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City of Toronto: Walkability Report - June 2019



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# Executive Summary

The City of Toronto Walkability Assessment was a collective effort by the Data Analytics and Visualization team (DAV) and Transportation Services. The project aimed to construct and assess a pedestrian walkable network that would be used further to generate an analytical lens for the assessment of walkability across the City of Toronto. The primary purpose of this project was to identify and analyze characteristics across the following domains:

- mode share for walking by census tract,
- walkability,
- economic impact of walkability,
- growth in the City of Toronto,
- vulnerable/social equity lens,
- streetscape quality,
- identify areas/locations for prioritizing pedestrian improvements,
- develop new tools for prioritization for city infrastructure investments & service improvements, and
- develop decision-support system for implementing new projects for minimum sidewalk design standards.

Data collection took place between August and September 2018. Data analysts examined all available datasets, compiled them into an integrated resource, and undertook an extensive quality assurance and control process consisting of automated and manual checks to ensure the data is suitable for the task at hand.

The methodological approach for this study was to create a pedestrian network (based on sidewalk centerlines), assess the inventory of pedestrian-assets (e.g., sidewalks, crosswalks, pedestrian controlled crossings) city-wide, and determine the walkability of various amenities relevant to the lived experiences of residents across the city. The focus was placed on topological consistency over spatial accuracy. Meaning that the sidewalk centerlines are not necessarily spatially located along with the actual locations of the sidewalk geographically, but the connections between different sidewalk segments were maintained as being a higher priority.

In 2018, the Transportation Services Division contracted the vendor iVision to capture sidewalk and pedestrian asset presence. Currently it is the division's intention to have iVision's data to be the source of truth regarding sidewalk presence, and going forward other groups will maintain or update this pedestrian network from these assets going forward. There are datasets being developed through work with IT and Road Operations within our Division (primarily using iVision data as an initial base) that will also create a pedestrian network (with a focus on maintenance of assets and route planning for inspectors). This will no doubt be useful, however it has yet to be realized fully and so applications surrounding it are envisioned for the longer term. The outputs of this project may be useful in the development of those datasets.

Walkability has been calculated to determine how-walkable a particular area is in relation to pedestrian access to various amenities and socio-demographic characteristics. In Toronto, several communities have lower-walkability when walking to schools. For example, West Humber-Clairville, Humber Summit, Briar Hill-Belgravia, Milliken east, Islington-City Centre West (southern areas), the eastern portion of York University Heights, Clairlea-Birchmount (north), southern parts of West Hill, the eastern part of Dorset Park neighbourhoods, some parts of Waterfront Communities-The Island and Niagara.

In terms of library walkability, people benefit from libraries which are within reach. Closeness to libraries is also one of the main factors of measuring pedestrian walkability. There are numerous and quite large libraries in the city center compared to some communities in the north, west and eastern part of Toronto. The study highlights that almost one-quarter of Toronto's communities are affected by poor walkability on foot (more than 20 minutes' walk) to the nearest library.

## Acknowledgements

This project was co-funded by the Transportation Services and Information & Technology Division of the City of Toronto and conducted by the Data Analytics and Visualization team.

## Working Group Members

Name	Division	Unit	Role	Project Role
Fiona Chapman	Transportation Services	Pedestrian Projects	Manager	Sponsor
Andy McGhie	Information & Technology	Geospatial Competency Centre	Director	
Ryan Garnett	Information & Technology	Geospatial Competency Centre, Data Integration and Access	Manager	Resources manager
Matthew Tenney	Information & Technology	Geospatial Competency Centre, Data Integration and Access	Team Lead	Team Lead

## Project Team Members

Name	Division	Unit	Role	Project Role
Bruce J. Walker	Information & Technology	Data Analytics and Visualization (DAV)	Spatial Data Integrator	Data Analyst
Zivorad Djokic	Information & Technology	Data Analytics and Visualization (DAV)	Spatial Data Integrator	Data Analyst
Karl Merrem	Information & Technology	Data Analytics and Visualization (DAV)	Spatial Specialist	Data Analyst
George Epure	Information & Technology	Data Analytics and Visualization (DAV)	Systems Integrator 2	Data Engineer
Ablajan Sulaiman	Information & Technology	Data Analytics and Visualization (DAV)	Senior Spatial Specialist	Data Analyst

## Goals

Transportation Services maintained an inventory of sidewalks network features over several years. However, this inventory was limited in scope and was generally based on City of Toronto's centreline dataset making it difficult for interested parties to leverage it for developing mapping products and services or data analysis for planning purposes. In 2018, the Transportation Services Division contracted the vendor iVision to capture sidewalk and pedestrian asset presence. Currently it is the division's intention to have iVision's data to be the source of truth regarding sidewalk presence, and going forward other groups will maintain or update this pedestrian network from these assets going forward. There are datasets being developed through work with IT and Road Operations within our Division (primarily using iVision data as an initial base) that will also create a pedestrian network (with a focus on maintenance of assets and route planning for inspectors). This will no doubt be useful, however it has yet to be realized fully and so applications surrounding it are envisioned for the longer term. The outputs of this project may be useful in the development of those datasets.

This project sought to identify specific data issues, gaps and plans for data collection, initiate partnerships to obtain additional relevant data, perform sidewalk inventory accuracy assessment and determine the quality, structure and usability of existing data and ultimately, convert it into a useable network model.

The inventory and assessment process was designed to achieve several objectives. These included:

- Creating a comprehensive pedestrian-network model for routing and walkability analysis
- Identifying the crosswalks
- Identifying sidewalk gaps, missing sections and areas for sidewalk network improvements
- Developing novel approaches for measuring “walkability” in the City of Toronto
- Performing GIS analysis, methodology refinement, network development and maps
- Launching a web app for public engagement and analytical capabilities

## Methods

The Pedestrian Network (pednet) was created by the [DAV](#) team at the City of Toronto, and it is based on the sidewalk inventory from Transportation Services, Toronto road centrelines, and manual collection from aerial imagery. Pednet is integrated with centerline intersections, traffic signals, pedestrian crosswalks and crossovers, traffic signal data from Transportation Services as well as other City of Toronto datasets.

Pednet was built using a variety of open source libraries such as [NetworkX<sup>\[2\]</sup>](#), [Pandana<sup>\[3\]</sup>](#), Quantum GIS, and [Space syntax<sup>\[4\]</sup>](#), as well as production mapping tools from ESRI's ArcPro/ArcMap. The project source code can be found on DAV's GitHub account [here](#), which includes the semi-automated offsetting method from the Sidewalk Inventory and the analytical procedures undertaken.

Pednet is a data model resembling a network graph (edges and nodes) weighted by linear distance. Shortest routes were calculated from every building centroid in the city to the nearest  $n^{\text{th}}$  amenity at the maximum distance of 5000m. Walk times were calculated in the nearest minutes, using the prescribed 1.0m/per-second velocity used by Transportation services. Two separate versions of pednet were created in this iteration of the project: 1) using actual linear distances as network weights, and 2) where crosswalks were “extended” by 20% of their length to impose additional impedance to their distances and walk times. For every address within the City of Toronto, the walk times were calculated to various amenities like schools, libraries, hospitals, supermarkets, TTC stops and convenience stores see Section 3. Walk times were assigned to individual addresses as attributes. We then aggregated all these walk times to the census tract level and calculated the minimum, maximum, standard deviation, median, and average walk times. We used these aggregated values to both: 1) relate walkability measures to Statistics Canada Census data for socio-demographic analysis, as well as 2) the building footprints, pednet centerlines, and census tract area boundaries to be used in choropleth maps contained within the following sections.

The following layers are used in the pedestrian network to perform walkability analyses. The layers were grouped into four categories Food Services, Health Services, Public Services and Transportation. The categories will be used to present the results in a consistent manner throughout the report.

Layer Name	Source	Theme
Convenience Stores	Toronto Business Directory	Food Services
Fast Food Stores	Centre For The Study Of Commercial Activity Ryerson University	Food Services
Supermarkets	Toronto Public Health	Food Services
Hospitals	Ontario Ministry of Health and Long-Term Care	Health Services
Sexual Health Clinics	Toronto Public Health	Health Services
Walk-In Clinics	TorontoCentralhealthline.ca	Health Services
Schools	Toronto Police Services	Public Services
Arenas	Toronto Parks Forestry and Recreation	Public Services
Day Care Centres	Toronto Children's Services	Public Services
Drop-Ins	Toronto Drop-In Network	Public Services
Toronto Paramedic Services	Toronto Paramedic Services	Public Services
Family Resource Centres	EarlyON centres	Public Services
Toronto Fire Services	Toronto Fire Services	Public Services
Toronto Public Libraries	Toronto Public Library	Public Services
Toronto Police Services	Toronto Police Services	Public Services
Recreation Centres	Toronto Parks Forestry and Recreation	Public Services
Things To Do	Toronto Economic Development & Culture	Public Services
Voting Locations	Toronto City Clerk's Office	Public Services
Bicycle On Street Parking	Transportation Services	Transportation
Bicycle Station Indoor Parking	Transportation Services	Transportation
TTC Stations	Toronto Transit Commission	Transportation
TTC Stops	Toronto Transit Commission	Transportation
TTC Accessible Stations	Toronto Transit Commission	Transportation

# Section 1: Asset Inventory

## Goals

To create a Pedestrian Network using the existing the Sidewalk Inventory [\[5\]](#) supplied by Transportation Services. It is augmented with traffic signals, pedestrian crosswalks and crossover, traffic signal data from Transportation Services as well as other City of Toronto datasets. There are datasets being developed through work with IT and Road Operations within our Division (primarily using iVision data as an initial base) that will also create a pedestrian network (with a focus on maintenance of assets and route planning for inspectors). This will no doubt be useful, however it has yet to be realized fully and so applications surrounding it are envisioned for the longer term. The outputs of this project may be useful in the development of those datasets.

## Methods

### Crosswalks

Structured data on the existence of all crosswalks were not available, making the data integration process difficult for these feature types. However, staff used a combination of approaches based on the traffic signals, pedestrian crossovers data sets and spatial database queries to determine the location of them in the majority of the cases. Pedestrian signals (traffic signals and pedestrian crossovers) data maintained by transportation services were used to identify 2,839 crosswalks locations. These locations were used to initially identify pedestrian crossings and use a semi-automated method to connect the two nearest points on perpendicular features so to create a crosswalk segment in pednet.

Staff identified and recorded crosswalk points at intersections across the city from aerial imagery interpretation and manual collection following the current marking schemes:

**Solid** – a cross marked by paint along the entire crossing surface

**Standard** – a crosswalk marked by solid lines at its outer edge

**Continental** – a crosswalk marked by wide stripes perpendicular to the direction of travel

**Ladder** – a crosswalk marked by wide stripes perpendicular to the direction of travel in its interior and solid lines along its outer edges

In addition, staff identified and recorded a couple of non-standard crosswalk marking types:

**Other** – a crosswalk marked by a different type of painted marking

**No Painted Markings** – a crosswalk without painted markings and indicated by the presence of a street sign (e.g. pedestrian crossover)

DAV staff grouped crosswalks into three types: non-signalized crosswalks, pedestrian crossover crosswalks and traffic signal crosswalks. Non-signalized crosswalks are those crosswalks where there is no traffic signal or pedestrian crossovers. Traffic signal crosswalks are located at those intersections where there are crosswalks. Pedestrian crossovers are located where there are overhead crosswalk signals that are activated by a button pushed by a pedestrian wishing to cross the road. Through a combination of programmatic and the visual inspection of aerial photography a total of 9,110 crosswalk segments were identified by DAV staff within the pedestrian network. The table below provides a breakdown of the crosswalk segment types in the City of Toronto.

Crosswalk Segment Type Description	Segment Count
Non-signalized	1,559
Pedestrian crossover	440
Traffic signal	7,111
Total	9,110

## Sidewalks

Sidewalks form the backbone of the pedestrian network and impact all pedestrians. Data on the location of sidewalks was provided by the Transportation Services and was used to create a sidewalk segment GIS layer in the database. Transportation Services sidewalk data was collected on street segments using attribution to indicate whether sidewalks existed along the street segment. An algorithm was used to generate the sidewalk segments based on Transportation Services road type and the attribution indicating the presence of sidewalks. In addition, new sidewalk segments were added to the sidewalk network based on 2018 aerial imagery. Those street segments coded as Laneways, Local Roads, Private Roads and Pending Roads did not have sidewalk segments generated. Instead, a single line representation for these features was used with the reasoning that pedestrians can navigate these road types without the aid of sidewalks.

The following table provides a summary of the Transportation Services sidewalk coding scheme.

**Transportation Services Sidewalk Coding Scheme**

Sidewalk Code	Sidewalk Description	Sidewalk Code	Sidewalk Description
1	Laneway with sidewalk on south side	12	Desire Line/Goat Path
1	Sidewalk on south side only	12	N/A
1	Sidewalk on south side; partially on other side	12	PARTIALLY PAVED WALKWAY
2	Laneway with sidewalk on north side	12	PAVED WALKWAY
2	Sidewalk on north side only	12	PAVED WALKWAY BETWEEN TWO STREETS
2	Sidewalk on north side; partially on other side	12	PAVED WALKWAY THROUGH A CITY PARK
3	Laneway with at least partial sidewalk on one side	12	PAVED WALKWAY TO A COMMUNITY GARDEN
3	No sidewalk on either side	12	PAVED WALKWAY TO A DAY CARE CENTER
3	Partial sidewalk on at least one side	12	PAVED WALKWAY TO A FAMILY RESOURCE CENTER
4	Laneway with sidewalk on west side	12	PAVED WALKWAY TO A FOOD BANK
4	Sidewalk on west side only	12	PAVED WALKWAY TO AN OUTDOOR POOL
4	Sidewalk on west side; partially on other side	12	PAVED WALKWAY TO A PARKING LOT
5	Laneway with sidewalk on east side	12	PAVED WALKWAY TO A SCHOOL
5	Sidewalk on east side only	12	PAVED WALKWAY TO DAY CARE CENTER
5	Sidewalk on east side; partially on other side	12	PAVED WALKWAY TO FOOD BANK
6	Roadway under development	12	PAVED WALKWAY TO PARKING LOT
6	Roadway under development; some sidewalk present	12	POP
7	Laneway with sidewalk on both sides	12	PRIVATELY OWNED PUBLICLY-ACCESSIBLE SPACE
7	Sidewalk on both sides	12	St. James Garden Walkway
10	Laneway without any sidewalks	13	Not applicable
11	City walkway	13	Not applicable; may be outdated
		13	Recreational Trail

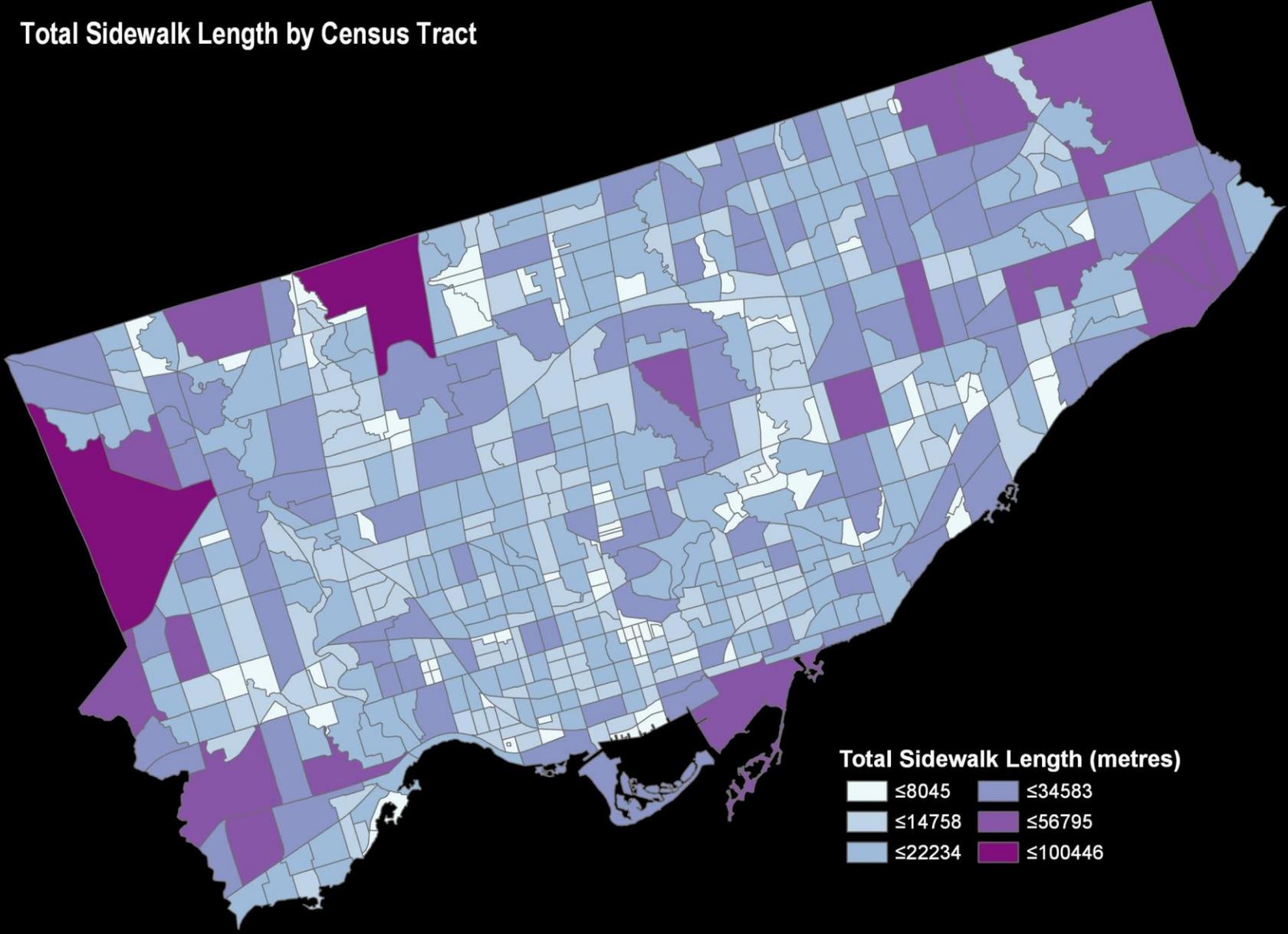
## Asset Inventory Mapping Series

In this section, a series of maps were created describing the state of pedestrian-related assets across the City of Toronto. Pedestrian assets include sidewalks, pedestrian signals and crosswalks. The primary purpose of this section is to highlight the locations, frequencies, and spatial distributions of pedestrian assets. The following maps have been produced at the census tract level including sidewalk length, several crosswalks, total crosswalk length, average crosswalk length, maximum crosswalk length, percentage of the number of crosswalks to sidewalks, percentage of the length of crosswalks to sidewalks. Sidewalk segments include any segments that are not classified as crosswalks in the Pedestrian Network.

## Total Sidewalk Length by Census Tract

**Interpretation:** The greatest total length of sidewalk segments are in census tracts 535024701.00 (area bounded by Highway 401, Highway 427 and Rexdale Blvd) and 5350311.06 area bounded by Dufferin St, Steeles Ave W, Black Creek and Sheppard Ave W). Census tracts with the least total length are 5350194.01 (area south of Thorncliffe Park Dr) and 5350006.00 (area between Close Ave and Dunn Ave, south of King St W and north of Springhurst Ave). In the case of census tracts 5350194.01 and 5350006.00 they are quite small with fewer sidewalks.

# Total Sidewalk Length by Census Tract

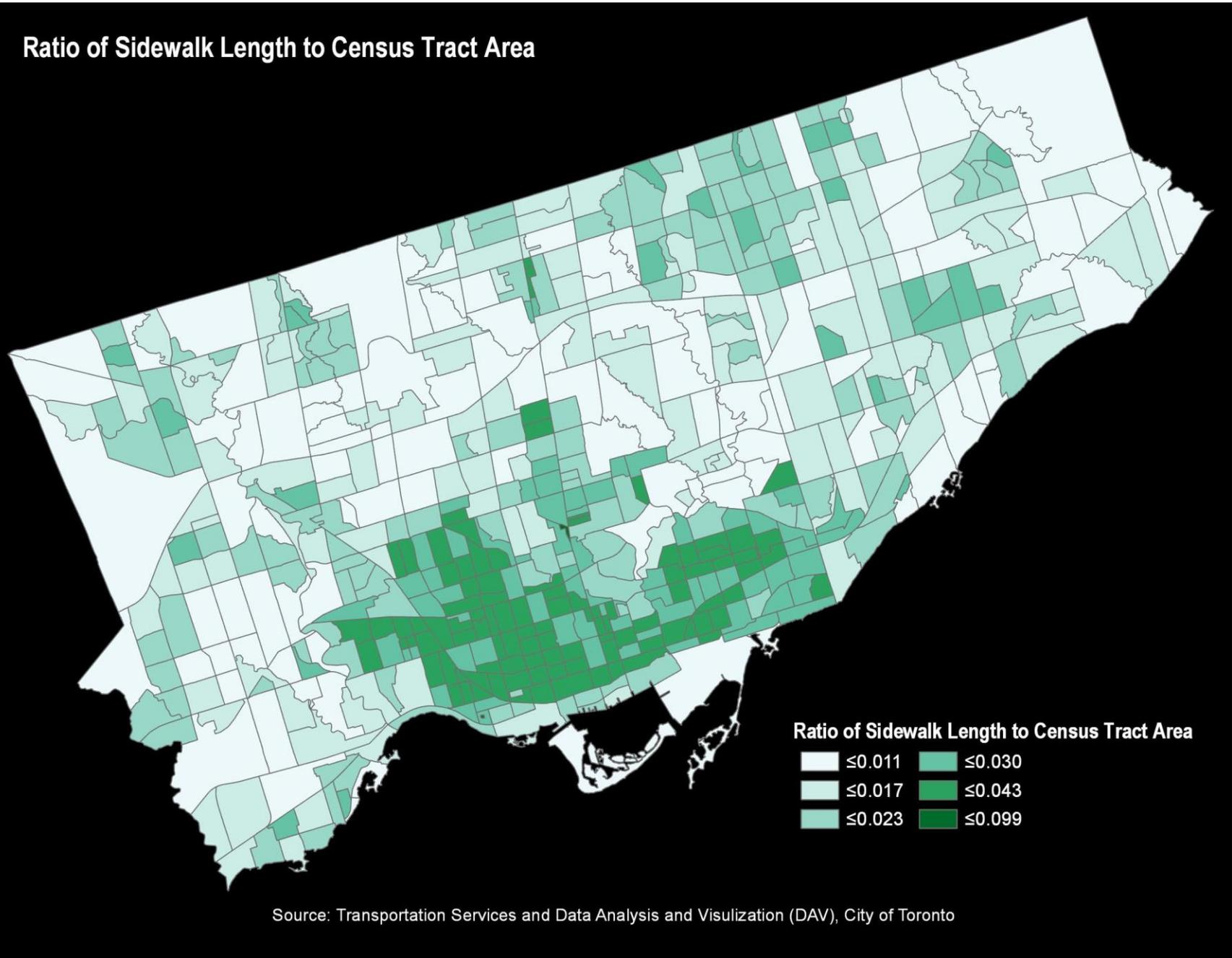


Source: Transportation Services and Data Analysis and Visualization (DAV), City of Toronto

## Ratio of Sidewalk Length to Census Tract Area

**Interpretation:** Due to the various sizes of census tracts the sidewalk length was normalized by the census tract area. The greatest ratio of total sidewalk segments lengths are in the downtown core whereas in the suburban areas the ratio is much less. A higher ratio of sidewalks in the downtown core provides a more walkable environment. Increasing the presence of sidewalks in the suburban areas would provide a more walkable environment for those people that have less or no access to private vehicles.

# Ratio of Sidewalk Length to Census Tract Area

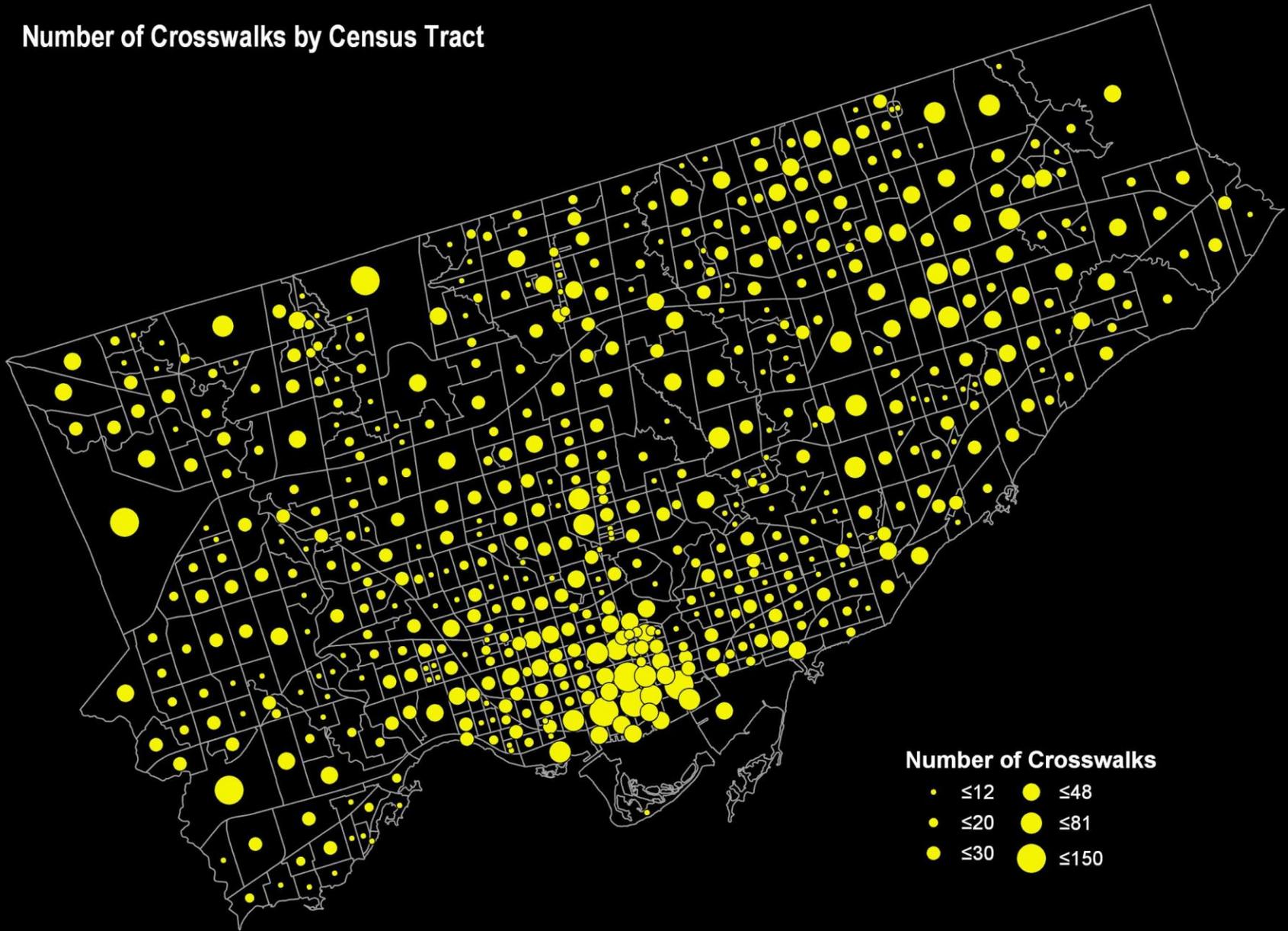


Source: Transportation Services and Data Analysis and Visualization (DAV), City of Toronto

## Number of Crosswalks by Census Tract

**Interpretation:** The census tracts with the largest number of crosswalks are typically in the downtown core although census tract 5350247.01, 5350213.02 and 5350311.06 in western Etobicoke and York University have large numbers as well. Census tract 5350006.00, 5350002.00 (Toronto Islands), 5350194.01, and 5350123.00 have no crosswalks due to the small size of the census tract or no requirement for crosswalks on the Toronto Islands. Census Tracts 5350193.00 (Woodbine Heights Blvd and St Clair Ave E area) and 5350378.26 (Steeles Ave E and Staines Rd area) have only one crosswalk each. Less pedestrian crossovers or signalized crosswalks at traffic signals require pedestrians to either cross roads at stop signs or cross roads without stop signs thus offering motor vehicle drivers less visual cues to detect pedestrians.

# Number of Crosswalks by Census Tract



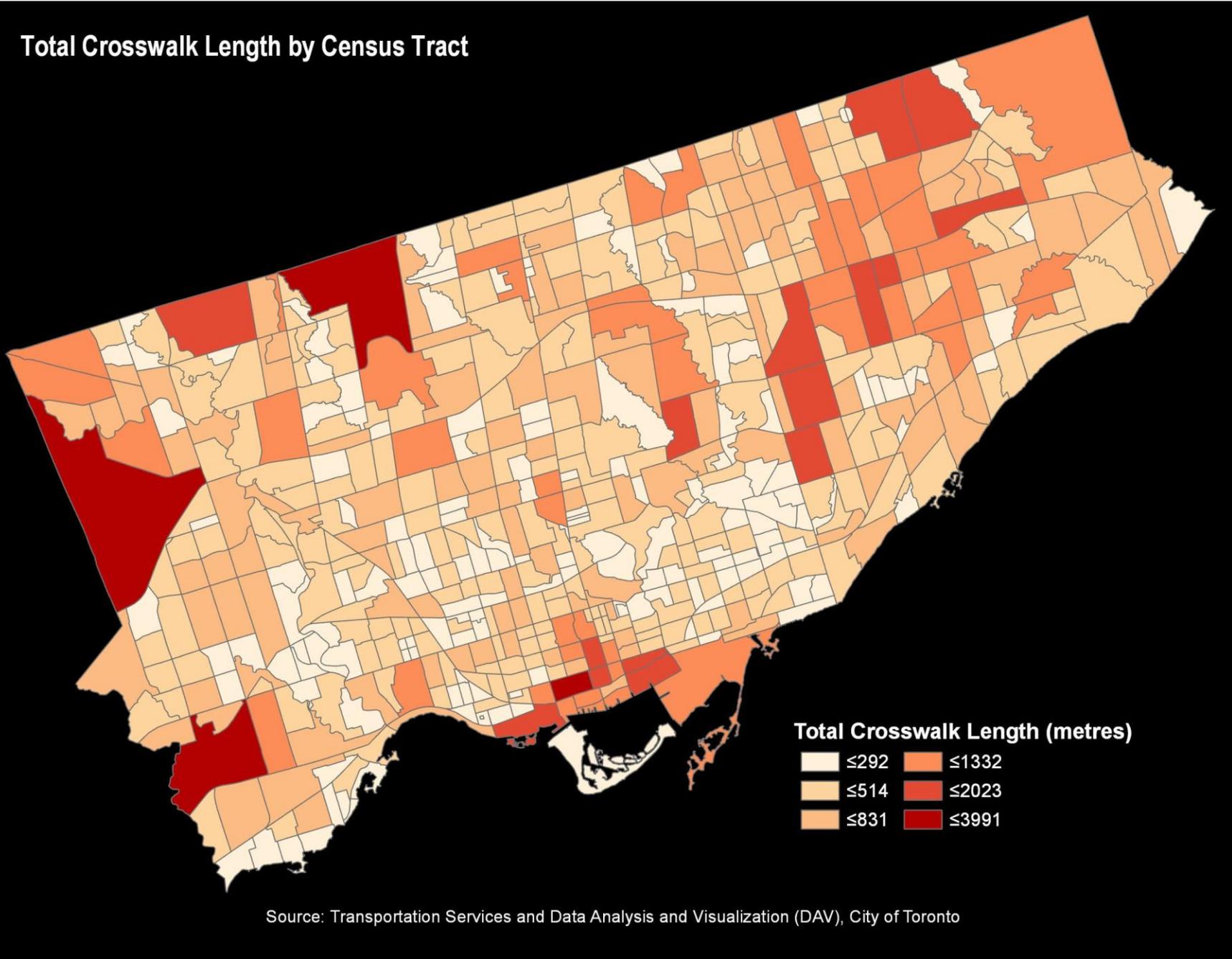
Source: Transportation Services and Data Analysis and Visualization (DAV), City of Toronto

## Total Crosswalk Length by Census Tract

**Interpretation:** The census tracts with the largest total length of crosswalks are typically in the downtown core. Census tract 5350011.00 (area bounded by Front St W, Bathurst St, Queen St W and Simcoe St) has a value of 2689.65 metres. Census tract 5350247.01, 5350006.00 and 5350264.00 in western Etobicoke and York University have large total lengths as well. Census Tracts 5350002.00 (Toronto Islands), 5350006.00 (area between Close Ave and Dunn Ave, south of King St W and north of Springhurst Ave), 5350123.00 (area bounded by Yonge St, Lawton Blvd, Lascelles Blvd and the Beltline). None of these census tracts have any crosswalks in them. The next census tract with the least crosswalk total length is 5350193.00 (St Clair Ave E and Woodbine Heights Blvd area) which has a value of 13.98 metres. The table below provides a breakdown of the total lengths within each of the ranges.

Total Crosswalk Length Range (metres)	Count
0 to 292	164
292 to 514	220
514 to 831	123
831 to 1332	46
1332 to 2023	15
2023 to 3991	5

# Total Crosswalk Length by Census Tract

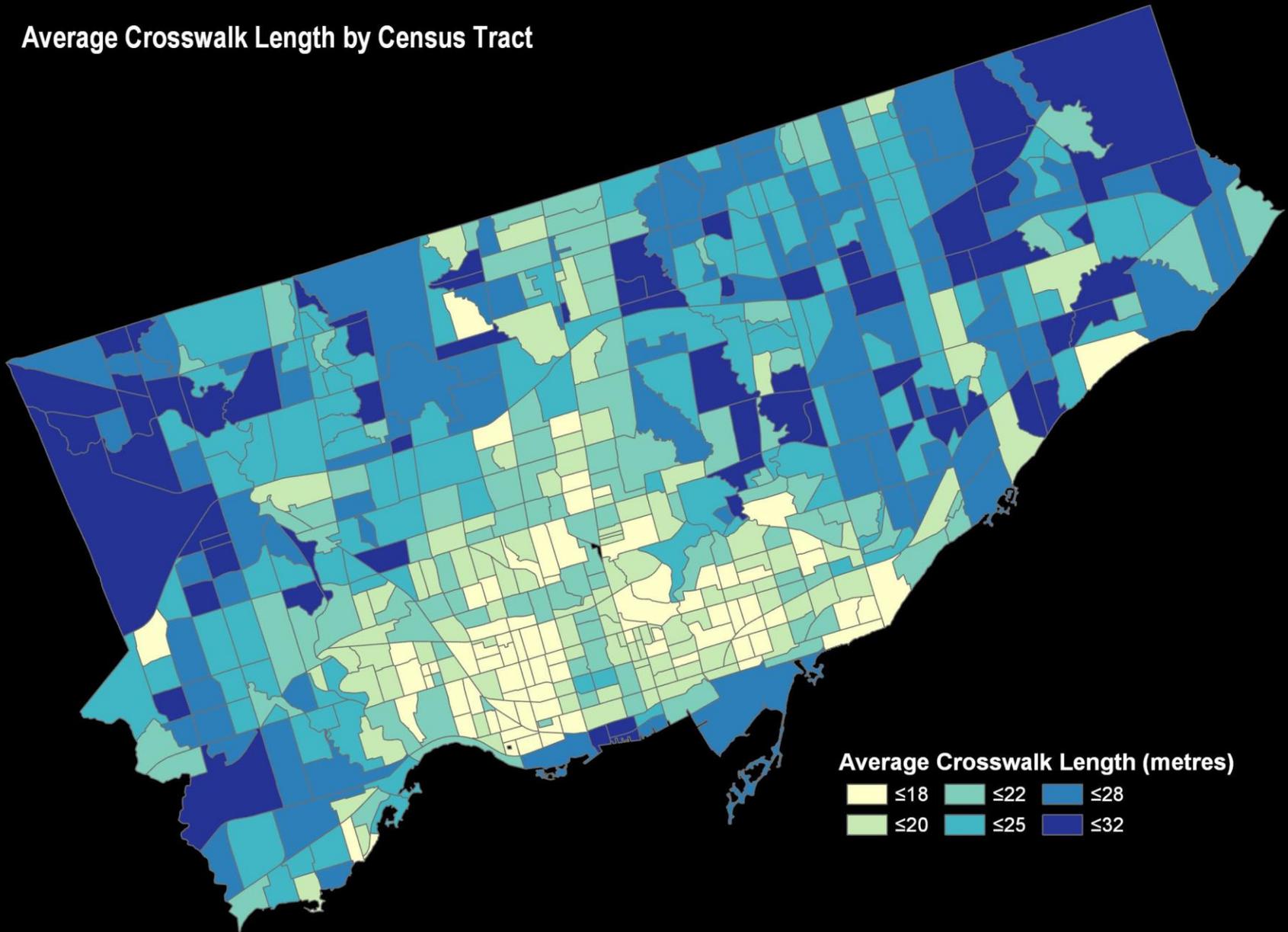


Source: Transportation Services and Data Analysis and Visualization (DAV), City of Toronto

## Average Crosswalk Length by Census Tract

**Interpretation:** The census tracts with the largest concentration of average length of crosswalks are typically in the downtown core. Although census tract 5350249.03, 5350248.03, 5350248.04, 5350247.01, 5350247.02, 5350006.00, 5350213.02 and 5350264.00 in western Etobicoke and York University census tract 5350378.27 in north eastern Scarborough have large average lengths.

# Average Crosswalk Length by Census Tract

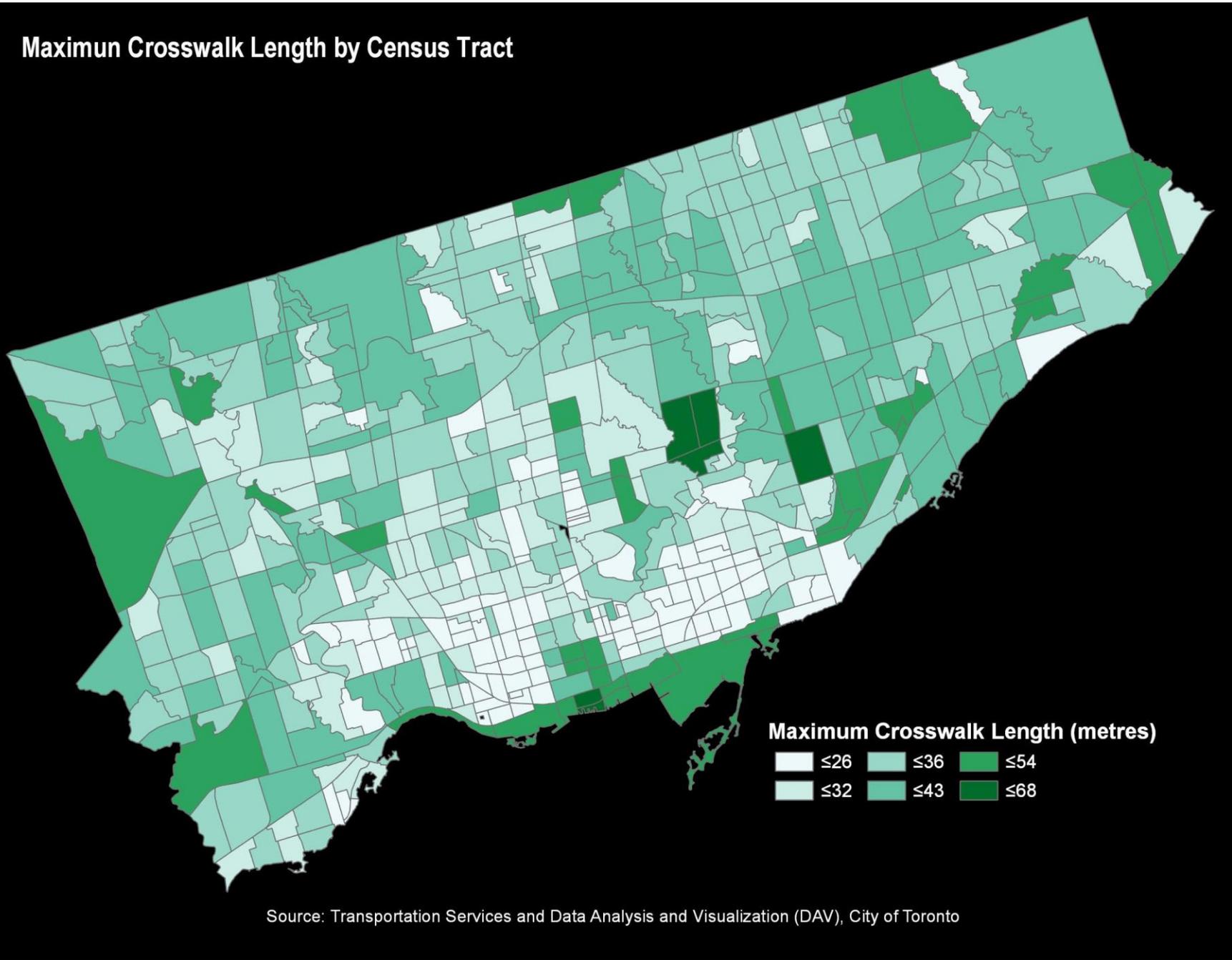


Source: Transportation Services and Data Analysis and Visualization (DAV), City of Toronto

## Maximum Crosswalk Length by Census Tract

**Interpretation:** The largest average length of crosswalk length is in census tract 5350034.02 in northwestern Etobicoke. Significant lengths are also in the downtown core along the south side of the Highway 401 and in northeastern Scarborough.

# Maximum Crosswalk Length by Census Tract

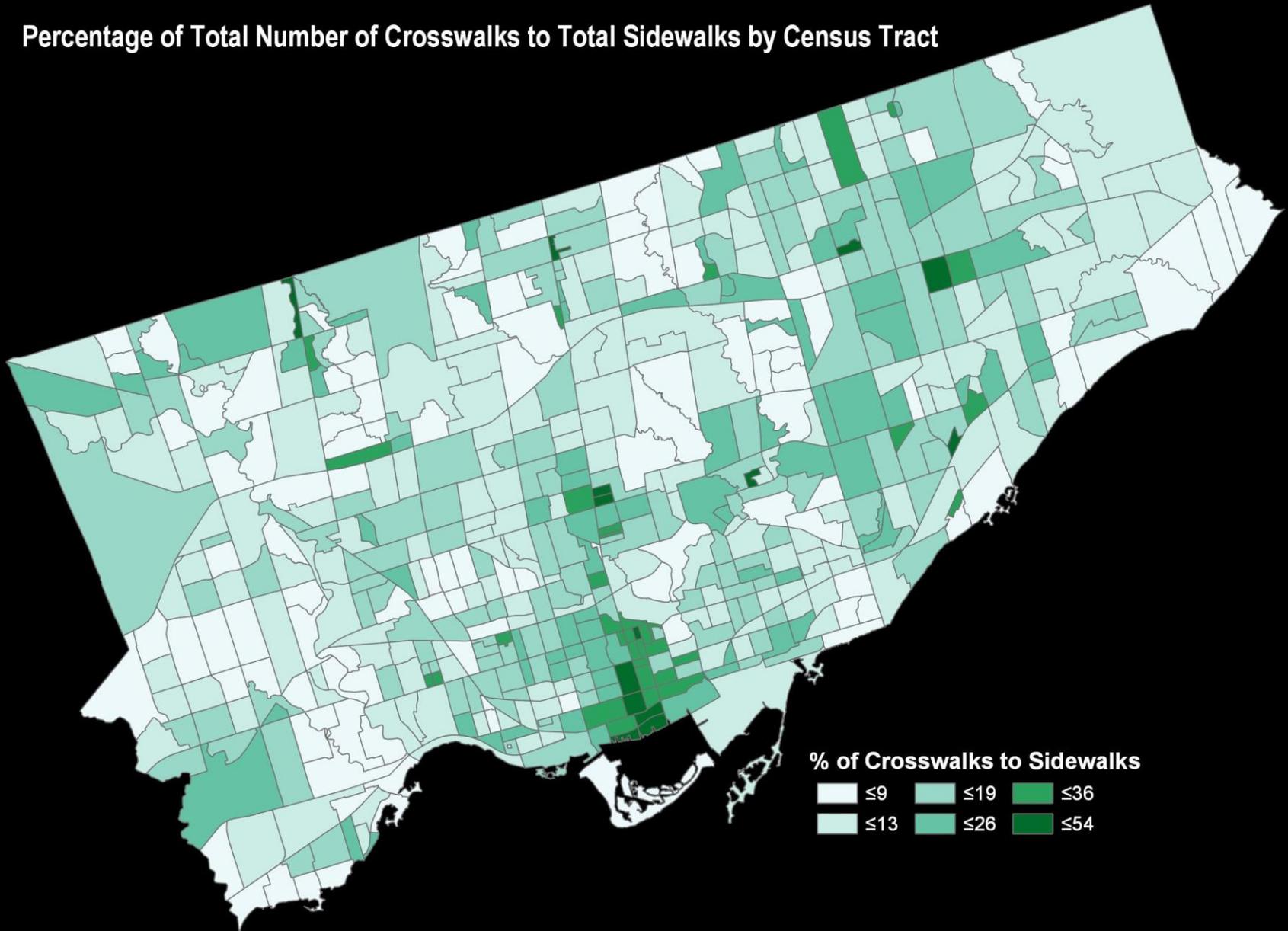


Source: Transportation Services and Data Analysis and Visualization (DAV), City of Toronto

## Percentage of Total Number of Crosswalks to Sidewalks by Census Tract

Interpretation: The percentage of the number of crosswalk to sidewalks is high in the downtown core at the north east corner of Yonge and Eglinton in census tract 5350376.06 and in the Finch Ave E and Kennedy Rd area of Scarborough.

# Percentage of Total Number of Crosswalks to Total Sidewalks by Census Tract



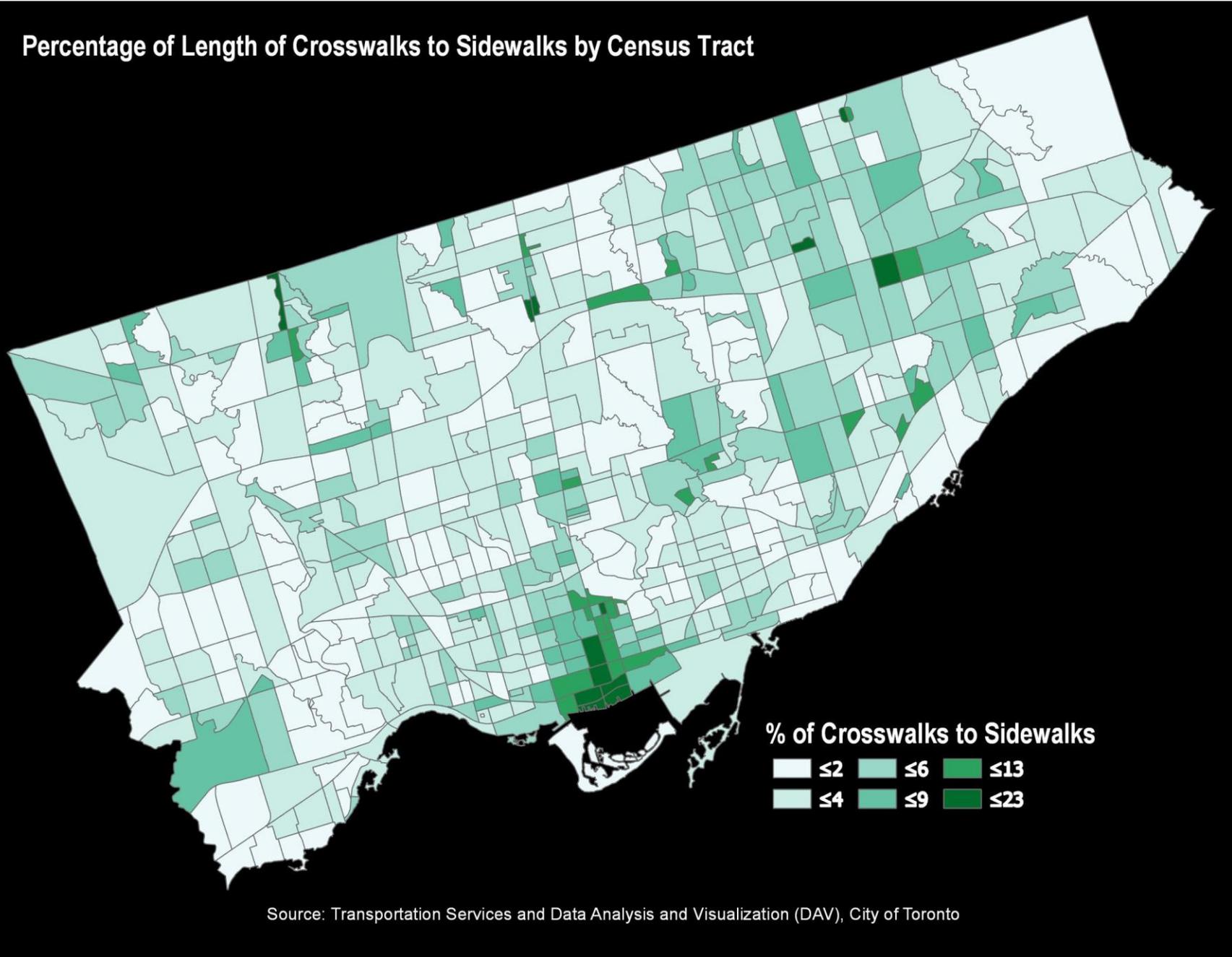
Source: Transportation Services and Data Analysis and Visualization (DAV), City of Toronto

## Percentage of Total Length of Crosswalks to Sidewalks by Census Tract

**Interpretation:** The highest percentage of length of crosswalks to sidewalks are within the downtown core, the north east section Yonge and Eglinton, Yonge and Sheppard, Yonge and Finch and a section around the Scarborough Town Centre and Sheppard Ave E and Birchmount Rd. The table below provides a summary of the percentage of total length of crosswalks to sidewalks across the City of Toronto.

Percentage of Total Length of Crosswalks to Sidewalks	Count
0 to 2	102
2 to 4	273
4 to 6	116
6 to 9	45
9 to 13	23
13 to 23	13

# Percentage of Length of Crosswalks to Sidewalks by Census Tract



Source: Transportation Services and Data Analysis and Visualization (DAV), City of Toronto

## Section 2: Connectivity

The physical sidewalks determine the real walkability of the pedestrian network along with curb ramps, crosswalks, and pedestrian signals, as well as the connectivity among these street features. A well-connected network increases mobility and decreases travel time for pedestrians while a poorly-connected network forces pedestrians to take indirect routes or risk travelling through precarious roadways. A well-connected transportation network reduces the distances travelled to reach destinations, increases the options for routes of travel, and can facilitate walking and bicycling. Well-connected, multimodal networks are characterized by seamless bicycle and pedestrian infrastructure, direct routing, accessibility, few dead-ends, and few physical barriers. Increased levels of connectivity are associated with higher levels of physical activity from transportation. Connectivity via transportation networks can also improve health by increasing access to health care, goods and services, etc. (DoT, 2010)

### Goals

Determine metrics for well-connected nodes and edges in the pedestrian network. Measure how well a given area is connected to surrounding locations treating pednet purely as a connected network graph and without consideration of amenities or importance of area.

### Methods

Space Syntax<sup>1</sup> metrics are used for quantifying the pedestrian network connectivity through the measures of integration, choice, and edge connectivity. Edge connectivity is the summed node degree (number of incoming edges) per edge in the network. Choice is calculated by counting the number of times each street segment falls on the shortest path between all pairs of segments within a selected distance. Integration is a normalised measure of distance from any space of origin to all others in a system. Furthermore, the graph theory measure of betweenness centrality was used to determine how often a place is traversed when traveling between all other origins and all possible destinations within the network using shortest paths.

### Results

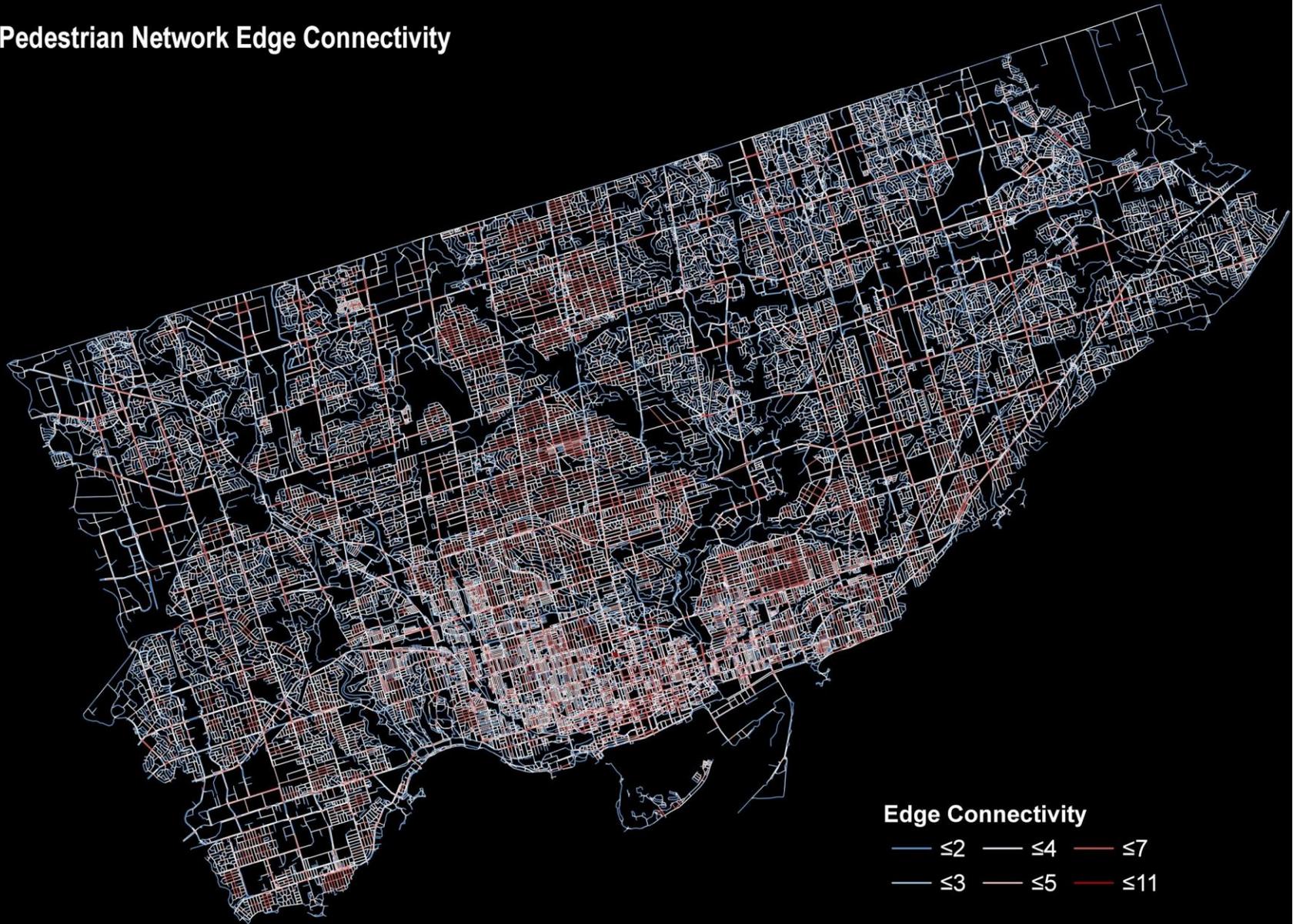
Network Description: It is comprised of a set of nodes (103622) and edges (126056). It has 125262 records segmented at 100m intervals. The highest node degree is 8 and it has network density of 2.344. In terms of connectivity, the dark color on the maps below indicate highly connected network edges while light color shows lower connectivity.

