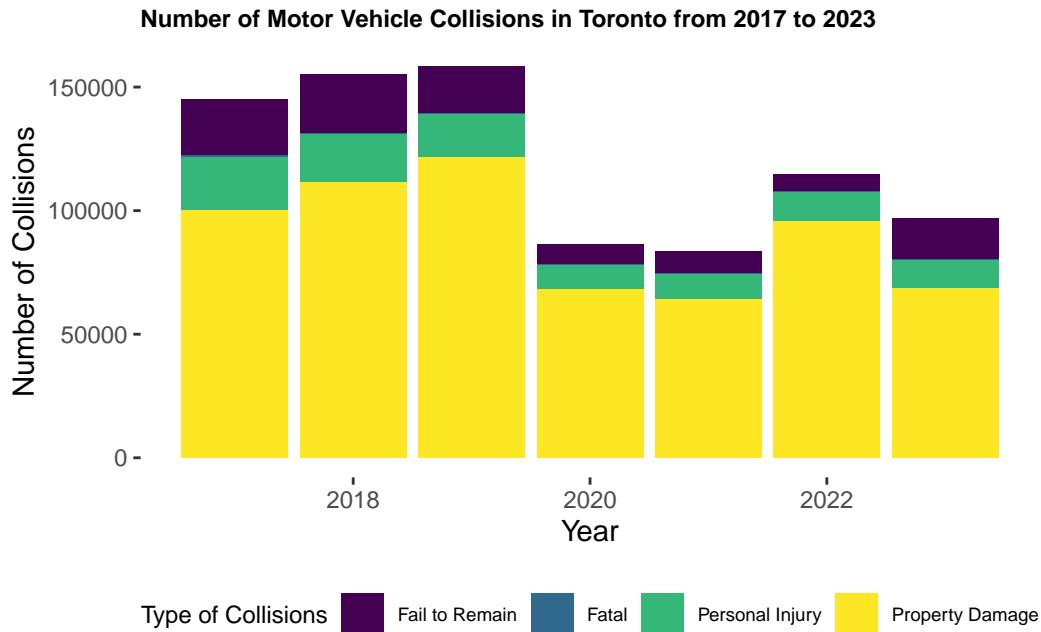


Figure 2: Number of motor vehicle collisions in Toronto grouped by types from 2017 to 2023

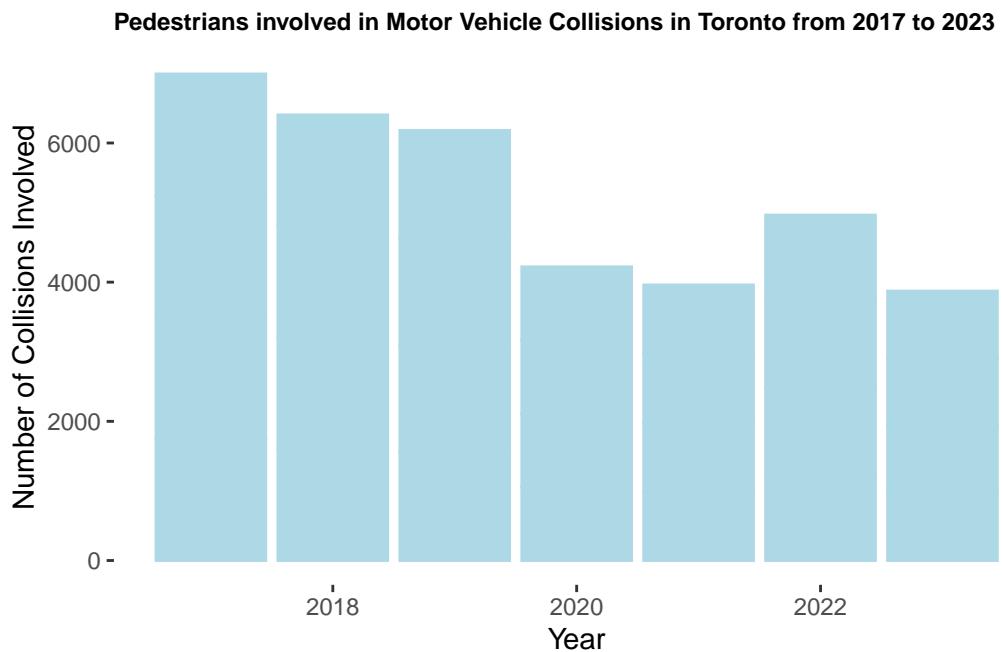


Figure 3: Number of pedestrians involved in motor vehicle collisions from 2017 to 2023 in Toronto.

4 Discussion

4.1 First discussion point

Vision Zero has also faced criticism due to its lack of focus on addressing road and pedestrian safety in low-income areas (Roy, n.d.). While we did not directly looked at income compared to wards, which could be further investigated in the future, we found that the number of crashes across Toronto stayed pretty consistent from 2017 to 2023 based on Figure 1 and the neighbourhoods we found impacted with high amounts of vehicle collisions in Table 1 were in wards that are below the mean average household income based on data from 2020.

4.2 Second discussion point

4.3 Third discussion point

4.4 Weaknesses and next steps

Appendix

Table 6: Population size and average household income across Toronto wards in 2020

Ward Number	Ward Name	Population Number	Average Household Income (CAD)
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

Table 7: Toronto Neighbourhoods with the most number of motor vehicle collisions from 2017 to 2023

Neighbourhood Name and Number	Number of Motor Vehicle Collisions (2017 to 2023)	Proportion of Motor Vehicle Collisions (2017 to 2023)
West Humber-Clairville (1)	2812	0.02
Wexford/Maryvale (119)	2075	0.02
South Riverdale (70)	1866	0.02
York University Heights (27)	1781	0.02
Clairlea-Birchmount (120)	1567	0.01
Etobicoke City Centre (159)	1519	0.01
Milliken (130)	1491	0.01
Annex (95)	1327	0.01
St Lawrence-East	1324	0.01
Bayfront-The Islands (166)		
High Park-Swansea (87)	1294	0.01
Dorset Park (126)	1272	0.01
Moss Park (73)	1259	0.01
Yorkdale-Glen Park (31)	1255	0.01
Banbury-Don Mills (42)	1252	0.01
Morningside Heights (144)	1251	0.01
Wellington Place (164)	1224	0.01
Stonegate-Queensway (16)	1223	0.01
Rosedale-Moore Park (98)	1212	0.01
The Beaches (63)	1181	0.01
Yonge-Bay Corridor (170)	1160	0.01
Agincourt South-Malvern West (128)	1159	0.01
Kensington-Chinatown (78)	1140	0.01
Bedford Park-Nortown (39)	1132	0.01
South Parkdale (85)	1110	0.01
Golfdale-Cedarbrae-Woburn (141)	1058	0.01
West Hill (136)	1054	0.01

Table 7: Toronto Neighbourhoods with the most number of motor vehicle collisions from 2017 to 2023

Neighbourhood Name and Number	Number of Motor Vehicle Collisions (2017 to 2023)	Proportion of Motor Vehicle Collisions (2017 to 2023)
Downtown Yonge East (168)	1046	0.01
Woburn North (142)	1023	0.01
Glenfield-Jane Heights (25)	1004	0.01
Humber Summit (21)	971	0.01
Birchcliffe-Cliffside (122)	961	0.01
East End-Danforth (62)	926	0.01
Trinity-Bellwoods (81)	896	0.01
Junction Area (90)	895	0.01
Tam O'Shanter-Sullivan (118)	887	0.01
Harbourfront-CityPlace (165)	885	0.01
Malvern East (146)	883	0.01
Oakdale-Beverley Heights (154)	882	0.01
Bendale-Glen Andrew (156)	868	0.01
Newtonbrook West (36)	858	0.01
Rockcliffe-Smythe (111)	853	0.01
Downsview (155)	849	0.01
Leaside-Bennington (56)	849	0.01
Agincourt North (129)	838	0.01
Islington (158)	810	0.01
Junction-Wallace Emerson (171)	807	0.01
Mount Pleasant East (99)	803	0.01
Oakwood Village (107)	790	0.01
Mount Olive-Silverstone-Jamestown (2)	778	0.01
Mimico-Queensway (160)	774	0.01
Bayview Village (52)	772	0.01
Clanton Park (33)	766	0.01
Newtonbrook East (50)	747	0.01
West Rouge (143)	746	0.01

Table 7: Toronto Neighbourhoods with the most number of motor vehicle collisions from 2017 to 2023