Highest Edge Connectivity: 11  
Highest Node Degree: 8  
Highest Node Connectivity: 0.000077  
Highest Node Betweenness: 0.121572  
Highest Edge Choice: 1.925886  
Highest Edge Integration: 3.66

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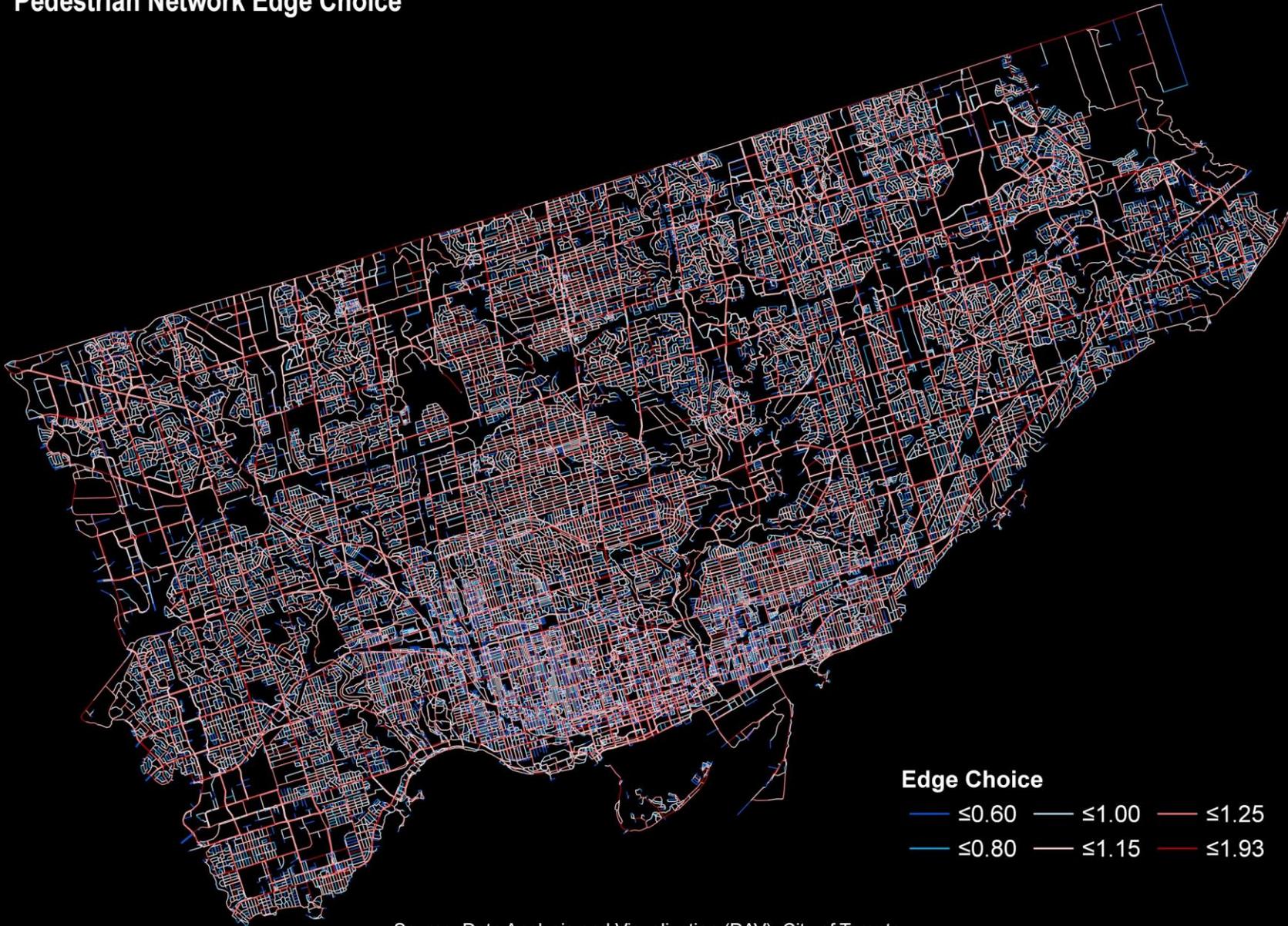
<sup>1</sup> **Space Syntax** is a set of techniques for analysing spatial layouts and human activity patterns in buildings and urban areas.

# Pedestrian Network Edge Connectivity



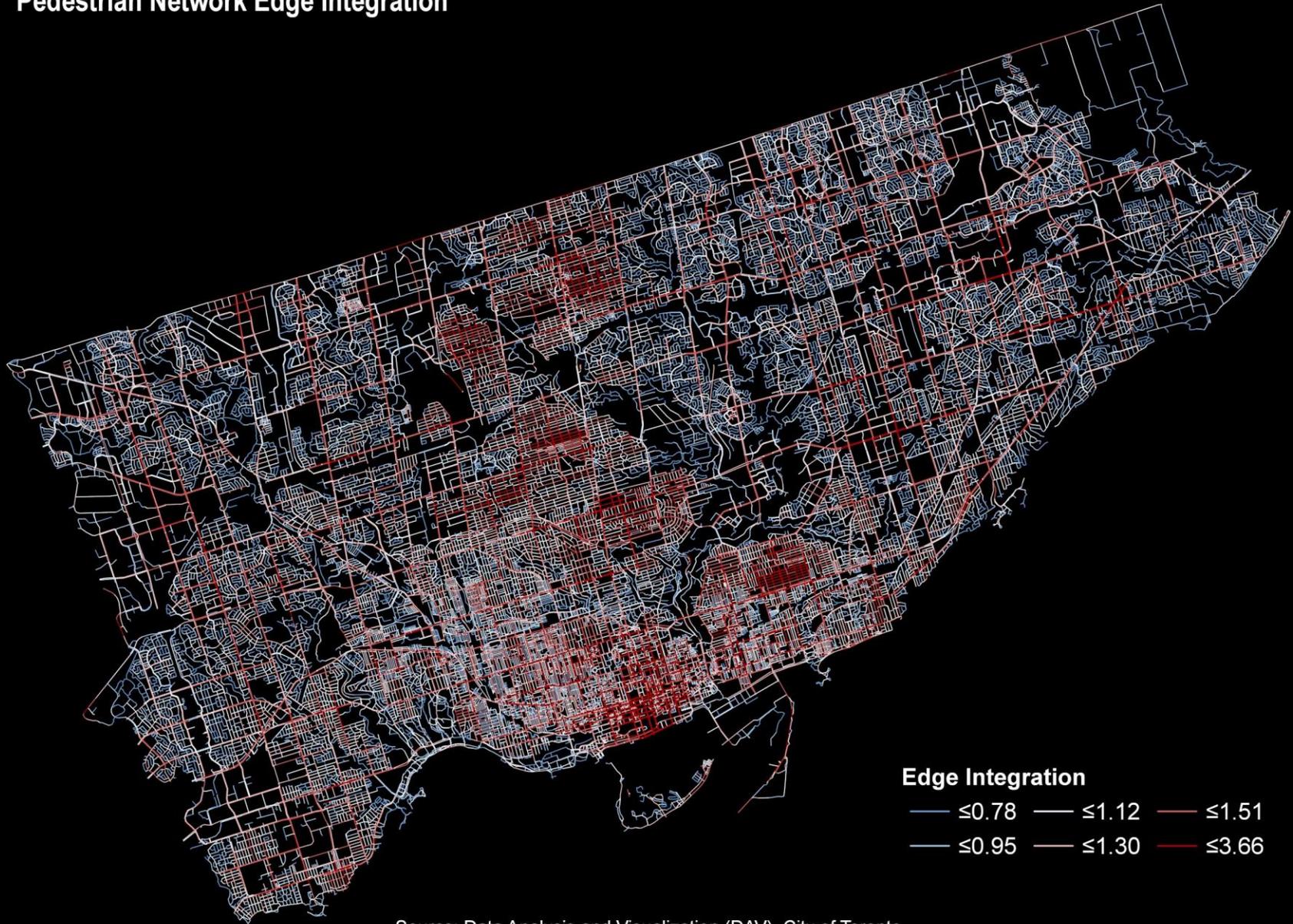
Source: Data Analysis and Visualization (DAV), City of Toronto

# Pedestrian Network Edge Choice



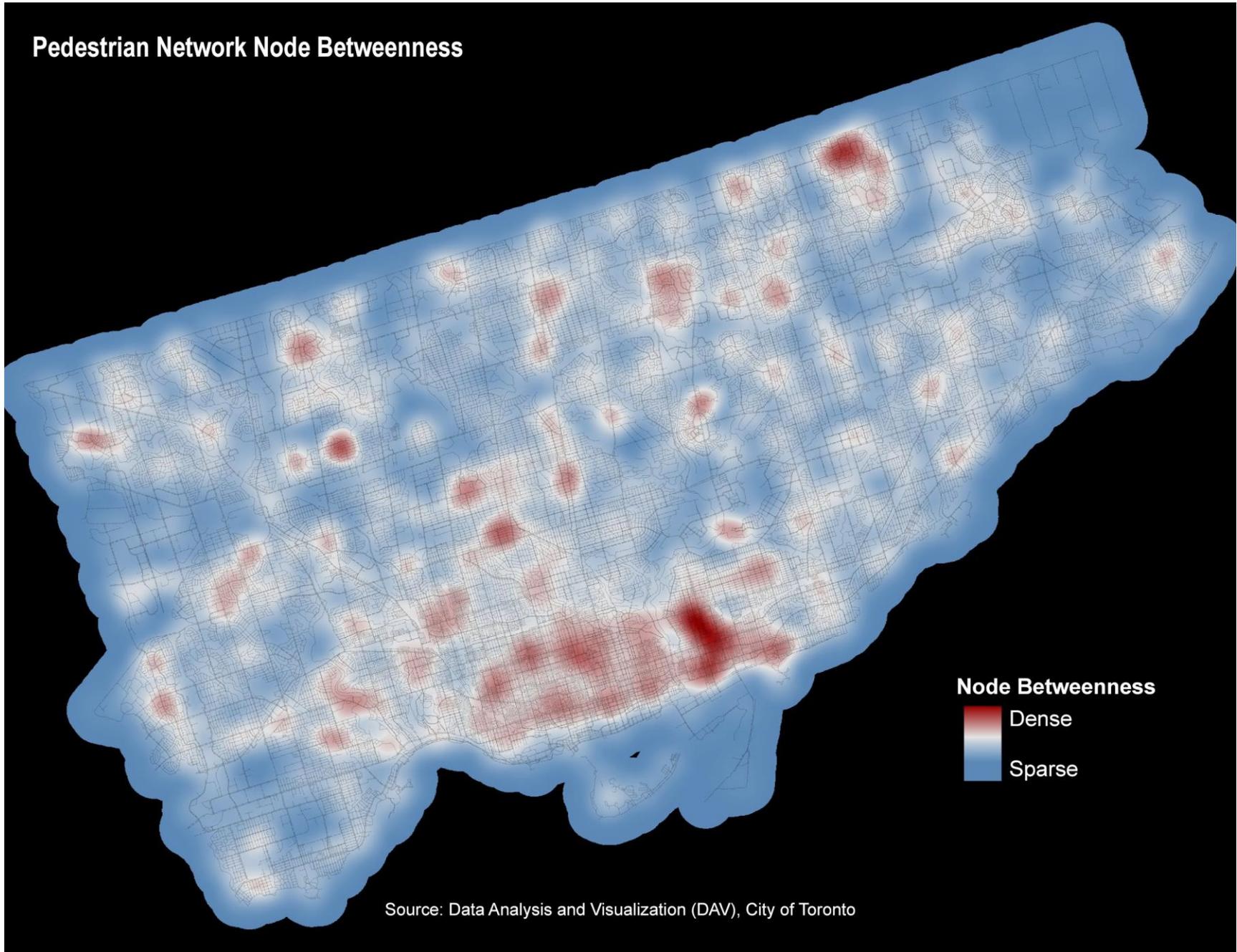
Source: Data Analysis and Visualization (DAV), City of Toronto

# Pedestrian Network Edge Integration

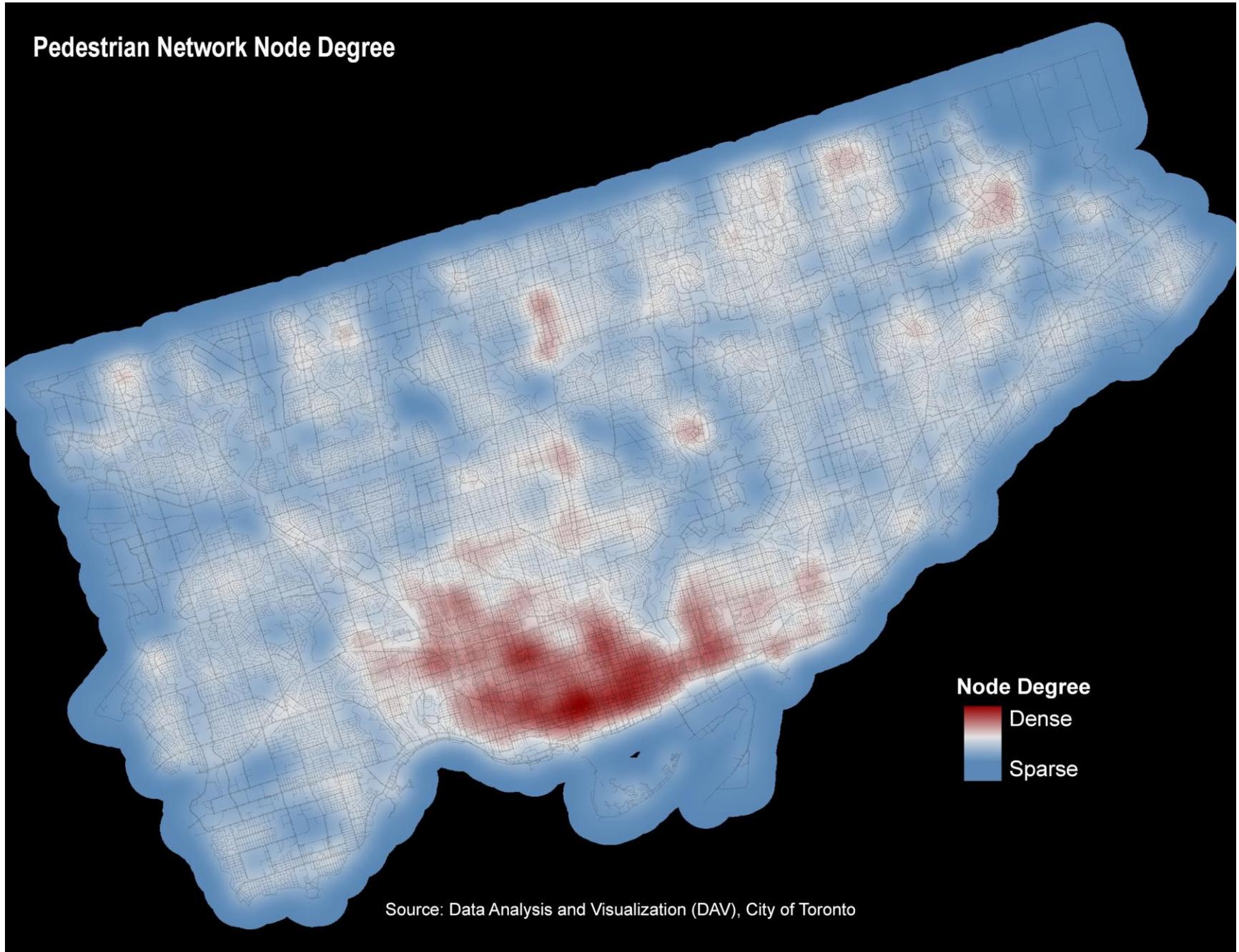


Source: Data Analysis and Visualization (DAV), City of Toronto

## Pedestrian Network Node Betweenness



# Pedestrian Network Node Degree



Source: Data Analysis and Visualization (DAV), City of Toronto

## Section 3: Walkability Measures

The pedestrian network is the core of the city’s transportation network. The basic approach of this study is first to create a pedestrian network as a connected set of links and nodes, then calculate walking distance and minutes based on the walkability (distance and walking times) to these various amenities from every address location within the City. Using deliberate “locations” as the destinations for various points of interest, as well as several amenities relevant to citizen life every address in the city has been assigned their “walkability” metrics in both distance and time on a pedestrian network. These analytical results provide policy opportunities for city planners to pursue strategies to encourage the development of more walkable (pedestrian friendly) neighbourhoods.

### Goals

Creating a pedestrian network as a series of connected links and nodes, then to calculate walking distance and minutes to the two-closest various amenities via pedestrian sidewalks from every address location in the city as a measure of pedestrian walkability.

### Methods

Using this pedestrian network, we performed a network routing query, for a max distance of 5000 meters to the two nearest destinations (amenities such as schools, libraries, hospitals, walk-in clinics, supermarkets, TTC stops and convenience stores etc.) from any building located in the City of Toronto. Three variations of cartographic outputs are provided for interpretation: a disaggregated “from each building” map to provide a clear visualization on the geographic distribution regarding walkability measures, an average walk time aggregated by every census tract and attributed to the actual pednet for visualization of walk times in relation to the existence or density of assets, as well as the average walk times for each address aggregated to census tract areas. All maps use a choropleth symbology method using natural breaks classification into six classes. Each subsection in this report is broken down by “theme” of amenity: Food Services, Health Services, Public Services and Transit.

### Results

The overall result gives a walkability score which allows users to know if given neighbourhoods are more accessible. The table below provides a sample of the data generated for each of the 103,622 nodes and the nearest 2 libraries represented by columns 1 through 2 by distance.

**The Closest 2 Library Points of Interest**

Start Point	Distance to Library 1	Distance to Library 2
0	1420.48	2307.34
1	832.86	1262.95
2	1143.38	1359.79
3	775.19	852.67
4	307.21	1428.34
.....	.....	.....
103622	827.874023	2767.297119

## Food Services

Food services walkability analysis includes deriving the walk times to the nearest food-related amenity location within the City of Toronto (at a max distance of 5000 meters). Food services includes access to food convenience stores, food fast food restaurants (limited-service restaurants), full-service restaurants, and food supermarkets.

### Food Walkability: Deserts and Oasis

The concept of a food desert is an area, often demarcated by inhabitants of low-income or minority status, that has limited access to affordable and nutritious food. In contrast, an area with supermarkets or vegetable shops is often called a food oasis. Food deserts are characterized by a lack of supermarkets, which decreases residents' access to fruits, vegetables and other whole foods.

There are three categories for food deserts: ability-related, assets-related, and attitude-related. Ability-related food deserts are “anything that physically prevents access to food which a consumer otherwise has the financial resources to purchase and the mental desire to buy.” An asset-related food desert involves the absence of financial assets, thus preventing consumption of desirable food that is otherwise available. Lastly, there are attitude-related food deserts any state of mind that prevents the consumer from accessing foods they can otherwise physically bring into their home and have the necessary assets to procure. This section focuses on the asset-related restrictions of food walkability.

### Research Questions:

1. Do people in Toronto have the ability to access healthy and convenient food services by walking?
2. Are people limited in the quality and/or quantity of food because of urban walkability?
3. Where do people have more/less access to healthy and affordable food services by walking?
4. Are there public health implications due to urban walkability of food related services?

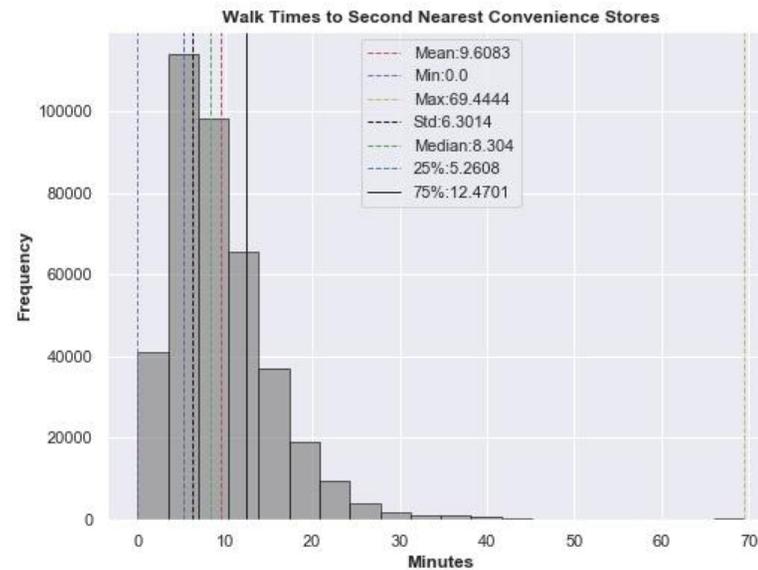
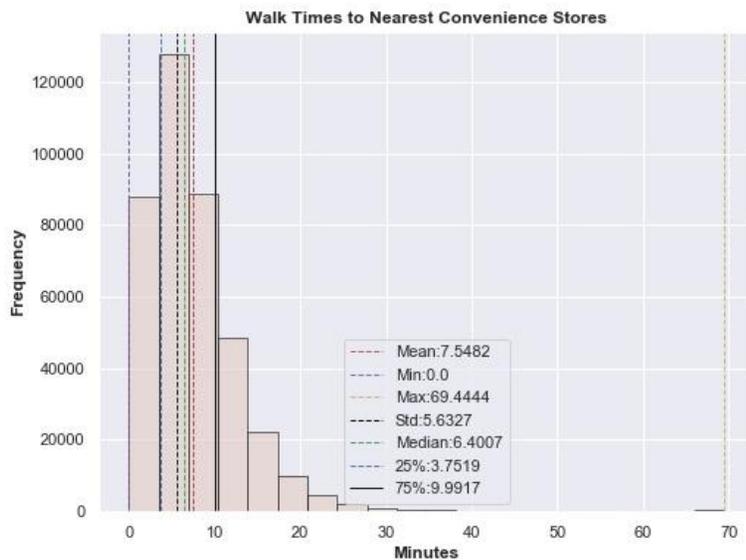
### Overview:

There are 2730 convenience stores, 3721 fast food restaurants, and 456 food supermarkets locations used in this study.

# Food Convenience Store

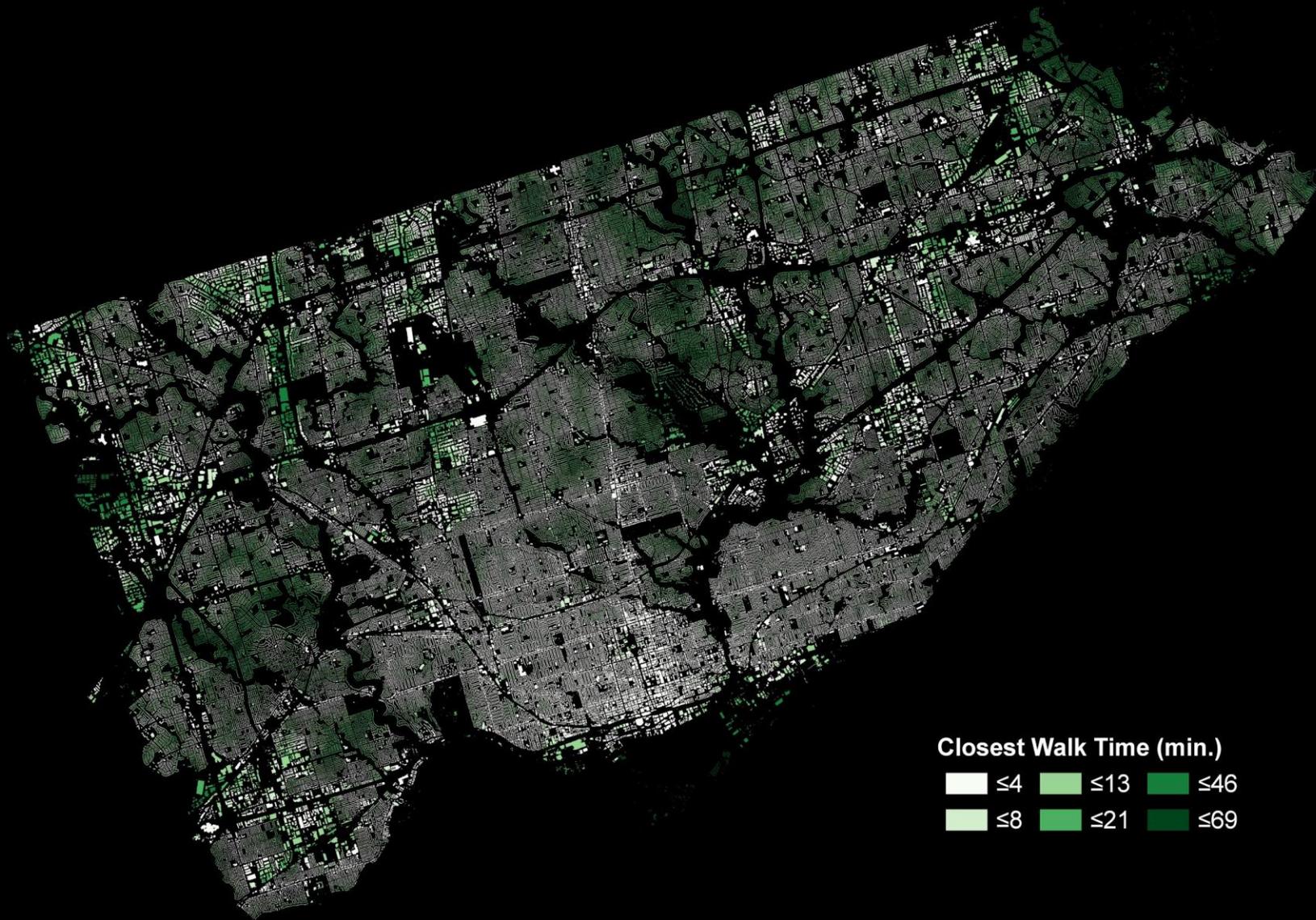
**Definition:** A convenience store, convenience shop, or corner store is a small retail business that stocks a range of everyday items such as groceries, snack foods, confectionery, soft drinks, tobacco products, over-the-counter drugs, toiletries, newspapers, and magazines.

**Description:** The mean walking time to a convenience store is 7.5 minutes and the median walking time is 6.4 minutes city-wide. City-wide walktimes vary with a standard deviation of 5.6 minutes. Approximately 25% of all addresses in the city have less than a 3.8 minute walk, while 75% of all addresses have less than a 10.0 minute walk to the closest convenience store. Census tract 5350002.00 has the maximum average walk time with over a 69.0 minute walk to the closest convenience store and is shared by 1 other census tracts. Census Tract 5350014.00 has less than a 0.8 minute walk to the closest convenience store and is shared by 1 other census tracts.



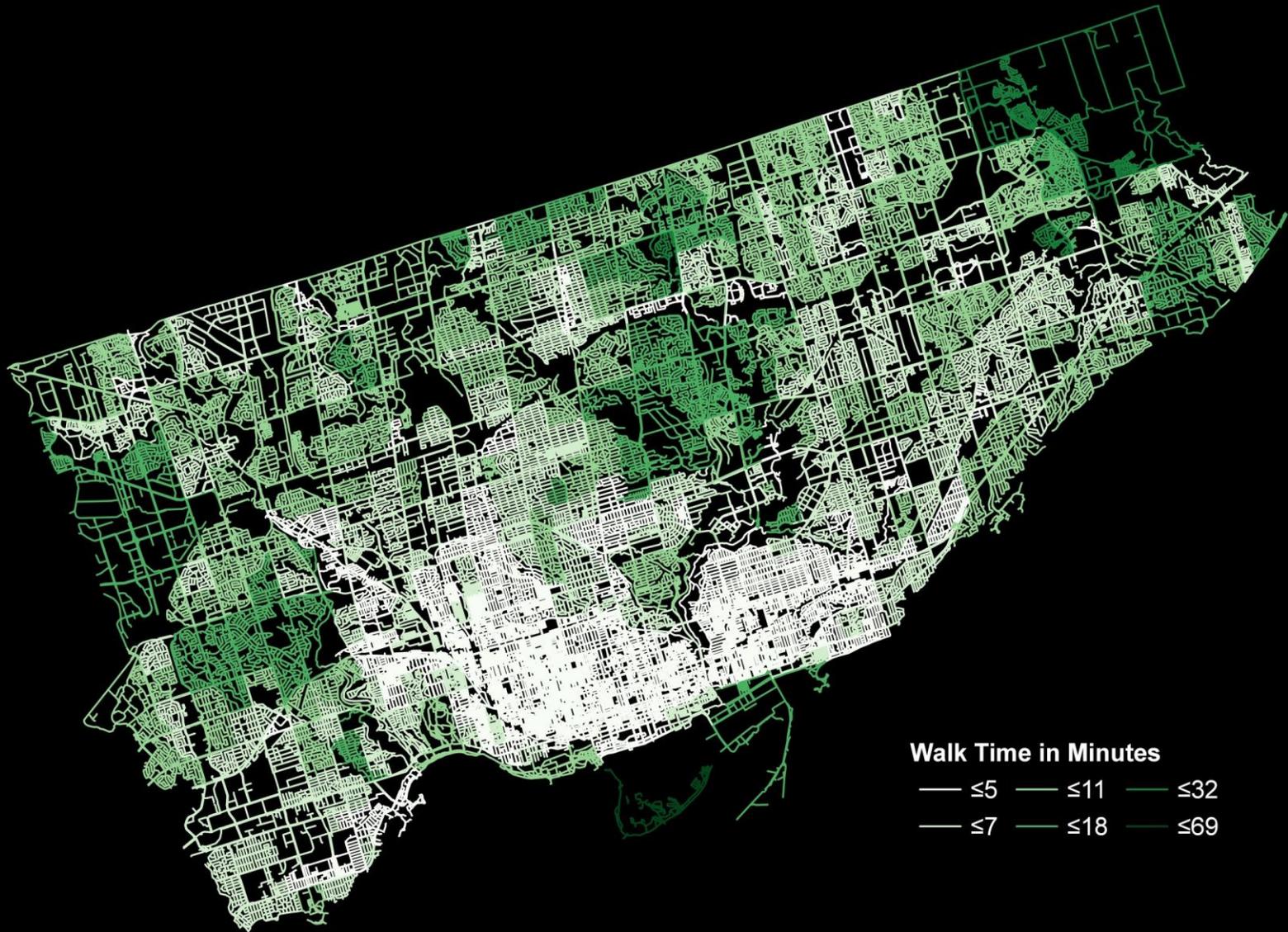
**Interpretation:** There appears to be no significant change in walk times from the first to the second closest Food Convenience Store with a 3.1 minute difference in mean walk times from the closest to the second closest Food Convenience Store. There is less than a 0.5 minute increase in the standard deviation of walktimes between the first and second closest Food Convenience Store. There is not a significant change in the geographic distribution between the first and second Food Convenience Stores with a p-value of 0.0 at a .95 confidence interval. Suggesting that locations are geographically stationary across the city. Walk times to convenience stores are considerably short in the former City of Toronto and East York. Walk times compared to northeastern Scarborough with significantly higher walk times as the area is more suburban or even rural. The area defined by Rexdale Boulevard, Highways 401 and 427 also shows increased walktimes due to lack of stores in this industrial commercial area.

## Walk Times To Nearest Convenience Stores



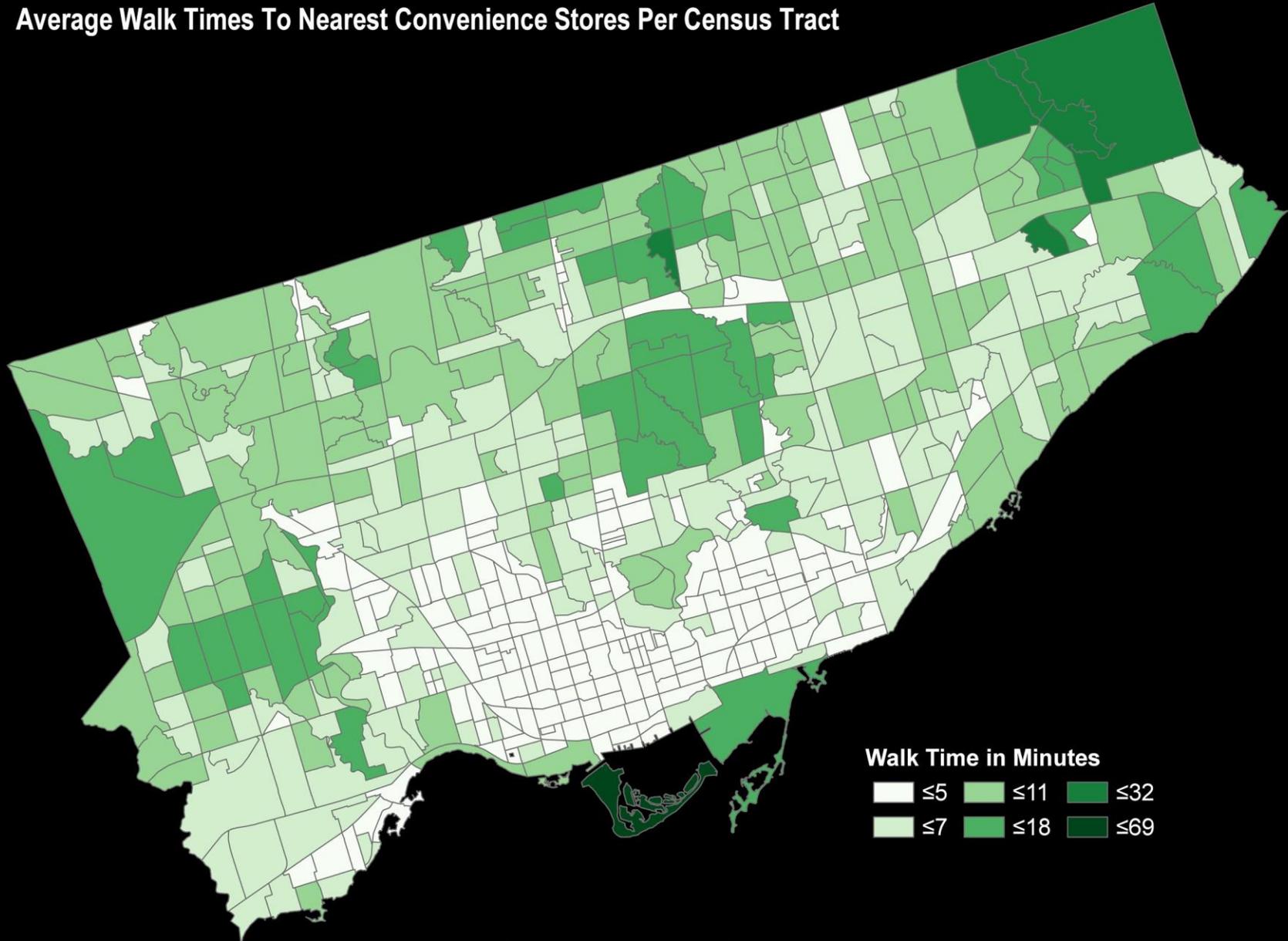
Source: Toronto Business Directory

## Average Walk Times To Nearest Convenience Stores Per Census Tract



Source: Toronto Business Directory

# Average Walk Times To Nearest Convenience Stores Per Census Tract

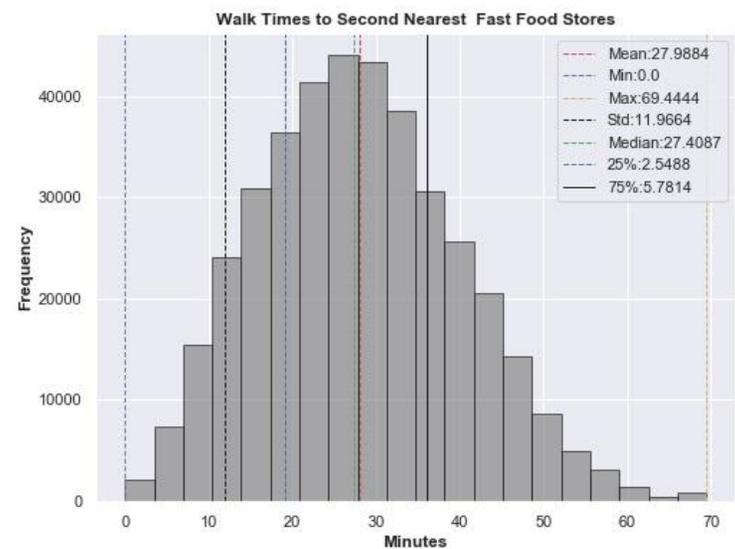
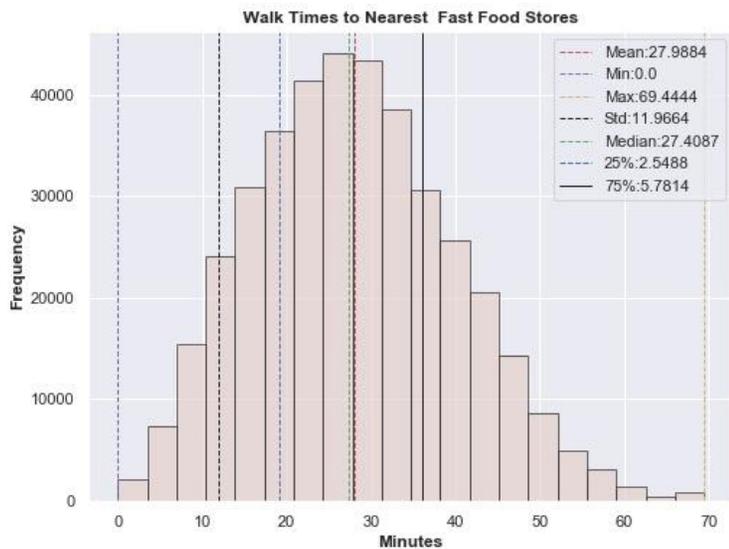


Source: Toronto Business Directory

# Fast Food Store

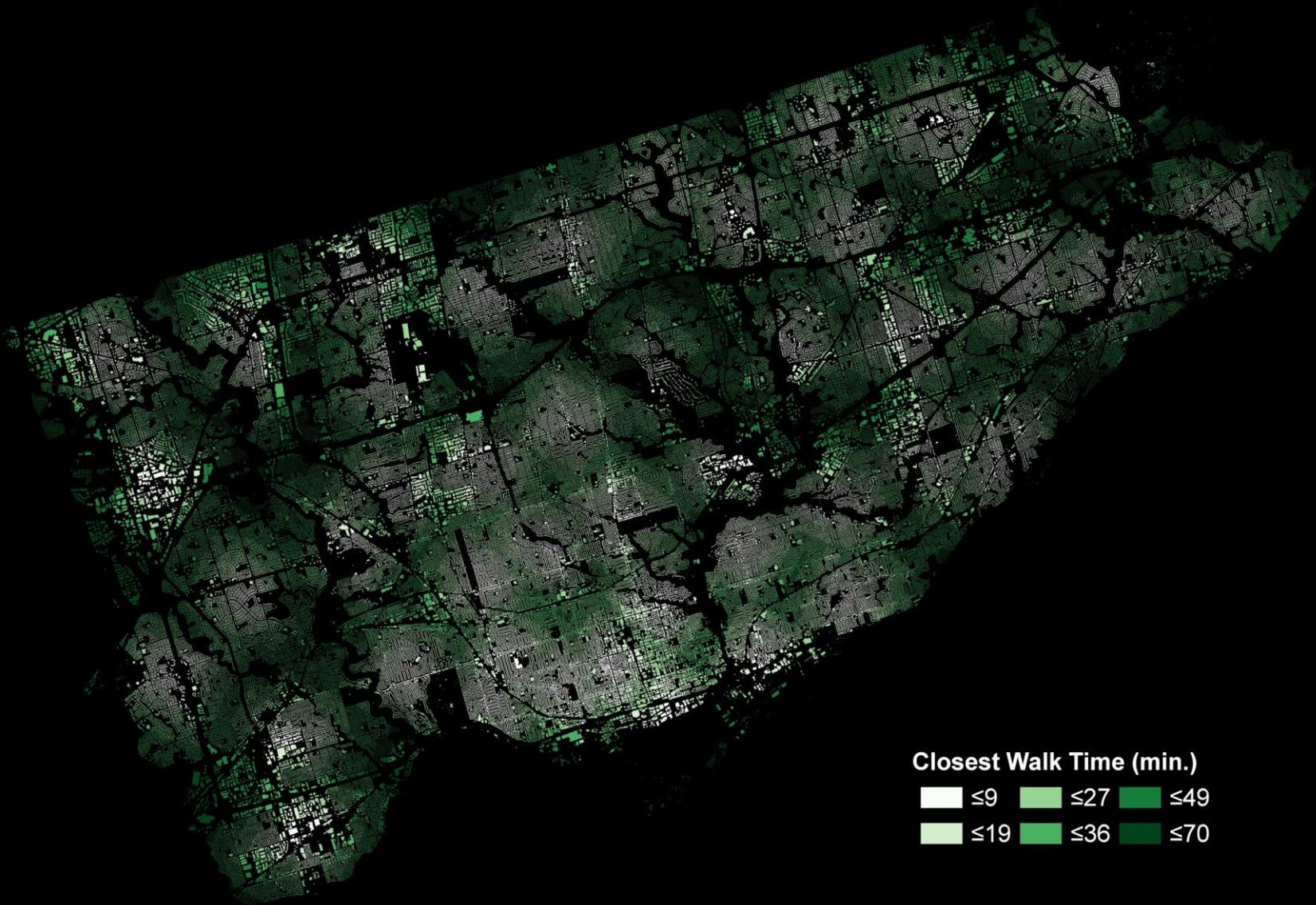
**Definition:** Food sold in a restaurant or store with frozen, preheated or precooked ingredients, and served to the customer in a packaged form for take-out/take-away. A fast food restaurant was identified using a NAICS code indicating a “Limited Service Food Establishment”

**Description:** The mean walking time to a fast food store is 28.0 minutes and the median walking time is 27.4 minutes city-wide. City-wide walktimes vary with a standard deviation of 12.0 minutes. Approximately 25% of all addresses in the city have less than a 19.2 minute walk, while 75% of all addresses have less than a 36.0 minute walk to the closest fast food store. Census tract 5350002.00 has the maximum average walk time with over a 69.2 minute walk to the closest fast food store and is shared by 1 other census tracts. Census Tract 5350013.02 has less than a 4.4 minute walk to the closest fast food store and is shared by 1 other census tracts.



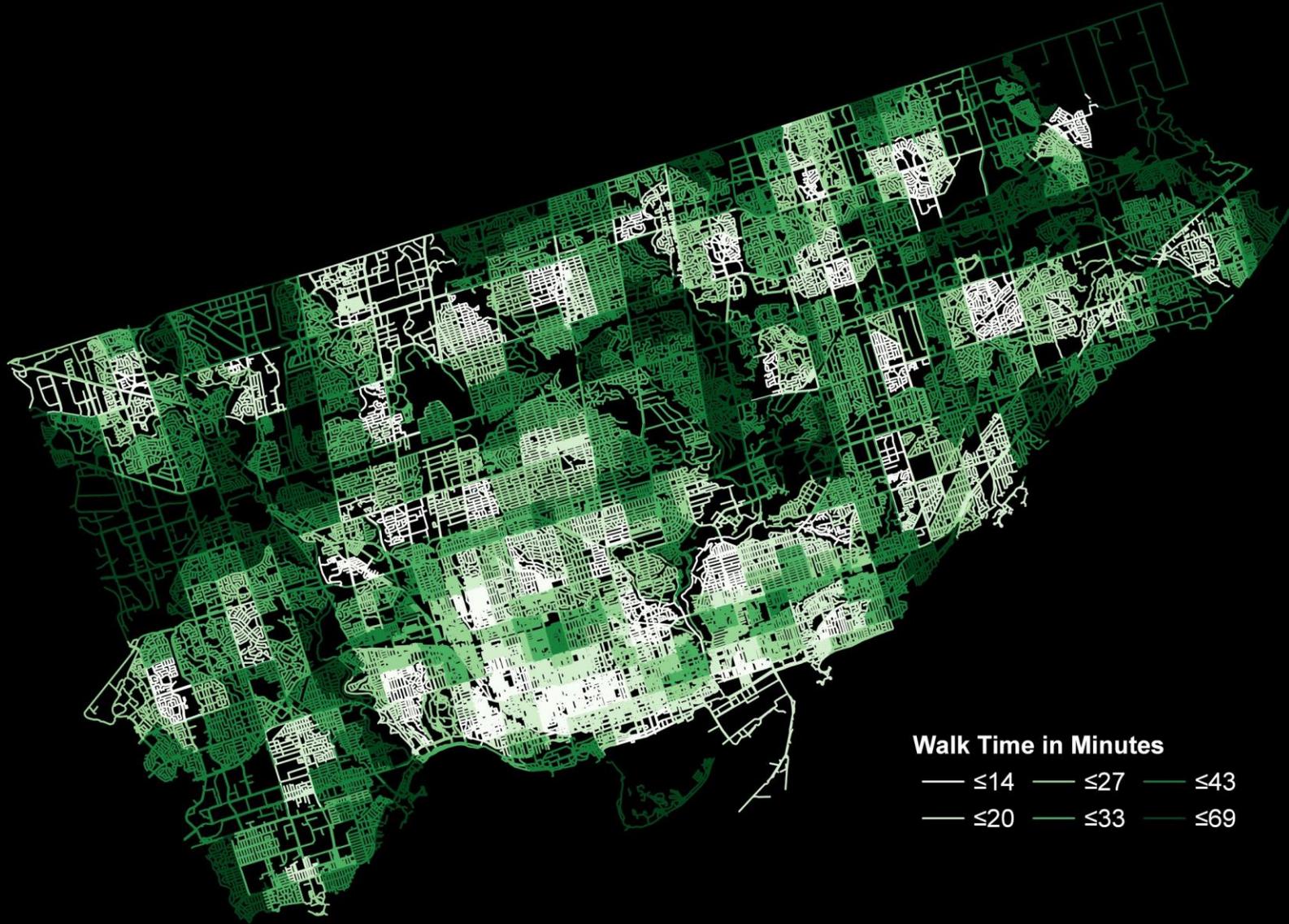
**Interpretation:** There is no significant change in walk times from the first to the second closest Fast Food Store. There is no increase in the standard deviation of walk times between the first and second closest Fast Food Store. The mean value of distribution between the first and second closest Fast Food Store is 1 across the city. Short walk times to Fast Food Stores is more concentrated in the downtown core. There are large pockets of shorter walk times to Fast Food Stores throughout the city surrounded by higher walk times. Fast Food Stores are located along major roads where they are accessible to private and public transit and have the appropriate land use zoning that encourage automobile traffic as evident by the relatively high walk times with locations near major roadways in the city.

## Walk Times To Nearest Fast Food Stores



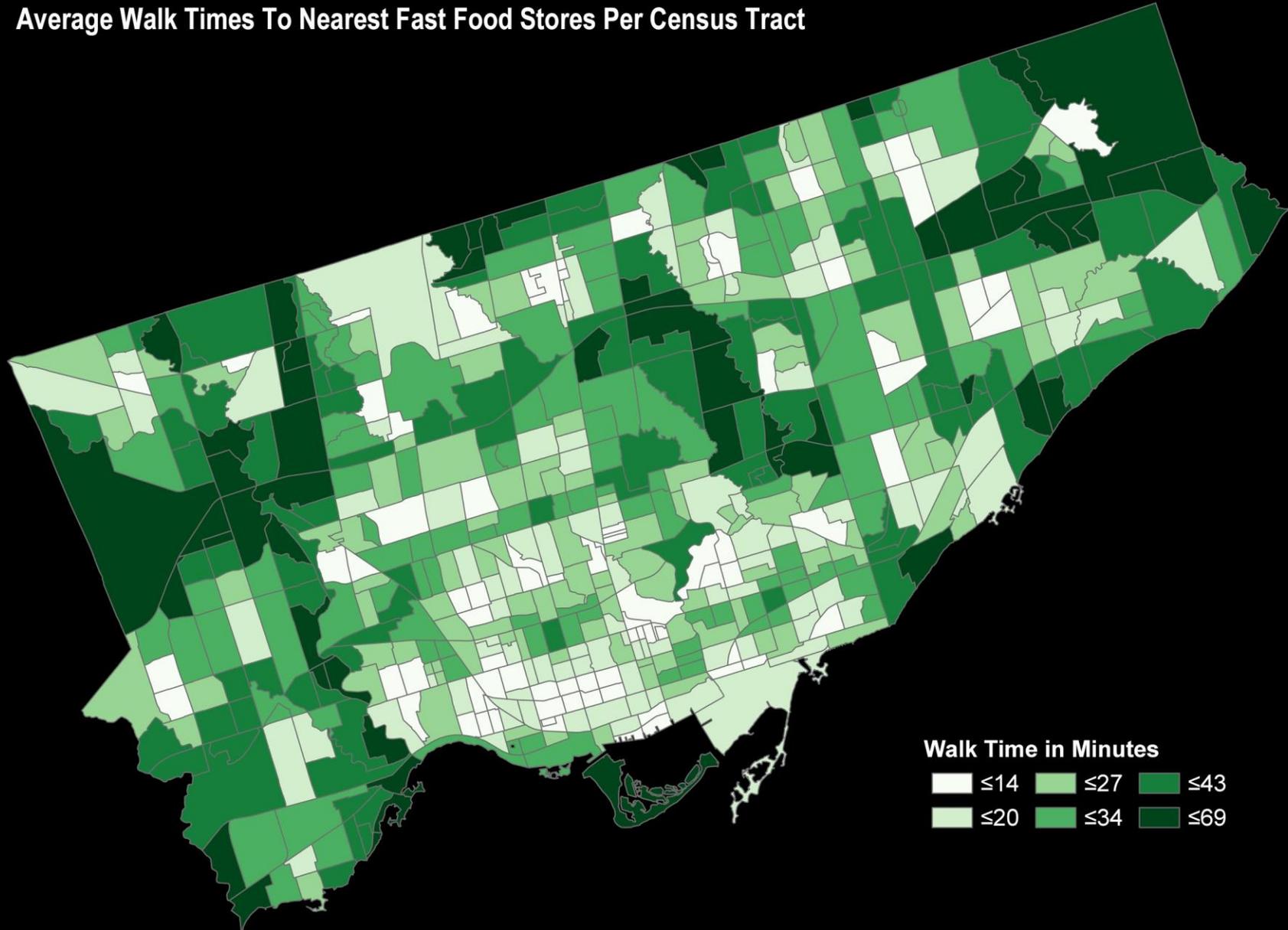
Source: Centre For The Study Of Commercial Activity Ryerson University

# Average Walk Times To Nearest Fast Food Stores Per Census Tract



Source: Centre For The Study Of Commercial Activity Ryerson University

## Average Walk Times To Nearest Fast Food Stores Per Census Tract

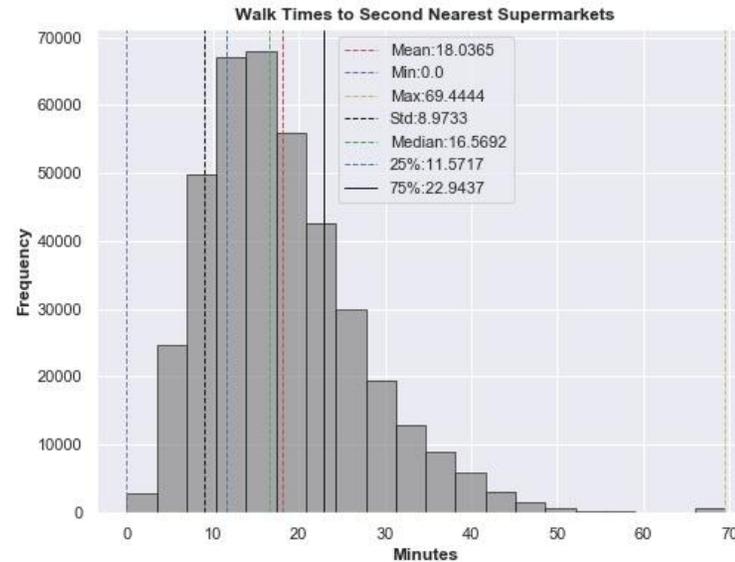
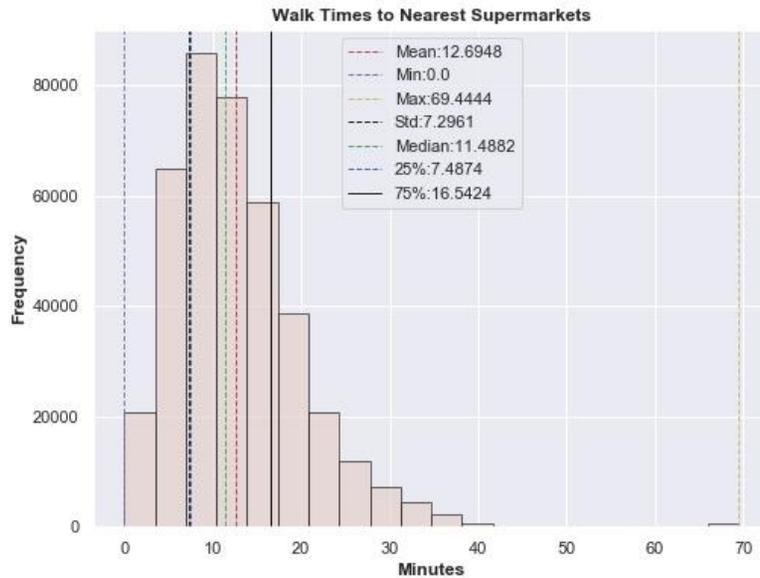


Source: Centre For The Study Of Commercial Activity Ryerson University

# Supermarkets

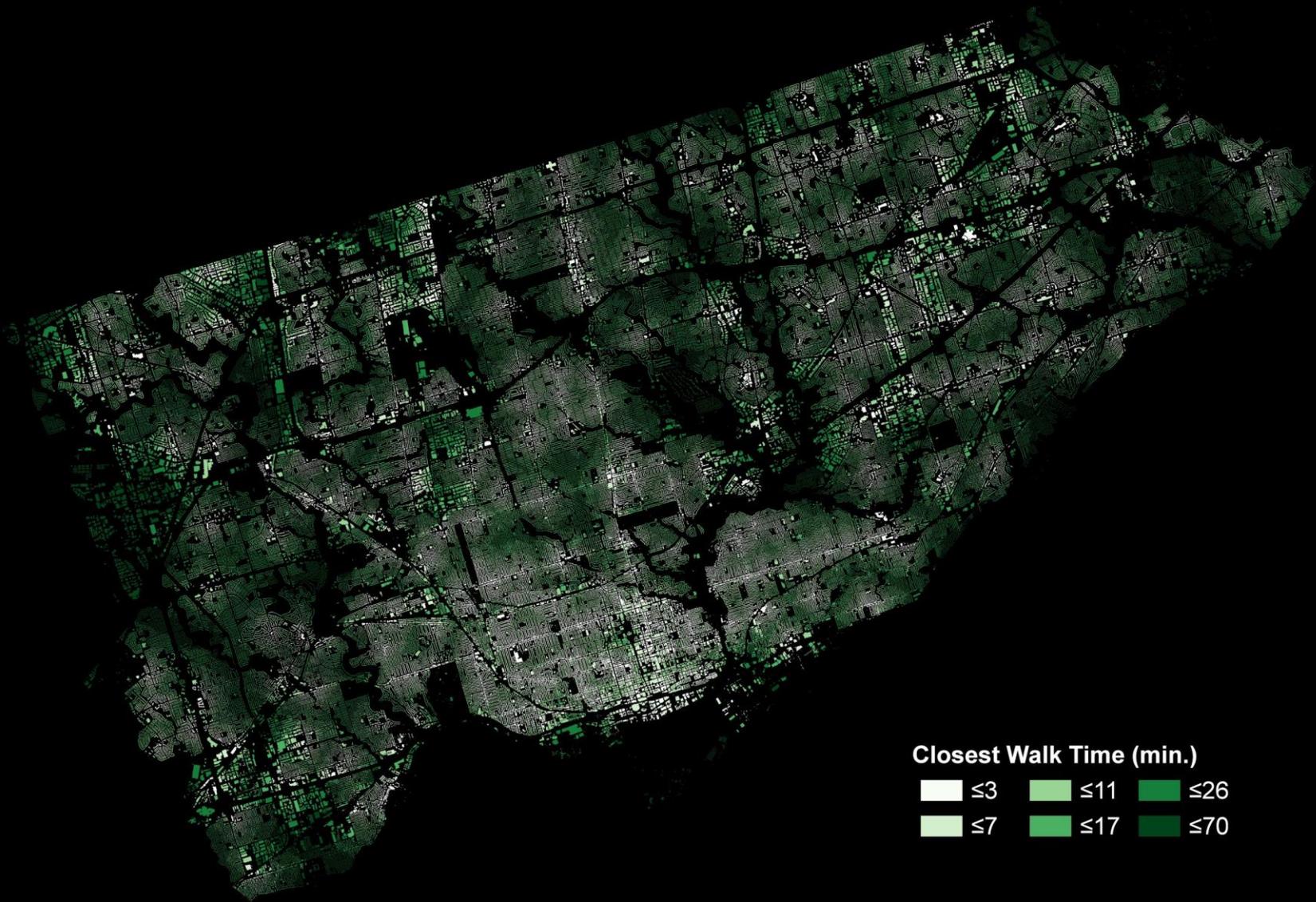
**Definition:** A supermarket is a self-service shop offering a wide variety of food, beverages and household products, organized into sections and shelves.

**Description:** The mean walking time to a supermarket is 12.7 minutes and the median walking time is 11.5 minutes city-wide. City-wide walk times vary with a standard deviation of 7.3 minutes. Approximately 25% of all addresses in the city have less than a 7.5 minute walk, while 75% of all addresses have less than a 16.5 minute walk to the closest supermarket. Census tract 5350002.00 has the maximum average walk time with over a 69.1 minute walk to the closest supermarket and is shared by 1 other census tracts. Census Tract 5350307.03 has less than a 2.7 minute walk to the closest supermarket and is shared by 1 other census tracts.



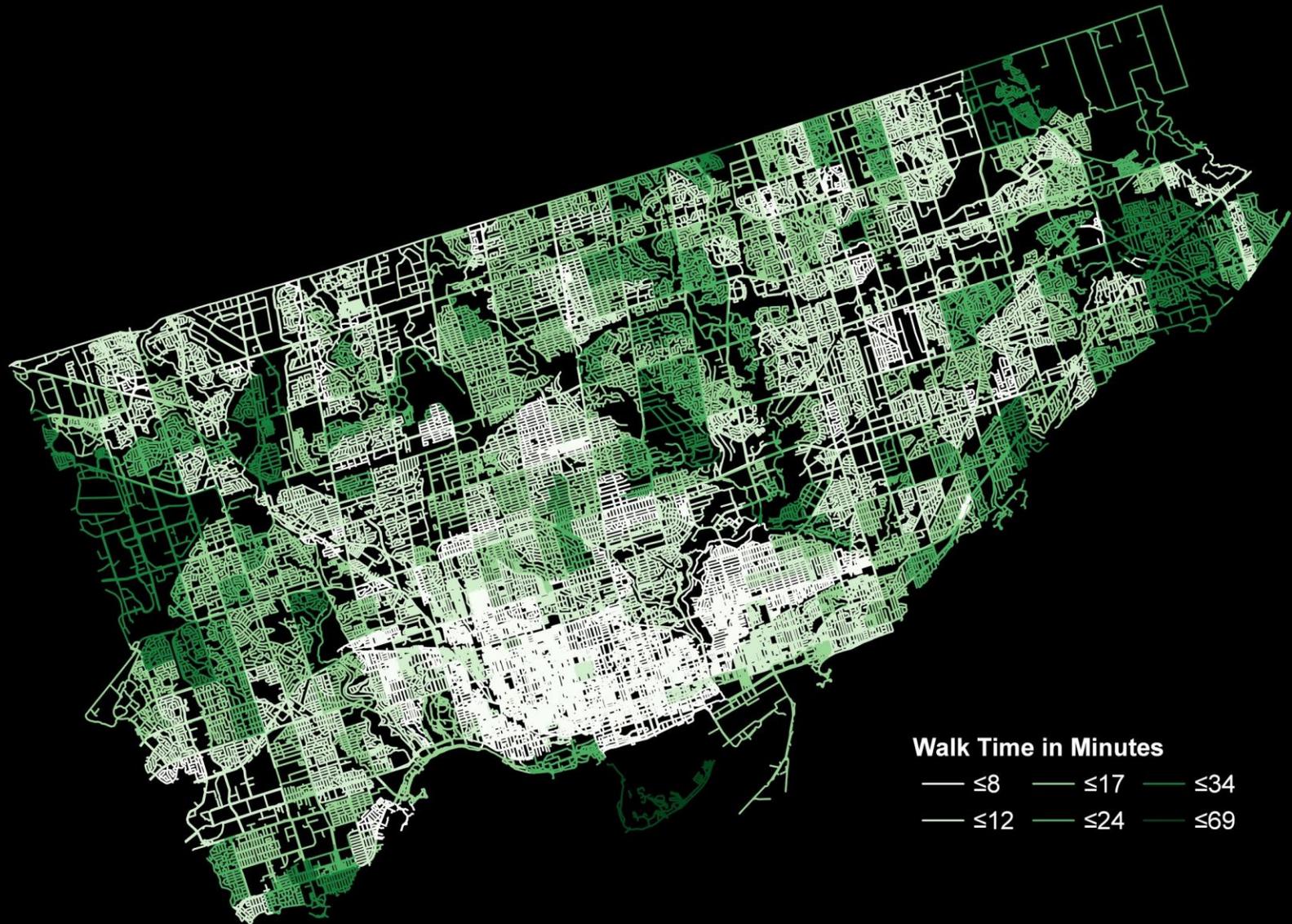
**Interpretation:** There appears to be a slight change in walk times from the first to the second closest Supermarkets with a 6 minute difference in mean walk times from the closest to the second closest Supermarkets. There is a 1.7 minute increase in the standard deviation of walktimes between the first and second closest Supermarkets. There is not a significant change in the geographic distribution between the first and second Supermarkets with a p-value of 0.0 at a .95 confidence interval. Suggesting that locations are geographically stationary across the city. Walk times to supermarkets are considerably short in the former City of Toronto and East York. Walk times in northeastern and southeastern Scarborough are significantly higher as the area is more suburban and even rural. The area defined by REXDALE Boulevard, Highways 401 and 427 also shows increased walktimes due to lack of supermarkets in this industrial commercial area.

## Walk Times To Nearest Supermarkets



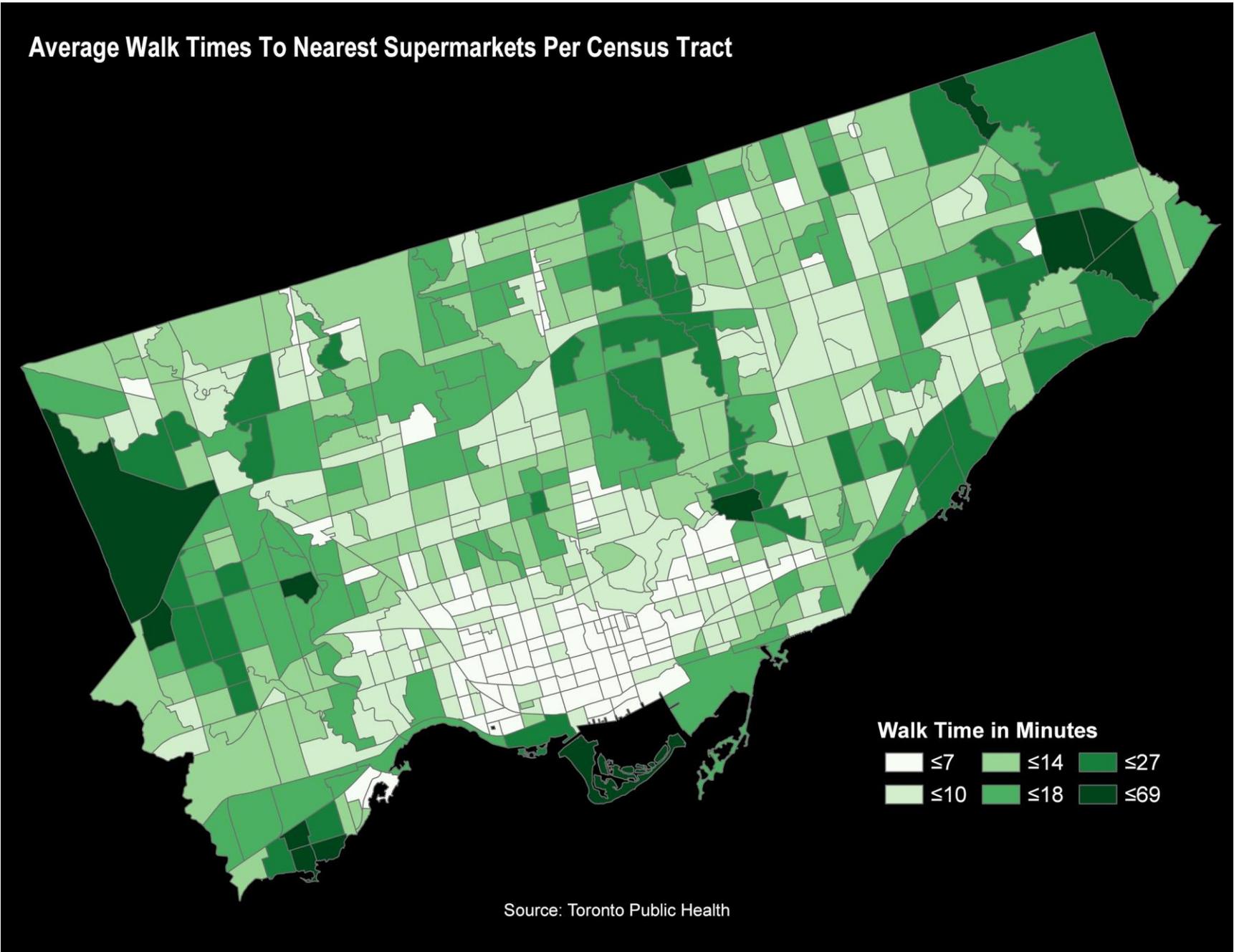
Source: Toronto Public Health

## Average Walk Times To Nearest Supermarkets Per Census Tract



Source: Toronto Public Health

# Average Walk Times To Nearest Supermarkets Per Census Tract



## Health Services

Health Services walkability analysis includes the nearest 2 points analysis at a max distance of 5000 meters to hospitals, sexual health clinics and walk-in clinics in the pedestrian network. Access to healthcare services has an essential role in promoting health equity and quality of life.

### Health Service Walkability: Physical Accessibility

**Physical accessibility** “is understood as the availability of good health services within reasonable reach of those who need them and of opening hours, appointment systems and other aspects of service organization and delivery that allow people to obtain the services when they need them”. Universal health coverage and universal access, Bulletin of the World Health Organization 2013; 91:546–546A. As defined in the human rights context, “health facilities, goods and services must be within safe physical reach for all sections of the population, especially vulnerable or marginalized groups, such as ethnic minorities and indigenous populations, women, children, adolescents, older persons, persons with disabilities and persons with HIV/AIDS, including in rural areas”.<sup>[26]</sup>

### Research Questions:

1. How will the proposed service cuts at Scarborough Health Network’s Birchmount campus impact walk times in the Finch Ave E and Birchmount Rd area for particular medical services?
2. Do greater walktimes to health services limit people’s access to health services?

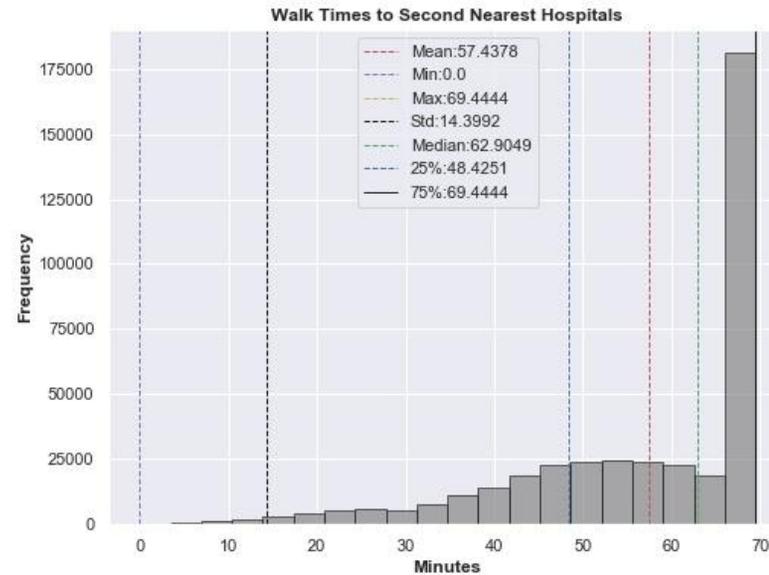
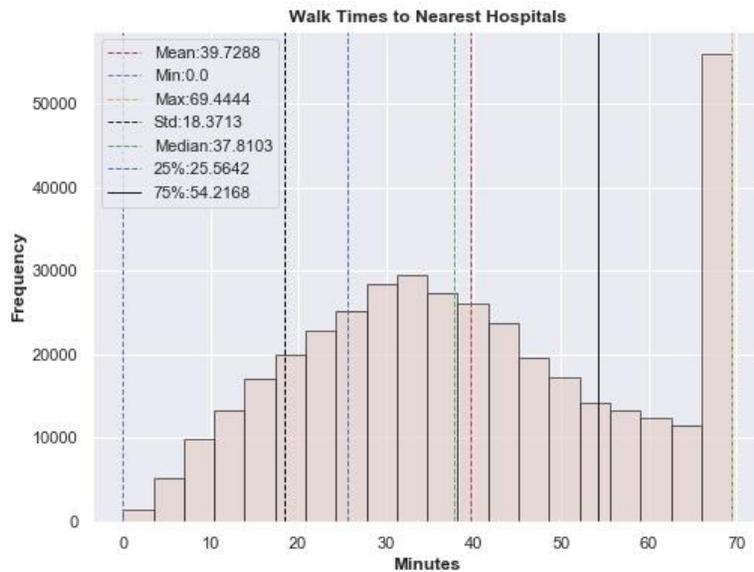
### Overview:

The City of Toronto is the provincial capital of Ontario and the most populous city in Canada, with a population of 2,731,571 in 2016. Access to healthcare services has an essential role in promoting health equity and quality of life.

# Hospitals

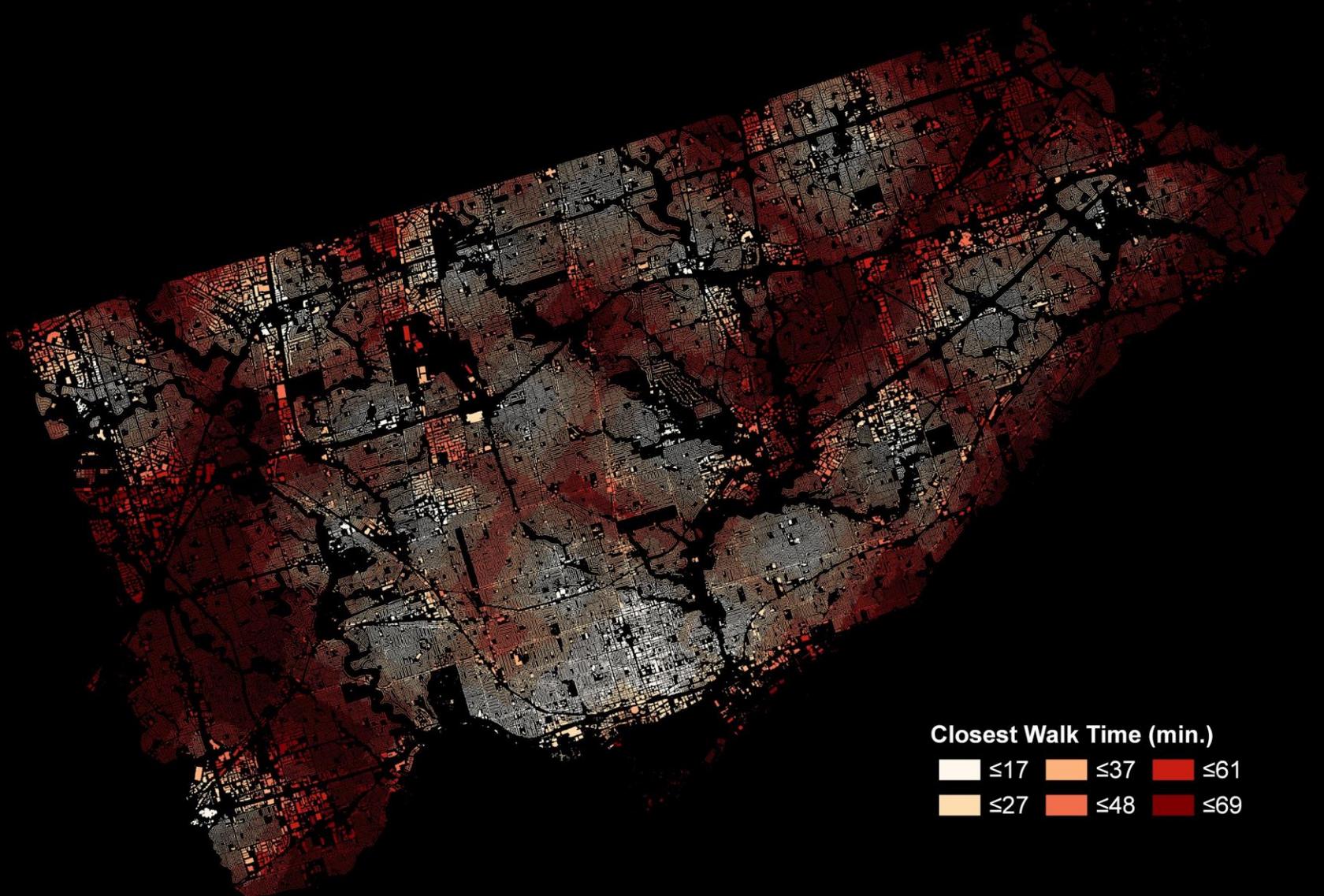
**Definition:** Hospitals listed on the Province of Ontario’s website.

**Description:** The mean walking time to a hospital is 39.7 minutes and the median walking time is 37.8 minutes city-wide. City-wide walktimes vary with a standard deviation of 18.4 minutes. Approximately 25% of all addresses in the city have less than a 25.6 minute walk, while 75% of all addresses have less than a 54.2 minute walk to the closest hospital. Census tract 5350208.00 has the maximum average walk time with over a 69.4 minute walk to the closest hospital and is shared by 1 other census tracts. Census Tract 5350063.03 has less than a 3.8 minute walk to the closest hospital and is shared by 23 other census tracts.



**Interpretation:** There appears to be a significant change in walk times from the first to the second closest Hospitals with a 17.7 minute difference in mean walk times from the closest to the second closest Hospitals. There is less a 4 minute decrease in the standard deviation of walktimes between the first and second closest Hospitals. There is not a significant change in the geographic distribution between the first and second Hospitals with a p-value of 0.0 at a .95 confidence interval. Suggesting that locations are geographically stationary across the city. Large walk times indicate that a number of Torontonians need to use other travel mode(s) to access hospitals.

# Walk Times To Nearest Hospitals



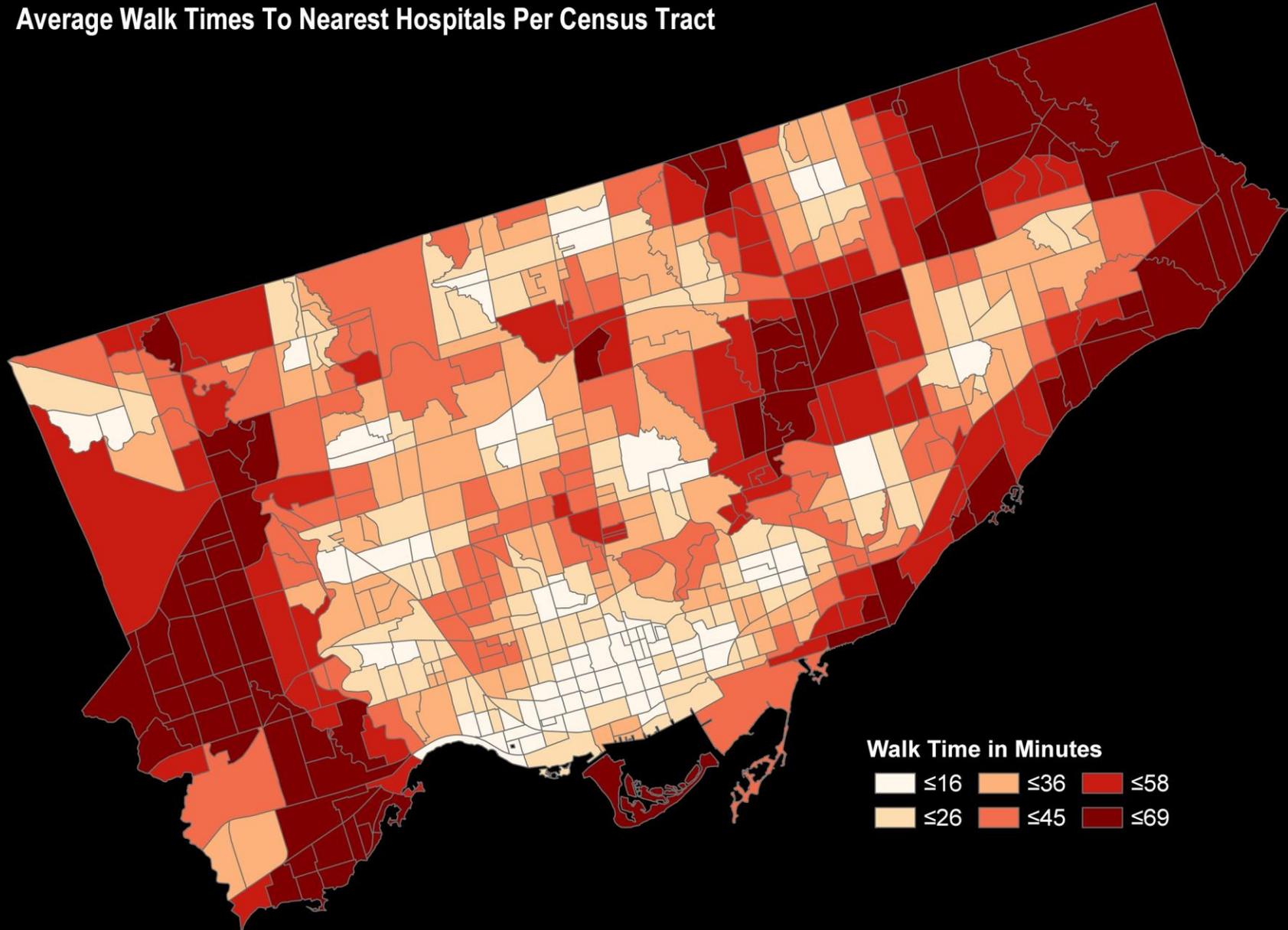
Source: Ontario Ministry of Health and Long-Term Care

# Average Walk Times To Nearest Hospitals Per Census Tract



Source: Ontario Ministry of Health and Long-Term Care

## Average Walk Times To Nearest Hospitals Per Census Tract

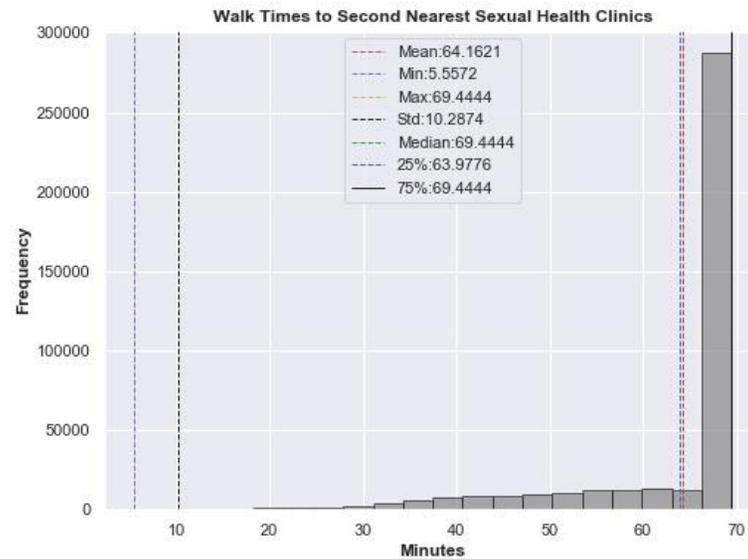
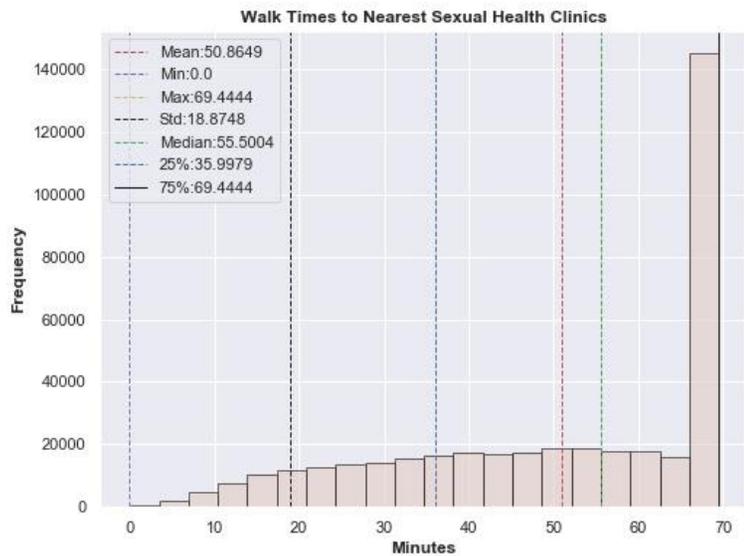


Source: Ontario Ministry of Health and Long-Term Care

# Sexual Health Clinics

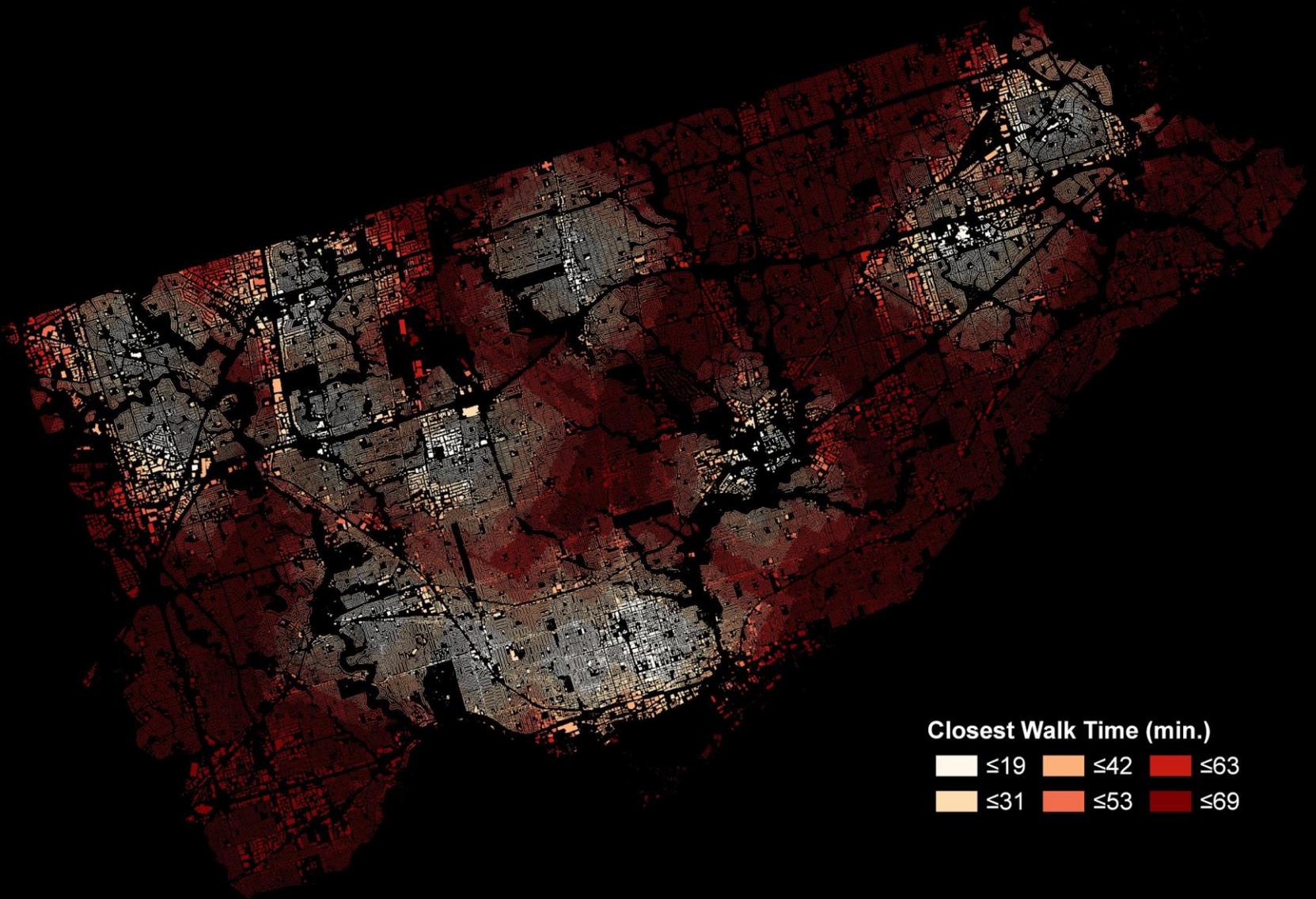
**Definition:** This dataset reflects only the hours of operation by Toronto Public Health. Some of the sexual health clinics are located in facilities owned and/or operated by other community health service organizations.

**Description:** The mean walking time to a sexual health clinic is 50.9 minutes and the median walking time is 55.5 minutes city-wide. City-wide walktimes vary with a standard deviation of 18.9 minutes. Approximately 25% of all addresses in the city have less than a 36.0 minute walk, while 75% of all addresses have less than a 69.4 minute walk to the closest sexual health clinic. Census tract 5350213.02 has the maximum average walk time with over a 69.4 minute walk to the closest sexual health clinic and is shared by 1 other census tracts. Census Tract 5350034.01 has less than a 3.0 minute walk to the closest sexual health clinic and is shared by 112 other census tracts.



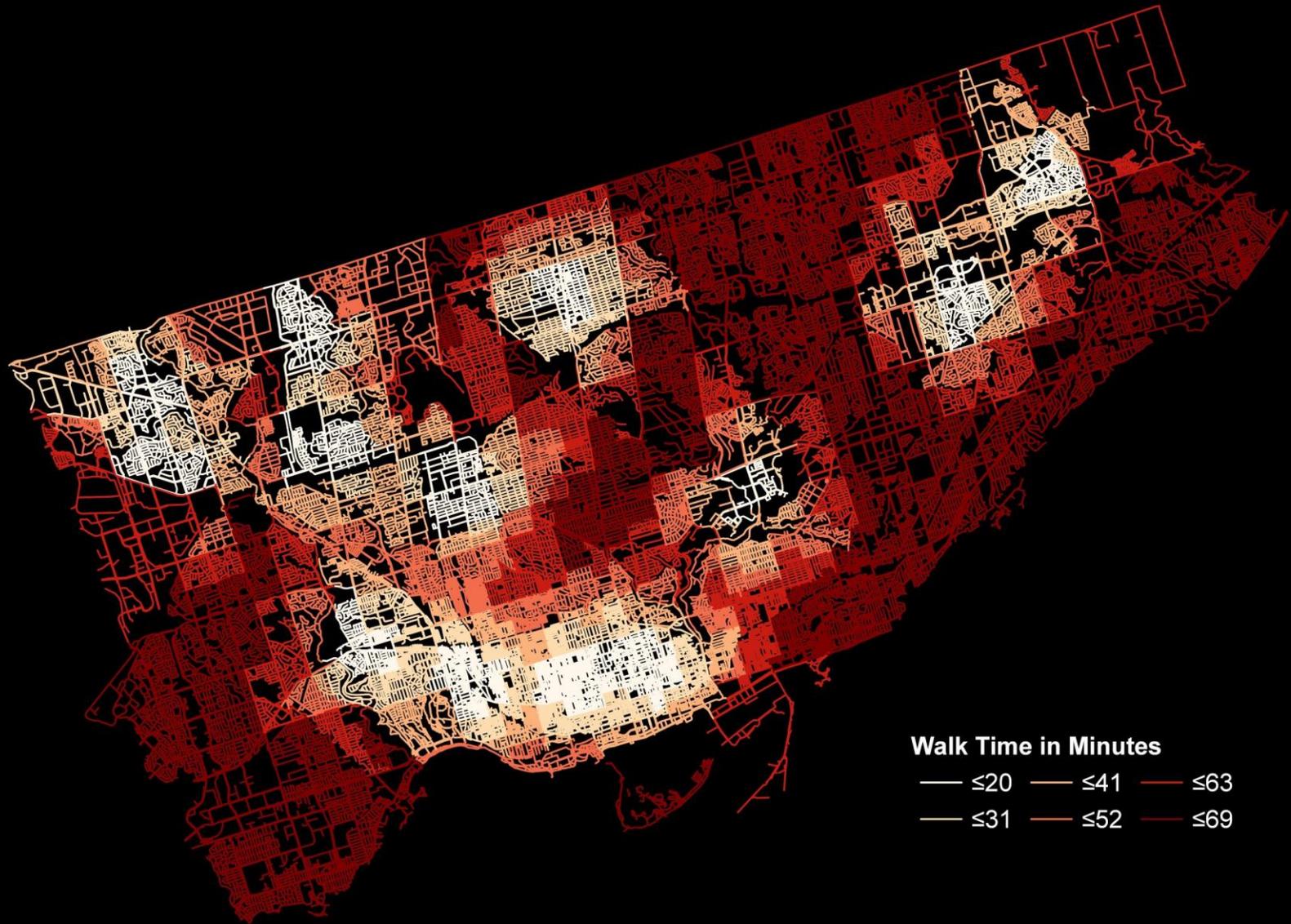
**Interpretation:** There appears to be a significant change in walk times from the first to the second closest Sexual Health Clinics with a 13.3 minute difference in mean walk times from the closest to the second closest Sexual Health Clinics. There is an 8.6 minute decrease in the standard deviation of walktimes between the first and second closest Sexual Health Clinics. There is not a significant change in the geographic distribution between the first and second Sexual Health Clinics with a p-value of 0.0 at a .95 confidence interval. Suggesting that locations are geographically stationary across the city. Large portions of the City of Toronto have considerable walk times to sexual health clinics. Access is concentrated in the downtown core and portions of Scarborough, North York and northern Etobicoke.

## Walk Times To Nearest Sexual Health Clinics



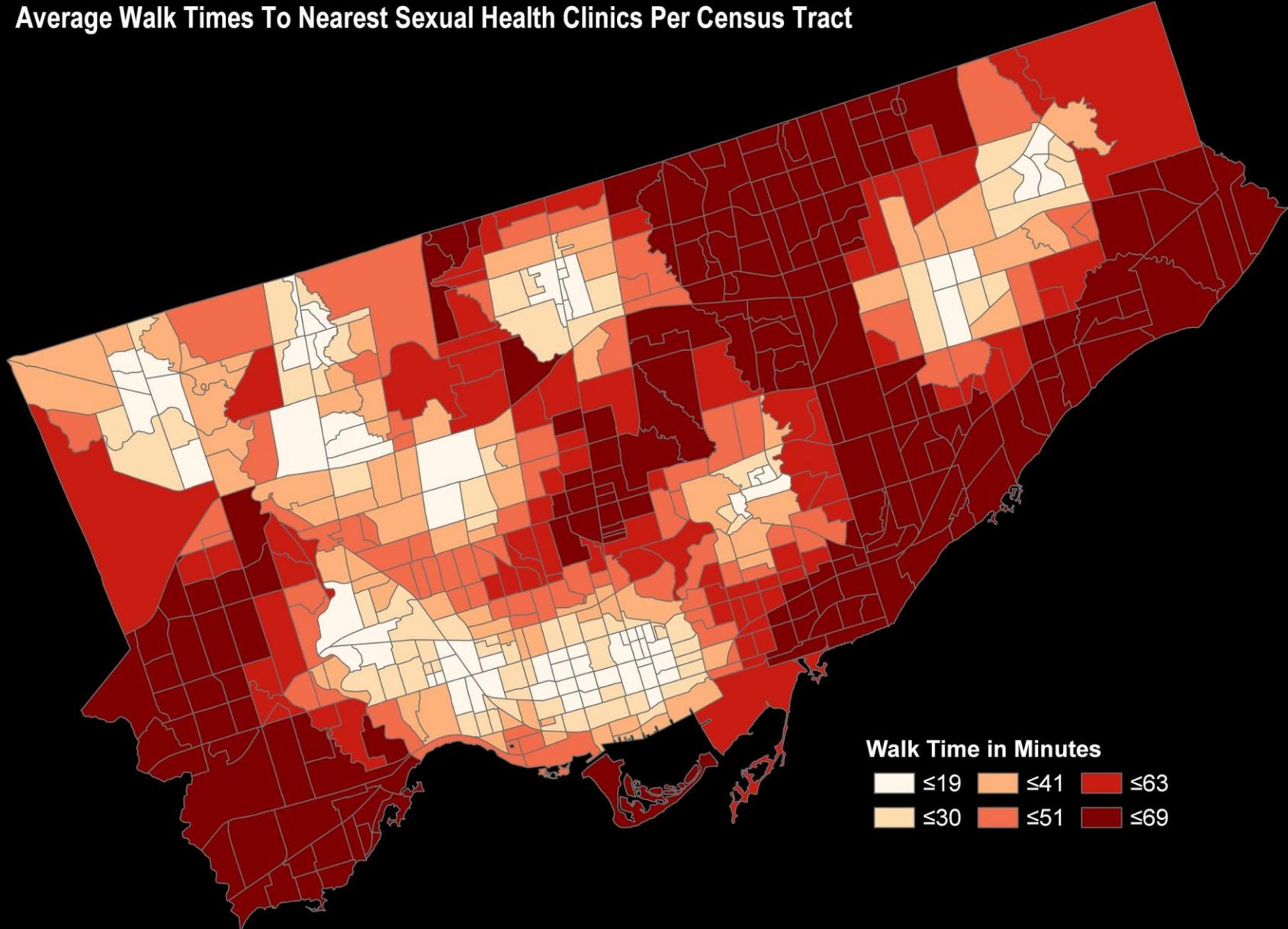
Source: Toronto Public Health

## Average Walk Times To Nearest Sexual Health Clinics Per Census Tract



Source: Toronto Public Health

# Average Walk Times To Nearest Sexual Health Clinics Per Census Tract

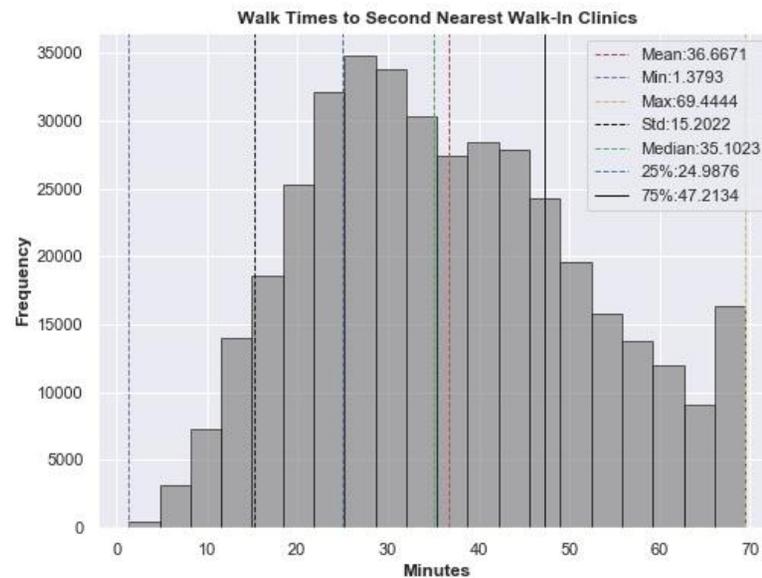
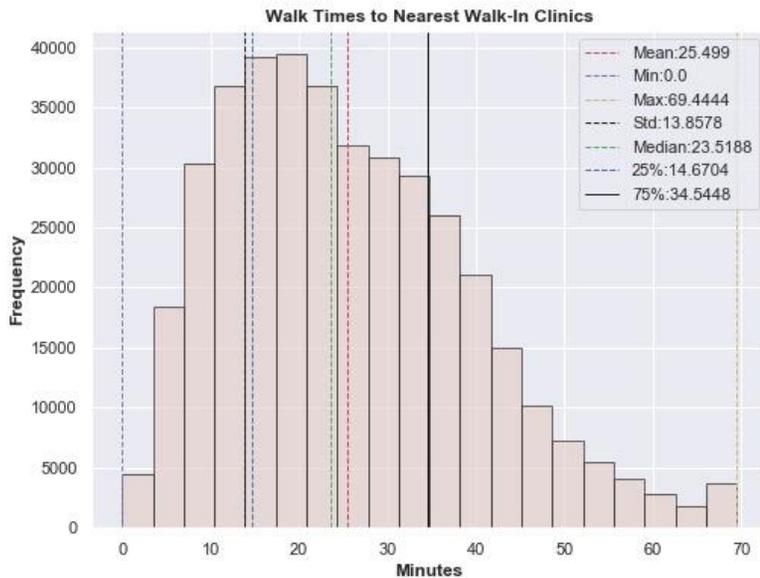


Source: Toronto Public Health

# Walk-in Clinics

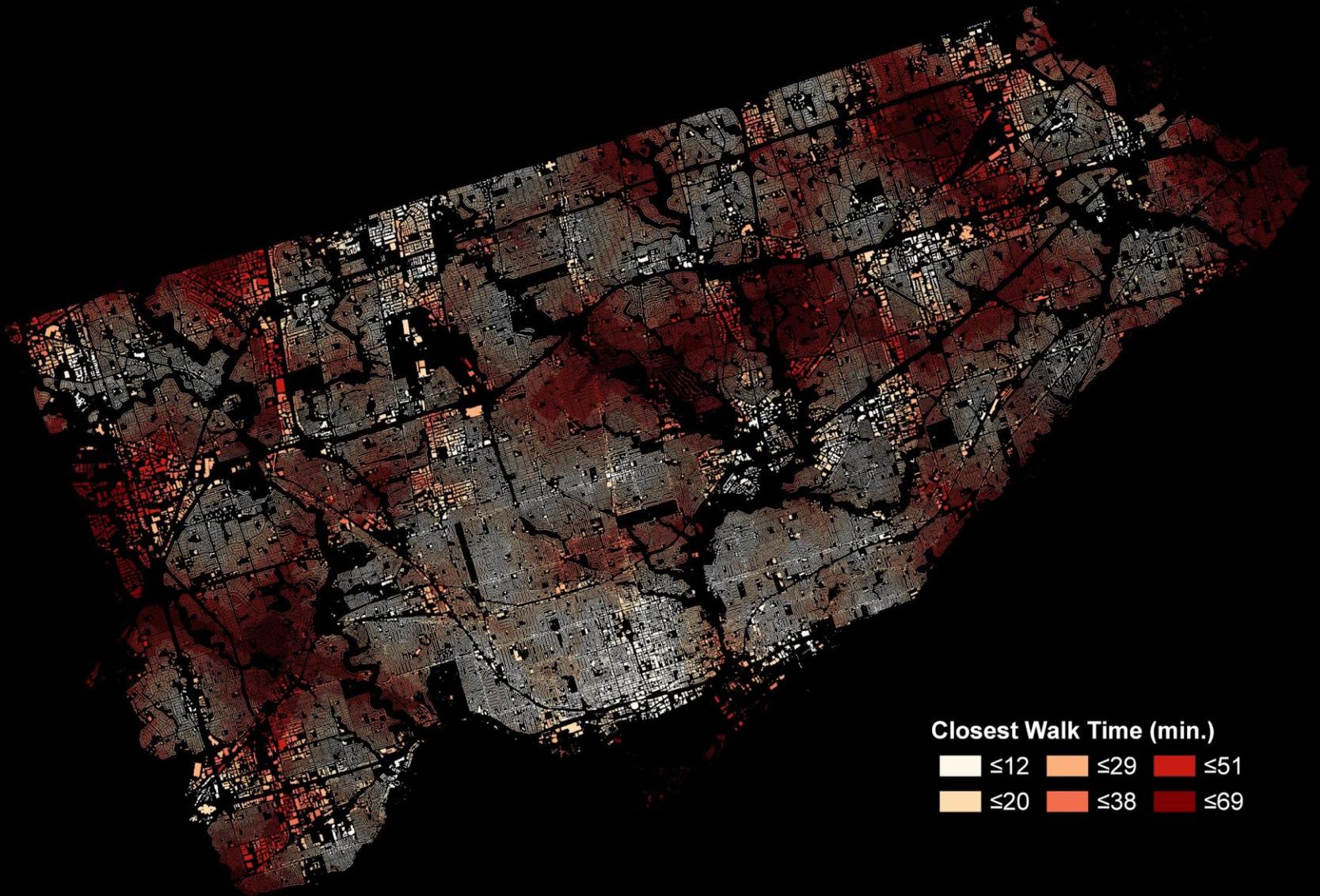
**Definition:** Walk-in clinics provide medical care for people who do not have a family doctor or have one and are unable to reach them [22]. Walk-in data was obtained from TorontoCentralhealthline.ca which puts accurate and up-to-date information about health services for consumers and health care providers in Toronto, Ontario.

**Description:** The mean walking time to a walk-in clinic is 25.5 minutes and the median walking time is 23.5 minutes city-wide. City-wide walktimes vary with a standard deviation of 13.9 minutes. Approximately 25% of all addresses in the city have less than a 14.7 minute walk, while 75% of all addresses have less than a 34.5 minute walk to the closest walk-in clinic. Census tract 5350802.02 has the maximum average walk time with over a 69.4 minute walk to the closest walk-in clinic and is shared by 1 other census tracts. Census Tract 5350034.01 has less than a 3.1 minute walk to the closest walk-in clinic and is shared by 1 other census tracts.



**Interpretation:** There appears to be a significant change in walk times from the first to the second closest Walk-in Clinics with a 10 minute difference in mean walk times from the closest to the second closest Walk-in Clinics. There is less than a 1.4 minute increase in the standard deviation of walktimes between the first and second closest Walk-in Clinics. There is not a significant change in the geographic distribution between the first and second Walk-In Clinics with a p-value of 0.0 at a .95 confidence interval. Suggesting that locations are geographically stationary across the city. There are several areas in the City of Toronto where there are considerable walk times to walk-in clinics including southeast Scarborough. The McNicoll Ave and Tapscott Rd area also has considerable walk times but it is primarily an industrial commercial area. High walk times are also present in the Woodbine Racetrack area. The Bridle Path area also has high walk times.

## Walk Times To Nearest Walk-In Clinics



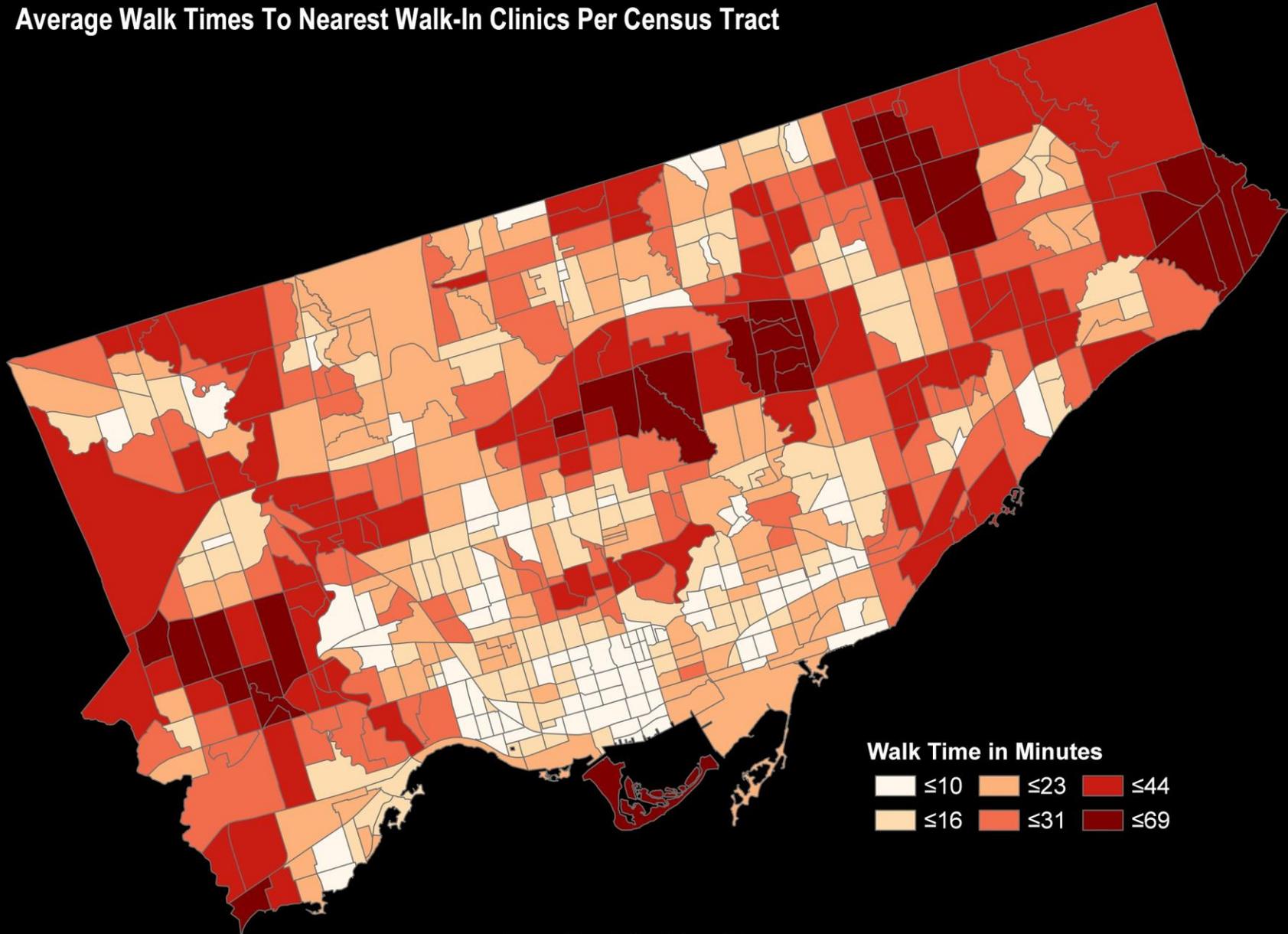
Source: TorontoCentralhealthline.ca

# Average Walk Times To Nearest Walk-In Clinics Per Census Tract



Source: TorontoCentralhealthline.ca

## Average Walk Times To Nearest Walk-In Clinics Per Census Tract



Source: TorontoCentralhealthline.ca

## Public Services

Public services walkability analysis includes the nearest 2 points analysis at a max distance of 5000 meters to schools, arenas, day care centres, drop-in centres, paramedic services, family resource centres, fire services, libraries, police services, recreation centres, things to do and 2018 voting locations data in the pedestrian network.

### Public Service Walkability:

Public service is a service which is provided by government to people living within its jurisdiction, either directly (through the public sector) or by financing provision of services. The term is associated with a social consensus (usually expressed through democratic elections) that certain services should be available to all, regardless of income, physical ability or mental acuity. Even where public services are neither publicly provided nor publicly financed, for social and political reasons they are usually subject to regulation going beyond that applying to most economic sectors. Public policy when made in the public's interest and motivations can provide public services [\[6\]](#).

### Research Questions:

1. Where do people have more access and less access to public services by walking?
2. Are there public perception differences due to the walkability of public services?