Neighbourhood Name and Number	Number of Motor Vehicle Collisions (2017 to 2023)	Proportion of Motor Vehicle Collisions (2017 to 2023)
Brookhaven-Amesbury (30)	745	0.01
Forest Hill South (101)	742	0.01
Cliffcrest (123)	732	0.01
Kennedy Park (124)	706	0.01
Lawrence Park South (103)	703	0.01
Don Valley Village (47)	695	0.01
Hillcrest Village (48)	691	0.01
Old East York (58)	687	0.01
St. Andrew-Windfields (40)	680	0.01
Steeles (116)	672	0.01
Malvern West (145)	667	0.01
Eglinton East (138)	665	0.01
East Willowdale (152)	662	0.01
Danforth East York (59)	655	0.01
Bridle Path-Sunnybrook-York Mills (41)	648	0.01
Little Portugal (84)	647	0.01
Keelesdale-Eglinton West (110)	643	0.01
Wychwood (94)	642	0.01
Bathurst Manor (34)	640	0.01
Corso Italia-Davenport (92)	635	0.01
Lansing-Westgate (38)	627	0.01
Fort York-Liberty Village (163)	626	0.01
Roncesvalles (86)	625	0.01
Weston (113)	624	0.01
University (79)	620	0.01
Englemount-Lawrence (32)	619	0.01
Yonge-Eglinton (100)	619	0.01
Greenwood-Coxwell (65)	616	0.01

Table 7: Toronto Neighbourhoods with the most number of motor vehicle collisions from 2017 to 2023

Neighbourhood Name and Number	Number of Motor Vehicle Collisions (2017 to 2023)	Proportion of Motor Vehicle Collisions (2017 to 2023)
Humbermede (22)	607	0.01
Henry Farm (53)	605	0.01
Casa Loma (96)	601	0.01
West Queen West (162)	601	0.01
Willowridge-Martingrove-Richview (7)	597	0.01
Cabbagetown-South	589	0.01
St.James Town (71)	587	0.01
Palmerston-Little Italy (80)	587	0.01
Dufferin Grove (83)	585	0.01
Alderwood (20)	584	0.01
O'Connor-Parkview (54)	583	0.01
Victoria Village (43)	574	0.01
North Riverdale (68)	569	0.01
Pelmo Park-Humberlea (23)	568	0.01
Willowdale West (37)	562	0.00
High Park North (88)	558	0.00
Thorncliffe Park (55)	556	0.00
Dovercourt Village (172)	552	0.00
Lawrence Park North (105)	552	0.00
L'Amoreaux West (147)	548	0.00
Edenbridge-Humber Valley (9)	534	0.00
Black Creek (24)	517	0.00
Bay-Cloverhill (169)	517	0.00
East L'Amoreaux (148)	517	0.00
Church-Wellesley (167)	516	0.00
Bendale South (157)	509	0.00
Fenside-Parkwoods (150)	497	0.00
Oakridge (121)	493	0.00
Morningside (135)	490	0.00
Kingsview Village-The Westway (6)	489	0.00
Flemington Park (44)	487	0.00

Table 7: Toronto Neighbourhoods with the most number of motor vehicle collisions from 2017 to 2023

Neighbourhood Name and Number	Number of Motor Vehicle Collisions (2017 to 2023)	Proportion of Motor Vehicle Collisions (2017 to 2023)
Eringate-Centennial-West Deane (11)	486	0.00
Woodbine Corridor (64)	484	0.00
Westminster-Branson (35)	467	0.00
Weston-Pelham Park (91)	465	0.00
Scarborough Village (139)	464	0.00
Mount Dennis (115)	461	0.00
New Toronto (18)	460	0.00
Highland Creek (134)	460	0.00
Parkwoods-O'Connor Hills (149)	459	0.00
Thistletown-Beaumont Heights (3)	456	0.00
Runnymede-Bloor West Village (89)	454	0.00
Briar Hill-Belgravia (108)	453	0.00
South Eglinton-Davisville (174)	432	0.00
Regent Park (72)	431	0.00
Yonge-Doris (151)	429	0.00
Yonge-St.Clair (97)	428	0.00
Humber Heights-Westmount (8)	423	0.00
Beechborough-Greenbrook (112)	422	0.00
Forest Hill North (102)	420	0.00
Caledonia-Fairbank (109)	416	0.00
Long Branch (19)	413	0.00
Humewood-Cedarvale (106)	412	0.00
Humber Bay Shores (161)	400	0.00
Pleasant View (46)	399	0.00
Broadview North (57)	399	0.00
Kingsway South (15)	397	0.00
Avondale (153)	396	0.00
Elms-Old Rexdale (5)	392	0.00

Table 7: Toronto Neighbourhoods with the most number of motor vehicle collisions from 2017 to 2023

Neighbourhood Name and Number	Number of Motor Vehicle Collisions (2017 to 2023)	Proportion of Motor Vehicle Collisions (2017 to 2023)
Bayview Woods-Steeles (49)	388	0.00
Danforth (66)	384	0.00
Centennial Scarborough (133)	383	0.00
Rexdale-Kipling (4)	382	0.00
Princess-Rosethorn (10)	368	0.00
Blake-Jones (69)	357	0.00
Maple Leaf (29)	340	0.00
Ionview (125)	324	0.00
North St.James Town (74)	320	0.00
Woodbine-Lumsden (60)	313	0.00
Taylor-Massey (61)	298	0.00
Etobicoke West Mall (13)	295	0.00
Markland Wood (12)	289	0.00
Rustic (28)	287	0.00
Guildwood (140)	281	0.00
Playter Estates-Danforth (67)	276	0.00
North Toronto (173)	246	0.00
Lambton Baby Point (114)	130	0.00
NSA	48	0.00

References

- Callan, Isaac. January 11 2024. “Toronto Among World’s Worst Cities for Congestion, According to a New Report,” January 11 2024. <https://globalnews.ca/news/10220758/toronto-traffic-world-worst-3rd/>.
- “City Wards.” 2024. Open Data Toronto; City Clerk’s Office. <https://open.toronto.ca/dataset/city-wards/>.
- Cordeiro, Adriana, and Sanyam Sethi. n.d. “Perceptions about the Safety of Canada’s Roads Have Deteriorated Within the Last Two Years.” <https://thelocal.to/vision-zero-inequality-toronto/>.
- Firke, Sam. 2023. *Janitor: Simple Tools for Examining and Cleaning Dirty Data*. <https://github.com/sfirke/janitor>.
- Gelfand, Sharla. 2022. *Opendatatoronto: Access the City of Toronto Open Data Portal*. <https://CRAN.R-project.org/package=opendatatoronto>.
- Pebesma, E, and R Bivand. 2023. *Spatial Data Science: With Applications in r*. Chapman; Hall/CRC. <https://doi.org/10.1201/9780429459016>.
- “Police Annual Statistical Report - Traffic Collisions.” 2023. Open Data Toronto; Toronto Police Services. <https://open.toronto.ca/dataset/police-annual-statistical-report-traffic-collisions/>.
- R Core Team. 2023. *R: A Language and Environment for Statistical Computing*. Vienna, Austria: R Foundation for Statistical Computing. <https://www.R-project.org/>.
- Roy, Inori. n.d. “The Deadly Inequality of Toronto’s Vision Zero Rollout.” <https://thelocal.to/vision-zero-inequality-toronto/>.
- Toronto. n.d. “Find Your Neighbourhood.” Toronto. <https://www.toronto.ca/city-government/data-research-maps/neighbourhoods-communities/neighbourhood-profiles/find-your-neighbourhood>.
- Toronto, City of. n.d. “Vision Zero Plan Overview.” <https://www.toronto.ca/services-payments/streets-parking-transportation/road-safety/vision-zero/vision-zero-plan-overview/>.
- “Ward Profiles (25-Ward Model).” 2024. Open Data Toronto; City Planning. <https://open.toronto.ca/dataset/ward-profiles-25-ward-model/>.
- Wickham, Hadley. 2016. *Ggplot2: Elegant Graphics for Data Analysis*. Springer-Verlag New York. <https://ggplot2.tidyverse.org>.
- Wickham, Hadley, Mara Averick, Jennifer Bryan, Winston Chang, Lucy D’Agostino McGowan, Romain François, Garrett Grolemund, et al. 2019. “Welcome to the tidyverse.” *Journal of Open Source Software* 4 (43): 1686. <https://doi.org/10.21105/joss.01686>.
- Wickham, Hadley, Romain François, Lionel Henry, Kirill Müller, and Davis Vaughan. 2023. *Dplyr: A Grammar of Data Manipulation*. <https://CRAN.R-project.org/package=dplyr>.
- Xie, Yihui. 2014. “Knitr: A Comprehensive Tool for Reproducible Research in R.” In *Implementing Reproducible Computational Research*, edited by Victoria Stodden, Friedrich Leisch, and Roger D. Peng. Chapman; Hall/CRC. <http://www.crcpress.com/product/isbn/9781466561595>.