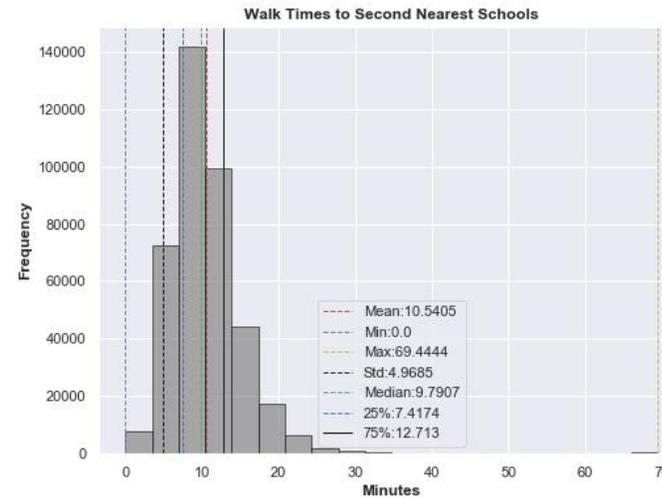
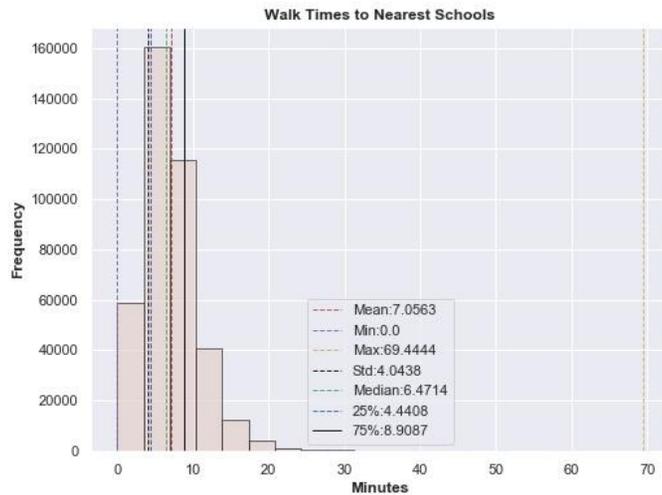
### Overview:

The City of Toronto is the provincial capital of Ontario and the most populous city in Canada, with a population of 2,731,571 in 2016. The Organisation for Economic Co-operation and Development (OECD) considers access to public services as a performance criterion for governments, reflecting their capacities to accurately recognise the diversity and nature of different needs, create and tailor delivery and communication channels accordingly, and ensure equity and fairness in delivery and distribution.[\[27\]](#)

# Schools

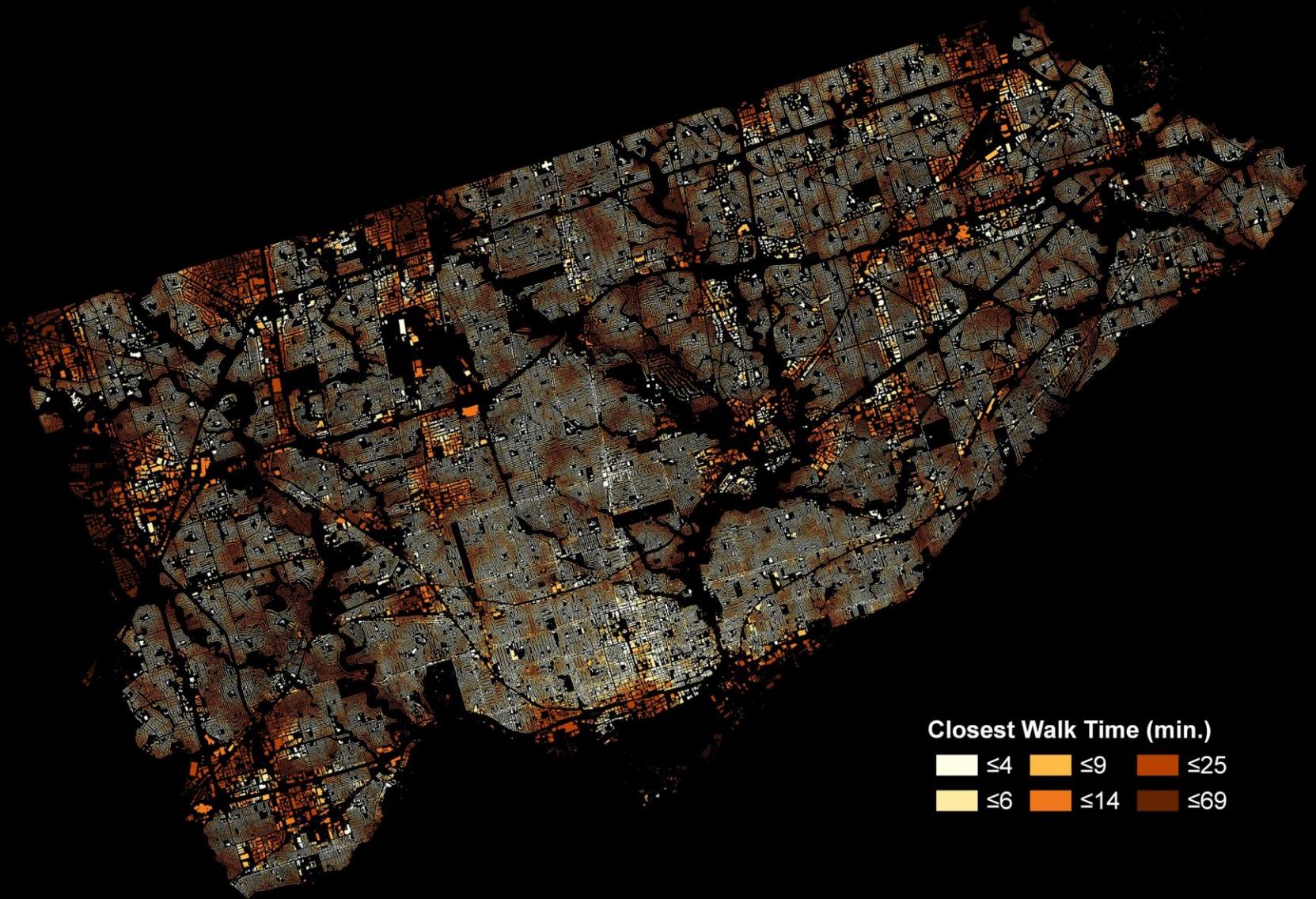
**Definition:** School data supplied from Toronto Police Services that includes Conseil scolaire Viamonde, Conseil scolaire de district catholique Centre-Sud, Toronto District School Board, the Toronto Catholic District School Board, private schools, universities and colleges.

**Description:** The mean walking time to a school is 7.1 minutes and the median walking time is 6.5 minutes city-wide. City-wide walktimes vary with a standard deviation of 4.0 minutes. Approximately 25% of all addresses in the city have less than a 4.4 minute walk, while 75% of all addresses have less than an 8.9 minute walk to the closest school. Census tract 5350002.00 has the maximum average walk time with over a 33.2 minute walk to the closest school and is shared by 1 other census tracts. Census Tract 5350136.02 has less than a 2.0 minute walk to the closest school and is shared by 1 other census tracts.



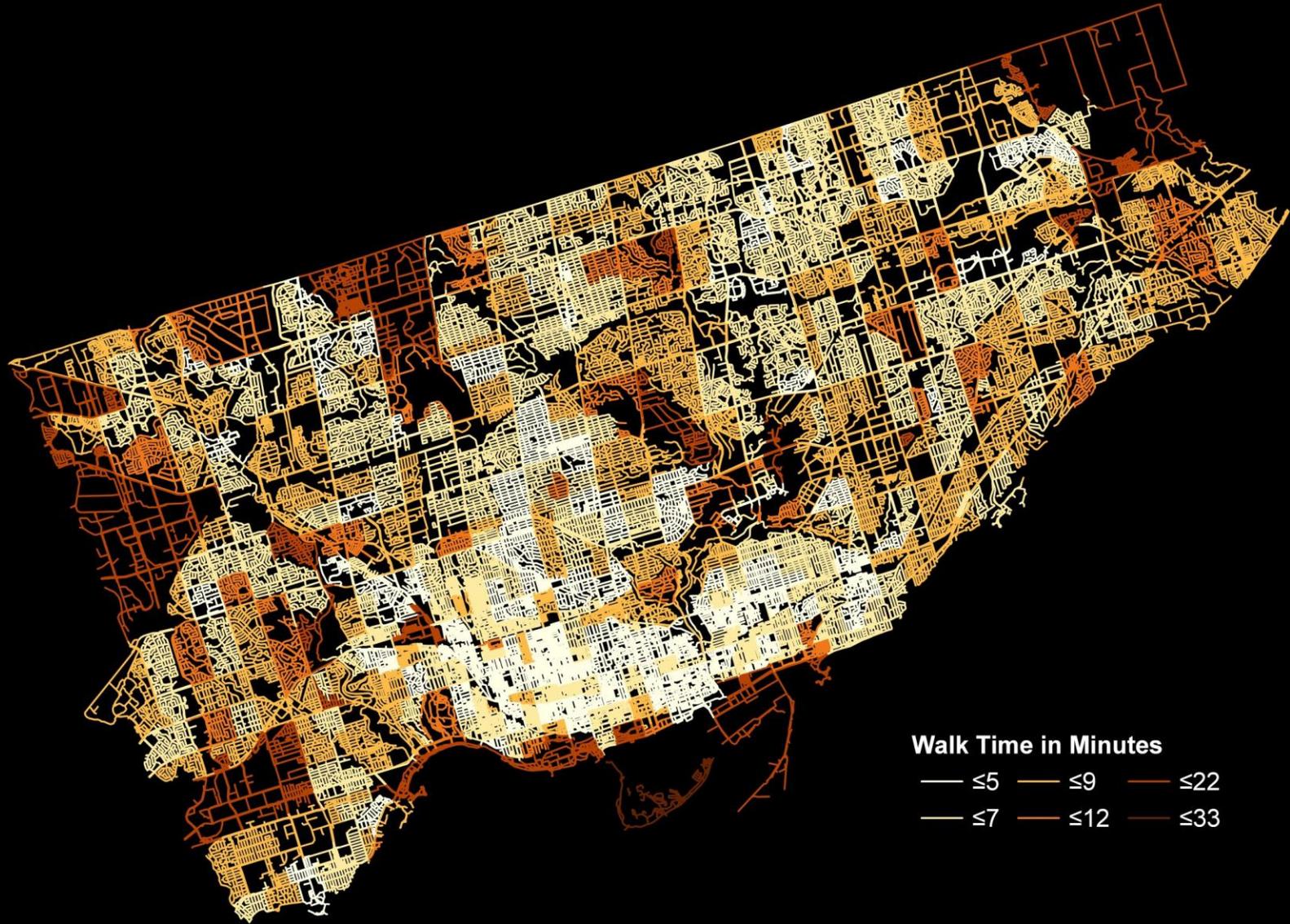
**Interpretation:** There appears to be a change in walk times from the first to the second closest Schools with a 3.1 minute difference in mean walk times from the closest to the second closest Schools. There is less than a 0.9 minute increase in the standard deviation of walktimes between the first and second closest Schools. There is not a significant change in the geographic distribution between the first and second Schools with a p-value of 0.0 at a .95 confidence interval. Suggesting that locations are geographically stationary across the city. Most areas of the City of Toronto have close walk times to schools. There are pockets of longer walk times including northwestern Etobicoke that is an industrial area and northeastern Scarborough that is a rural area. The downtown core has increased walk times. Changes in demographic data in the downtown core should be used to determine whether more school age children are living in new condo developments. Public transit or school contracted buses are used to decrease the impact of long walk times in suburban areas.

## Walk Times To Nearest Schools



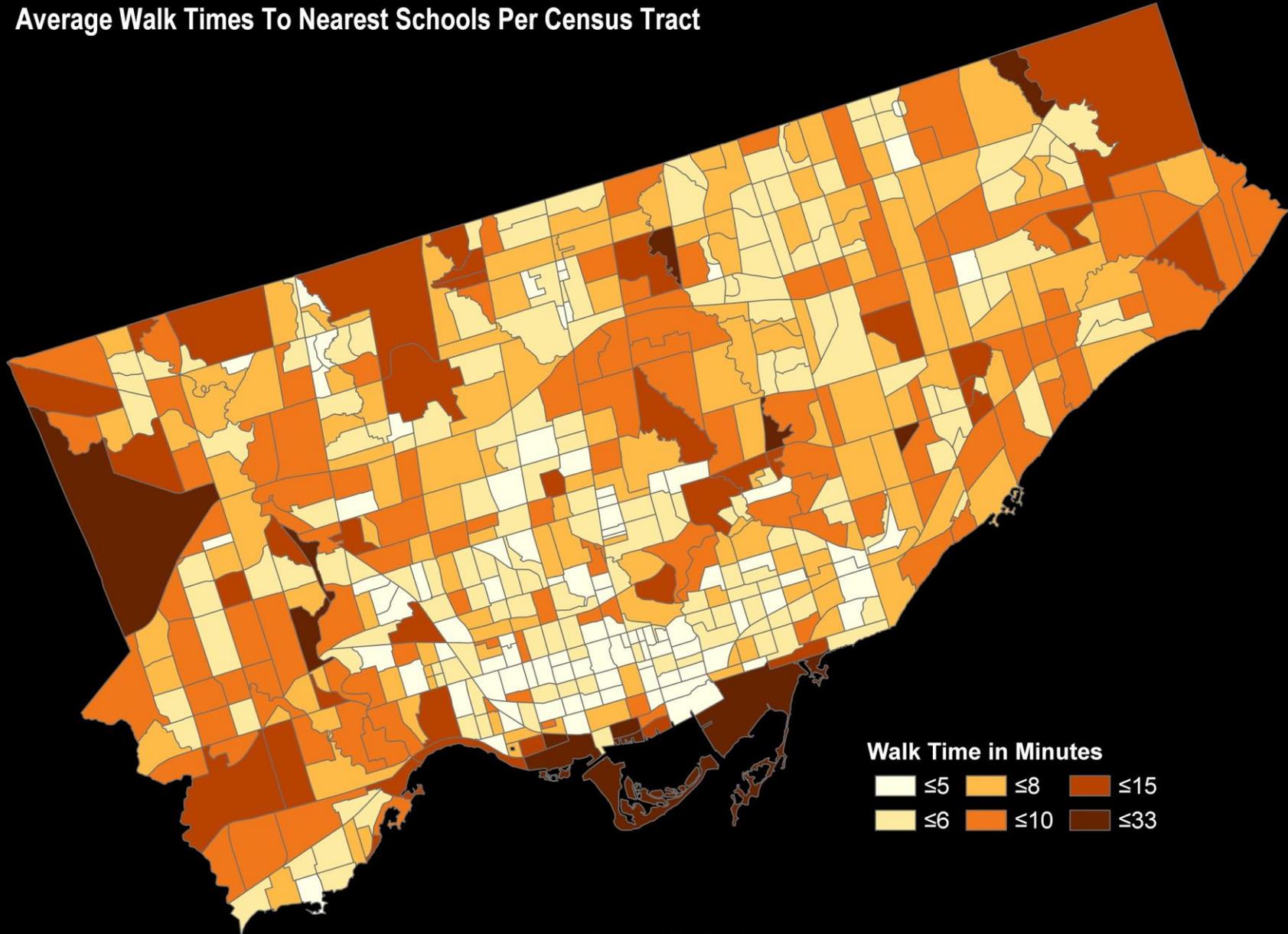
Source: Toronto Police Services

# Average Walk Times To Nearest Schools Per Census Tract



Source: Toronto Police Services

## Average Walk Times To Nearest Schools Per Census Tract

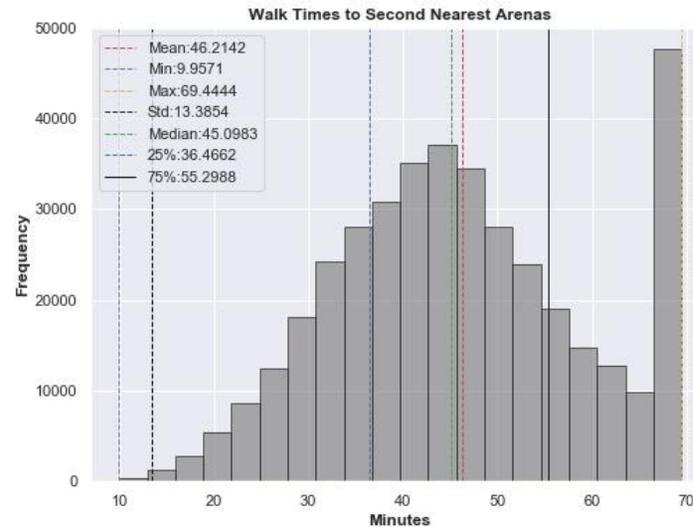
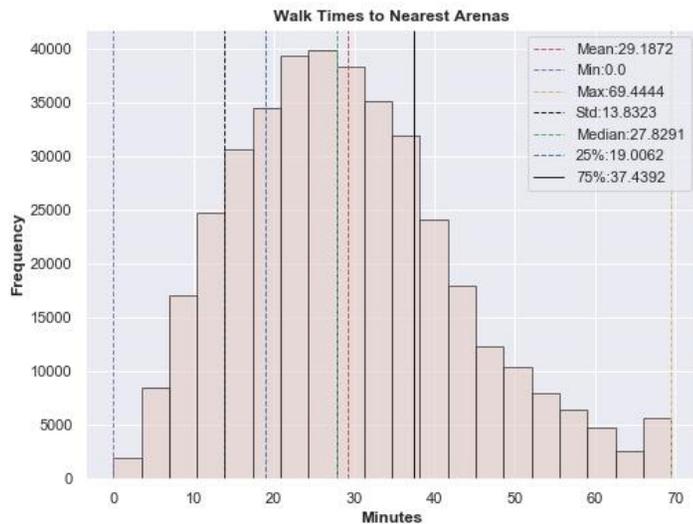


Source: Toronto Police Services

# Arenas

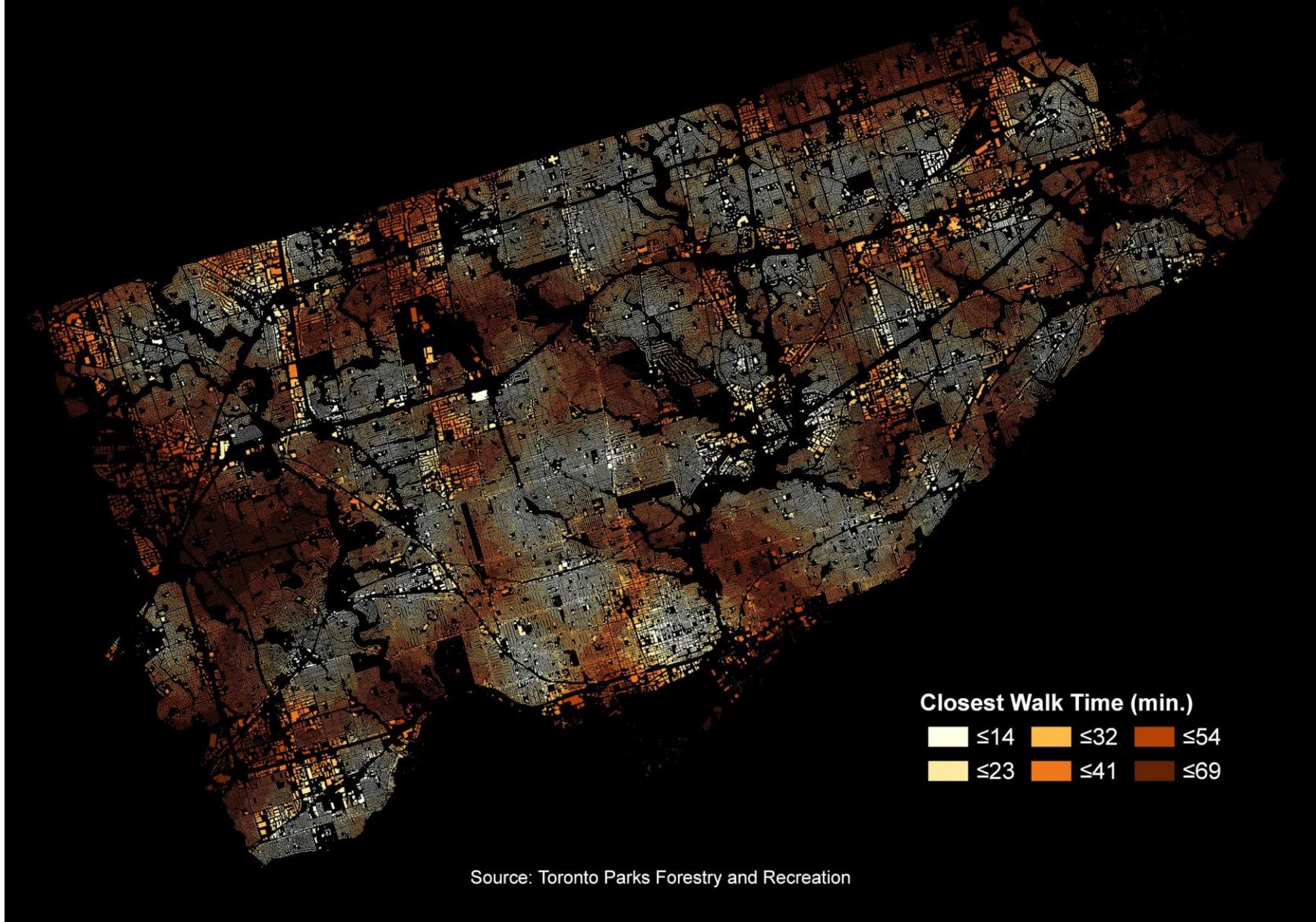
**Definition:** **Arena** is an enclosed area designed for sporting events and other recreational activities. There are [50 City arenas](#) operated and managed by [Parks, Forestry and Recreation Division](#) in Toronto city.

**Description:** The mean walking time to an arena is 29.2 minutes and the median walking time is 27.8 minutes city-wide. City-wide walktimes vary with a standard deviation of 13.8 minutes. Approximately 25% of all addresses in the city have less than a 19.0 minute walk, while 75% of all addresses have less than a 37.4 minute walk to the closest arena. Census tract 5350002.00 has the maximum average walk time with over a 69.3 minute walk to the closest arena and is shared by 1 other census tracts. Census Tract 5350046.00 has less than a 4.9 minute walk to the closest arena and is shared by 1 other census tracts.

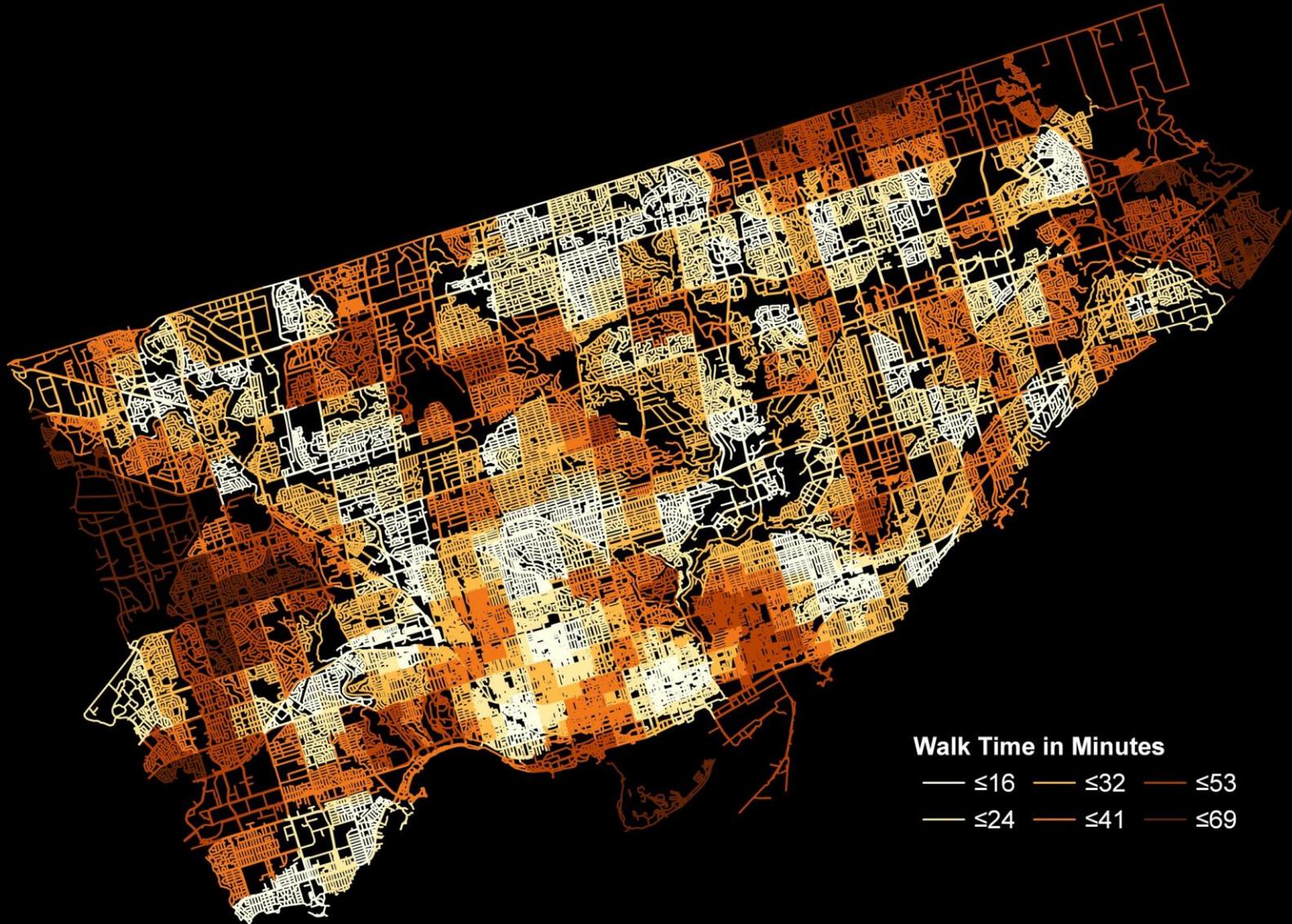


**Interpretation:** There appears to be a significant change in walk times from the first to the second closest Arenas with a 17.1 minute difference in mean walk times from the closest to the second closest Arenas. There is less than a 0.5 minute decrease in the standard deviation of walktimes between the first and second closest Arenas. There is not a significant change in the geographic distribution between the first and second Arenas with a p-value of 0.0 at a .95 confidence interval. Suggesting that locations are geographically stationary across the city. There are pockets of the city that are within 14 minute walk times to the arenas, including the area bounded by Yonge St, the Don Valley Parkway, Carlton St and Front St E and the area bounded by Highway 400, Steeles Ave E, Jane St and Finch Ave W. Areas with walktimes between 46 minutes to 69 minutes include a large area north of Rathburn Rd, Islington Ave, Rexdale Blvd and Highway 427. Without access to private or public transportation a walktime of over 46 minutes would make access to these arenas very time consuming and difficult.

## Walk Times To Nearest Arenas

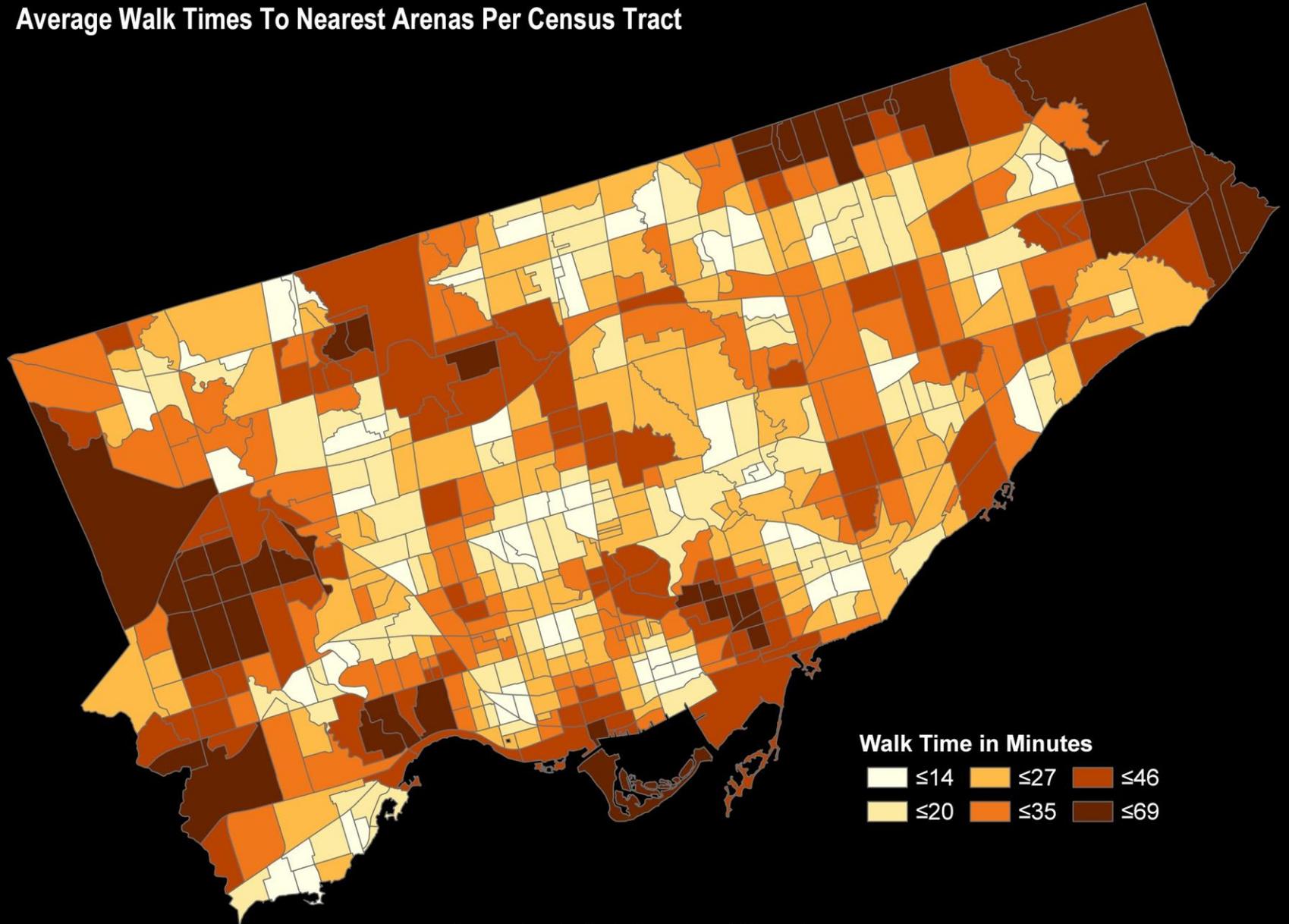


# Average Walk Times To Nearest Arenas Per Census Tract



Source: Toronto Parks Forestry and Recreation

## Average Walk Times To Nearest Arenas Per Census Tract

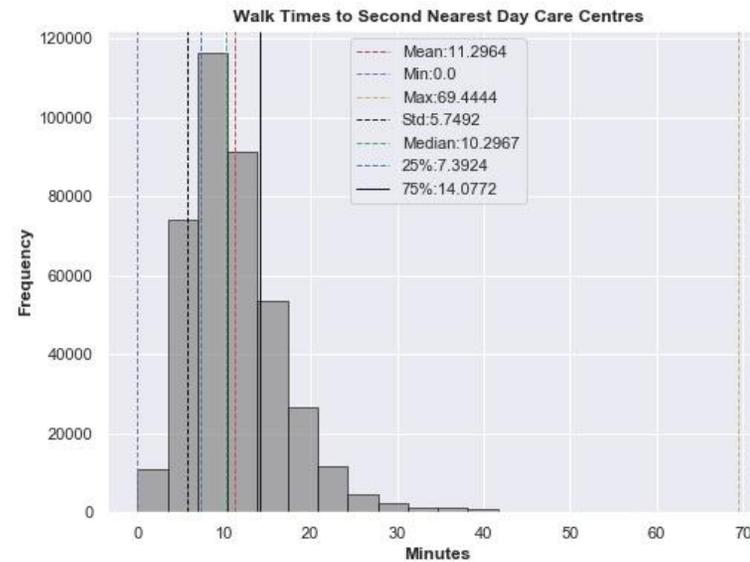
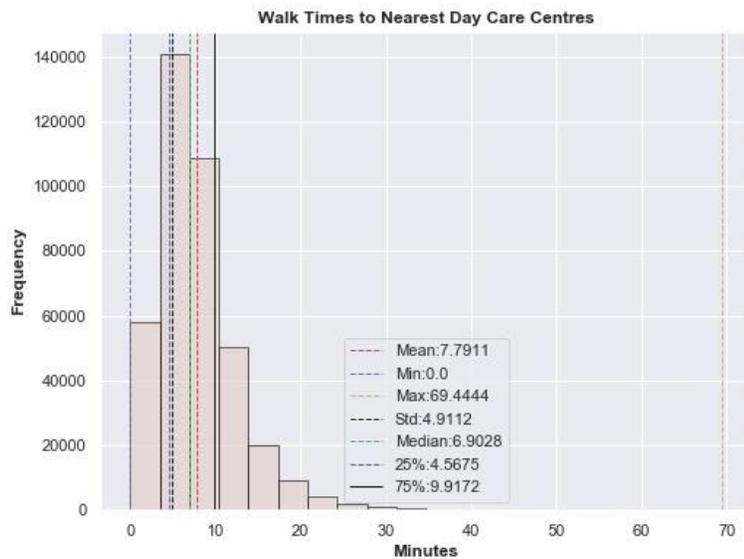


Source: Toronto Parks Forestry and Recreation

# Day Care Centres

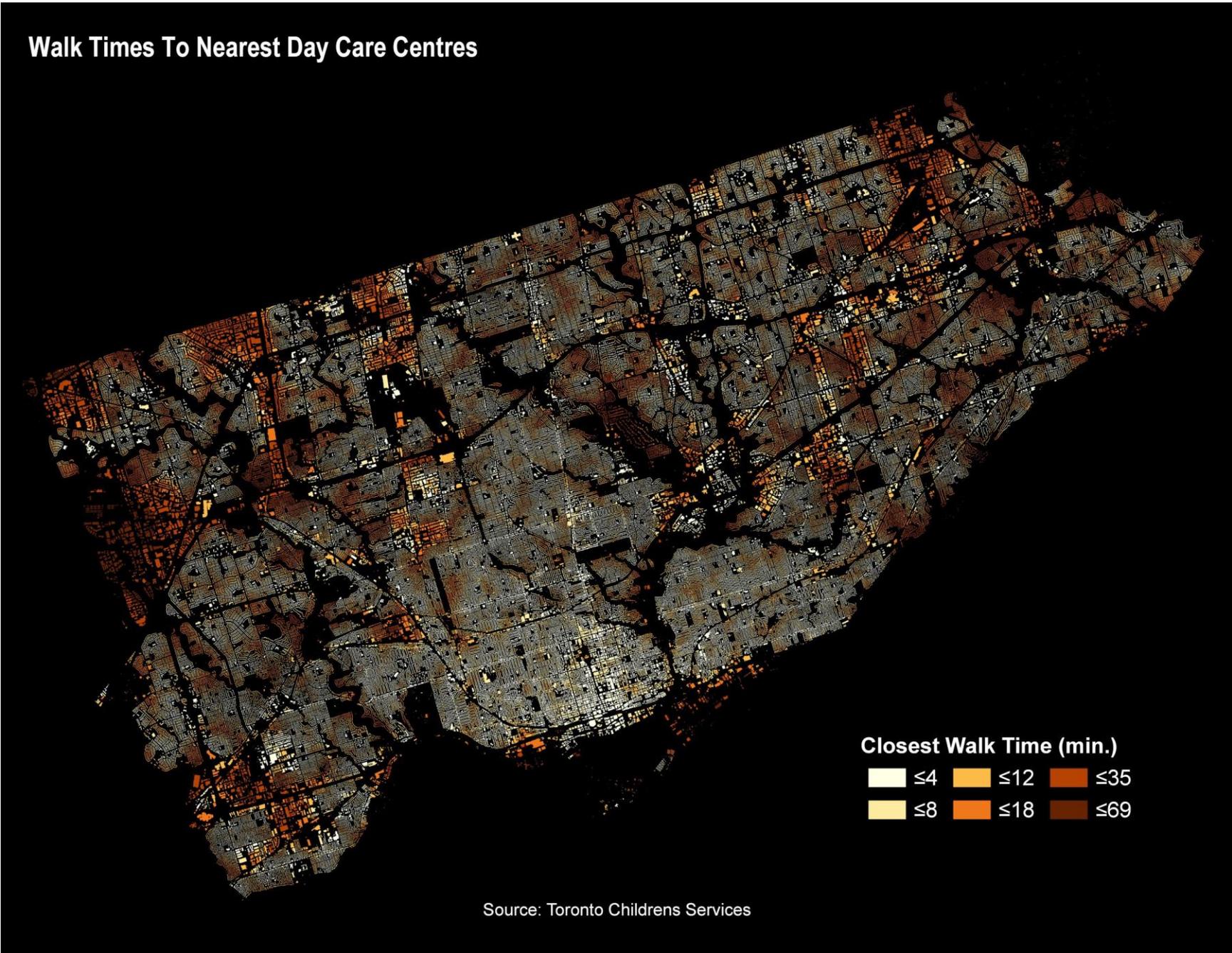
**Definition:** Licensed day care centres within the City of Toronto. This report did not take into account unlicensed day care centres.

**Description:** The mean walking time to a day care centre is 7.8 minutes and the median walking time is 6.9 minutes city-wide. City-wide walktimes vary with a standard deviation of 4.9 minutes. Approximately 25% of all addresses in the city have less than a 4.6 minute walk, while 75% of all addresses have less than a 9.9 minute walk to the closest day care centre. Census tract 5350378.26 has the maximum average walk time with over a 24.2 minute walk to the closest day care centre and is shared by 1 other census tracts. Census Tract 5350194.03 has less than a 2.3 minute walk to the closest day care centre and is shared by 1 other census tracts.



**Interpretation:** There appears to be no significant change in walk times from the first to the second closest Day Care Centre with a 3.5 minute difference in mean walk times from the closest to the second closest Day Care Centres. There is less than a 0.8 minute increase in the standard deviation of walktimes between the first and second closest Day Care Centres. There is not a significant change in the geographic distribution between the first and second Day Care Centres with a p-value of 0.0 at a .95 confidence interval. Suggesting that locations are geographically stationary across the city. The majority of the City of Toronto has relatively close walking times to City of Toronto licensed day care centres. Due to the limitation of number of day care spots at each facility walking times to second or further closest day care centres may have to be considered. Anecdotally, Toronto Children's Services has received comments from parents that a lack of day spaces near home is an issue. [28]

# Walk Times To Nearest Day Care Centres



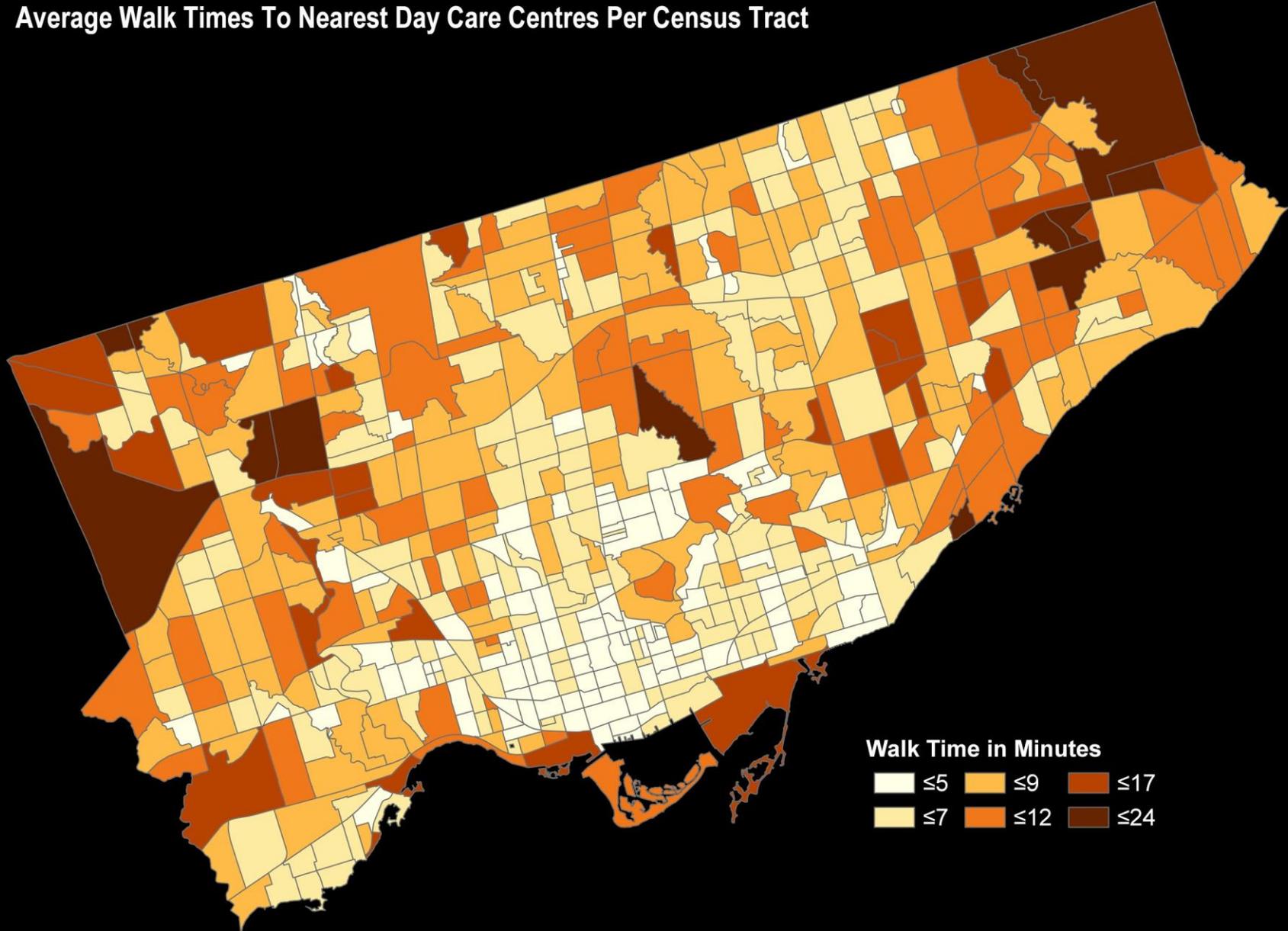
Source: Toronto Childrens Services

# Average Walk Times To Nearest Day Care Centres Per Census Tract



Source: Toronto Childrens Services

# Average Walk Times To Nearest Day Care Centres Per Census Tract

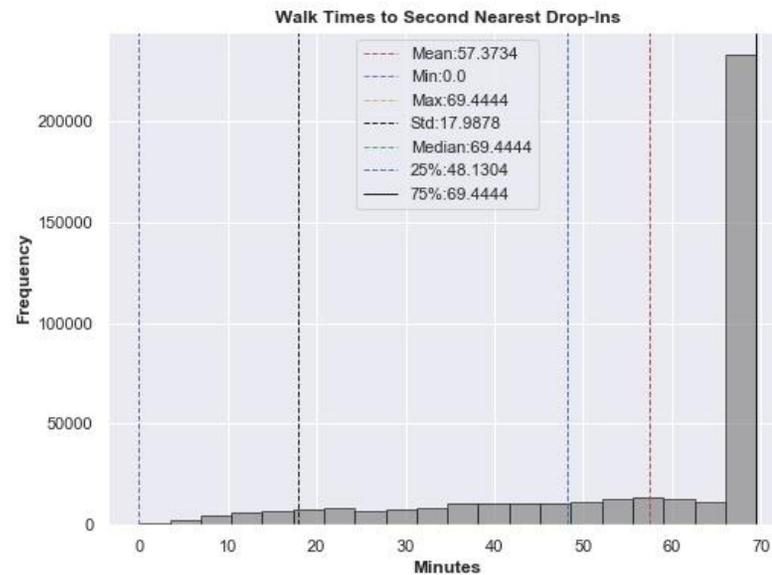
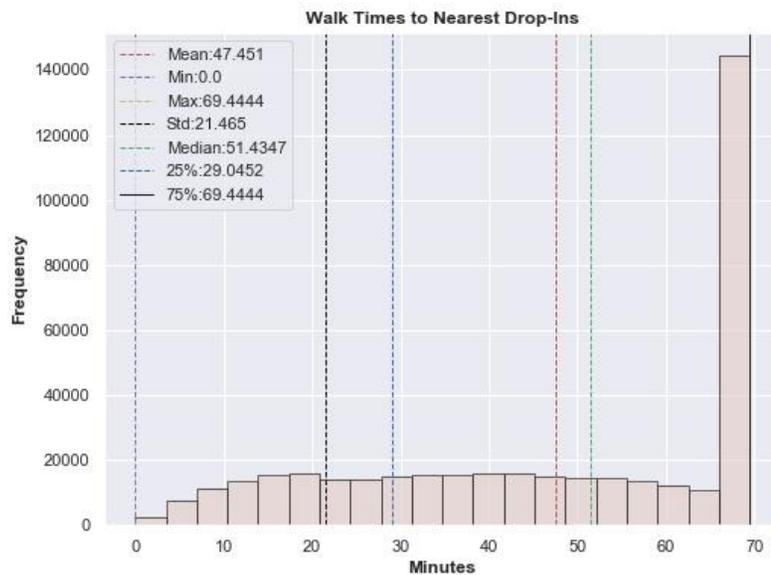


Source: Toronto Childrens Services

# Drop-in Centres

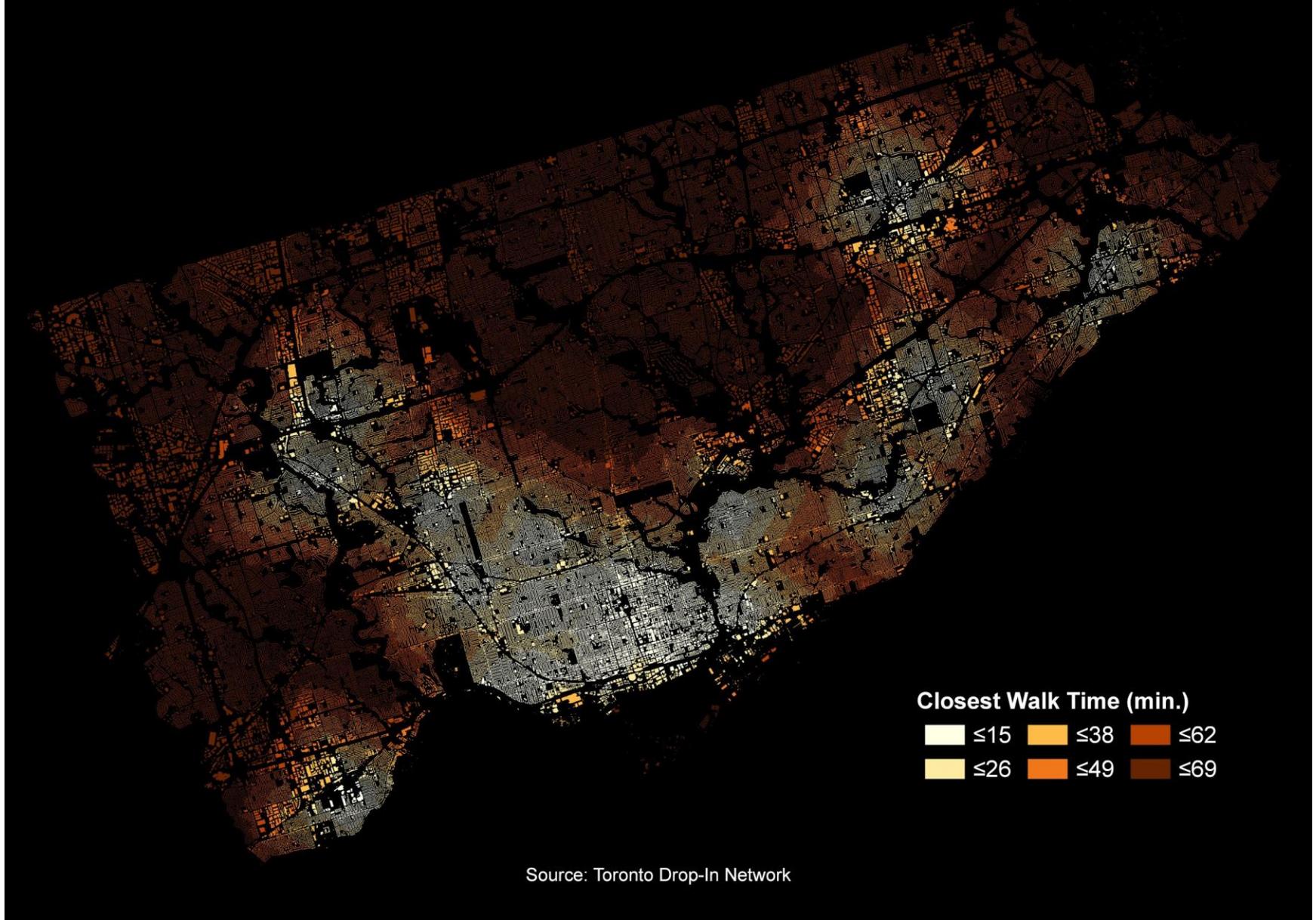
**Definition:** This data set contains the locations of drop-in centres within Toronto that are members of the Toronto Drop-In Network. The Toronto Drop-In Network (TDIN) is an active coalition of drop-in centres working with people who are homeless, marginally housed or socially isolated in Toronto. The Network includes drop-ins of all sizes and diverse philosophies serving men, women, youth, seniors and families. Member agencies are located throughout the City of Toronto.

**Description:** The mean walking time to a drop-in centre is 47.5 minutes and the median walking time is 51.4 minutes city-wide. City-wide walktimes vary with a standard deviation of 21.5 minutes. Approximately 25% of all addresses in the city have less than a 29.0 minute walk, while 75% of all addresses have less than a 69.4 minute walk to the closest drop-in centre. Census tract 5350264.00 has the maximum average walk time with over a 69.4 minute walk to the closest drop-in centre and is shared by 1 other census tracts. Census Tract 5350063.05 has less than a 3.1 minute walk to the closest drop-in centre and is shared by 134 other census tracts.



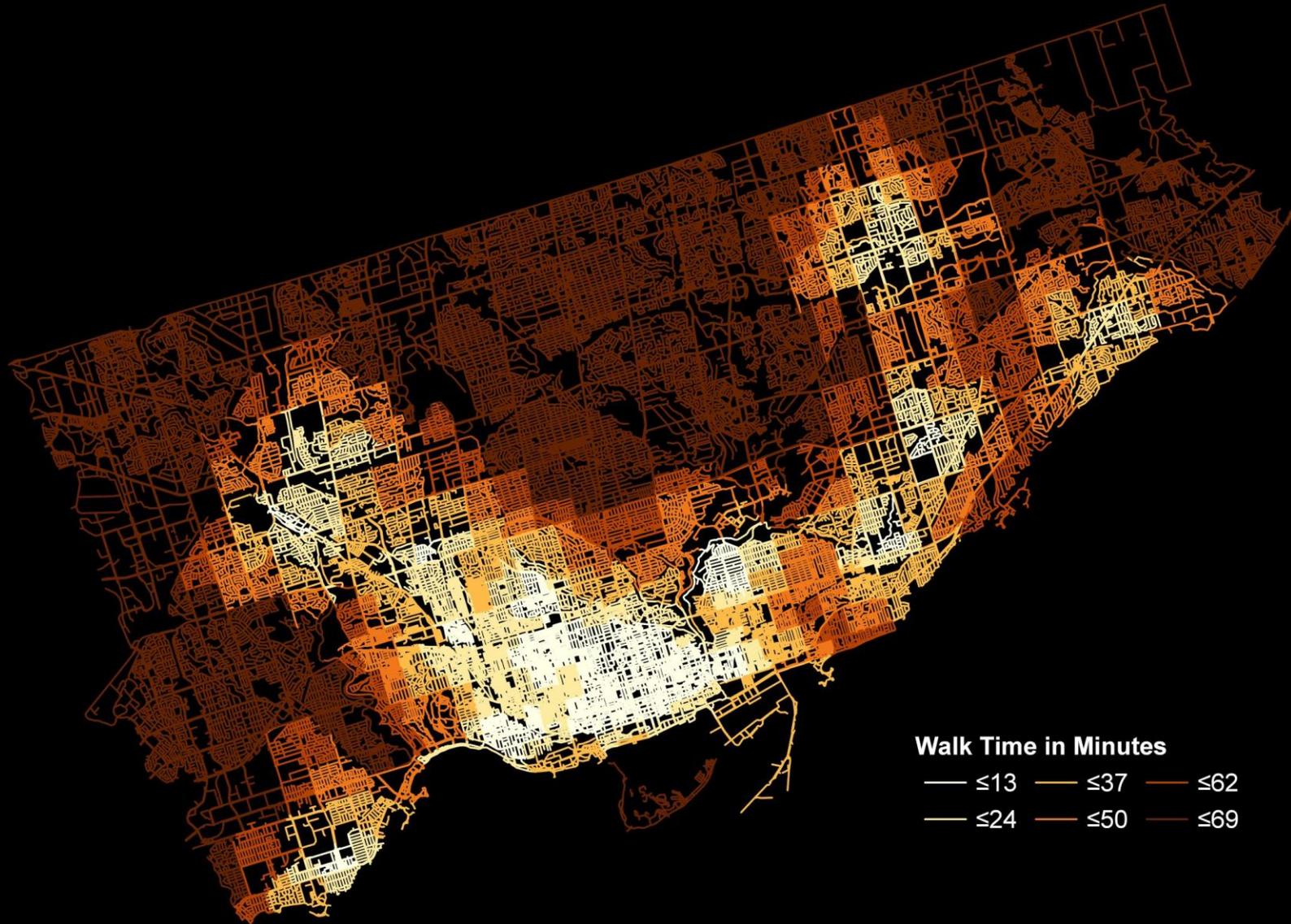
**Interpretation:** There appears to be a significant change in walk times from the first to the second closest Drop-in Centres with a 9.9 minute difference in mean walk times from the closest to the second closest Drop-in Centres. There is less than a 3.5 minute decrease in the standard deviation of walktimes between the first and second closest Drop-in Centres. There is not a significant change in the geographic distribution between the first and second Drop-Ins with a p-value of 0.0 at a .95 confidence interval. Suggesting that locations are geographically stationary across the city. Shorter walking times for drop-in centres are in those areas in south eastern Scarborough centred on Kingston Road and Lawrence Ave E, north central Scarborough in the Malvern community, south western Scarborough, most of downtown Toronto, southern Etobicoke, and the Highway 400 and 401 area.

## Walk Times To Nearest Drop-Ins



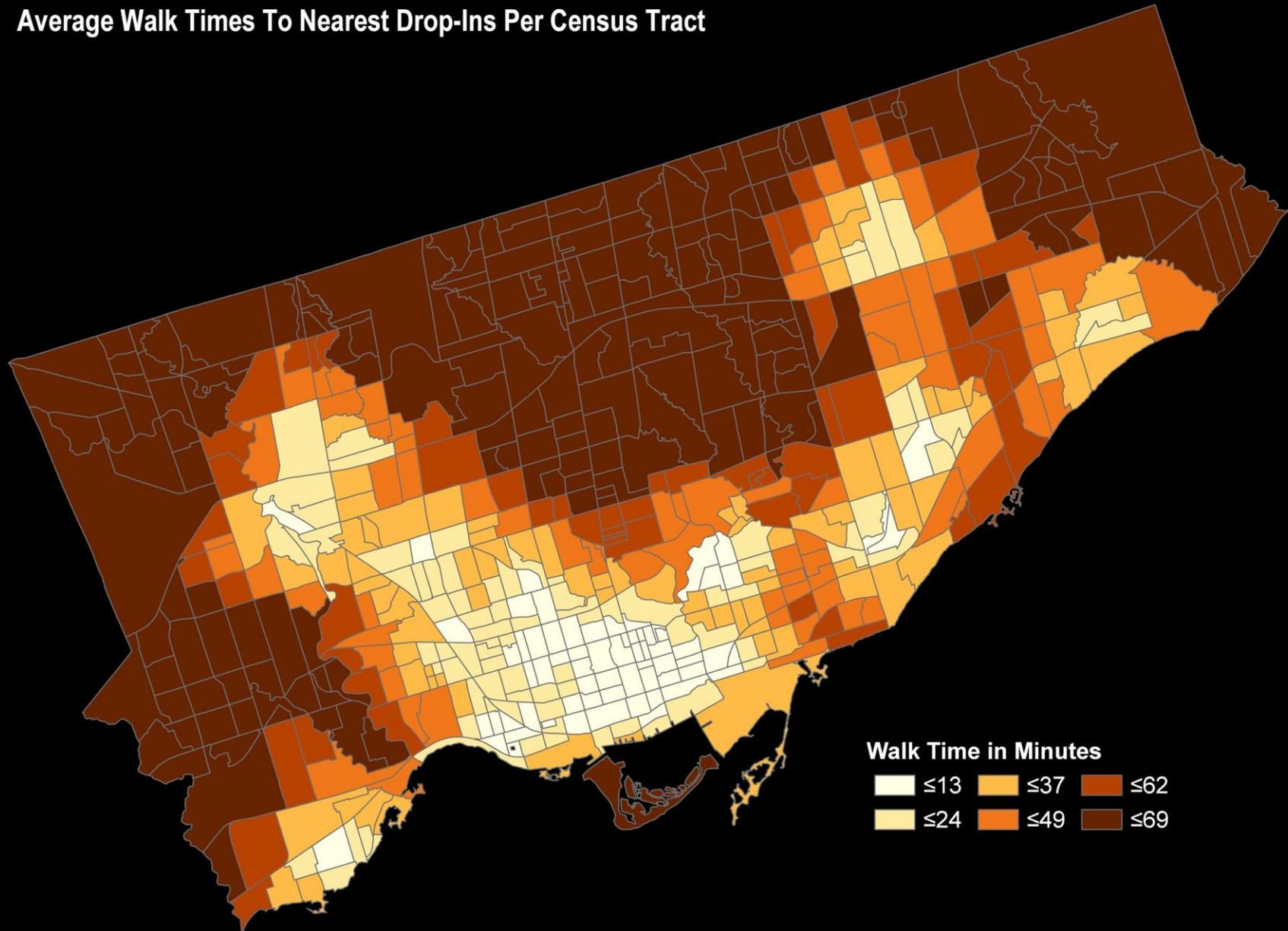
Source: Toronto Drop-In Network

## Average Walk Times To Nearest Drop-Ins Per Census Tract



Source: Toronto Drop-In Network

## Average Walk Times To Nearest Drop-Ins Per Census Tract

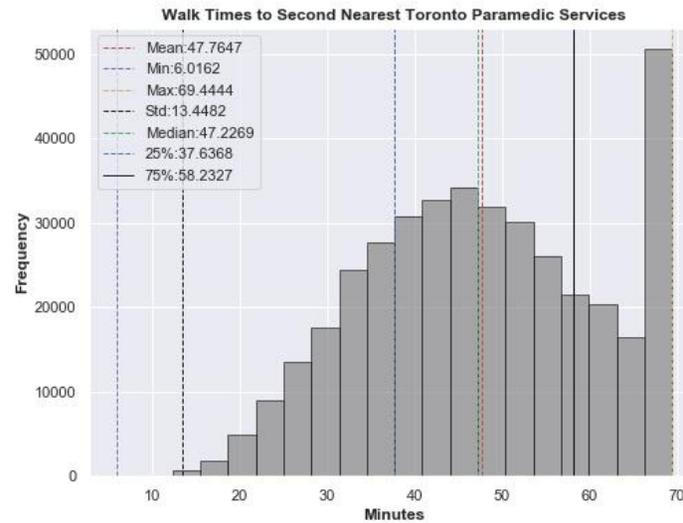
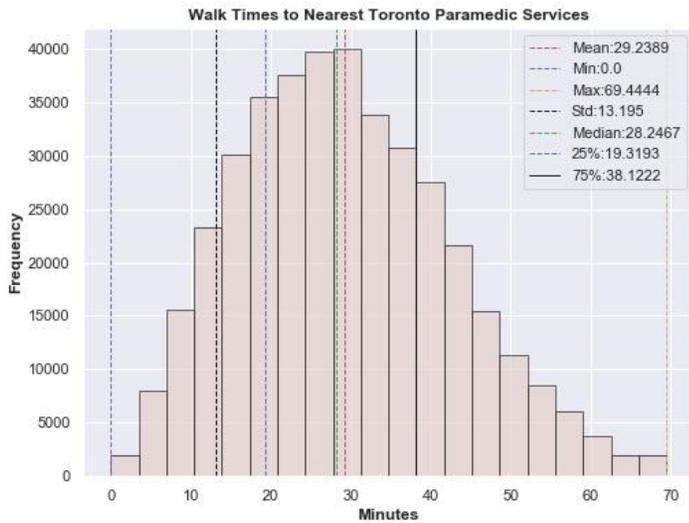


Source: Toronto Drop-In Network

# Toronto Paramedic Services

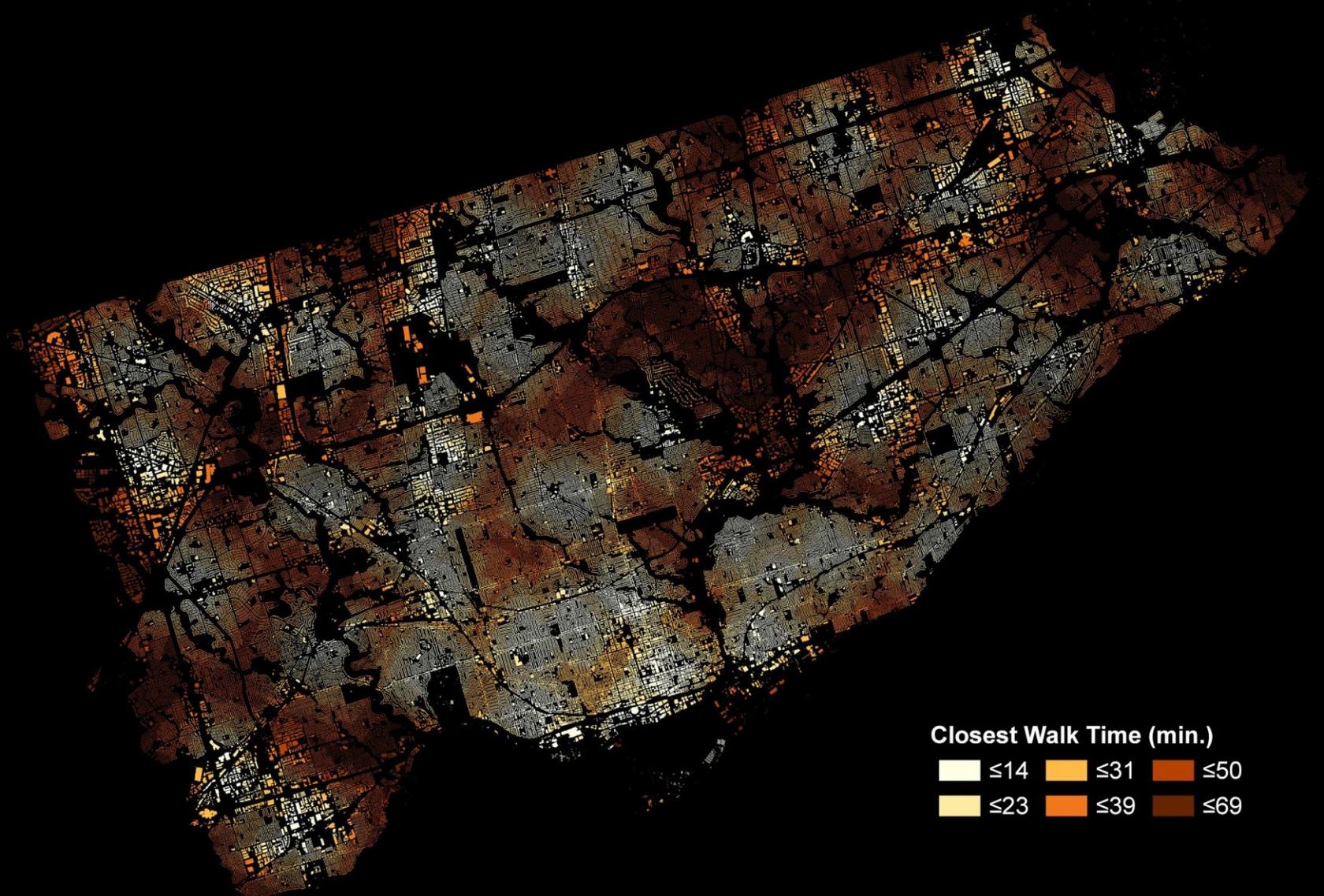
**Definition:** Toronto Paramedic Services locations.

**Description:** The mean walking time to a Toronto Paramedic Service is 29.2 minutes and the median walking time is 28.2 minutes city-wide. City-wide walktimes vary with a standard deviation of 13.2 minutes. Approximately 25% of all addresses in the city have less than a 19.3 minute walk, while 75% of all addresses have less than a 38.1 minute walk to the closest Toronto Paramedic Service. Census tract 5350802.02 has the maximum average walk time with over a 65.6 minute walk to the closest Toronto Paramedic Service and is shared by 1 other census tracts. Census Tract 5350015.00 has less than a 5.2 minute walk to the closest Toronto Paramedic Service and is shared by 1 other census tracts.



**Interpretation:** There appears to be a significant change in walk times from the first to the second closest Ambulance Stations with an 18.5 minute difference in mean walk times from the closest to the second closest Ambulance Stations. There is less than a 0.3 minute increase in the standard deviation of walktimes between the first and second closest Ambulance Stations. There is not a significant change in the geographic distribution between the first and second Toronto Paramedic Services with a p-value of 0.0 at a .95 confidence interval. Suggesting that locations are geographically stationary across the city. It should be noted that Toronto Paramedic Services responds to people in distress with a response time of 11.5 minutes [\[4\]](#). Since Toronto Paramedic Service locations don't offer services at the stations then low walkability is not a factor although the presence of essential services in a community does indicate a level of commitment by the City of Toronto.

# Walk Times To Nearest Toronto Paramedic Services



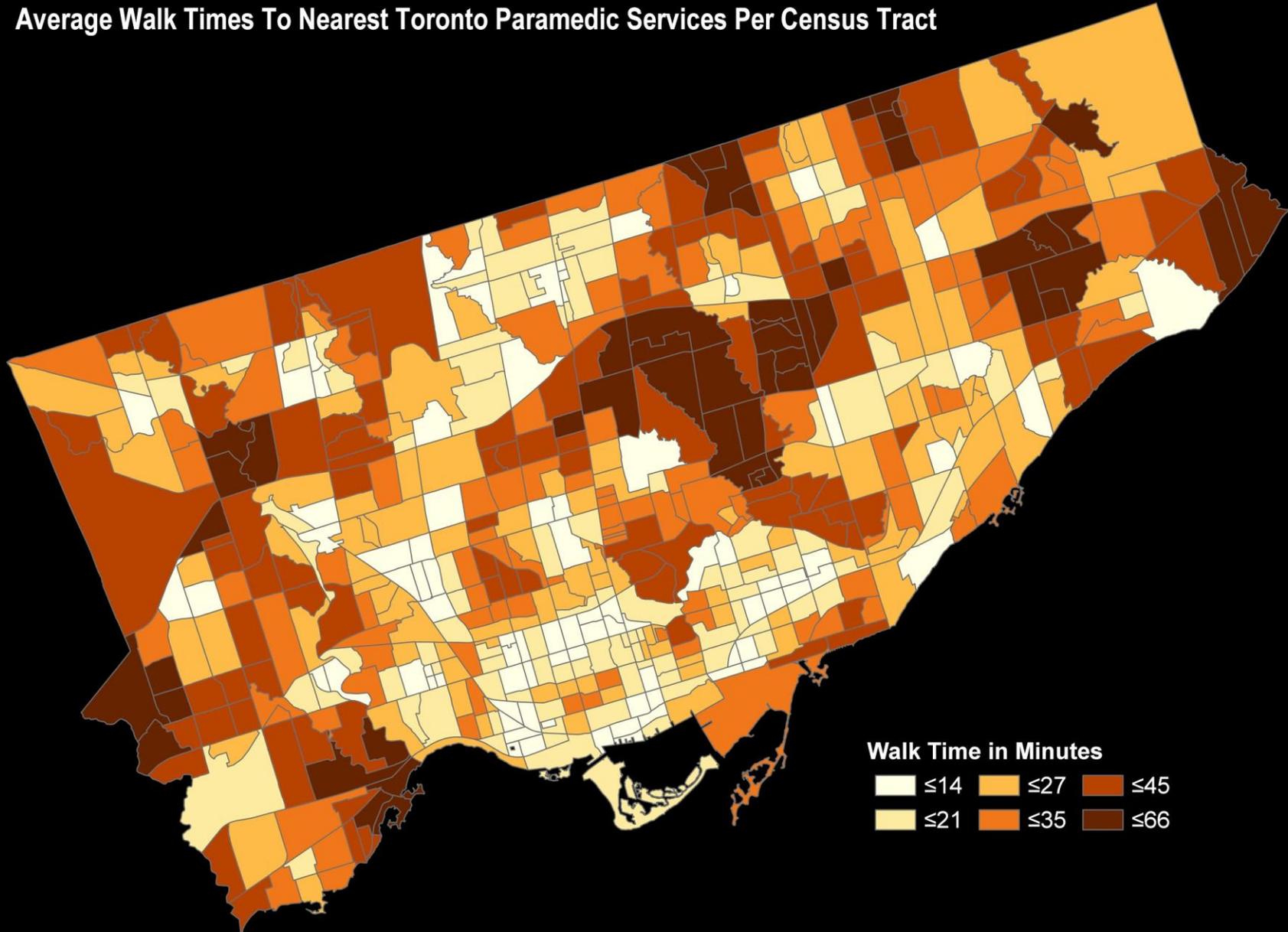
Source: Toronto Paramedic Services

# Average Walk Times To Nearest Toronto Paramedic Services Per Census Tract



Source: Toronto Paramedic Services

## Average Walk Times To Nearest Toronto Paramedic Services Per Census Tract



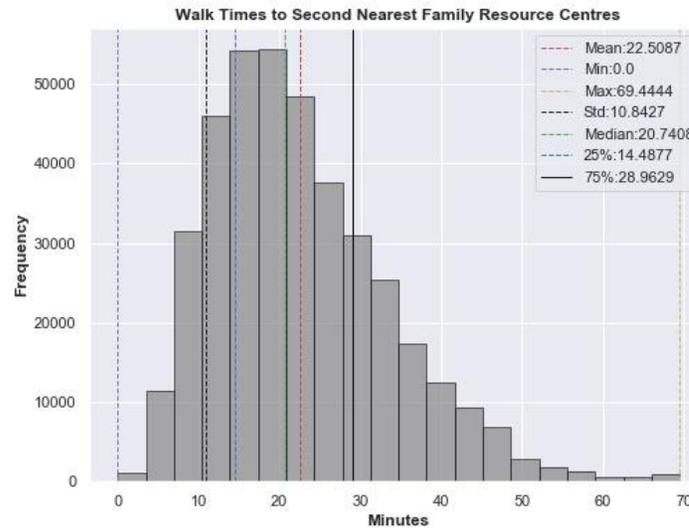
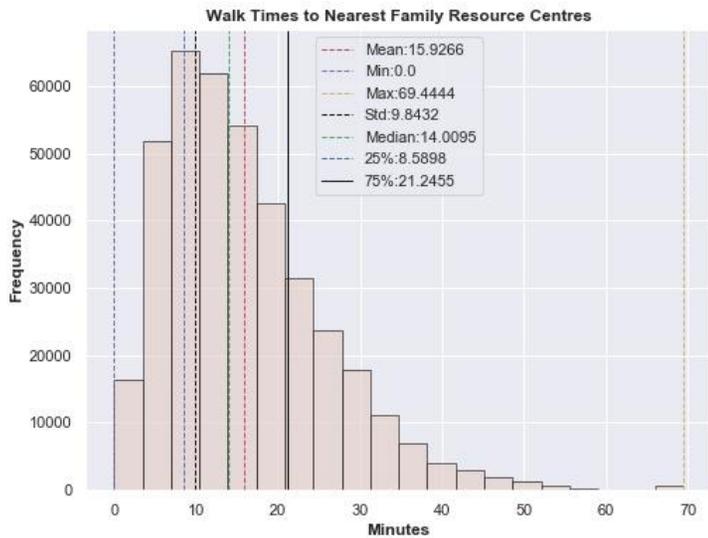
Source: Toronto Paramedic Services

# Family Resource Centres

**Definition:** Children's Services EarlyON Child and family centres offer free programs to parents/caregivers and their children from birth to six years of age. These centres welcome all families to participate in quality programs that

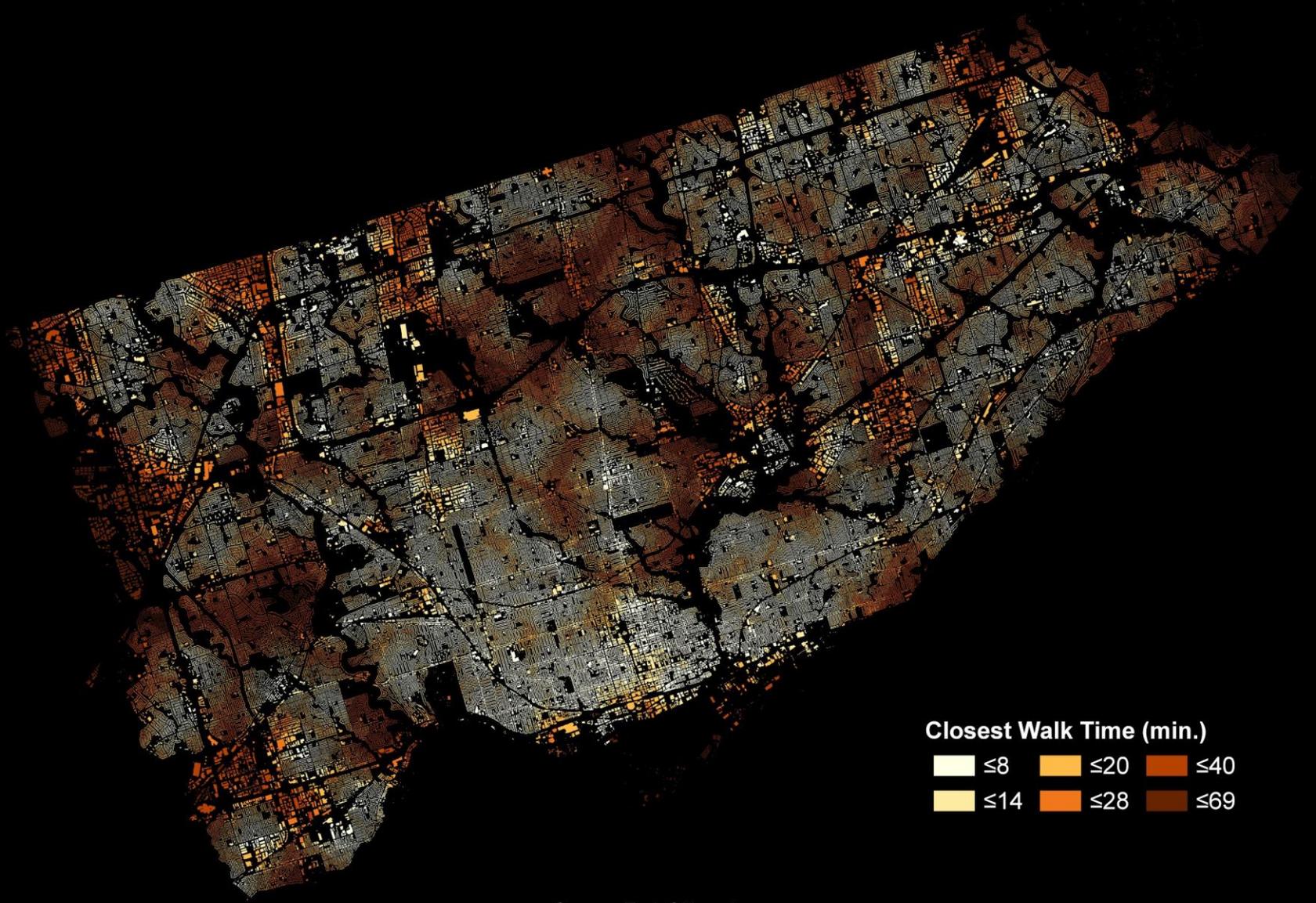
- 1) Help strengthen adult-child relationships,
- 2) Support parent education, and
- 3) Foster healthy child development.

**Description:** The mean walking time to a family resource centre is 15.9 minutes and the median walking time is 14.0 minutes city-wide. City-wide walktimes vary with a standard deviation of 9.8 minutes. Approximately 25% of all addresses in the city have less than an 8.6 minute walk, while 75% of all addresses have less than a 21.2 minute walk to the closest family resource centre. Census tract 5350002.00 has the maximum average walk time with over a 69.0 minute walk to the closest family resource centre and is shared by 1 other census tracts. Census Tract 5350063.04 has less than a 2.4 minute walk to the closest family resource centre and is shared by 1 other census tracts.



**Interpretation:** There appears to be a change in walk times from the first to the second closest Family Resource Centre with a 6.6 minute difference in mean walk times from the closest to the second closest Family Resource Centre. There is a 1 minute increase in the standard deviation of walktimes between the first and second closest Family Resource Centre. There is not a significant change in the geographic distribution between the first and second Family Resource Centres with a p-value of 0.0 at a .95 confidence interval. Suggesting that locations are geographically stationary across the city. Walktimes to Family Resource Centres are under 8 minutes for downtown Toronto and East York below the Don Valley Parkway. Increased walktimes are evident along the eastern border of Scarborough and the western border of Etobicoke. Increased walktimes are also evident in the area to the south of Eglinton Ave W and Royal York Rd.

# Walk Times To Nearest Family Resource Centres



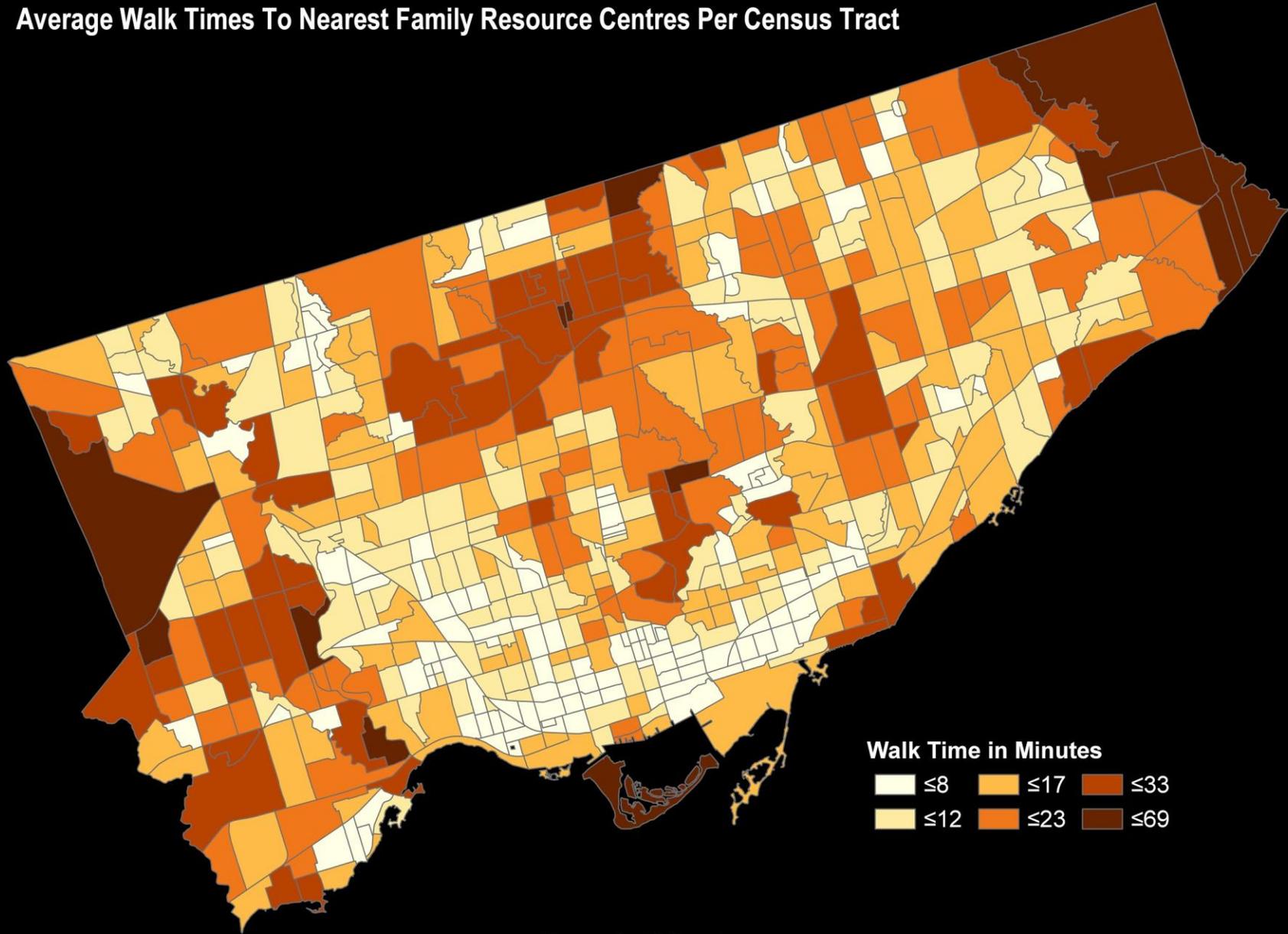
Source: EarlyON centres

# Average Walk Times To Nearest Family Resource Centres Per Census Tract



Source: EarlyON centres

# Average Walk Times To Nearest Family Resource Centres Per Census Tract

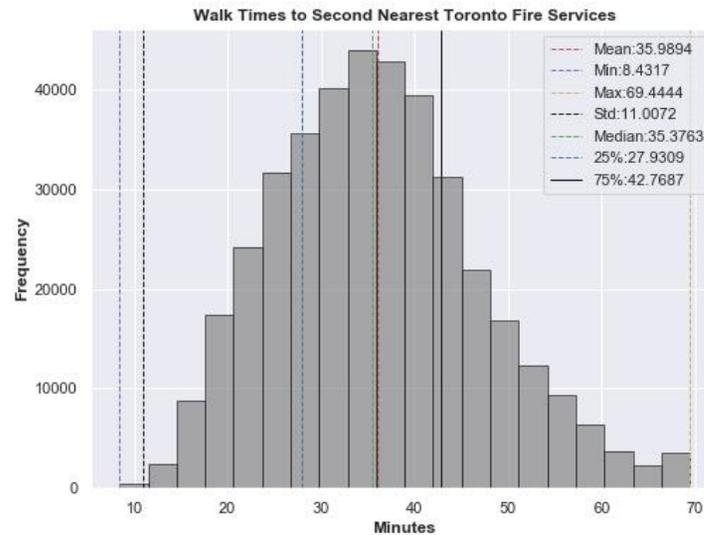
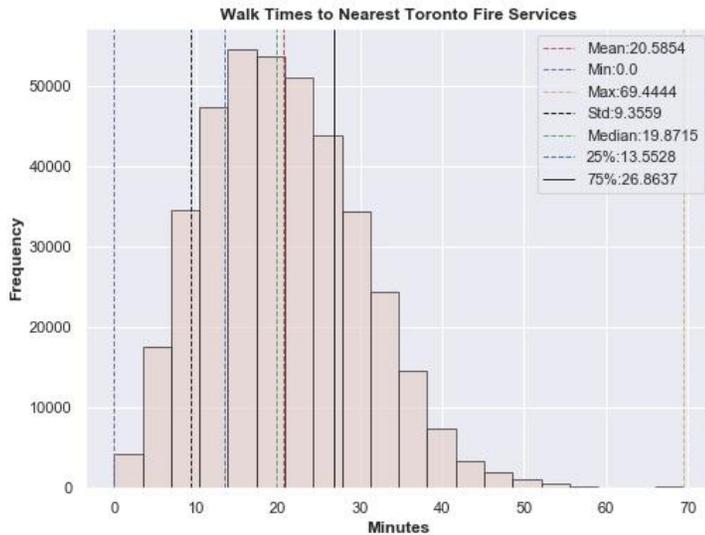


Source: EarlyON centres

# Fire Services

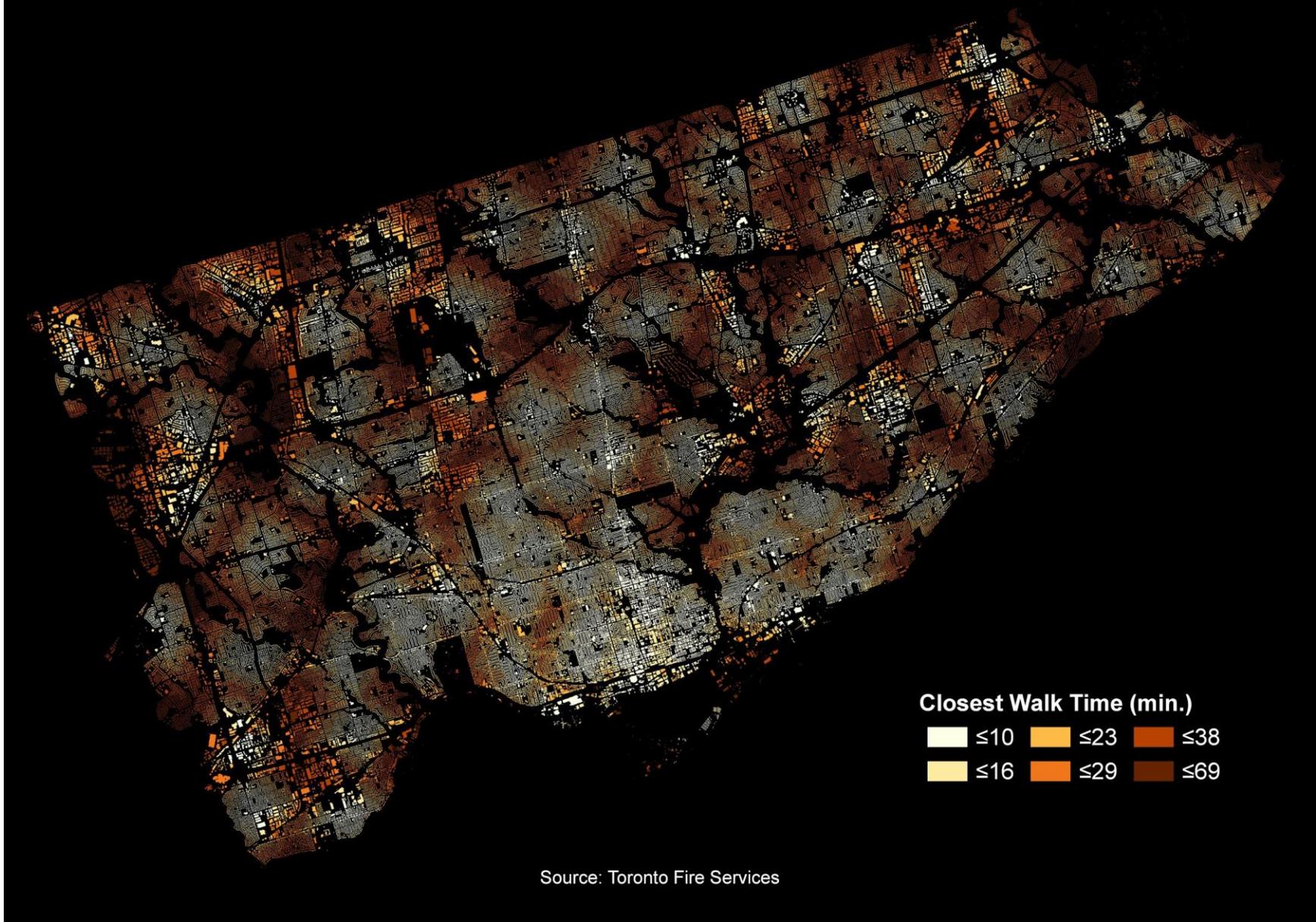
**Definition:** Toronto Fire Services locations.

**Description:** The mean walking time to a Toronto Fire Service is 20.6 minutes and the median walking time is 19.9 minutes city-wide. City-wide walktimes vary with a standard deviation of 9.4 minutes. Approximately 25% of all addresses in the city have less than a 13.6 minute walk, while 75% of all addresses have less than a 26.9 minute walk to the closest Toronto Fire Service. Census tract 5350378.28 has the maximum average walk time with over a 46.6 minute walk to the closest Toronto Fire Service and is shared by 1 other census tracts. Census Tract 5350065.01 has less than a 2.9 minute walk to the closest Toronto Fire Service and is shared by 1 other census tracts.



**Interpretation:** There appears to be a significant change in walk times from the first to the second closest Toronto Fire Services with a 15.4 minute difference in mean walk times from the closest to the second closest Toronto Fire Services. There is a 1.7 minute increase in the standard deviation of walktimes between the first and second closest Toronto Fire Services. There is not a significant change in the geographic distribution between the first and second Toronto Fire Services with a p-value of 0.0 at a .95 confidence interval. Suggesting that locations are geographically stationary across the city. Toronto Fire Services response time from initial call to arrival is 7.03 minutes while the Effective Firefighting Force ( Overall response time for fire emergencies from call acknowledgement to arrival of initial full alarm assignment at incident location.) is 10.29 minutes as of 2017 [8]. While walktimes to fire services is not that important, the location of core services does indicate an investment and commitment to the community.

## Walk Times To Nearest Toronto Fire Services

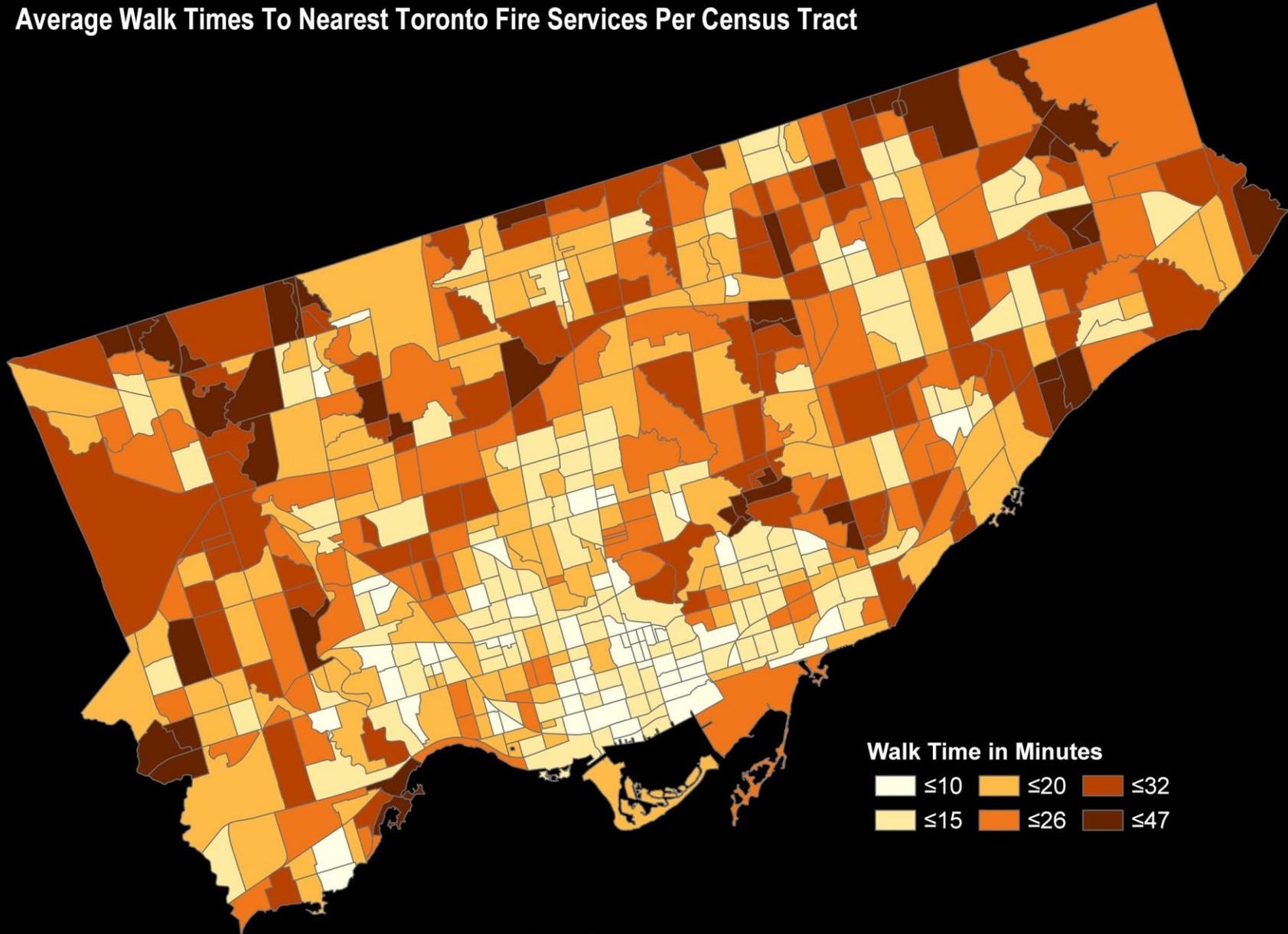


# Average Walk Times To Nearest Toronto Fire Services Per Census Tract



Source: Toronto Fire Services

# Average Walk Times To Nearest Toronto Fire Services Per Census Tract

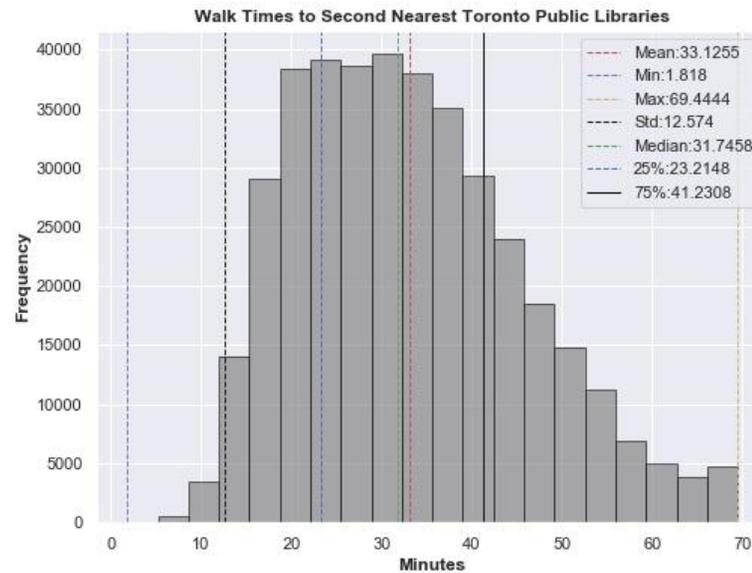
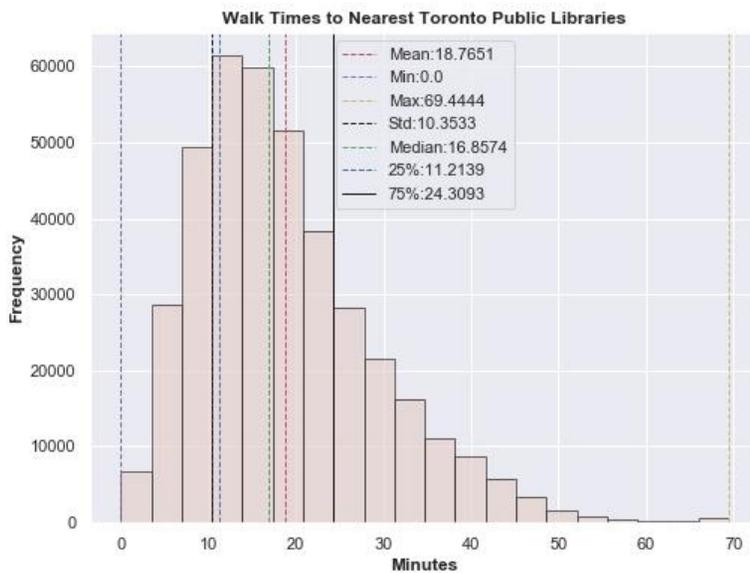


Source: Toronto Fire Services

# Libraries

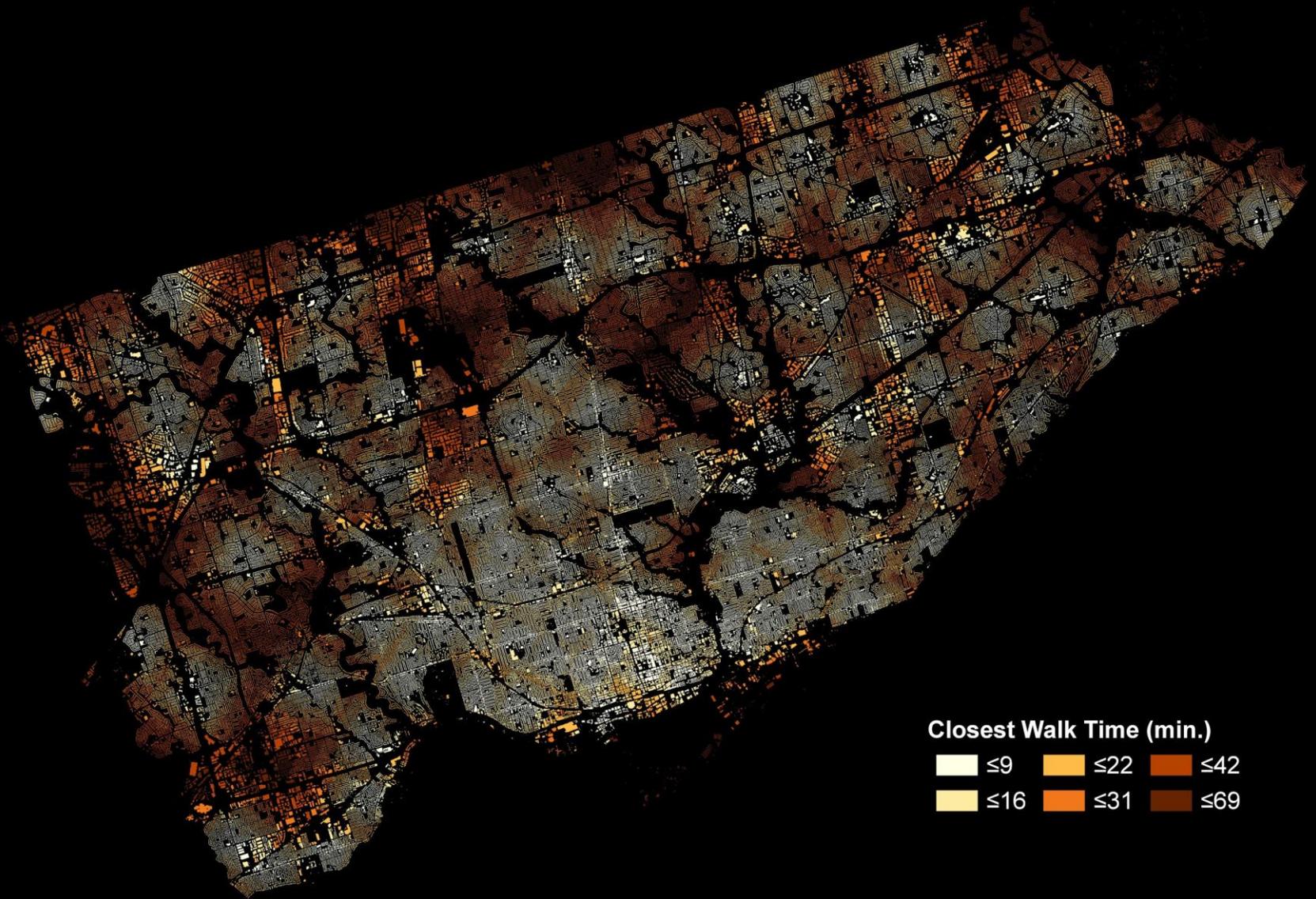
**Definition:** The Toronto Public Library operates a total of 100 branch libraries across Toronto. People benefit from libraries which are within reach. The study did not take into account the location of bookmobiles that are used to augment the service delivery area [\[9\]](#).

**Description:** The mean walking time to a Toronto Public Library is 18.8 minutes and the median walking time is 16.9 minutes city-wide. City-wide walktimes vary with a standard deviation of 10.4 minutes. Approximately 25% of all addresses in the city have less than an 11.2 minute walk, while 75% of all addresses have less than a 24.3 minute walk to the closest Toronto Public Library. Census tract 5350002.00 has the maximum average walk time with over a 69.0 minute walk to the closest Toronto Public Library and is shared by 1 other census tracts. Census Tract 5350190.01 has less than a 4.0 minute walk to the closest Toronto Public Library and is shared by 1 other census tracts.



**Interpretation:** There appears to be a significant change in walk times from the first to the second closest Public Library with a 14.4 minute difference in mean walk times from the closest to the second closest Public Library. There is a 2.2 minute increase in the standard deviation of walktimes between the first and second closest Public Library. There is not a significant change in the geographic distribution between the first and second Toronto Public Libraries with a p-value of 0.0 at a .95 confidence interval. Suggesting that locations are geographically stationary across the city. It can be seen from the maps that, libraries in city centre are more pedestrian-friendly. There are numerous and quite large libraries in the city centre compared to some communities in the north, west and east part of Toronto.

## Walk Times To Nearest Toronto Public Libraries



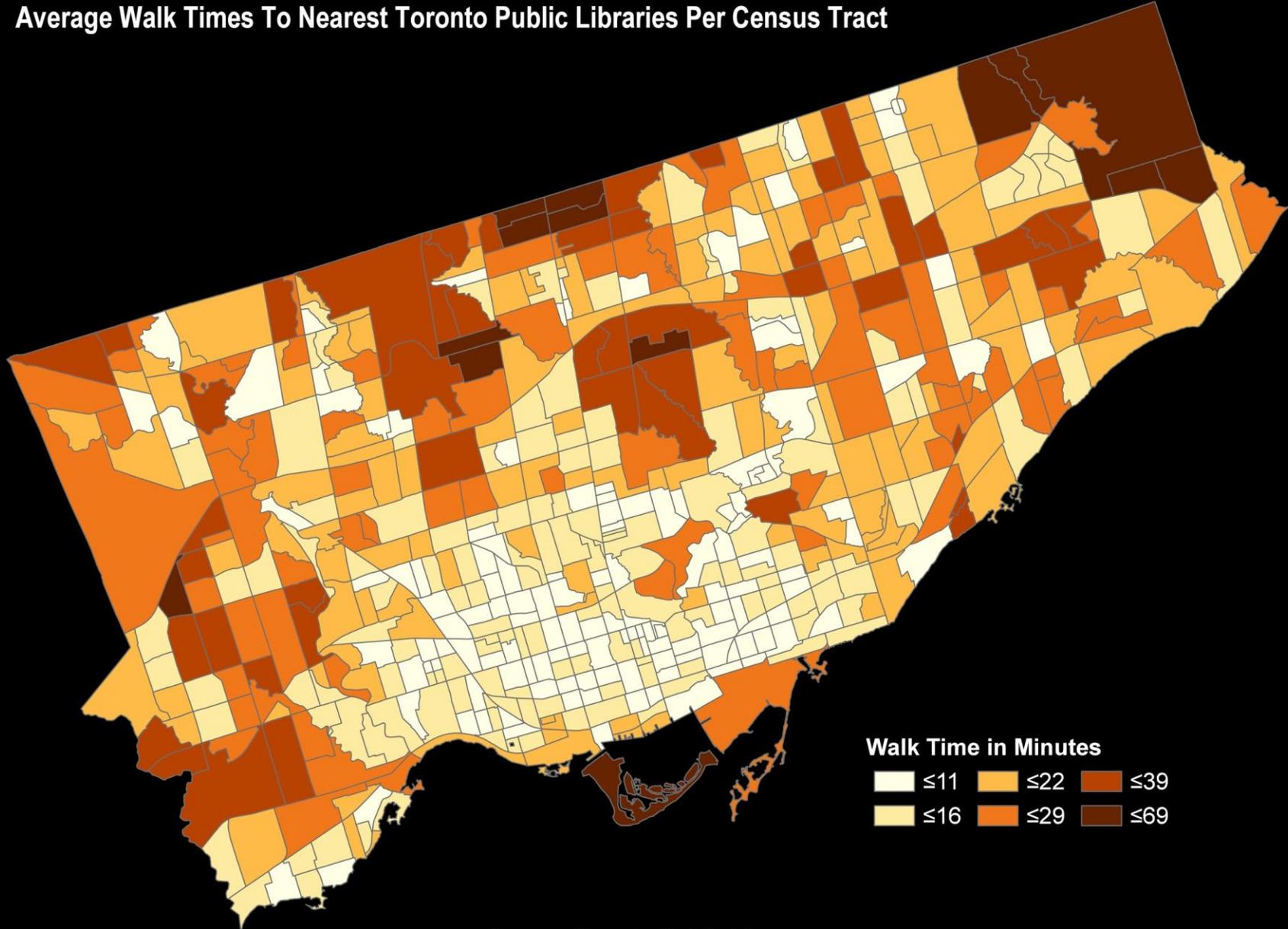
Source: Toronto Public Library

# Average Walk Times To Nearest Toronto Public Libraries Per Census Tract



Source: Toronto Public Library

# Average Walk Times To Nearest Toronto Public Libraries Per Census Tract

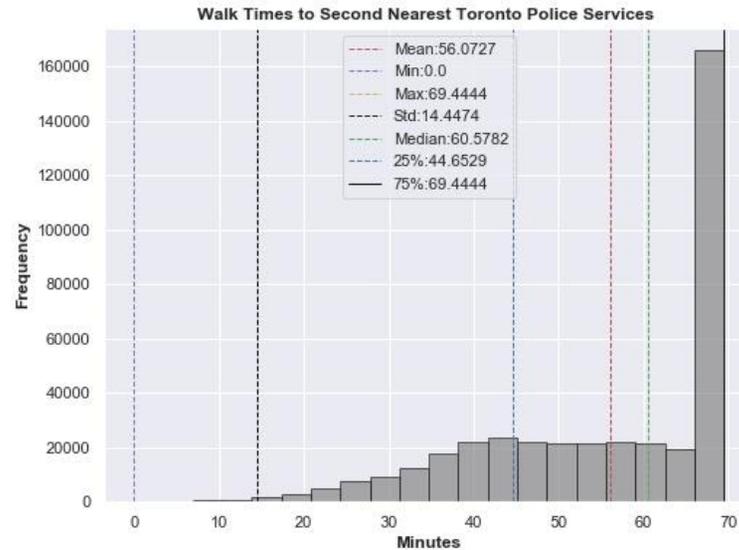
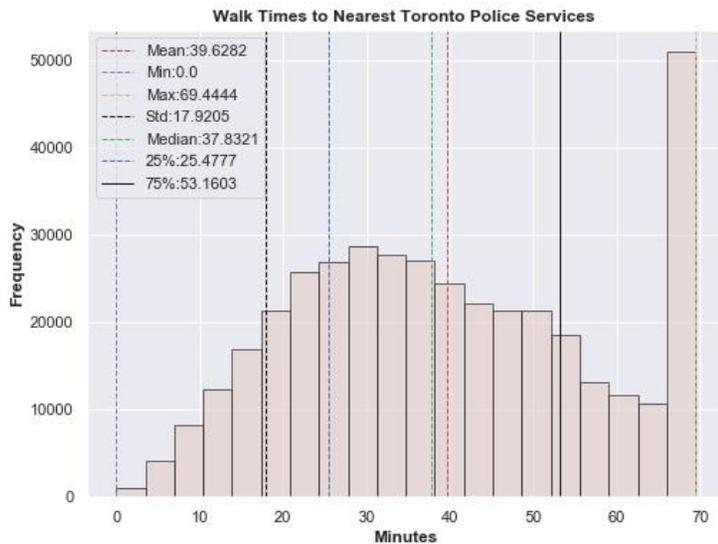


Source: Toronto Public Library

# Police Services

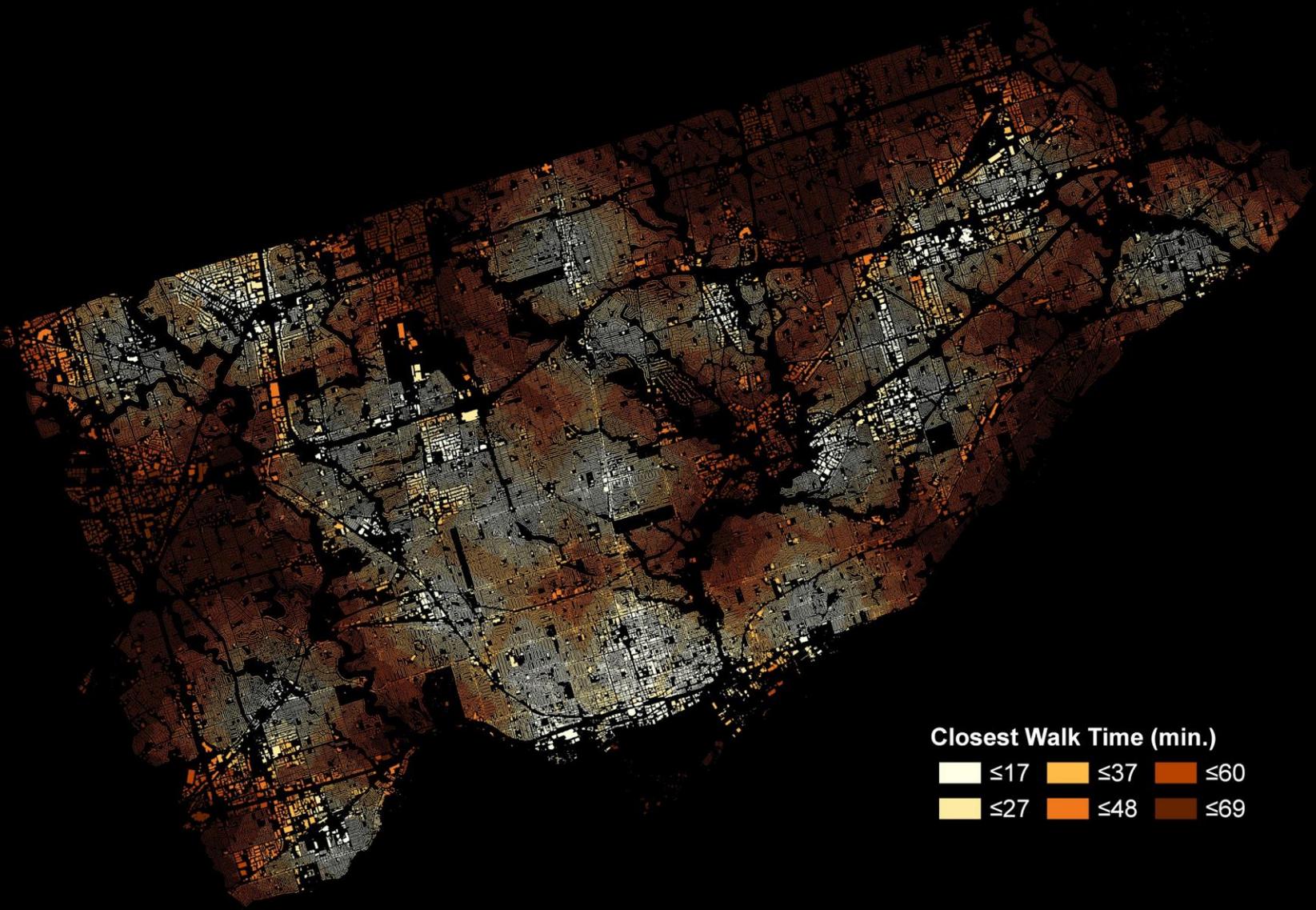
**Definition:** Toronto Police Services locations.

**Description:** The mean walking time to a Toronto Police Service is 39.6 minutes and the median walking time is 37.8 minutes city-wide. City-wide walktimes vary with a standard deviation of 17.9 minutes. Approximately 25% of all addresses in the city have less than a 25.5 minute walk, while 75% of all addresses have less than a 53.2 minute walk to the closest Toronto Police Service. Census tract 5350376.04 has the maximum average walk time with over a 69.4 minute walk to the closest Toronto Police Service and is shared by 1 other census tracts. Census Tract 5350012.04 has less than a 4.8 minute walk to the closest Toronto Police Service and is shared by 27 other census tracts.



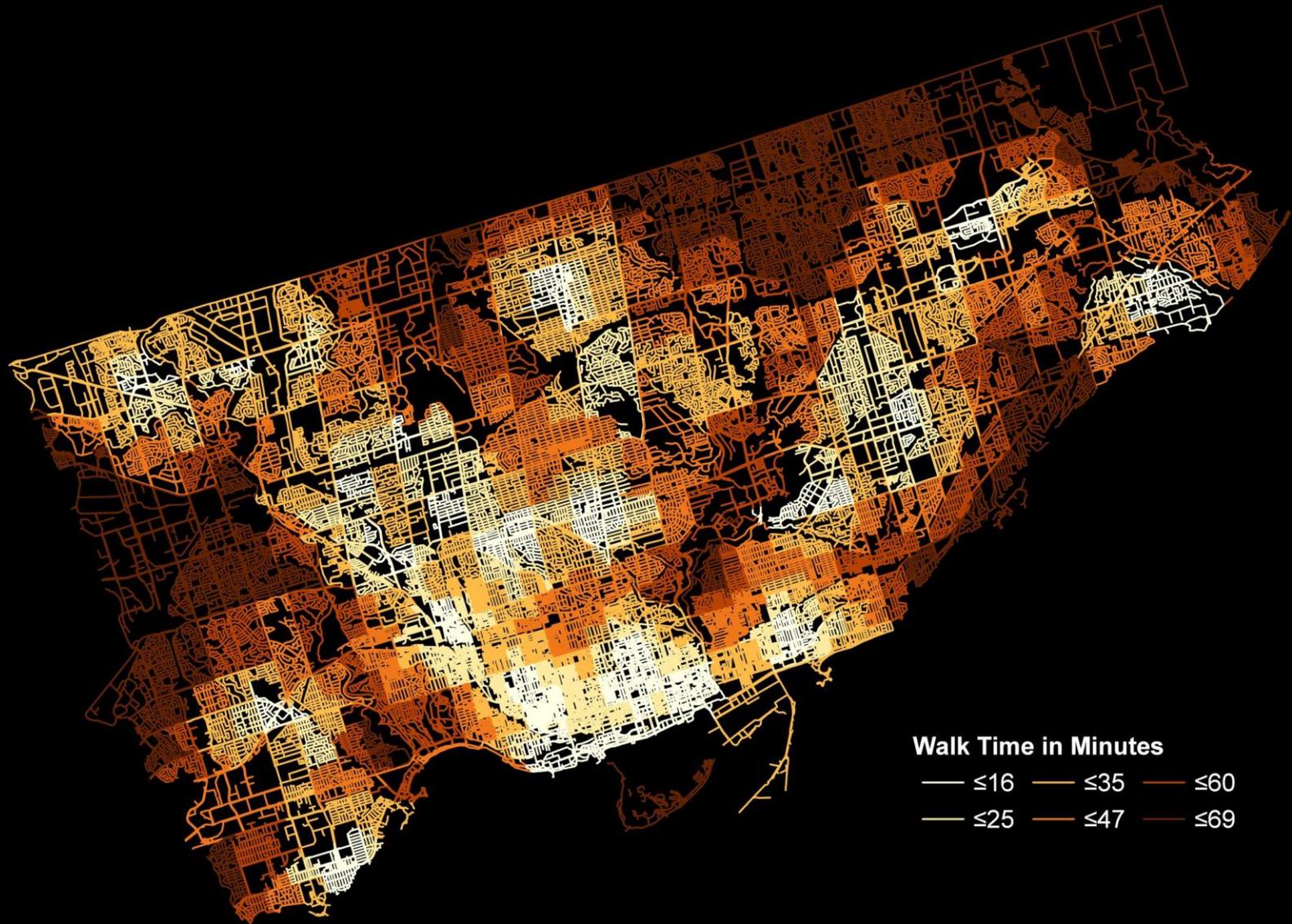
**Interpretation:** There appears to be a significant change in walk times from the first to the second closest Toronto Police Services with a 16.4 minute difference in mean walk times from the closest to the second closest Toronto Police Services. There is a 3.5 minute decrease in the standard deviation of walktimes between the first and second closest Toronto Police Services. There is not a significant change in the geographic distribution between the first and second Toronto Police Services with a p-value of 0.0 at a .95 confidence interval. Suggesting that locations are geographically stationary across the city. Shorter walktimes to Toronto Police Services are clustered around the service locations. Large areas of the City of Toronto are not within walking distance to a police station and thus would require other transportation options. While Toronto Police Services deploy services from stations vehicles are also on patrol thus reducing vehicle response times.

# Walk Times To Nearest Toronto Police Services



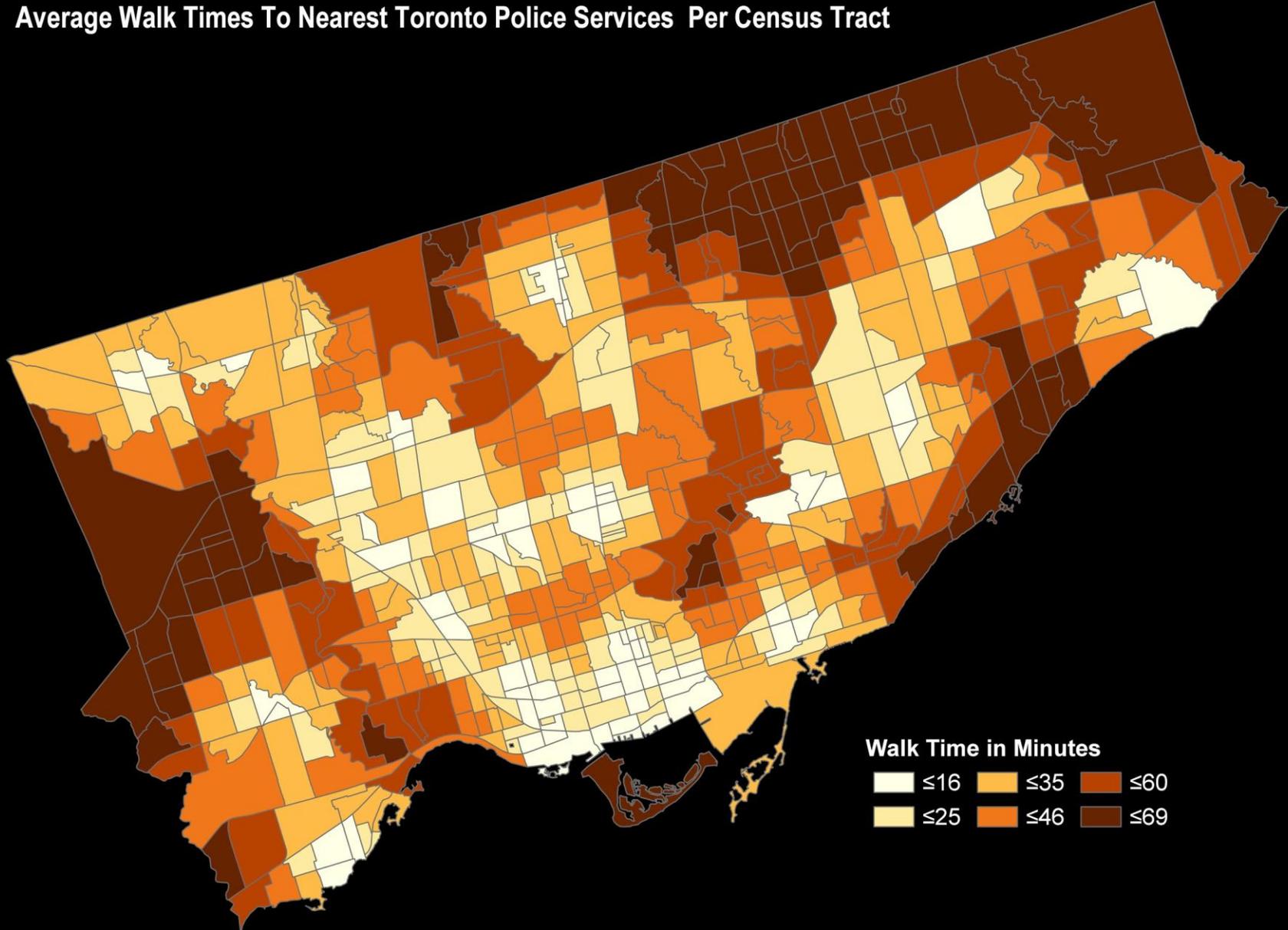
Source: Toronto Police Services

## Average Walk Times To Nearest Toronto Police Services Per Census Tract



Source: Toronto Police Services

# Average Walk Times To Nearest Toronto Police Services Per Census Tract

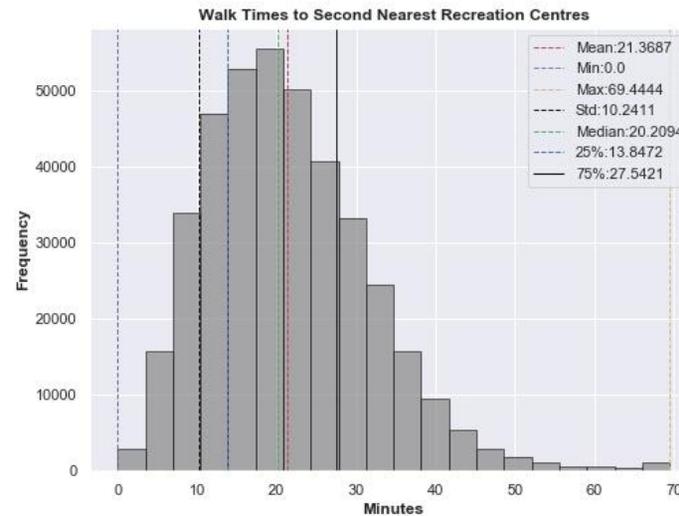
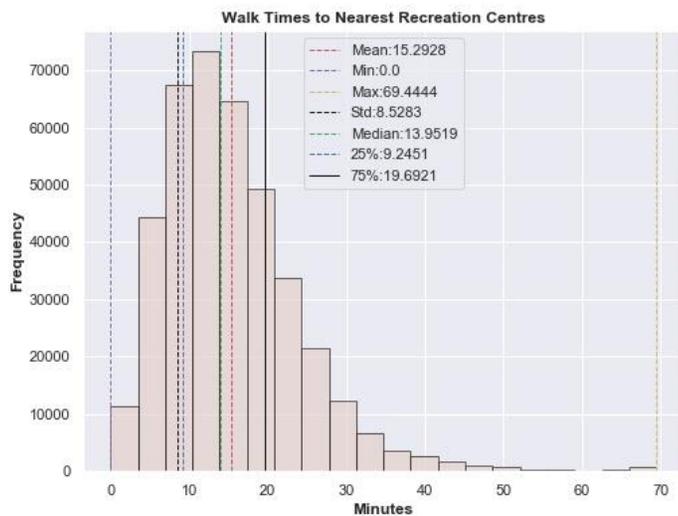


Source: Toronto Police Services

# Recreation Centres

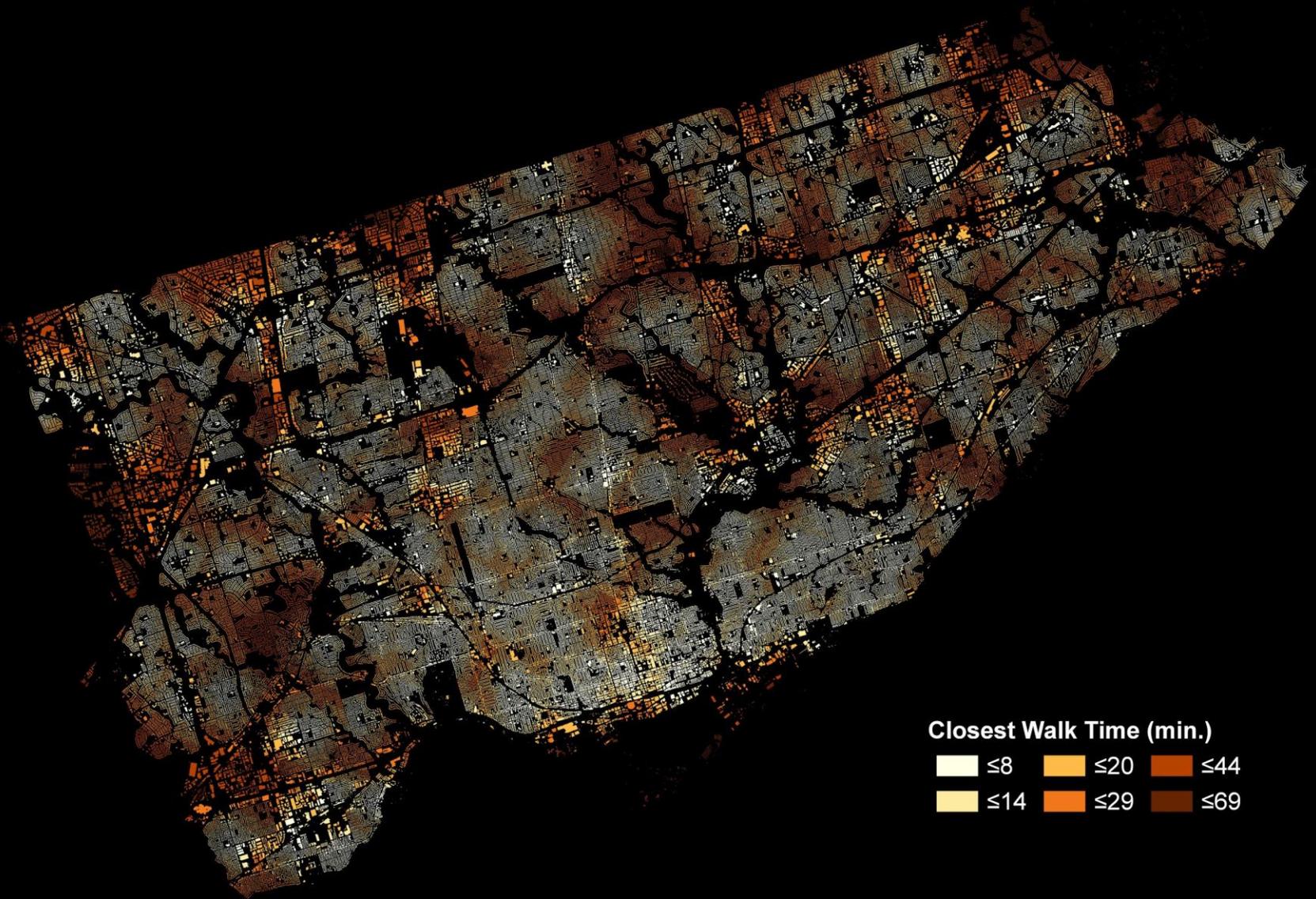
**Definition:** City of Toronto community recreation centres offer a wide range of facilities such as pools, rinks, gymnasiums, weight rooms, and meeting rooms. They also offer programs for all interests and age-groups. [29]

**Description:** The mean walking time to a recreation centre is 15.3 minutes and the median walking time is 14.0 minutes city-wide. City-wide walktimes vary with a standard deviation of 8.5 minutes. Approximately 25% of all addresses in the city have less than a 9.2 minute walk, while 75% of all addresses have less than a 19.7 minute walk to the closest recreation centre. Census tract 5350002.00 has the maximum average walk time with over a 69.1 minute walk to the closest recreation centre and is shared by 2 other census tracts. Census Tract 5350081.00 has less than a 3.7 minute walk to the closest recreation centre and is shared by 1 other census tracts.



**Interpretation:** There appears to be a change in walk times from the first to the second closest Recreation Centres with a 6.1 minute difference in mean walk times from the closest to the second closest Recreation Centres. There is a 1.7 minute increase in the standard deviation of walktimes between the first and second closest Recreation Centres. There is not a significant change in the geographic distribution between the first and second Recreation Centres with a p-value of 0.0 at a .95 confidence interval. Suggesting that locations are geographically stationary across the city. Walktimes are less than 8 minutes for large portions of the City Toronto especially in downtown Toronto east of Jarvis Street and the former city of East York. Suburban areas have higher walktimes with the area bounded by Bayview Ave, Finch Ave E, Leslie St and Highway 401 and northeastern Scarborough having the highest walktimes of between 35 and 69 minutes.

## Walk Times To Nearest Recreation Centres



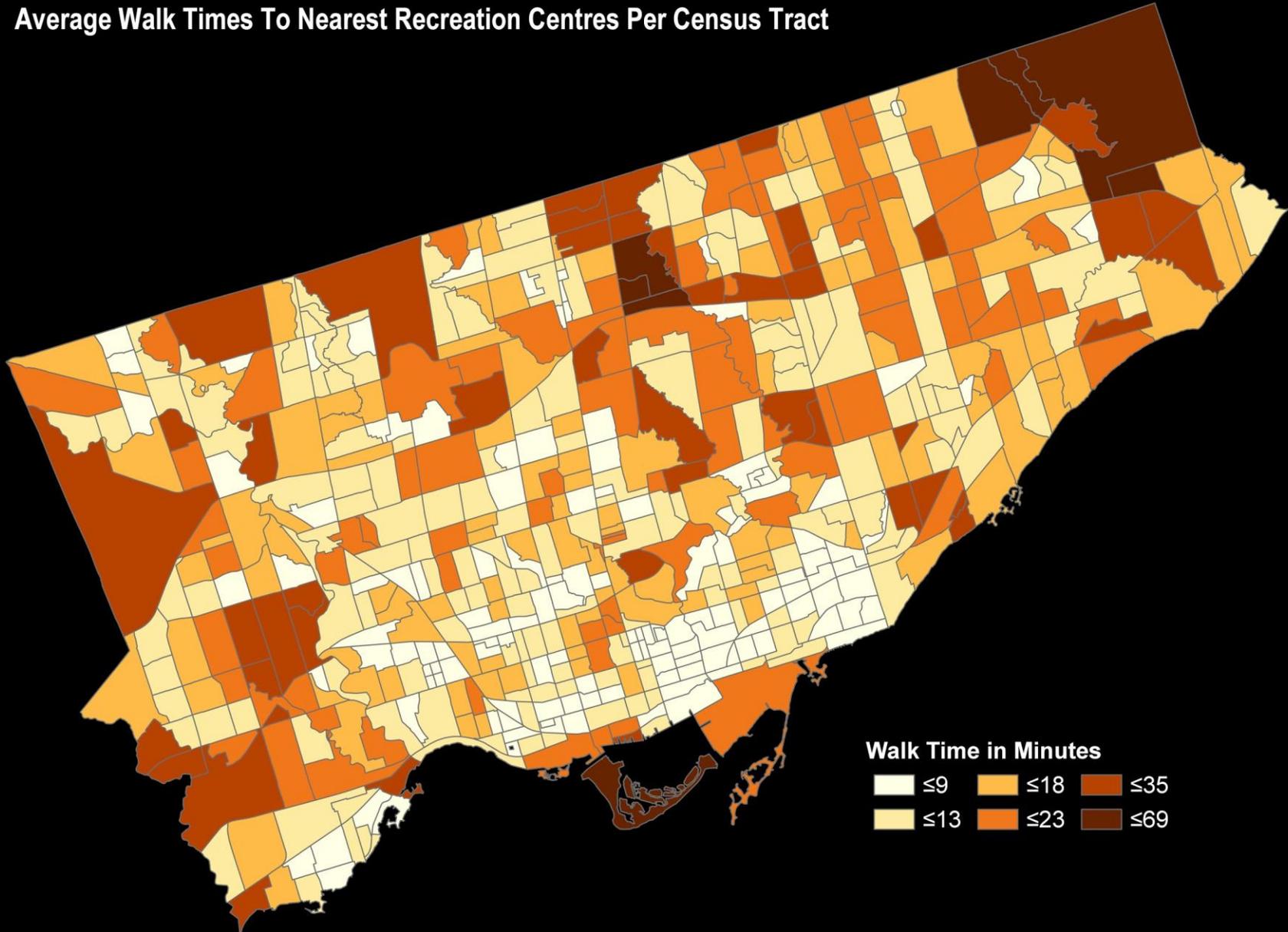
Source: Toronto Parks Forestry and Recreation

## Average Walk Times To Nearest Recreation Centres Per Census Tract



Source: Toronto Parks Forestry and Recreation

## Average Walk Times To Nearest Recreation Centres Per Census Tract

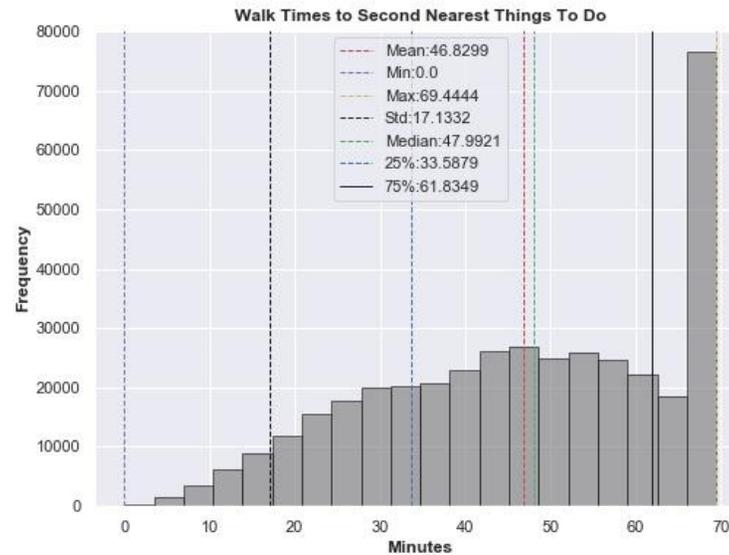
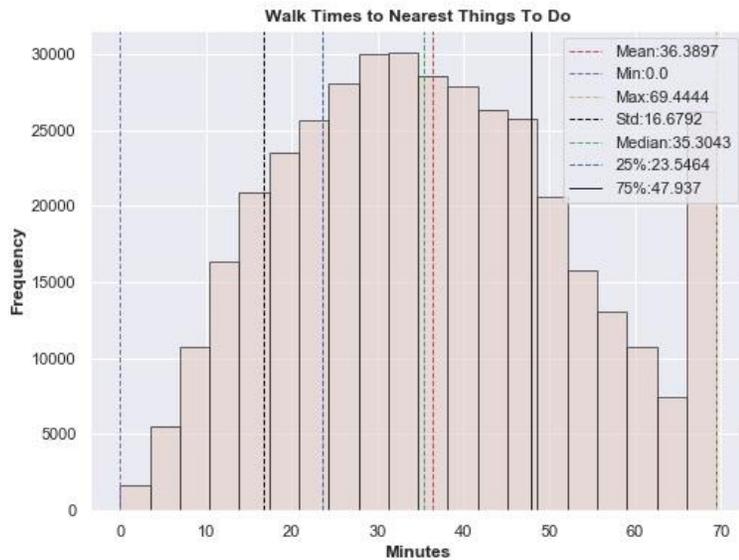


Source: Toronto Parks Forestry and Recreation

# Things to Do

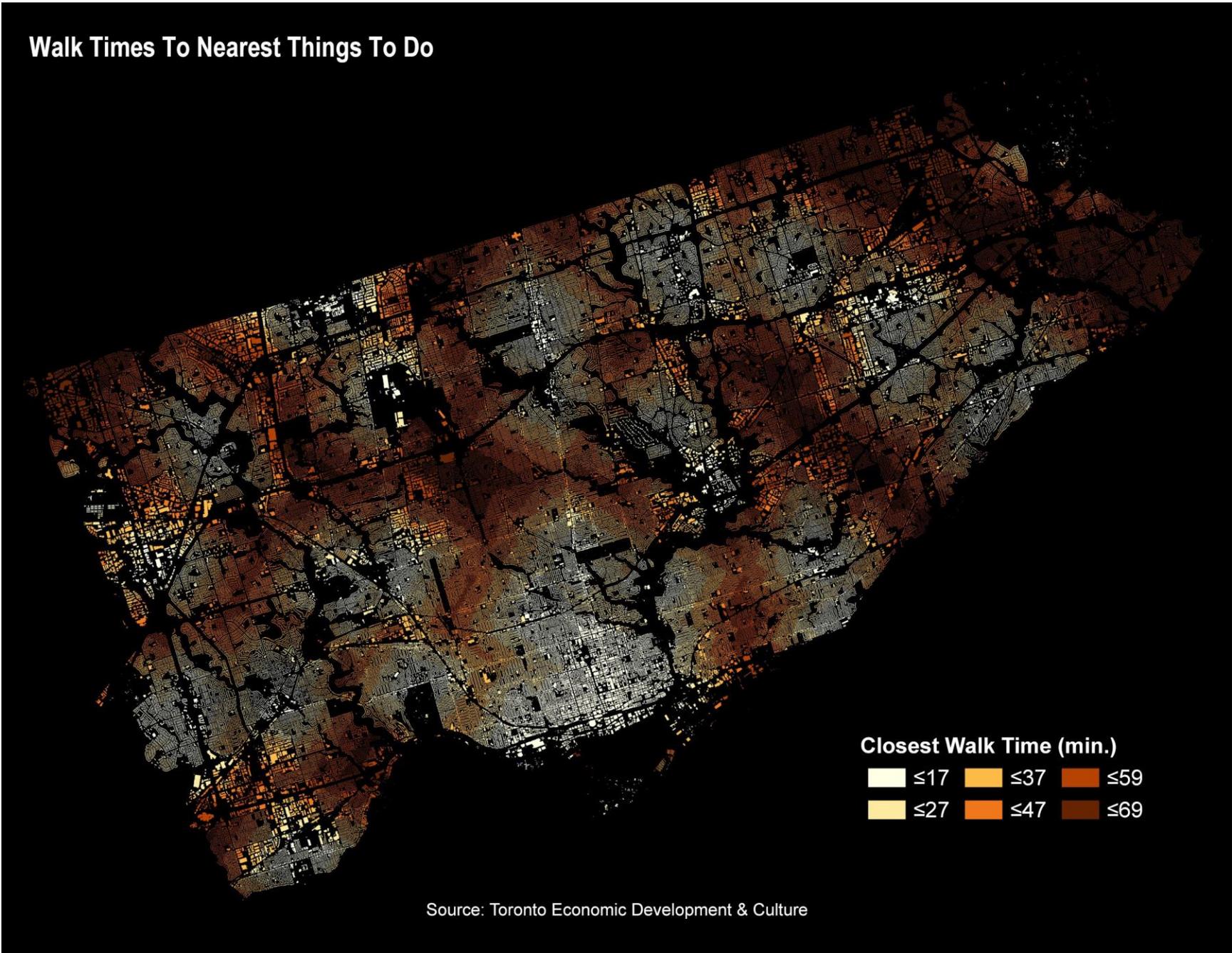
**Definition:** Things to do spans a vast geographic area and many local neighbourhoods with unique features. This dataset contains information about points of interest for residents and visitors to enjoy including public art, murals, buildings with historic or architectural significance, green spaces, restaurants and more.

**Description:** The mean walking time to Things To Do is 36.4 minutes and the median walking time is 35.3 minutes city-wide. City-wide walktimes vary with a standard deviation of 16.7 minutes. Approximately 25% of all addresses in the city have less than a 23.5 minute walk, while 75% of all addresses have less than a 47.9 minute walk to the closest things to do. Census tract 5350361.02 has the maximum average walk time with over a 69.4 minute walk to the closest things to do and is shared by 1 other census tracts. Census Tract 5350012.03 has less than a 2.9 minute walk to the closest things to do and is shared by 8 other census tracts.



**Interpretation:** There appears to be a significant change in walk times from the first to the second closest Things To Do with a 10.5 minute difference in mean walk times from the closest to the second closest Things To Do. There is a .5 minute increase in the standard deviation of walktimes between the first and second closest Things To Do. There is not a significant change in the geographic distribution between the first and second Things To Do with a p-value of 0.0 at a .95 confidence interval. Suggesting that locations are geographically stationary across the city. Walktimes to Things To Do is smallest in the downtown core as the majority of Things To Do are located in the downtown core including museums, sporting facilities, art galleries and retail. Another concentration is in the Yonge St and Shepard Ave area.

# Walk Times To Nearest Things To Do



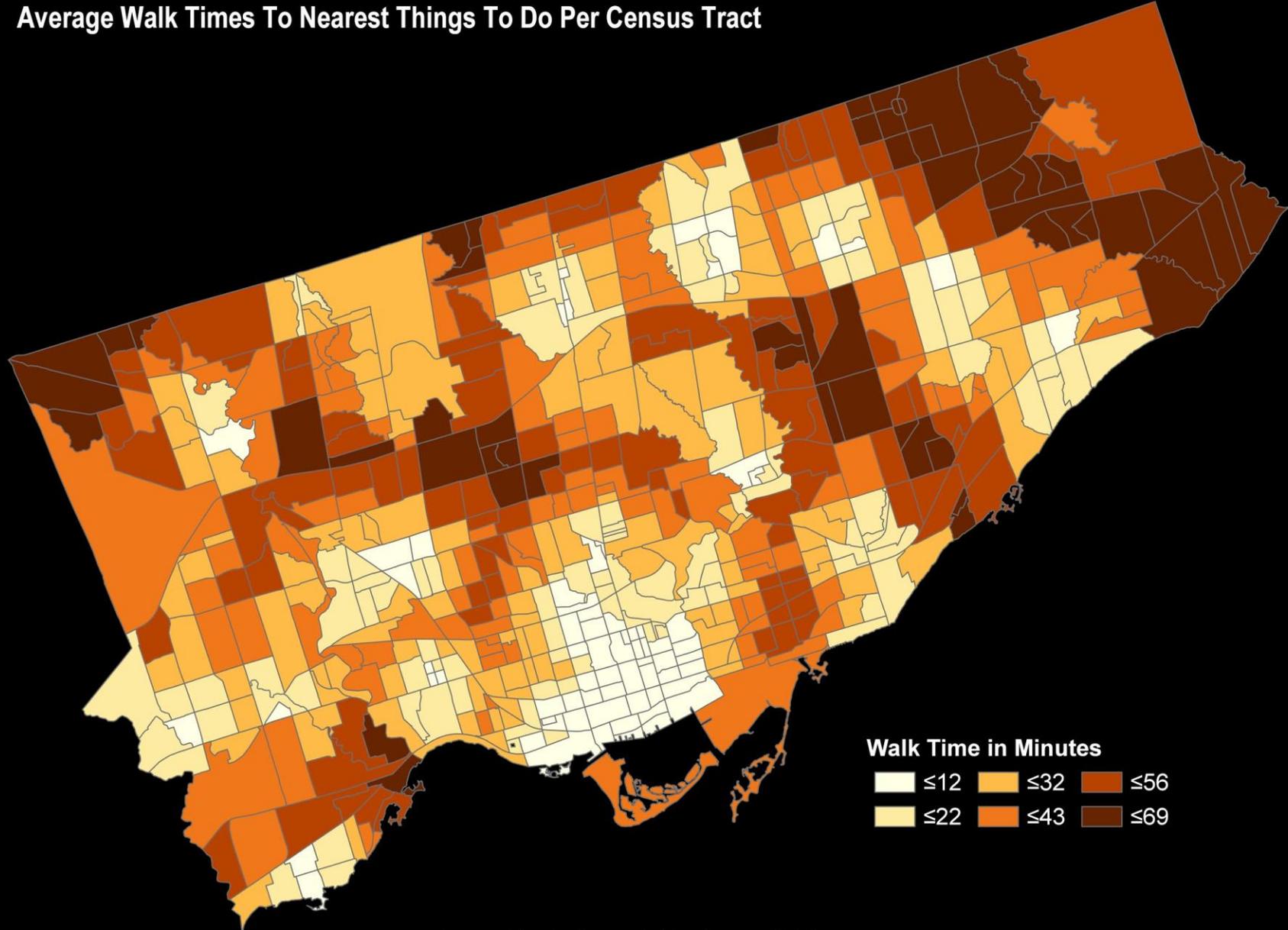
Source: Toronto Economic Development & Culture

# Average Walk Times To Nearest Things To Do Per Census Tract



Source: Toronto Economic Development & Culture

# Average Walk Times To Nearest Things To Do Per Census Tract

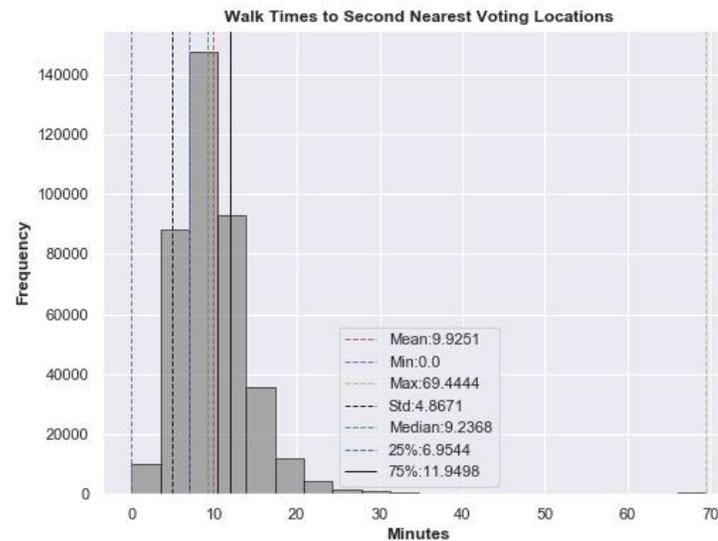
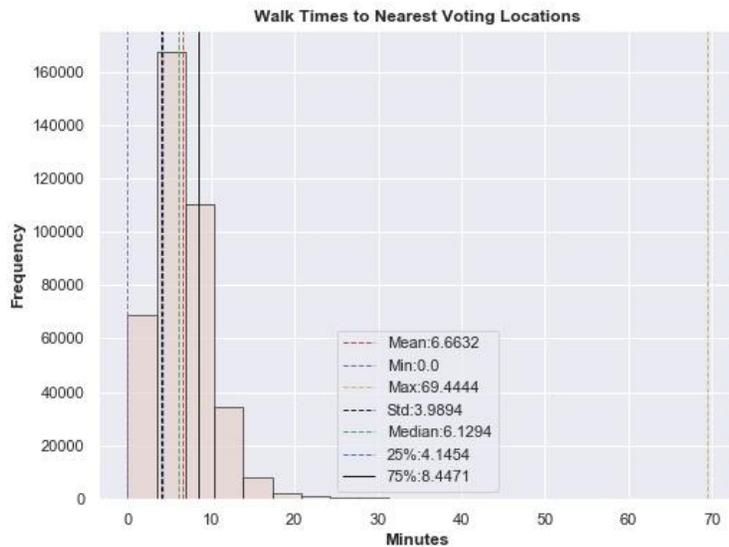


Source: Toronto Economic Development & Culture

# Voting Locations

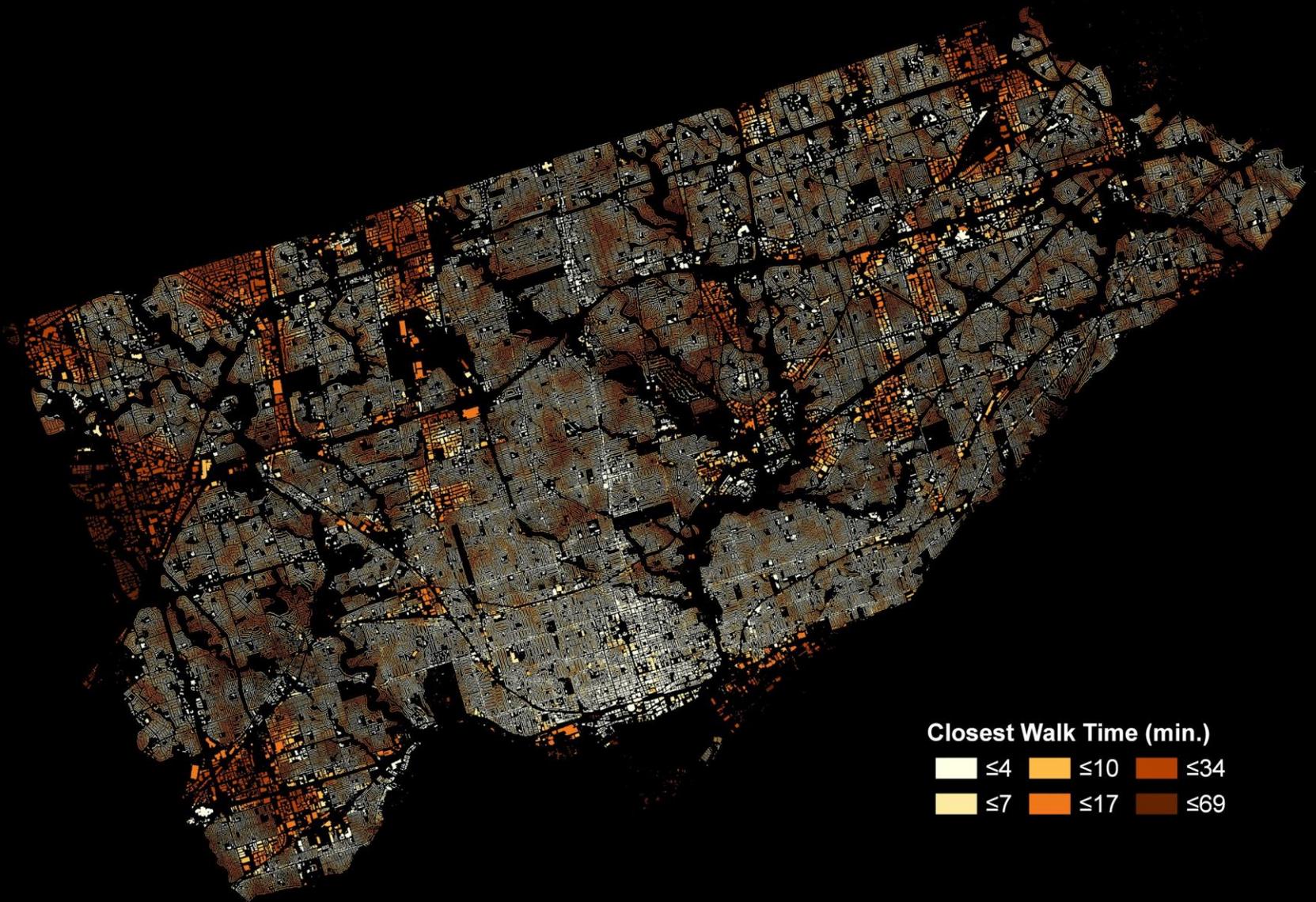
**Definition:** All the voting locations for the entire City of Toronto for the 2018 municipal election. The number and location of Voting Locations are established by the City Clerk who considers the convenience of electors [\[10\]](#). The clerk also takes into account that the accessible to electors with disabilities. Election staff work with voting lists supplied by the Municipal Property Assessment Corporation to allocate voters to each location.

**Description:** The mean walking time to a voting location is 6.7 minutes and the median walking time is 6.1 minutes city-wide. City-wide walktimes vary with a standard deviation of 4.0 minutes. Approximately 25% of all addresses in the city have less than a 4.1 minute walk, while 75% of all addresses have less than an 8.4 minute walk to the closest voting location. Census tract 5350378.26 has the maximum average walk time with over a 21.5 minute walk to the closest voting location and is shared by 1 other census tracts. Census Tract 5350194.01 has less than a 0.4 minute walk to the closest voting location and is shared by 1 other census tracts.



**Interpretation:** There appears to be a significant change in walk times from the first to the second closest Voting Locations with a 3.3 minute difference in mean walk times from the closest to the second closest Voting Locations. There is a .9 minute increase in the standard deviation of walktimes between the first and second closest Voting Locations. There is not a significant change in the geographic distribution between the first and second Voting Locations with a p-value of 0.0 at a .95 confidence interval. Suggesting that locations are geographically stationary across the city. Walktimes for the majority of the City of Toronto are less than 4 minutes to Voting Locations. Longer walktimes are industrial commercial areas in the city where eligible voters do not reside.

# Walk Times To Nearest Voting Locations



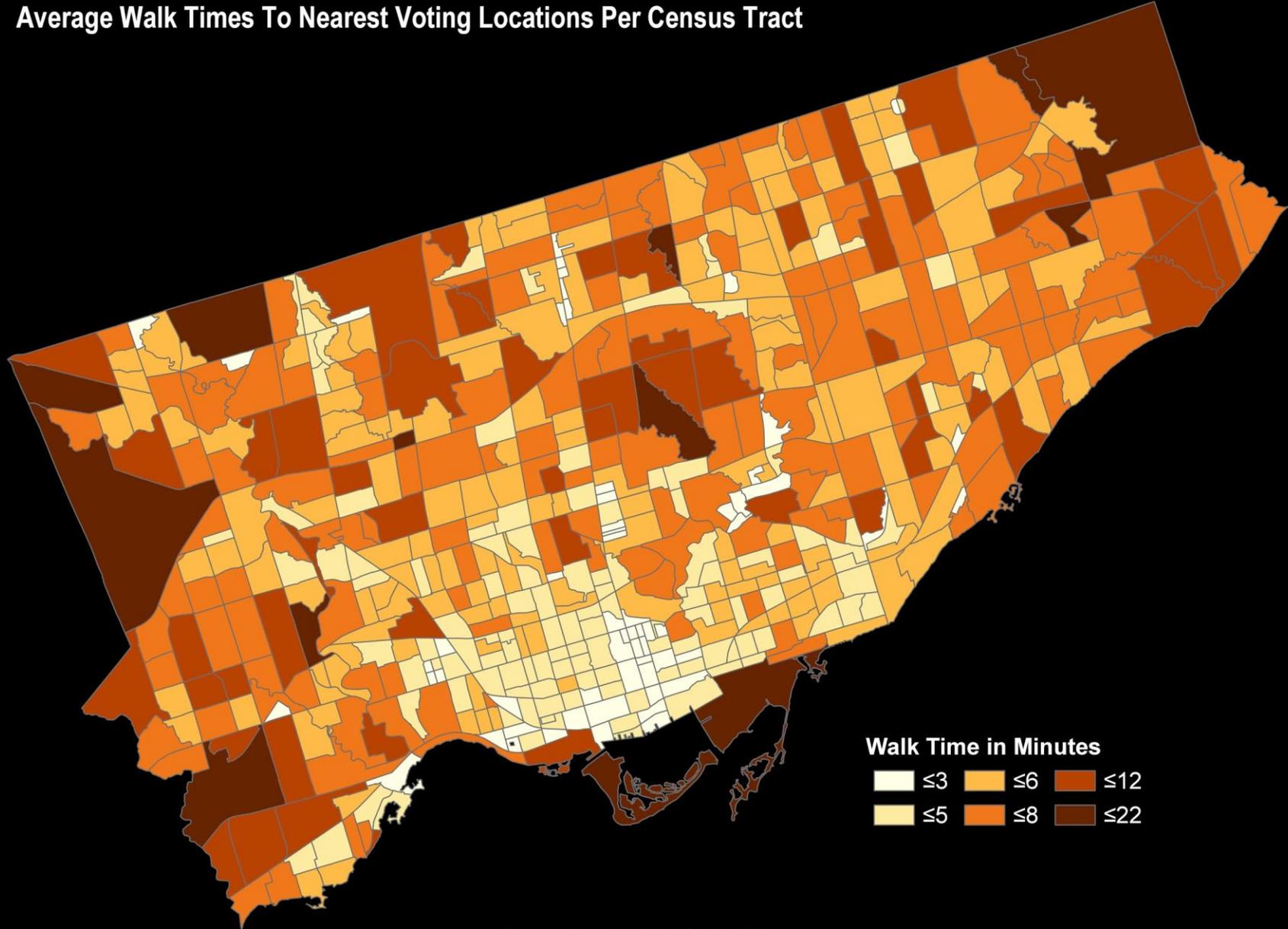
Source: Toronto City Clerk's Office

## Average Walk Times To Nearest Voting Locations Per Census Tract



Source: Toronto City Clerk's Office

# Average Walk Times To Nearest Voting Locations Per Census Tract



Source: Toronto City Clerk's Office

# Transit

Transit walkability analysis includes the nearest 2 points analysis at a max distance of 5000 meters to on street bicycle parking, Toronto Transit stations, Toronto Transit accessible stations and Toronto Transit stops data in the pedestrian network.

## Transit Walkability

Public transportation systems include a variety of transit options such as buses, light rail, and subways. These systems are available to the general public, may require a fare, and run at scheduled times. The purpose of introducing or expanding public transportation is to increase access to and use of public transit while, at the same time, reducing motor vehicle miles driven and traffic congestion. Transportation systems help ensure that people can reach everyday destinations, such as jobs, schools, healthy food outlets and healthcare facilities, safely and reliably. Public transportation services play an important role for people who are unable to drive, including those without access to personal vehicles, children, individuals with disabilities, and older adults [\[11\]](#).

### Research Questions:

1. Where do people have more access and less access to public services by walking?
2. Are there public perception differences due to the walkability of different types transit e.g. buses versus subways?
3. Does the availability of transit increase physical health?

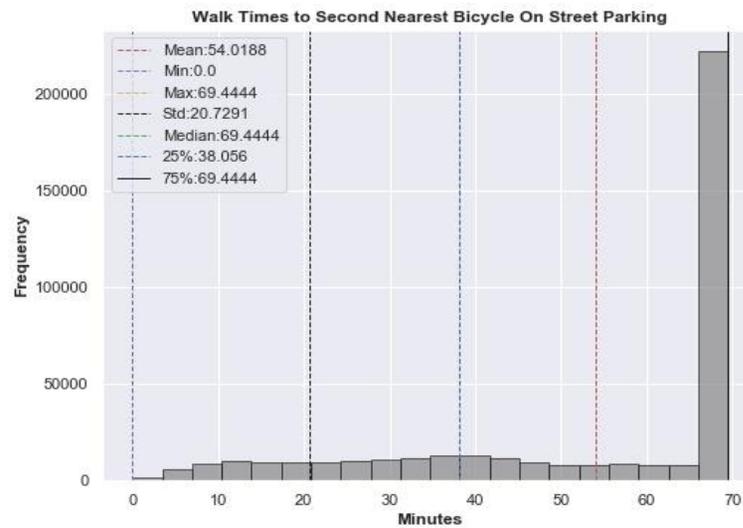
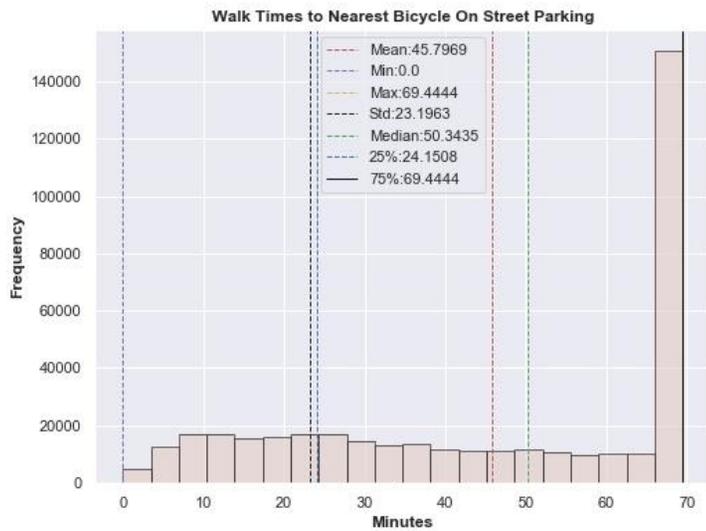
### Overview:

The Toronto Transit Commission (TTC) is a City agency which provides public transit services to approximately 1.7 million daily commuters in Toronto and from surrounding municipalities. On an average weekday in 2019, 1.69 million passengers made 2.76 million unlinked trips on the TTC, with the number of trips about evenly divided between the subways (1.34 million) and buses and streetcars (1.34 million).[\[24\]](#)

# On Street Bicycle Parking

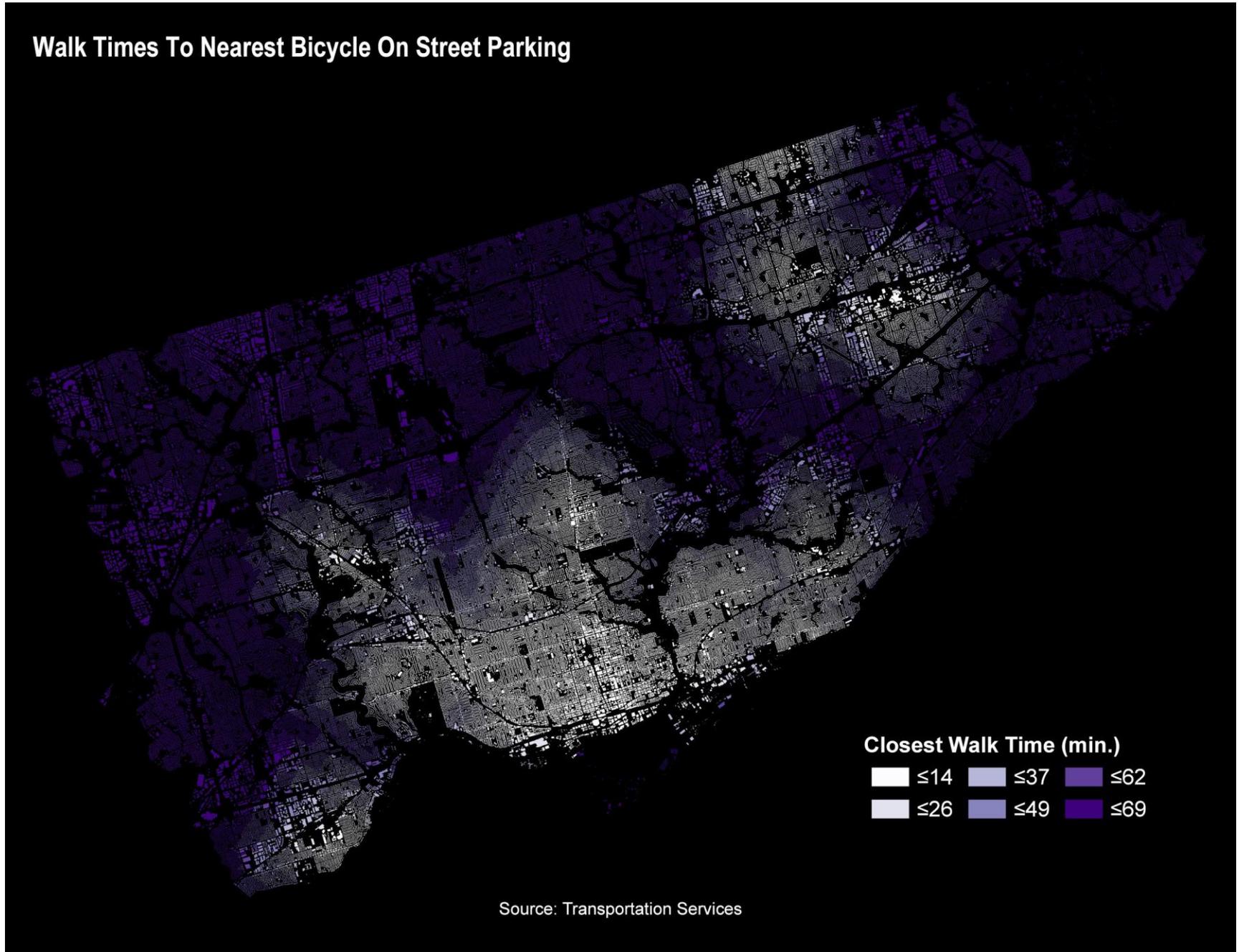
**Definition:** High Capacity Outdoor Bicycle Parking locations in the City of Toronto. The location of Outdoor Bicycle Parking locations is based on the Bicycle Parking strategy developed by the City of Toronto [\[12\]](#).

**Description:** The mean walking time to on street bicycle parking is 45.8 minutes and the median walking time is 50.3 minutes city-wide. City-wide walktimes vary with a standard deviation of 23.2 minutes. Approximately 25% of all addresses in the city have less than a 24.2 minute walk, while 75% of all addresses have less than a 69.4 minute walk to the closest on street bicycle parking. Census tract 5350247.01 has the maximum average walk time with over a 69.4 minute walk to the closest on street bicycle parking and is shared by 1 other census tracts. Census Tract 5350035.00 has less than a 2.8 minute walk to the closest on street bicycle parking and is shared by 145 other census tracts.



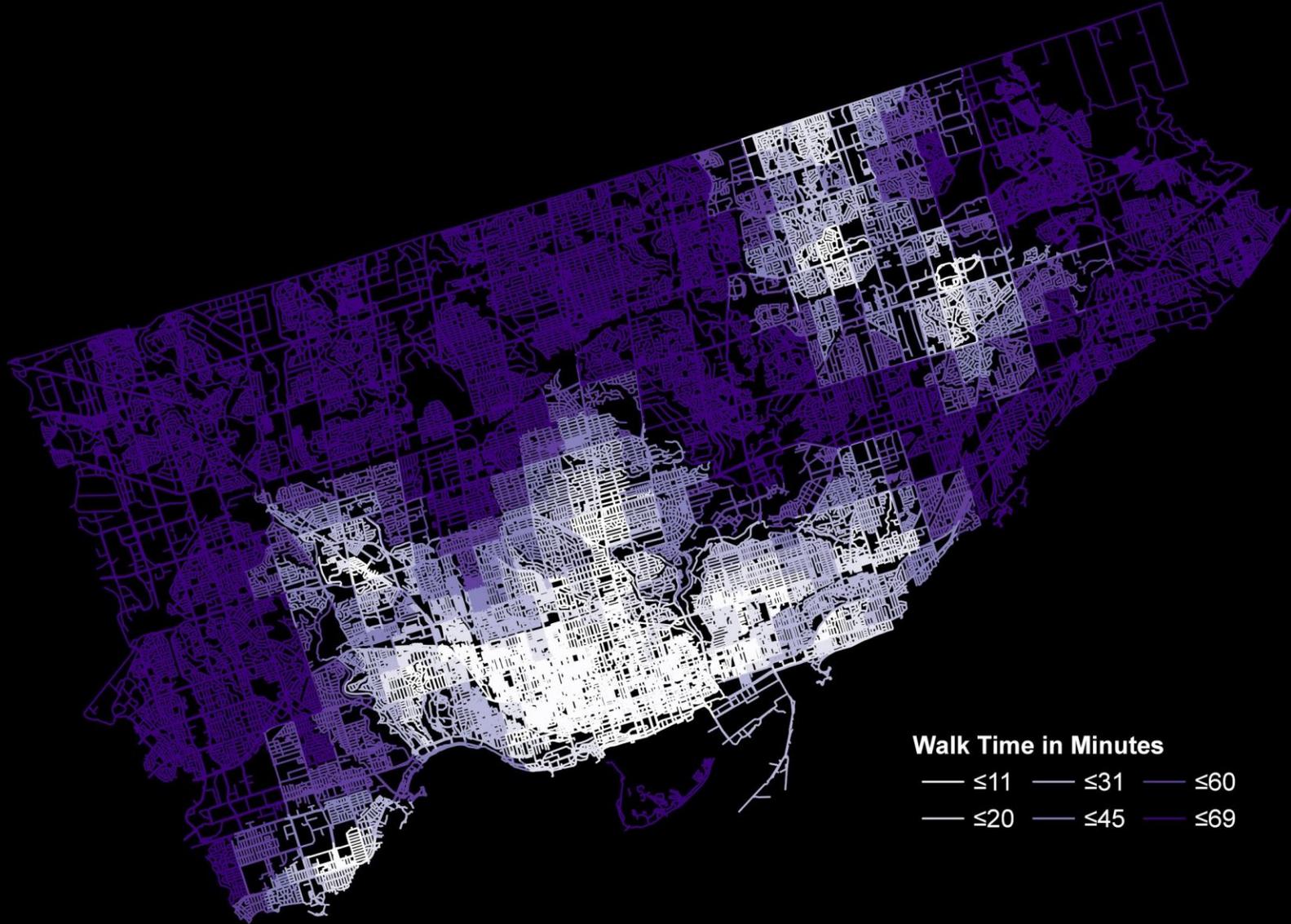
**Interpretation:** There appears to be a change in walk times from the first to the second closest Voting Locations with an 8.3 minute difference in mean walk times from the closest to the second closest High Capacity Outdoor Bicycle Parking. There is a 2.4 minute decrease in the standard deviation of walktimes between the first and second closest High Capacity Outdoor Bicycle Parking. There is not a significant change in the geographic distribution between the first and second Bicycle On Street Parking with a p-value of 0.0 at a .95 confidence interval. Suggesting that locations are geographically stationary across the city. The majority of the on street bicycle parking is located in the downtown core with a few locations in central and northern Scarborough. Walktimes are strongly influenced by this displacement.

## Walk Times To Nearest Bicycle On Street Parking



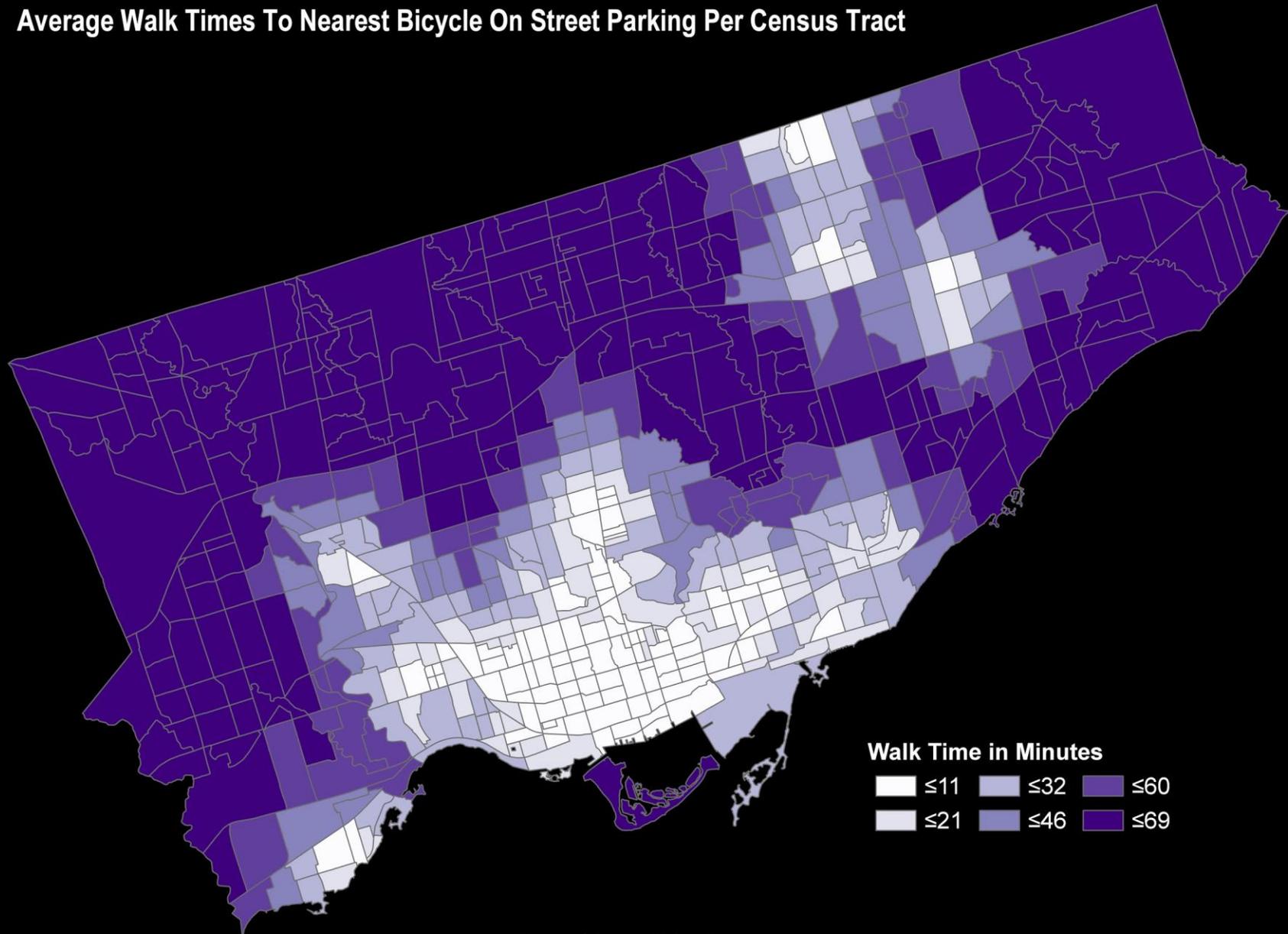
Source: Transportation Services

# Average Walk Times To Nearest Bicycle On Street Parking Per Census Tract



Source: Transportation Services

# Average Walk Times To Nearest Bicycle On Street Parking Per Census Tract

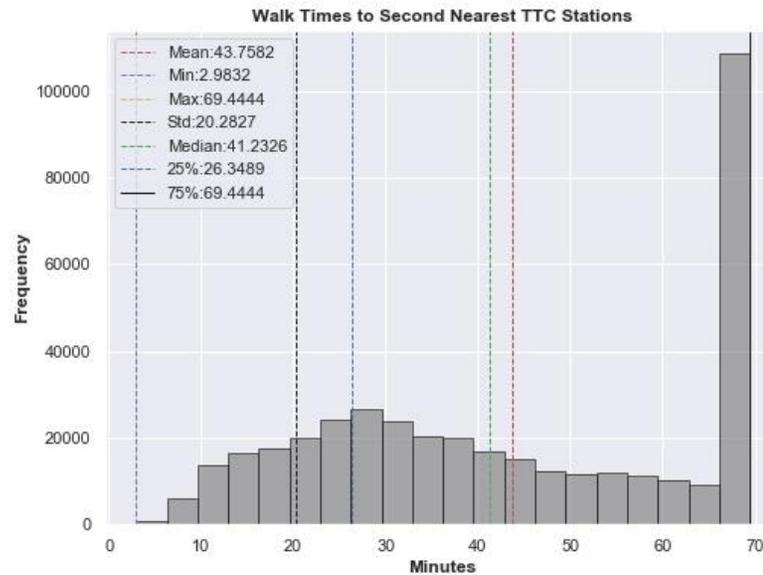
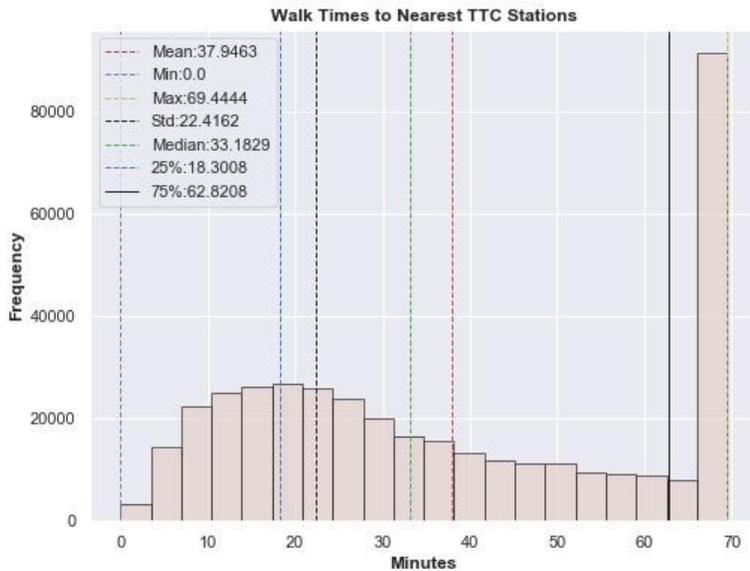


Source: Transportation Services

# Toronto Transit Stations

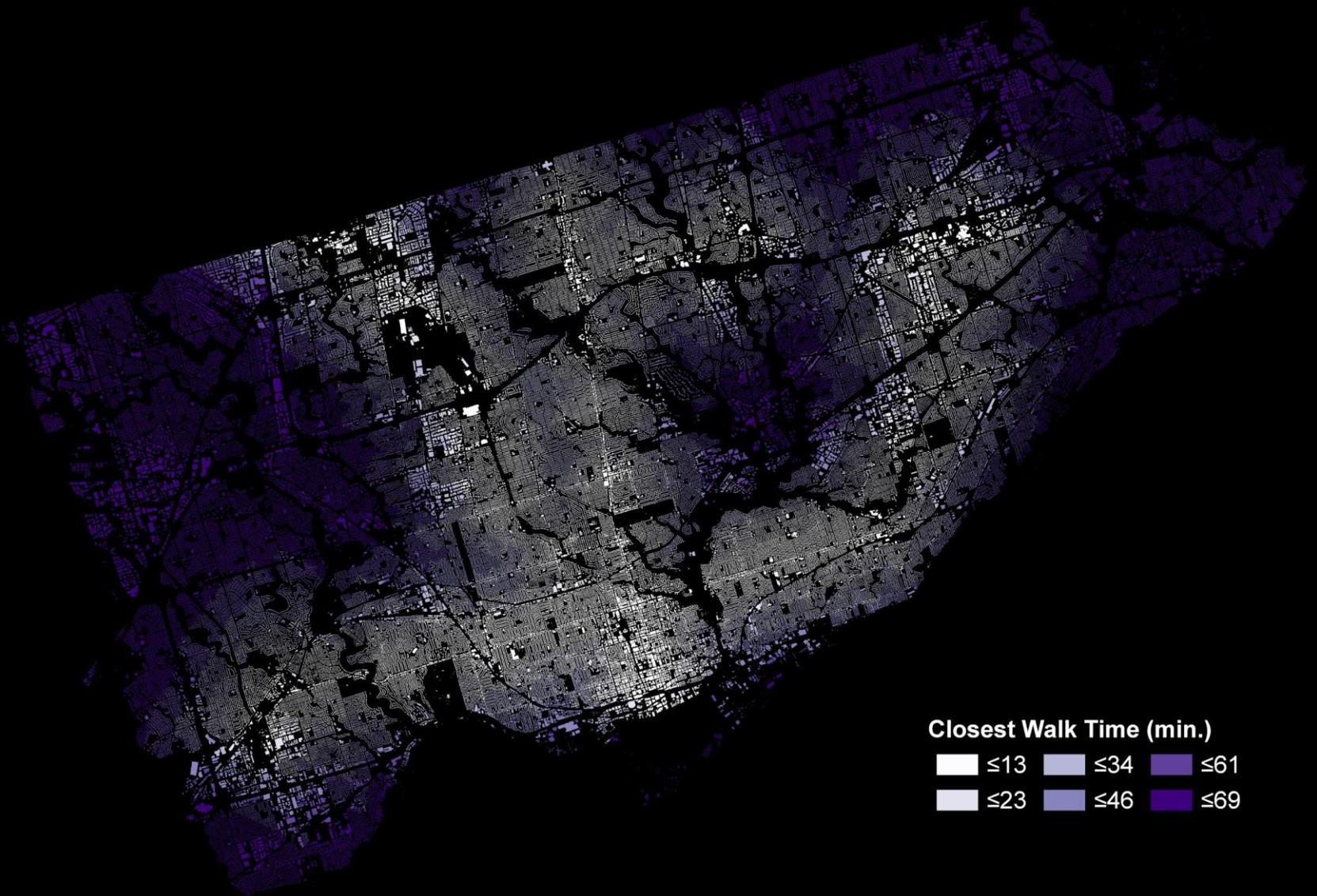
**Definition:** Toronto Transit Stations in the City of Toronto.

**Description:** The mean walking time to a TTC station is 37.9 minutes and the median walking time is 33.2 minutes city-wide. City-wide walktimes vary with a standard deviation of 22.4 minutes. Approximately 25% of all addresses in the city have less than an 18.3 minute walk, while 75% of all addresses have less than a 62.8 minute walk to the closest TTC station. Census tract 5350247.01 has the maximum average walk time with over a 69.4 minute walk to the closest TTC station and is shared by 1 other census tracts. Census Tract 5350065.01 has less than a 2.9 minute walk to the closest TTC station and is shared by 72 other census tracts.



**Interpretation:** There appears to be a significant change in walk times from the first to the second closest Toronto Transit Stations with a 5.8 minute difference in mean walk times from the closest to the second closest Toronto Transit Stations. There is a 2.2 minute decrease in the standard deviation of walktimes between the first and second closest Toronto Transit Stations. There is not a significant change in the geographic distribution between the first and second TTC Stations with a p-value of 0.0 at a .95 confidence interval. Suggesting that locations are geographically stationary across the city. The maps show the absence of stations in northwestern Etobicoke as well as southeastern Scarborough have greatly increased pedestrian walktimes. The introduction of the Eglinton Crosstown Light Rail Transit (LRT) project in 2021 consisting of 25 stations/stops from Mount Dennis Station in the west to Kennedy Station at the eastern end will decrease walktimes along the Eglinton Ave corridor.

## Walk Times To Nearest TTC Stations



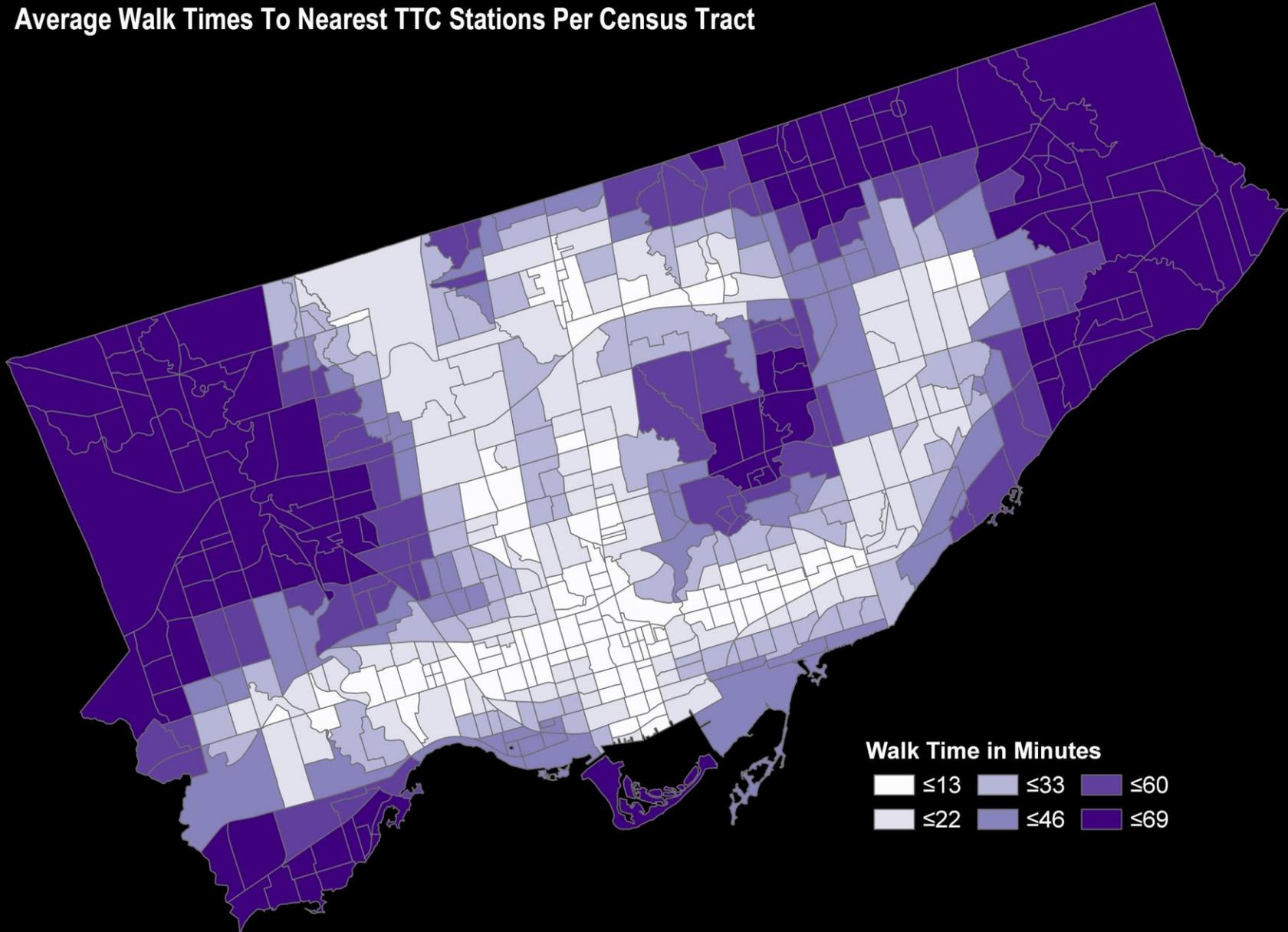
Source: Toronto Transit Commission

## Average Walk Times To Nearest TTC Stations Per Census Tract



Source: Toronto Transit Commission

# Average Walk Times To Nearest TTC Stations Per Census Tract

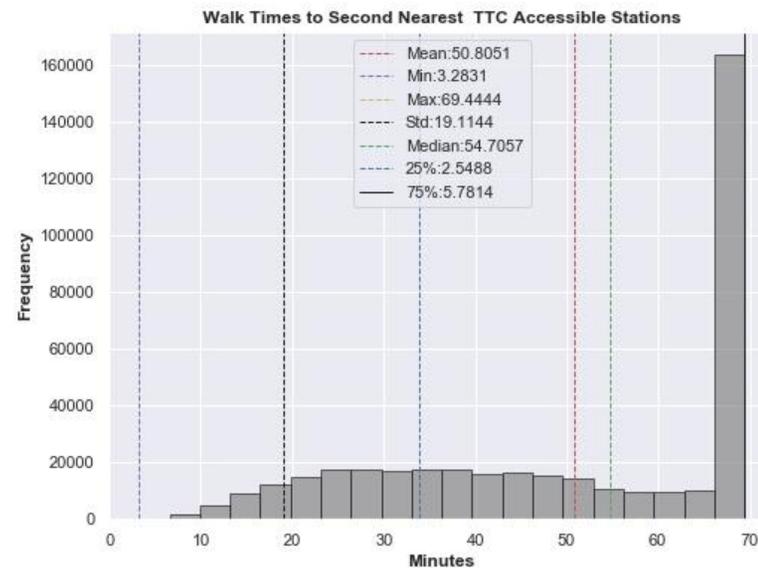
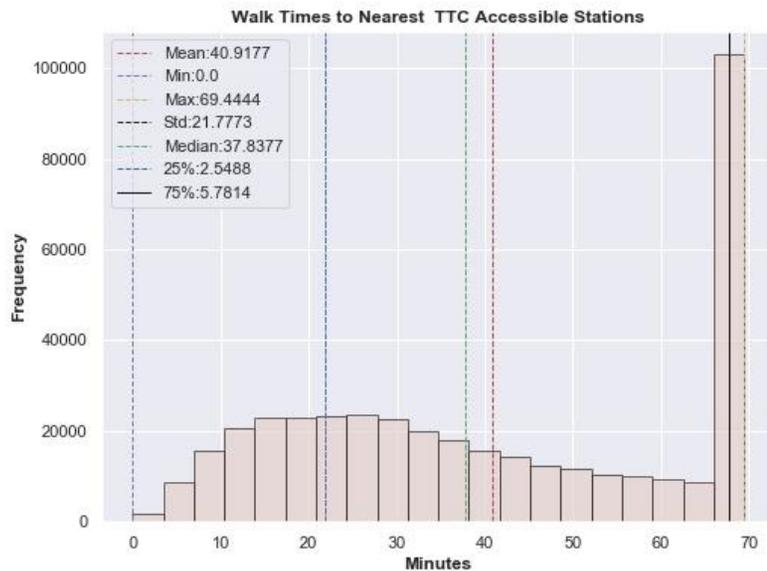


Source: Toronto Transit Commission

# Toronto Transit Accessible Stations

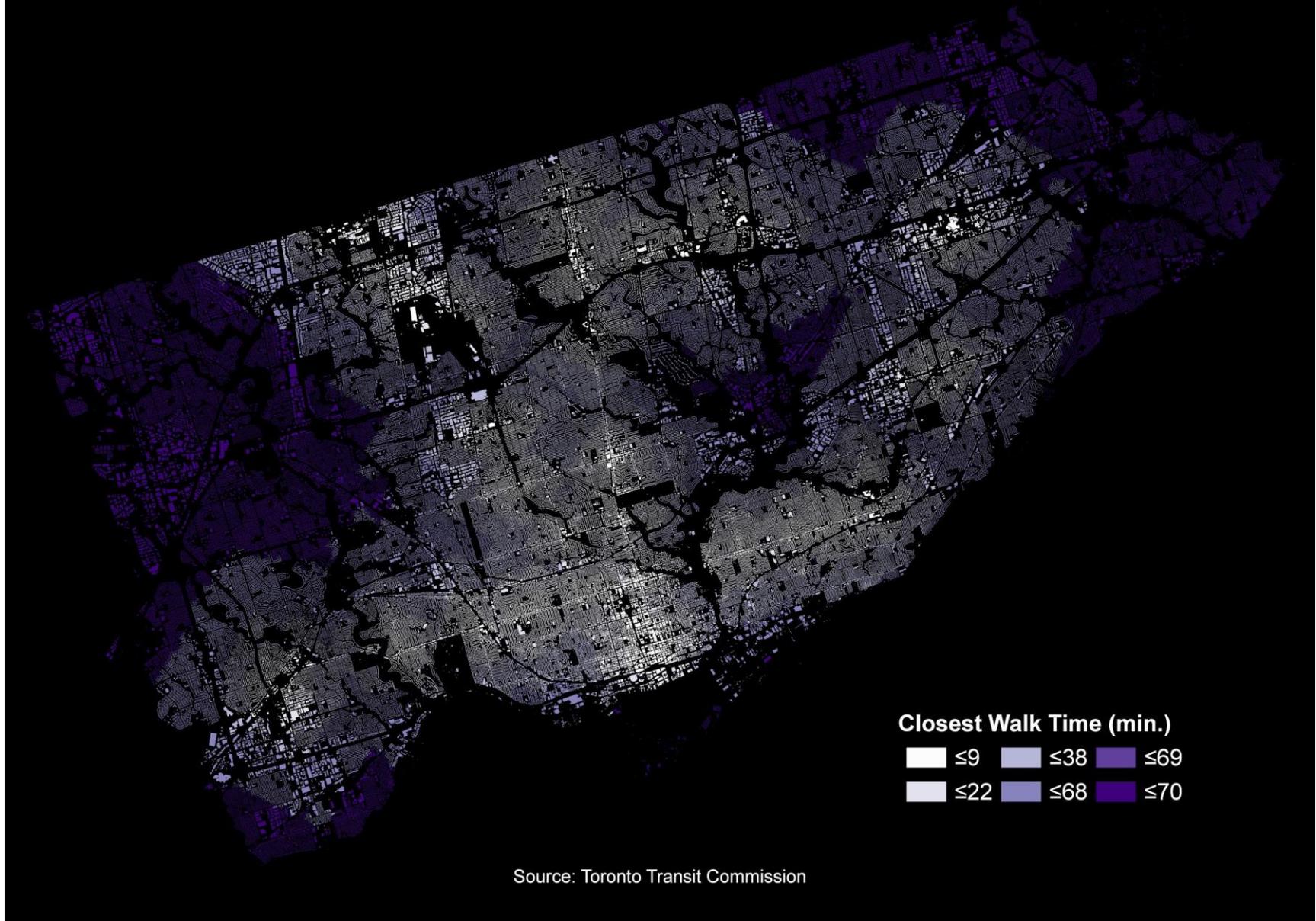
**Definition:** Toronto Transit Accessible Stations in the City of Toronto. The analysis was on 42 stations that have elevators. The TTC continues to work to provide a barrier-free transit system in support of the AODA’s goal of an accessible Ontario by 2025 [\[13\]](#). The TTC initiatives include the retrofitting of subway stations for barrier free accessibility.

**Description:** The mean walking time to a TTC accessible station is 40.9 minutes and the median walking time is 37.8 minutes city-wide. City-wide walktimes vary with a standard deviation of 21.8 minutes. Approximately 25% of all addresses in the city have less than a 21.8 minute walk, while 75% of all addresses have less than a 67.8 minute walk to the closest TTC accessible station. Census tract 5350247.01 has the maximum average walk time with over a 69.4 minute walk to the closest TTC accessible station and is shared by 1 other census tracts. Census Tract 5350014.00 has less than a 4.0 minute walk to the closest TTC accessible station and is shared by 82 other census tracts.



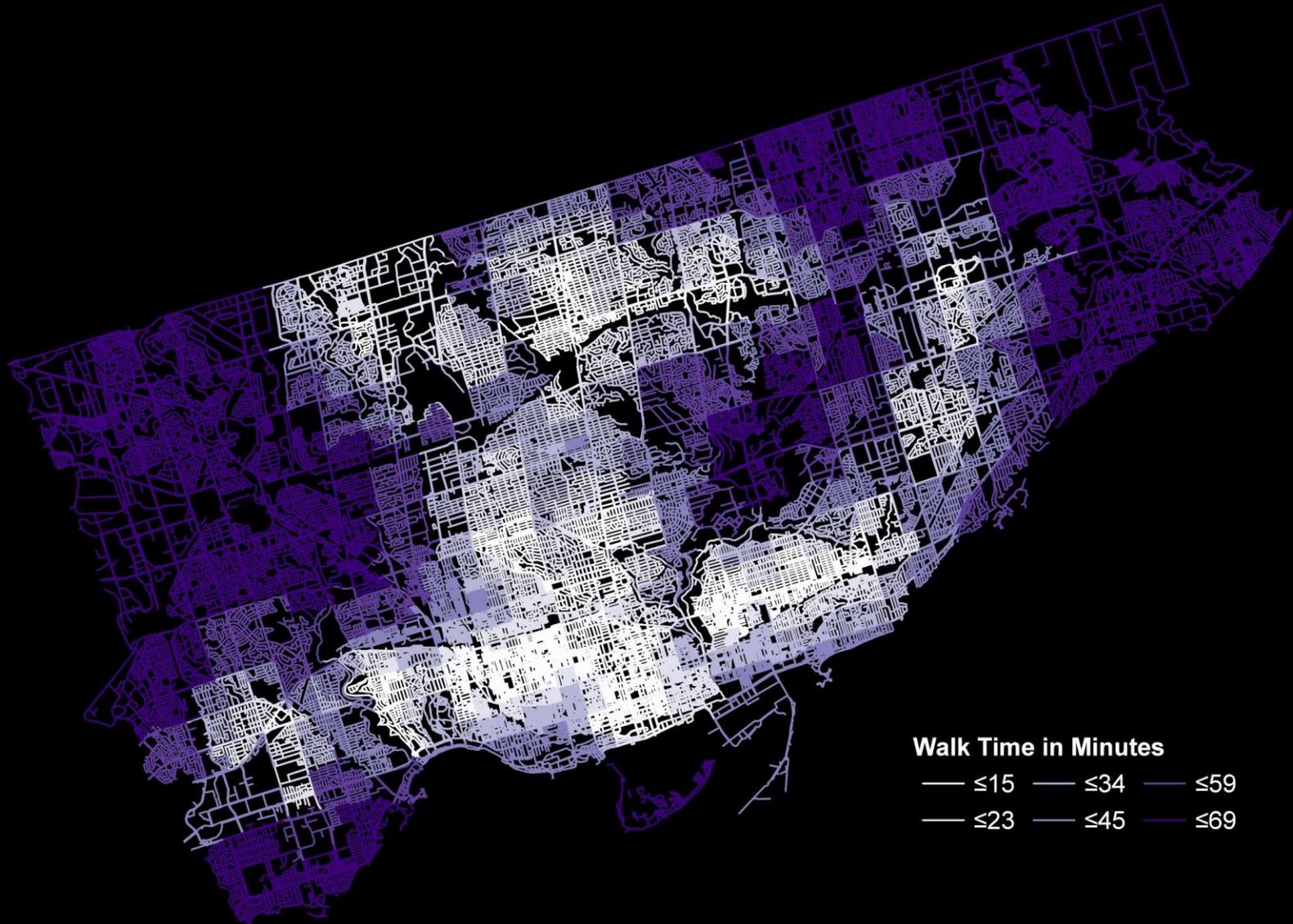
**Interpretation:** There appears to be a significant change in walk times from the first to the second closest Toronto Transit Accessible Stations with a 14 minute difference in mean walk times from the closest to the second closest Toronto Transit Accessible Stations. There is a 4.6 minute decrease in the standard deviation of walktimes between the first and second closest Toronto Transit Accessible Stations. There is not a significant change in the geographic distribution between the first and second TTC Accessible Stations with a p-value of 0.0 at a .95 confidence interval. Suggesting that locations are geographically stationary across the city. The maps show the absence of accessible stations in northwestern Etobicoke as well as southeastern Scarborough have greatly increased pedestrian walktimes.

## Walk Times To Nearest TTC Accessible Stations



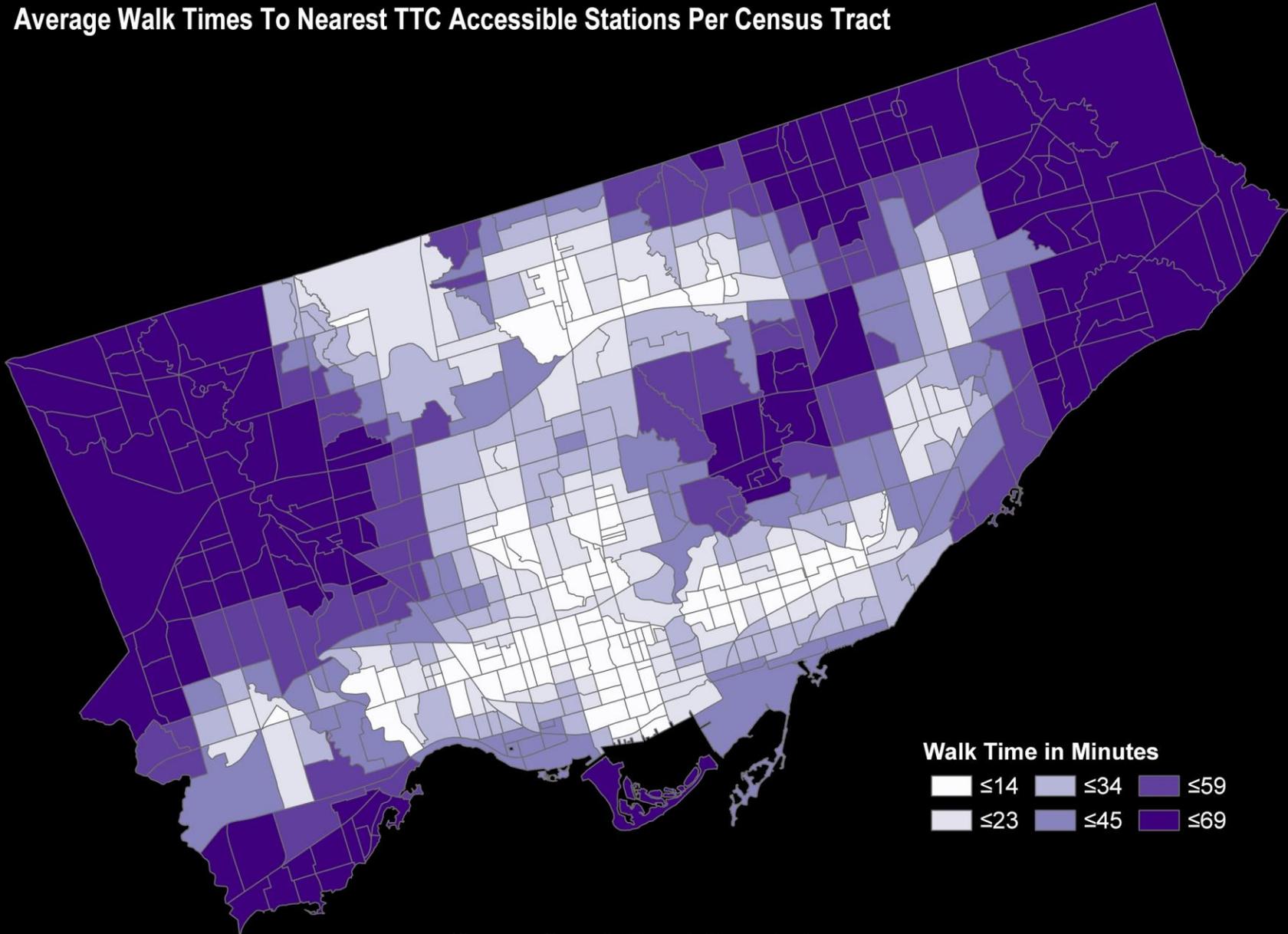
Source: Toronto Transit Commission

## Average Walk Times To Nearest TTC Accessible Stations Per Census Tract



Source: Toronto Transit Commission

# Average Walk Times To Nearest TTC Accessible Stations Per Census Tract

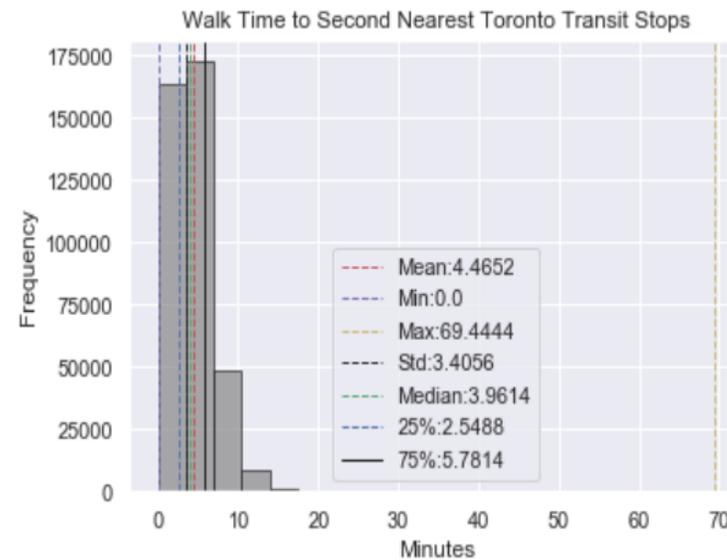
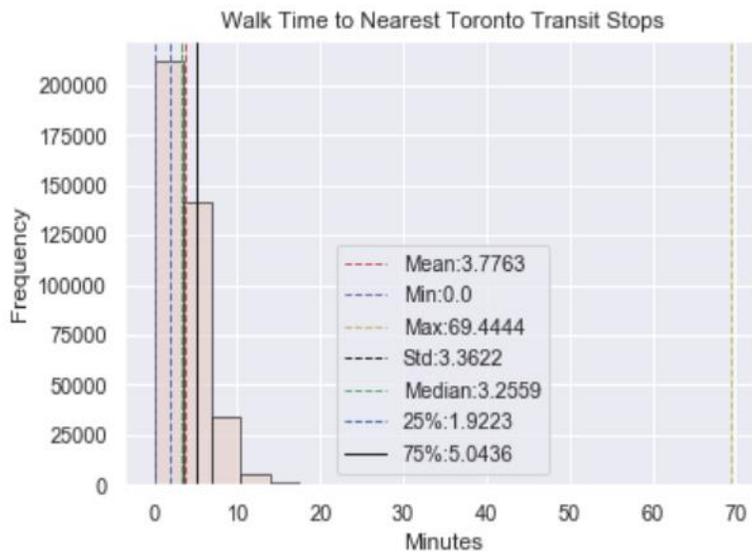


Source: Toronto Transit Commission

# Toronto Transit Stops

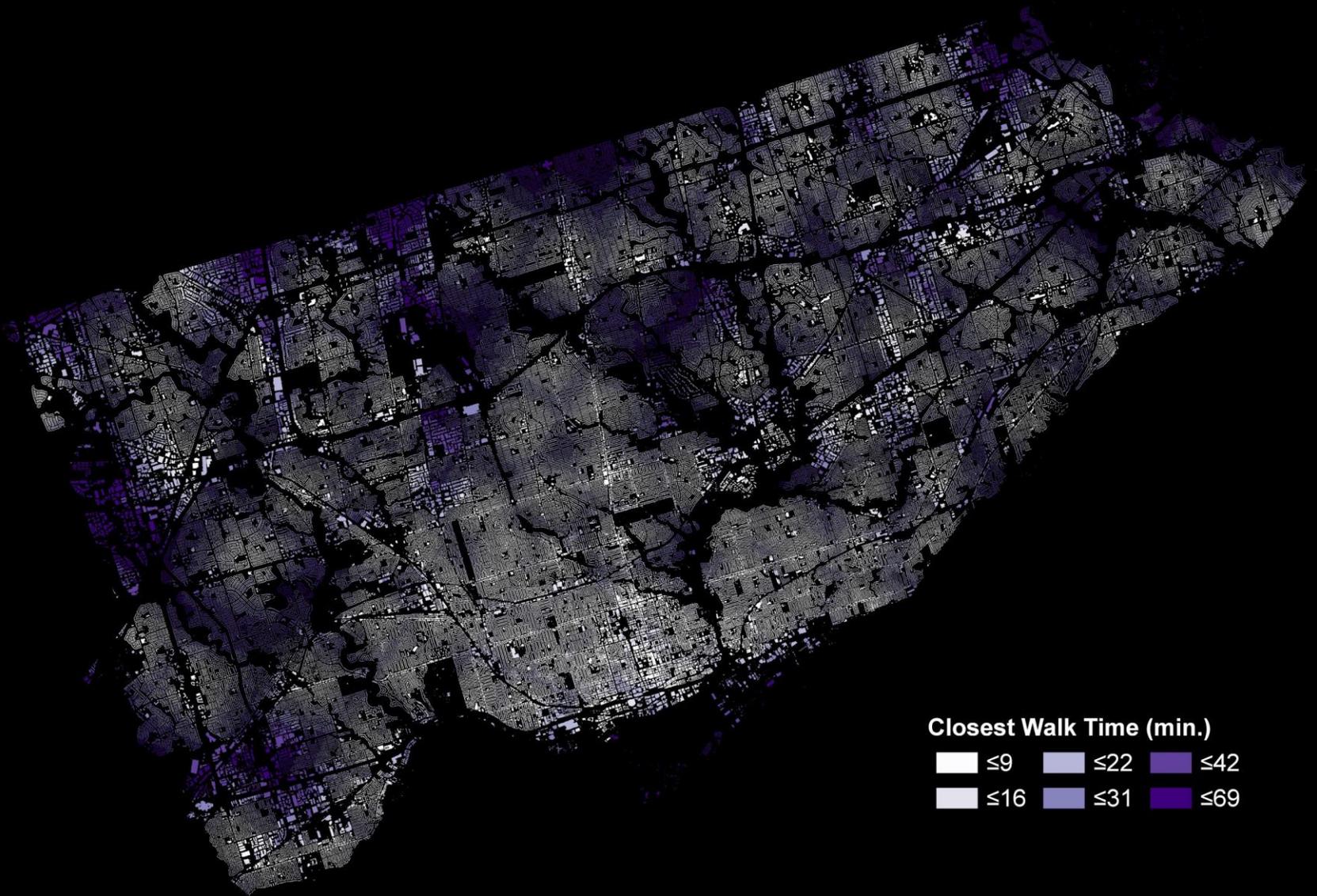
**Definition:** Toronto Transit Commission stops in the City of Toronto. The 5-minute walk, also known as the “pedestrian shed” is considered to be the distance people are willing to walk before opting to drive [14]. This equates to a walking distance of approximately 400m, using [an average walking speed of 5.0 km/h](#). In Toronto, TTC stops are highly accessible to pedestrians. The TTC All-Day, Every-Day network strategy is designed so that 90% of the population is within a 400 metre (5 minute) walk of transit service (subway, streetcar and bus service) seven days a week [15].

**Description:** The mean walking time to a TTC stop is 3.77 minutes and the median walking time is 3.25 minutes city-wide. City-wide walktimes vary with a standard deviation of 3.36 minutes. Approximately 25% of all addresses in the city have less than a 1.92 minute walk, while 75% of all addresses have less than a 5 minute walk to the closest TTC stop. Census tract 5350002.00 has the maximum average walk time with over a 69.0 minute walk to the closest TTC stop and is shared by 1 other census tracts. Census Tract 5350322.01 has less than a 0.6 minute walk to the closest TTC stop and is shared by 1 other census tracts.



**Interpretation:** There appears to be a significant change in walk times from the first to the second closest Toronto Transit Stops with a 1.06 minute difference in mean walk times from the closest to the second closest Toronto Transit Stops. There is not a significant change in the geographic distribution between the first and second TTC Stops with a p-value of 0.0 at a .95 confidence interval. Suggesting that locations are geographically stationary across the city. The majority of the City of Toronto has walktimes to Toronto Transit Stops less than 9 minutes although there are pockets of the City in northeastern Scarborough (rural area) and eastern Scarborough and along the northern border of North York that have higher walktimes.

## Walk Times To Nearest TTC Stops



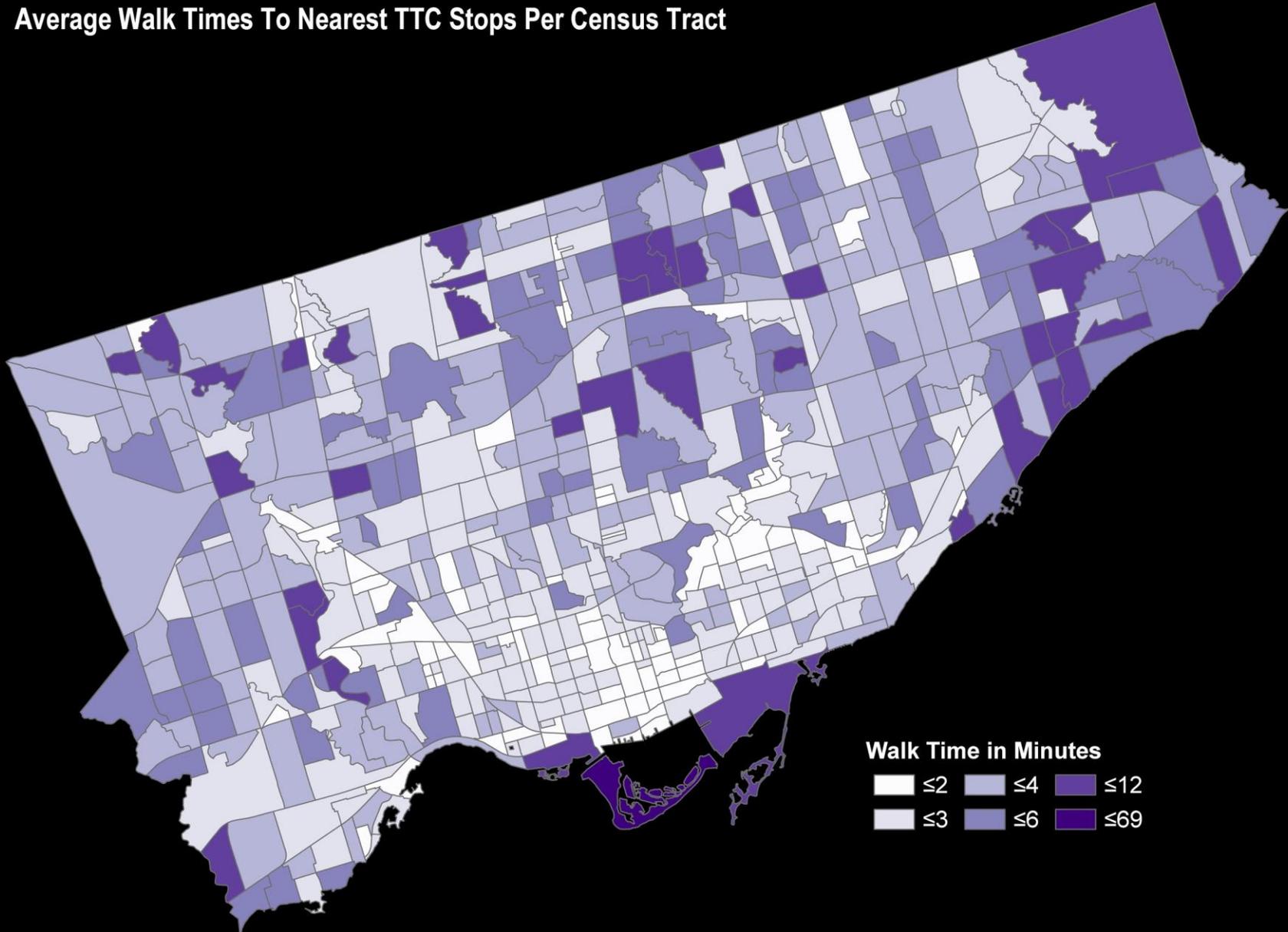
Source: Toronto Transit Commission

# Average Walk Times To Nearest TTC Stops Per Census Tract



Source: Toronto Transit Commission

# Average Walk Times To Nearest TTC Stops Per Census Tract



Source: Toronto Transit Commission

## Section 4: Walkability and Socio-Demographic Analysis

### Goals

To create Bivariate Choropleth maps that show the spatial relationship between walkability and socio-demographic data.

### Methods

Mean walk times were aggregated to the census tract level for each of the 22 amenities used in the previous section, with the values then normalized and categorized into three percentiles (High - 100%<, Middle - 66%<, Low - 33%<). The same process was performed on specific Statistics Canada socio-demographic indicators at the census tract level where they were normalized and categorized into three percentiles (High - 100%<, Middle - 66%<, Low - 33%<). Using 2 variables (e.g., walktime and sociodemographic indicator) we produced bivariate relationship maps that elucidate pedestrian walkability for targeted populations to relevant amenities and civic services.

Summary Walk Time	Socio Demographic Indicator	Combinations
High	High	High - High
High	Low	High - Low
High	Middle	High - Middle
Low	High	Low - High
Low	Low	Low - Low
Low	Middle	Low - Middle
Middle	High	Middle - High
Middle	Low	Middle - Low
Middle	Middle	Middle - Middle

### Results

Bivariate Choropleth maps were generated from the census tract layer based on the combination of the High, Middle and Low values for the walkability (in minutes) and various socio-demographic indicators. These maps are also grouped into four main categories of Food Services, Health Services, Public Services and Transit.

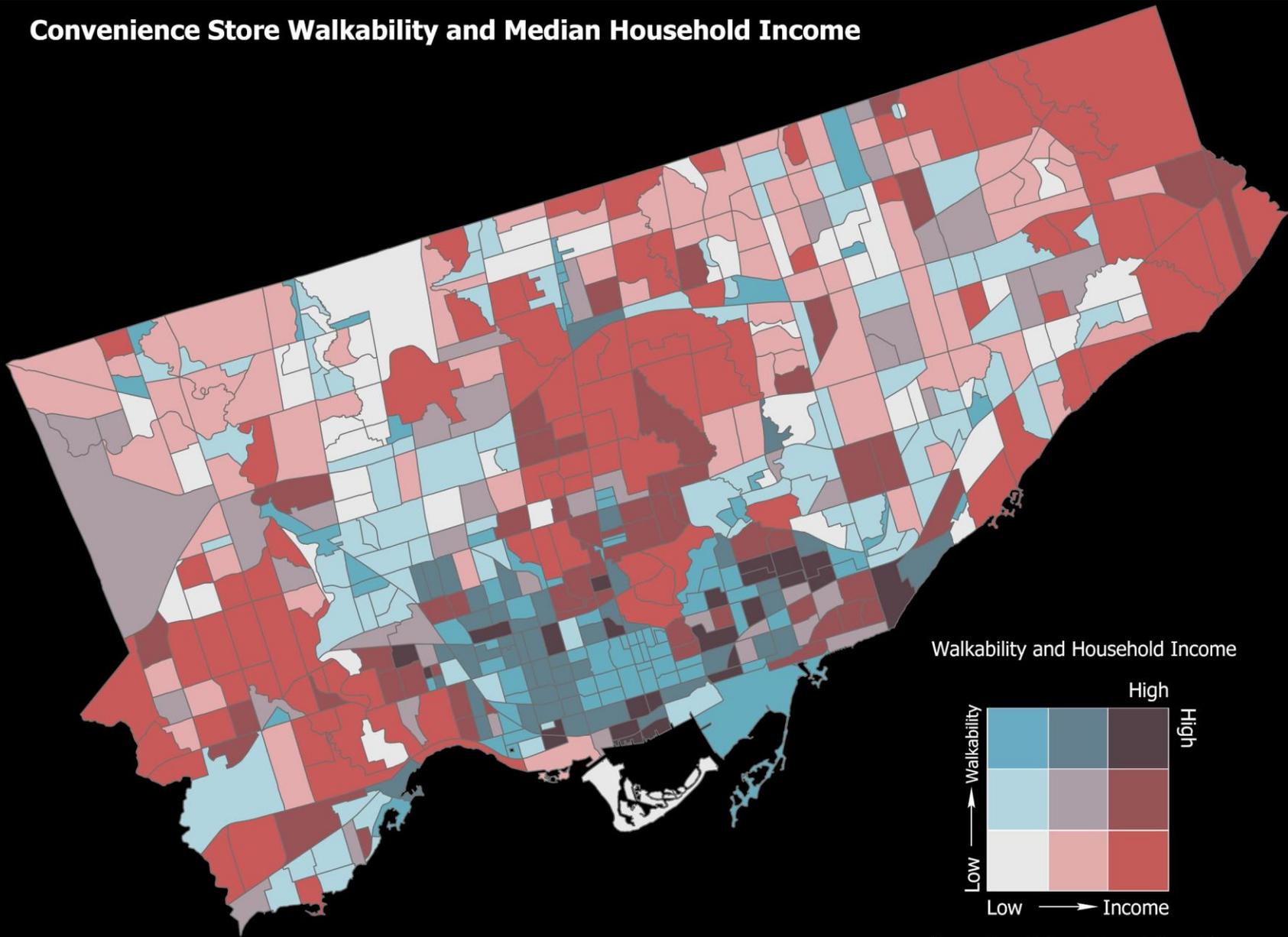
## Food Services

### Convenience Store Location Walkability and Household Median Income

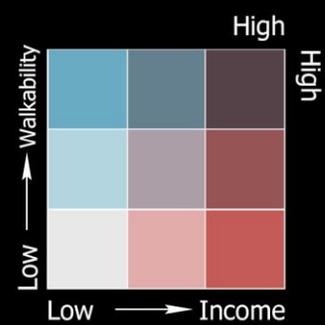
**Definition:** Mean walking times to convenience stores, median household (after-tax) income, 2016. Classified into 3 percentiles for Median Household Income (\$ - 2015): Low is \$21,941 to \$52,839, Medium is \$52,840 to \$66,811, and High is \$66,812 to \$206,336.

**Interpretation:** High concentrations of household median income to high convenience store walkability can be found primarily in the former City of Toronto and East York. In East York it is concentrated around the Danforth Ave and Woodbine Ave area. In the downtown core areas around Queen St and Yonge St and the condo intense area in the Bremner Blvd area and the Queens Quay area. Low walkability areas with higher incomes are in the eastern Scarborough area and south of Highway 401 near Bayview Ave where personal vehicle transportation allows greater access to convenience stores without the need for walking. Low walkability areas with lower income are scattered throughout Scarborough and North York in the industrial commercial area north of Sheppard Ave W between Dufferin St and Keele St.

# Convenience Store Walkability and Median Household Income



Walkability and Household Income



Normalized bi-variate relationship.  
Classified into 33% < 66% < 100%

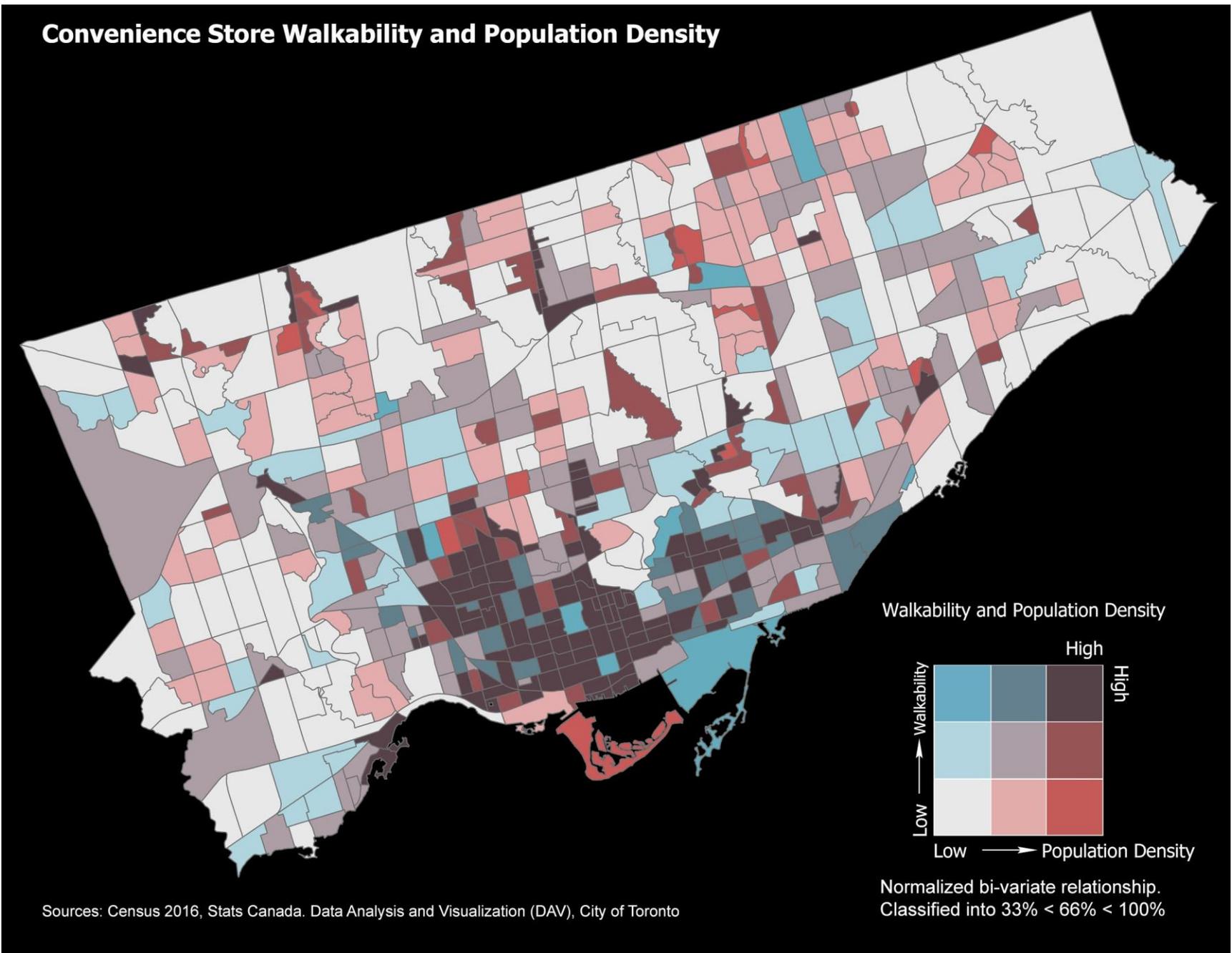
Sources: Census 2016, Stats Canada. Data Analysis and Visualization (DAV), City of Toronto

## Convenience Store Location Walkability and Population Density

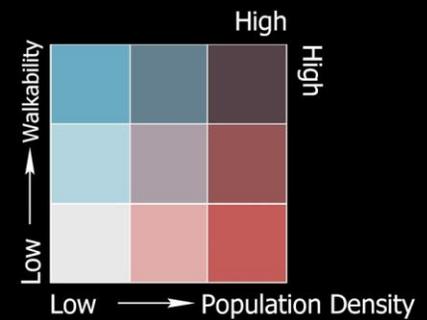
**Definition:** Mean walking times to convenience stores, population density, 2016. Classified into 3 percentiles for Population density per square kilometre: Low is 14 to 4,083, Medium is 4,084 to 7,536, and High is 7,537 to 82,434.

**Interpretation:** Large portions of the City of Toronto have low population density and low convenience store walkability. The downtown core and the former East York along Danforth Rd, the Yonge St corridor along Sheppard Ave to Cummer Ave have high population density and high convenience store walkability. While low walkability in suburban areas make convenience stores less accessible for pedestrians motor vehicle traffic provides the source of much of the business for these stores where between 5,000 and 15,000 vehicles per day is considered optimal [\[21\]](#).

# Convenience Store Walkability and Population Density



Walkability and Population Density



Normalized bi-variate relationship.  
Classified into 33% < 66% < 100%

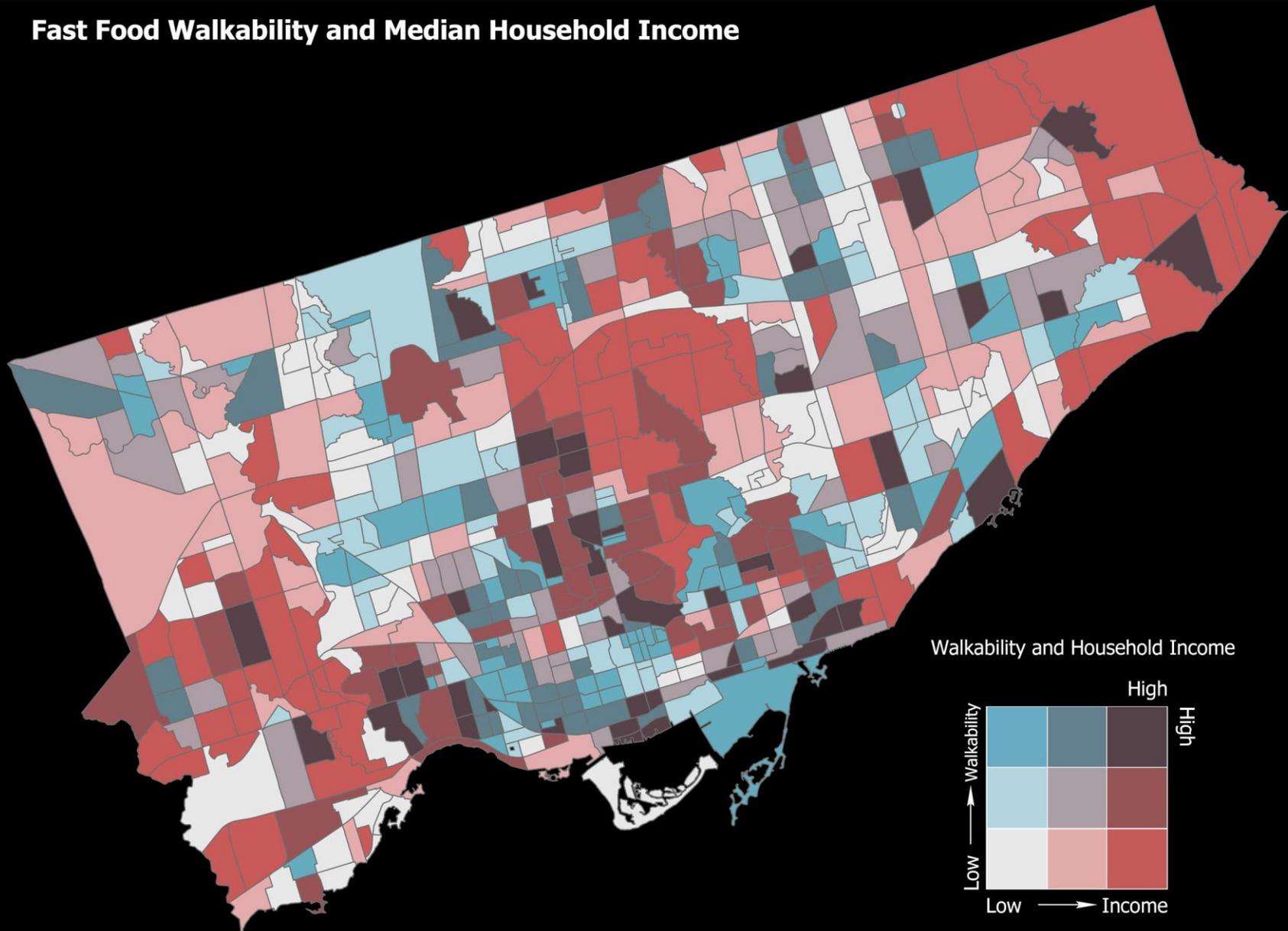
Sources: Census 2016, Stats Canada. Data Analysis and Visualization (DAV), City of Toronto

## Fast Food Location Walkability and Household Median Income

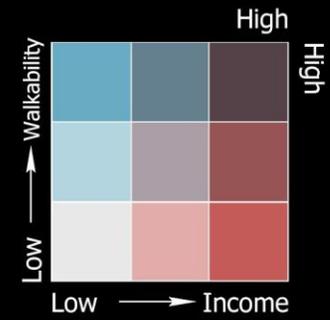
**Definition:** Mean walking times to fast food locations, median household (after-tax) income, 2016. Classified into 3 percentiles for Median Household Income (\$ - 2015): Low is \$21,941 to \$52,839, Medium is \$52,840 to \$66,811, and High is \$66,812 to \$206,336.

**Interpretation:** Fast food locations are typically located along major arterials throughout the City of Toronto, for example along Danforth Ave between Broadview Ave and Victoria Park Ave, Queen St between Victoria Park Ave and Roncesvalles Ave, large sections of Yonge St, large sections of Eglinton Ave, Lake Shore Blvd W in Etobicoke. High walkability and high median income are scattered throughout the City of Toronto with the largest concentration in the downtown core. Low walkability and low median income are in many sections of Scarborough and North York (Steeles Ave W and Bathurst St area) where there is a large concentration of apartment buildings.

# Fast Food Walkability and Median Household Income



Walkability and Household Income



Normalized bi-variate relationship.  
Classified into 33% < 66% < 100%

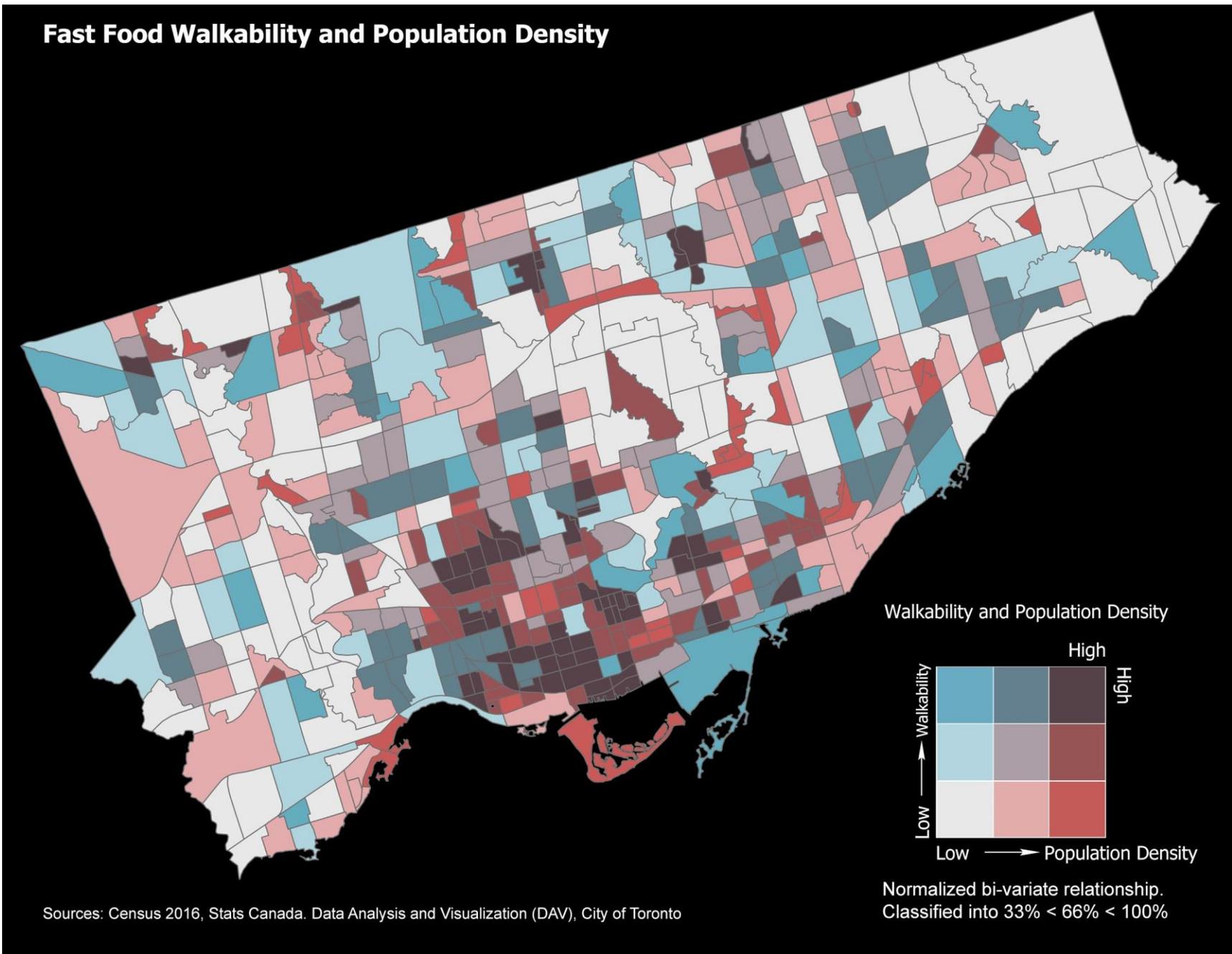
Sources: Census 2016, Stats Canada. Data Analysis and Visualization (DAV), City of Toronto

## Fast Food Location Walkability and Population Density

**Definition:** Mean walking times to fast food locations, population density, 2016. Classified into 3 percentiles for Population density per square kilometre: Low is 14 to 4,083, Medium is 4,084 to 7,536, and High is 7,537 to 82,434.

**Interpretation:** Large portions of the City of Toronto have low population density and low fast food walkability. The downtown core and the former East York along Danforth Rd, the corridor along Yonge St from Sheppard Ave to Finch Ave, the area around Don Mills Rd East and West above Sheppard Ave East have high population density and high fast food walkability.

# Fast Food Walkability and Population Density



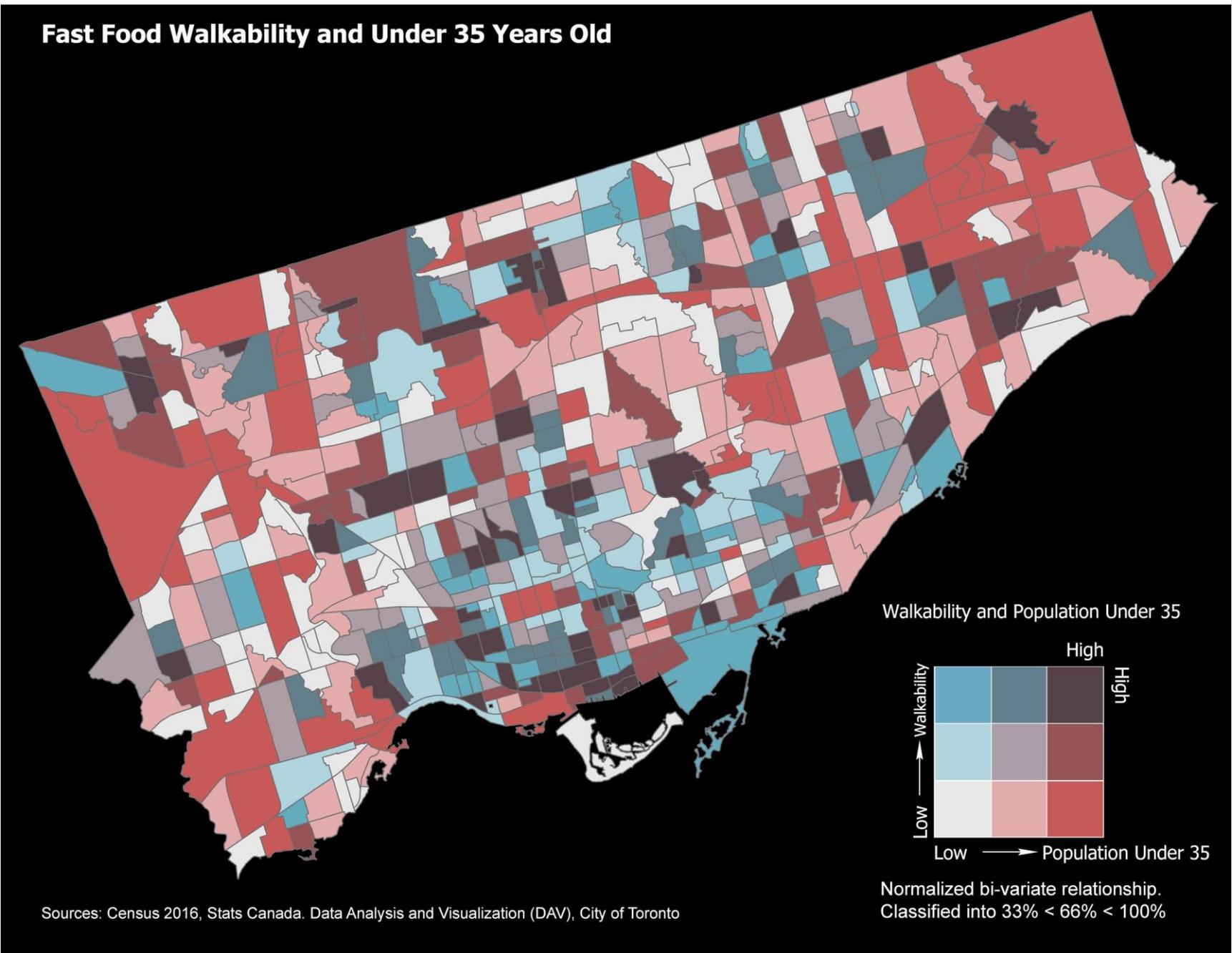
Sources: Census 2016, Stats Canada. Data Analysis and Visualization (DAV), City of Toronto

## Fast Food Location Walkability and Population Under 35

**Definition:** Mean walking times to fast food locations, and population under 35, 2016. Classified into 3 percentiles for Population Under 35 Years of Age: Low is 5 to 1,614, Medium is 1,615 to 2,312, and High is 2,313 to 11,765.

**Interpretation:** The downtown core have higher walkability and larger population under 35 years of age for fast food locations. The suburban areas have lower walkability and lower populations under 35 years of age for fast food locations.

# Fast Food Walkability and Under 35 Years Old



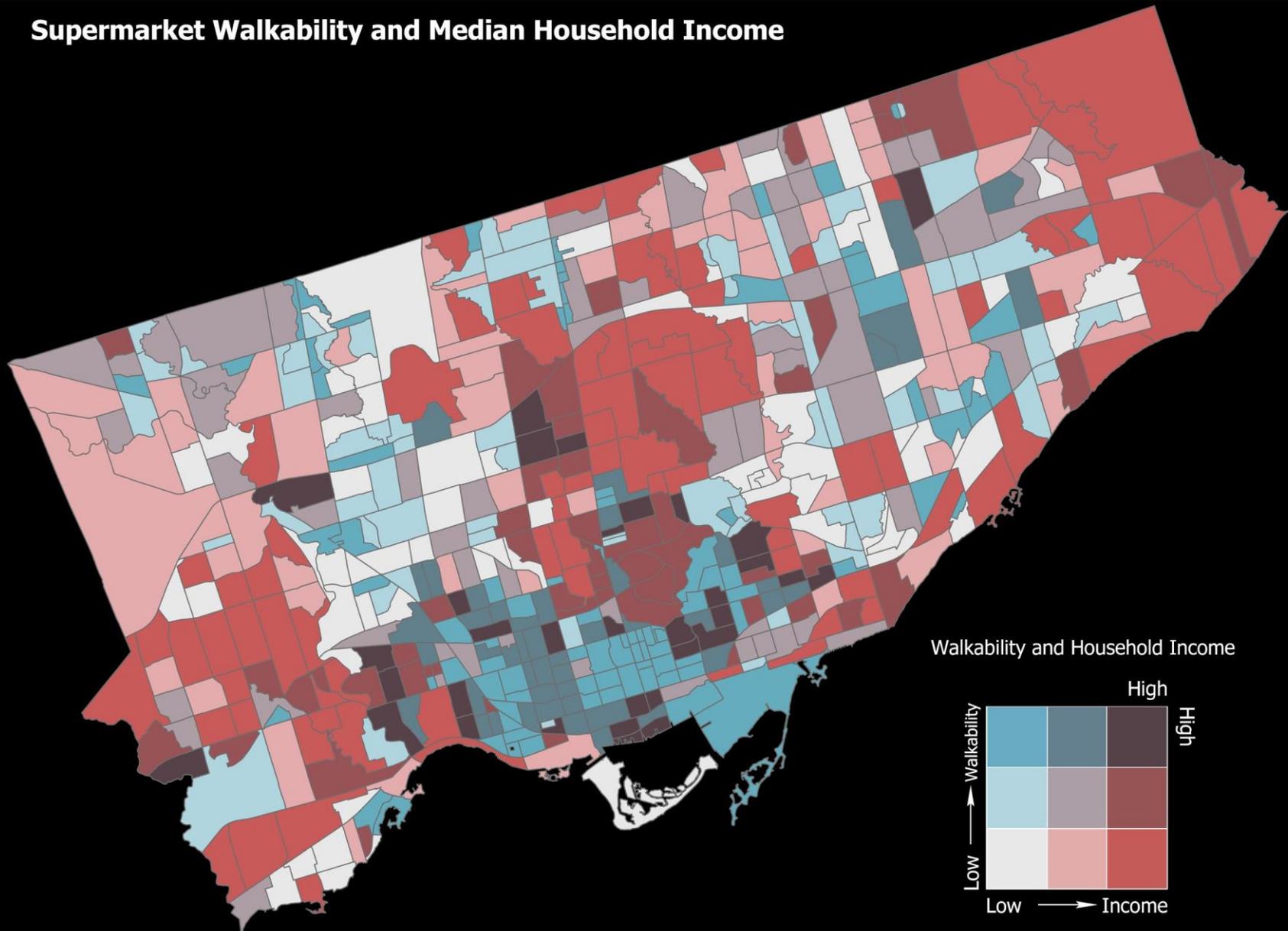
Sources: Census 2016, Stats Canada. Data Analysis and Visualization (DAV), City of Toronto

# Supermarket Location Walkability and Household Median Income

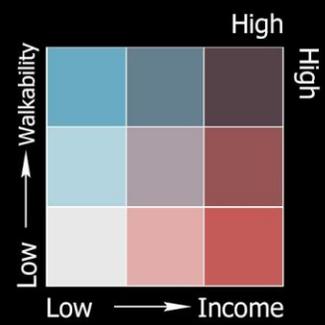
**Definition:** Mean walking times to supermarkets, median household (after-tax) income, 2016. Classified into 3 percentiles for Median Household Income (\$ - 2015): Low is \$21,941 to \$52,839, Medium is \$52,840 to \$66,811, and High is \$66,812 to \$206,336.

**Interpretation:** 456 supermarkets were available for analysis. The data is from Toronto Public Health. Typically supermarkets are located along or at close proximity to major intersections to facilitate maximum walkability to public transit and the convenience of parking for personal automobiles in suburban areas. In more densely populated urban areas underground parking replaces surface parking lots. High walkability and high median income are in the downtown core and Danforth Ave east of Broadview Ave and west of Pape Ave. Another concentration of high walkability and high median income is in the Bathurst St and Lawrence Ave area where there are numerous local roads that facilitate walking. Low walkability and low median income are found scattered in western Scarborough and northwestern and western North York as well as southern Etobicoke. In lower walkable low median income areas residents will have to rely on public transit to access supermarkets. Since sales-per-square foot not local community need dictates where supermarkets will locate stores (20) low median income areas may not be candidate areas for the location of supermarkets.

# Supermarket Walkability and Median Household Income



Walkability and Household Income



Normalized bi-variate relationship.  
Classified into 33% < 66% < 100%

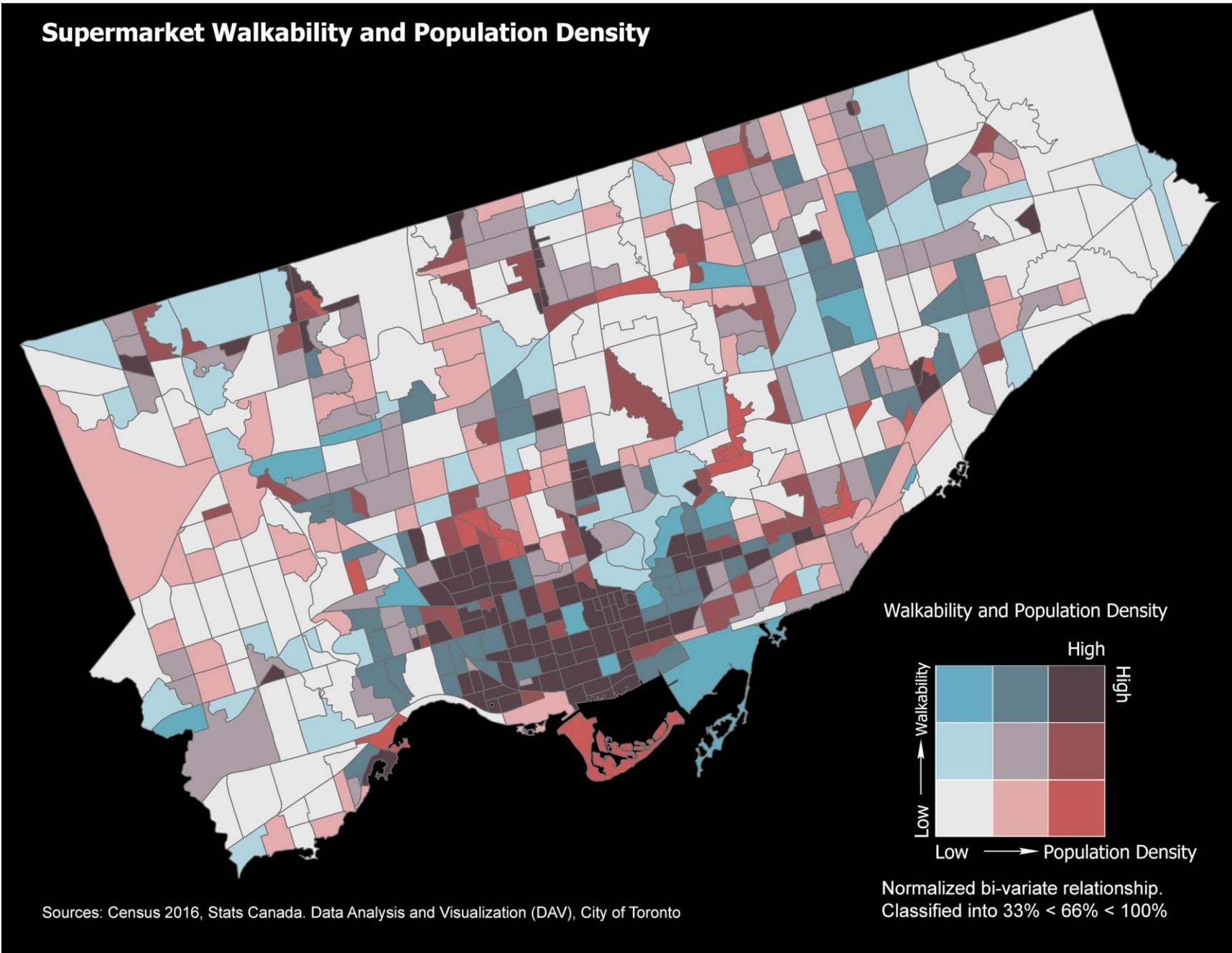
Sources: Census 2016, Stats Canada. Data Analysis and Visualization (DAV), City of Toronto

# Supermarket Location Walkability and Population Density

**Definition:** Mean walking times to supermarkets, population density, 2016. Classified into 3 percentiles for Population density per square kilometre: Low is 14 to 4,083, Medium is 4,084 to 7,536, and High is 7,537 to 82,434.

**Interpretation:** Low walkability and low population density are found scattered in eastern Scarborough, central and northern North York and large portions of Etobicoke. High walkability and high population density are found in the downtown core and in the Yonge St corridor between Sheppard Ave and Cummer Ave where many condominiums are being built. Condominium developers are being encouraged to consider the location of retail including supermarkets in their developments [\[19\]](#). However, while population density is a factor in the location of supermarkets, many other factors come into play including footfall, the proximity of public transit and schools [\[20\]](#). Location analysis software is also employed which segments households, postal codes and neighbourhoods into categories [\[20\]](#). Ultimately, sales-per-square foot not local community need dictates where supermarkets will locate stores [\[20\]](#).

# Supermarket Walkability and Population Density



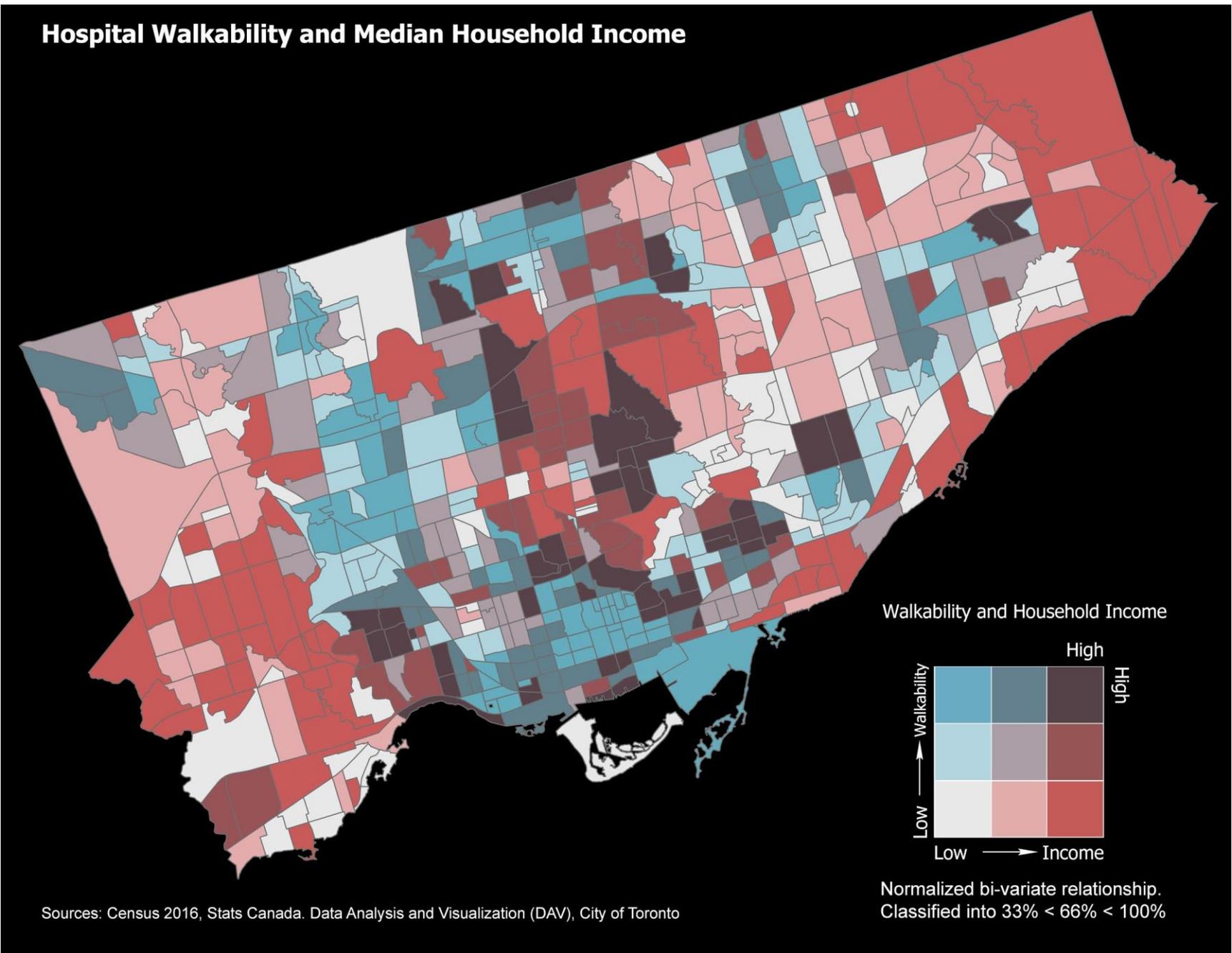
## Health Services

### Hospital Location Walkability and Household Median Income

**Definition:** Mean walking times to hospitals, median household (after-tax) income, 2016. Classified into 3 percentiles for Median Household Income (\$ - 2015): Low is \$21,941 to \$52,839, Medium is \$52,840 to \$66,811, and High is \$66,812 to \$206,336.

**Interpretation:** High walkability will be experienced in close proximity to hospitals. Hospitals in the study also included rehabilitation hospitals. Residents with low median income and low median walktimes would have to rely on public transit to visit hospitals for medical tests and scheduled procedures especially in the Lawrence Ave E and Victoria Park Ave area, Morningside Rd and Kingston Rd area. Conversely, high median income areas with low walkability would have the option of using personal transportation.

# Hospital Walkability and Median Household Income



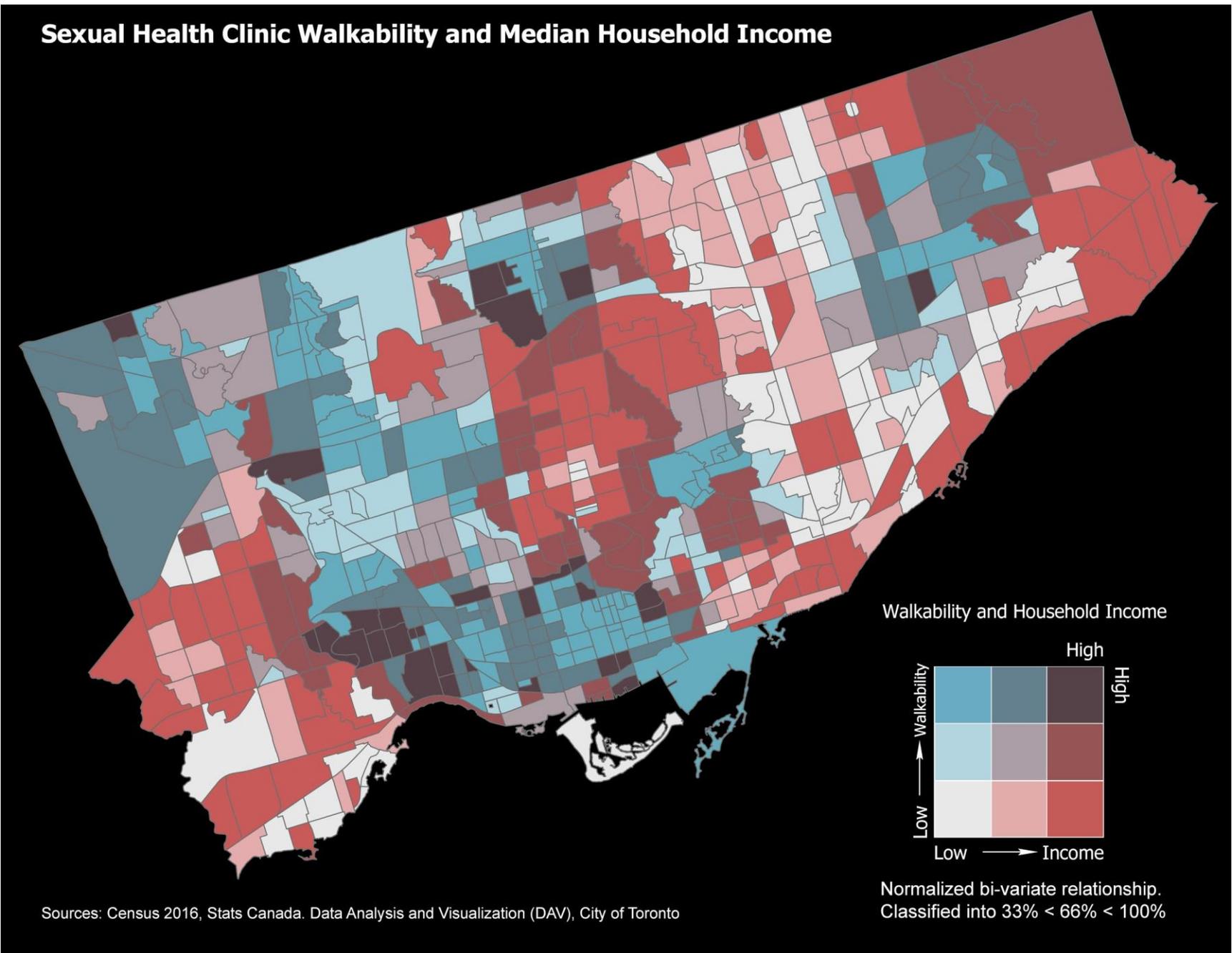
Sources: Census 2016, Stats Canada. Data Analysis and Visualization (DAV), City of Toronto

## Sexual Health Clinic Location Walkability and Household Median Income

**Definition:** Mean walking times to Sexual Health Clinic locations, median household (after-tax) income, 2016. Classified into 3 percentiles for Median Household Income (\$ - 2015): Low is \$21,941 to \$52,839, Medium is \$52,840 to \$66,811, and High is \$66,812 to \$206,336.

**Interpretation:** There are only 14 sexual health clinics throughout the City of Toronto with the largest concentration in the former city of Toronto. The highest concentration of low median income to low walkability occur along Victoria Park Ave between North York, East York, the former City of Toronto and Scarborough border. Low median income households in these areas would have to rely on public transit to personally visit these clinics.

# Sexual Health Clinic Walkability and Median Household Income



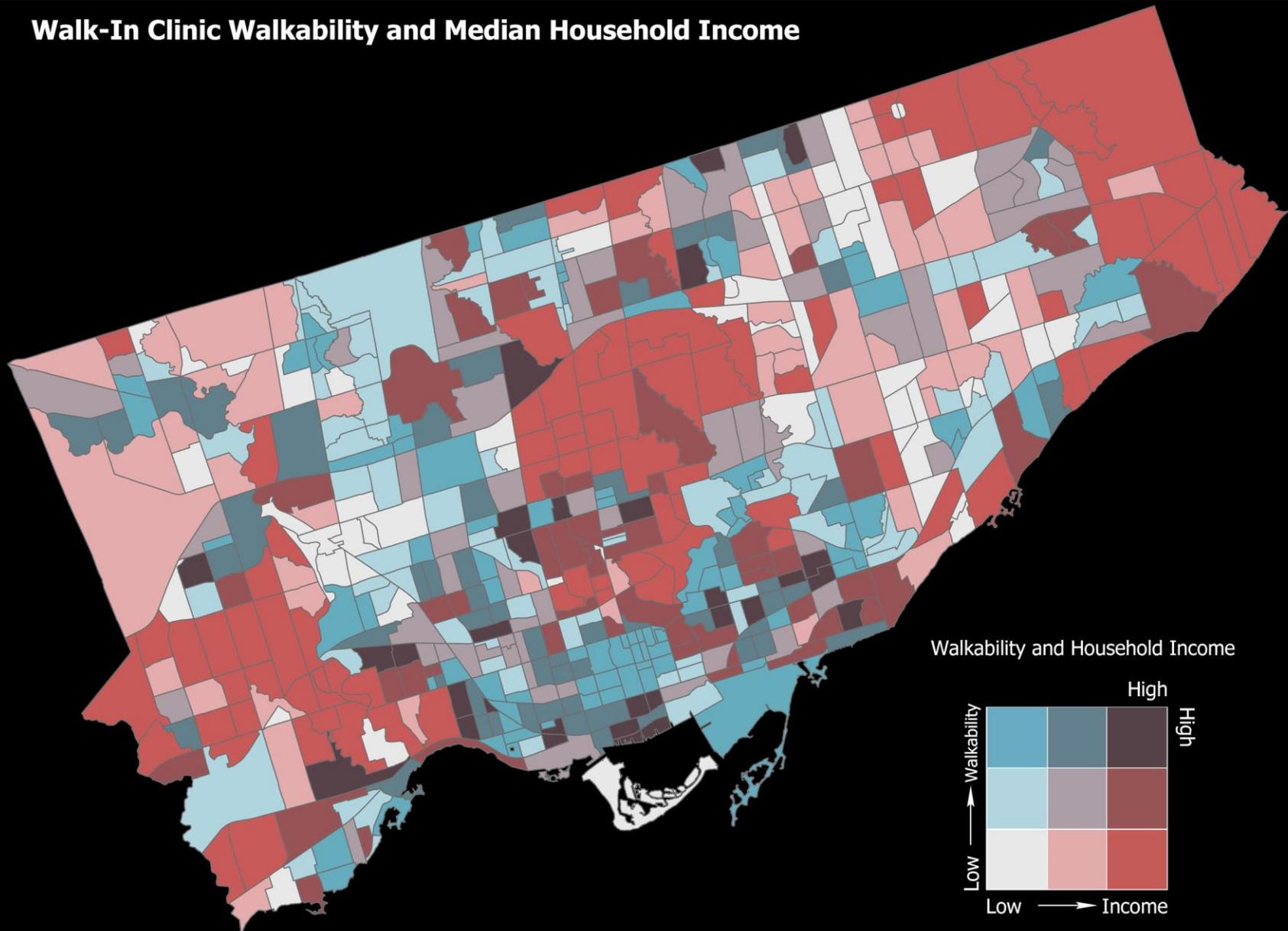
Sources: Census 2016, Stats Canada. Data Analysis and Visualization (DAV), City of Toronto

## Walk-in Clinic Location Walkability and Household Median Income

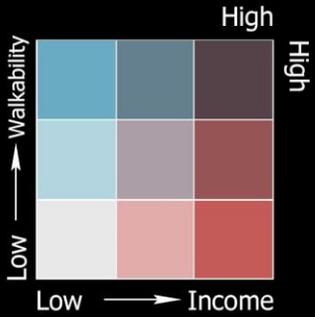
**Definition:** Mean walking times to walk-in clinics, median household (after-tax) income, 2016. Classified into 3 percentiles for Median Household Income (\$ - 2015): Low is \$21,941 to \$52,839, Medium is \$52,840 to \$66,811, and High is \$66,812 to \$206,336.

**Interpretation:** Of the 98 walk-in clinics distributed throughout the City of Toronto the highest concentration is in the former City of Toronto. Downtown Toronto has high walkability for low to high median income households. Areas in eastern Scarborough, the area south of Highway 401 between the Don Valley Parkway and Bathurst, the area centred on Rathburn Rd and Kipling Ave have low walkability and high household median income. These areas can compensate for low walkability by using personal transportation.

# Walk-In Clinic Walkability and Median Household Income



Walkability and Household Income



Normalized bi-variate relationship.  
Classified into 33% < 66% < 100%

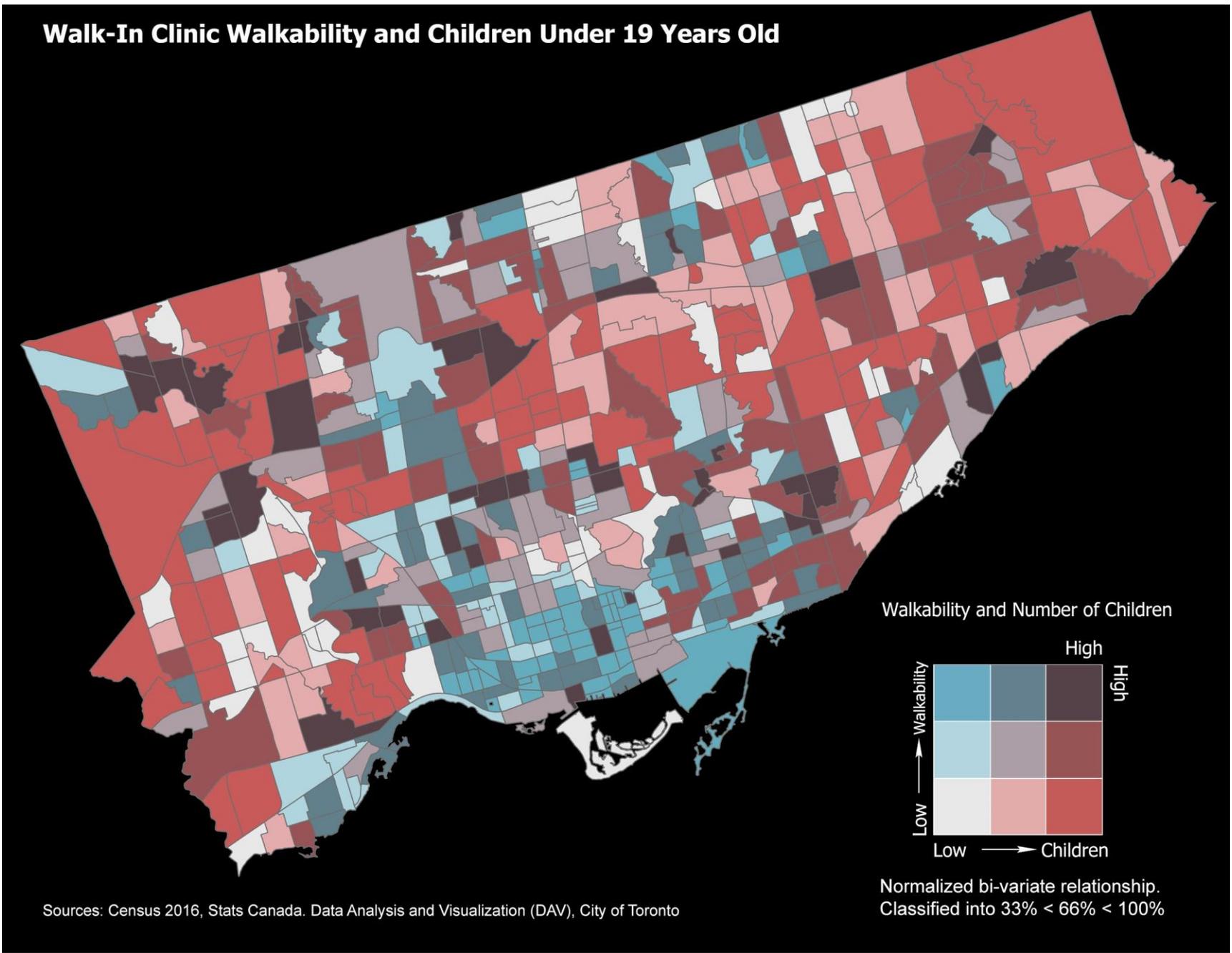
Sources: Census 2016, Stats Canada. Data Analysis and Visualization (DAV), City of Toronto

## Walk-in Clinic Location Walkability and Children Under 19 Years Old

**Definition:** Mean walking times to walk-in clinics, children under 19 using 2016 data. Classified into 3 percentiles for Population Under 19 Years of Age: Low is 5 to 718, Medium is 719 to 1,114, and High is 1,115 to 2,540.

**Interpretation:** The relationship between walk-in clinics and children under 19 was explored in order to determine whether children under 19 who make use of walk-in clinics for minor medical ailments including colds are adequately served by walk-in clinics. Common colds are the primary family of rhinoviruses [\[17\]](#). Middle to higher walkability scores are in the former city of Toronto. Depending on the severity of the child's illness walking to a walk-in clinic walking may not be an option and public or personal transport would have to be used. Low walkability and the higher number of children are in eastern Scarborough. However, children with parents who have personal vehicles can drive their children to a walk-in clinic thus negating the low walkability score.

# Walk-In Clinic Walkability and Children Under 19 Years Old



Sources: Census 2016, Stats Canada. Data Analysis and Visualization (DAV), City of Toronto

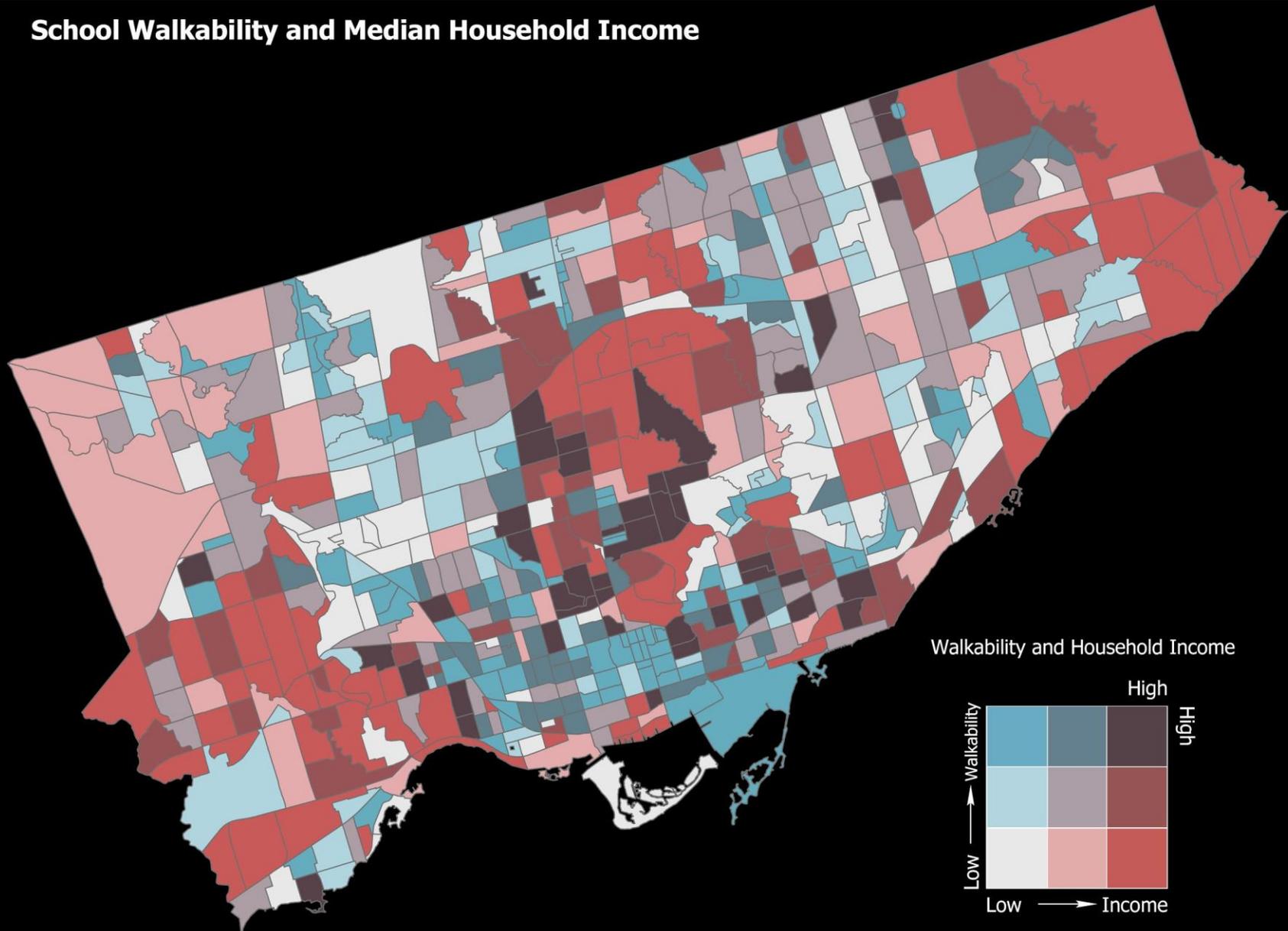
## Public Services

### School Location Walkability and Household Median Income

**Definition:** Mean walking times to schools, median household (after-tax) income, 2016. Classified into 3 percentiles for Median Household Income (\$ - 2015): Low is \$21,941 to \$52,839, Medium is \$52,840 to \$66,811, and High is \$66,812 to \$206,336.

**Interpretation:** Schools in this study include both public and private as well universities and colleges. High walkability for low to medium median household income exist in downtown Toronto with low walkability scores along Queens Quay where there is generally an absence of schools. Low walkability and low median income exist in portions of North York, Scarborough and York. High walkability with high median income occurred in the area bounded by Yonge St, St Clair Ave W, Bathurst and the CPR tracks to the south. Other high walkability areas with high median income include Leaside, Post Rd and the Bathurst and Lawrence area. Once the child transitions to a post-secondary institution (college or university) in Toronto and there are fewer institutions then public transit or private transportation would have to be used in areas where none of these institutions exist.

# School Walkability and Median Household Income



Sources: Census 2016, Stats Canada. Data Analysis and Visualization (DAV), City of Toronto

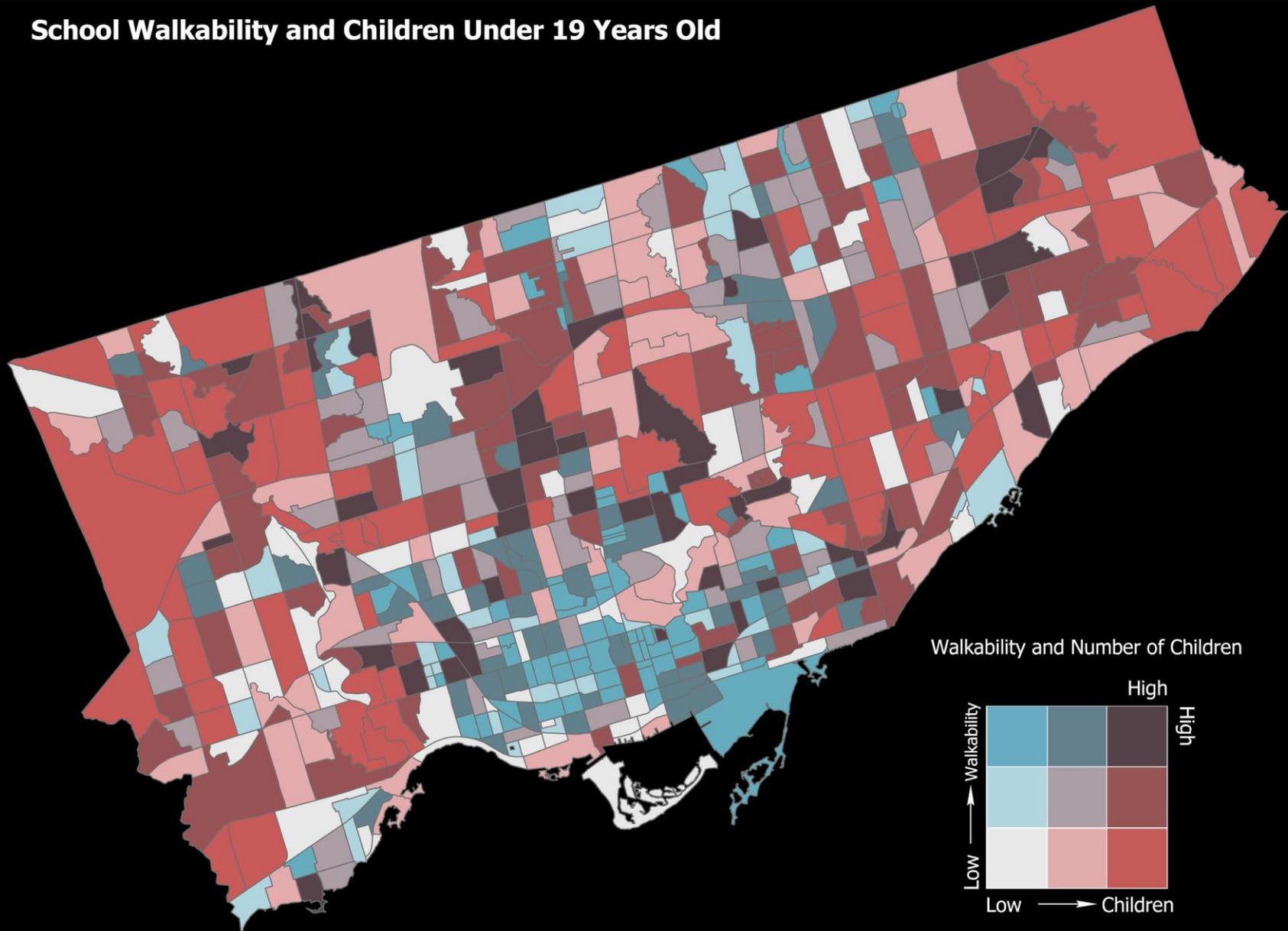
Normalized bi-variate relationship.  
Classified into 33% < 66% < 100%

## School Location Walkability and Population Under 19 Years Old

**Definition:** Mean walking times to schools, population under 19, 2016. Classified into 3 percentiles for Population Under 19 Years of Age: Low is 5 to 718, Medium is 719 to 1,114, and High is 1,115 to 2,540.

**Interpretation:** The suburban areas have lower walkability but a higher number of children while the downtown core has a higher walkability but a fewer number of children in the census tracts.

# School Walkability and Children Under 19 Years Old



Sources: Census 2016, Stats Canada. Data Analysis and Visualization (DAV), City of Toronto

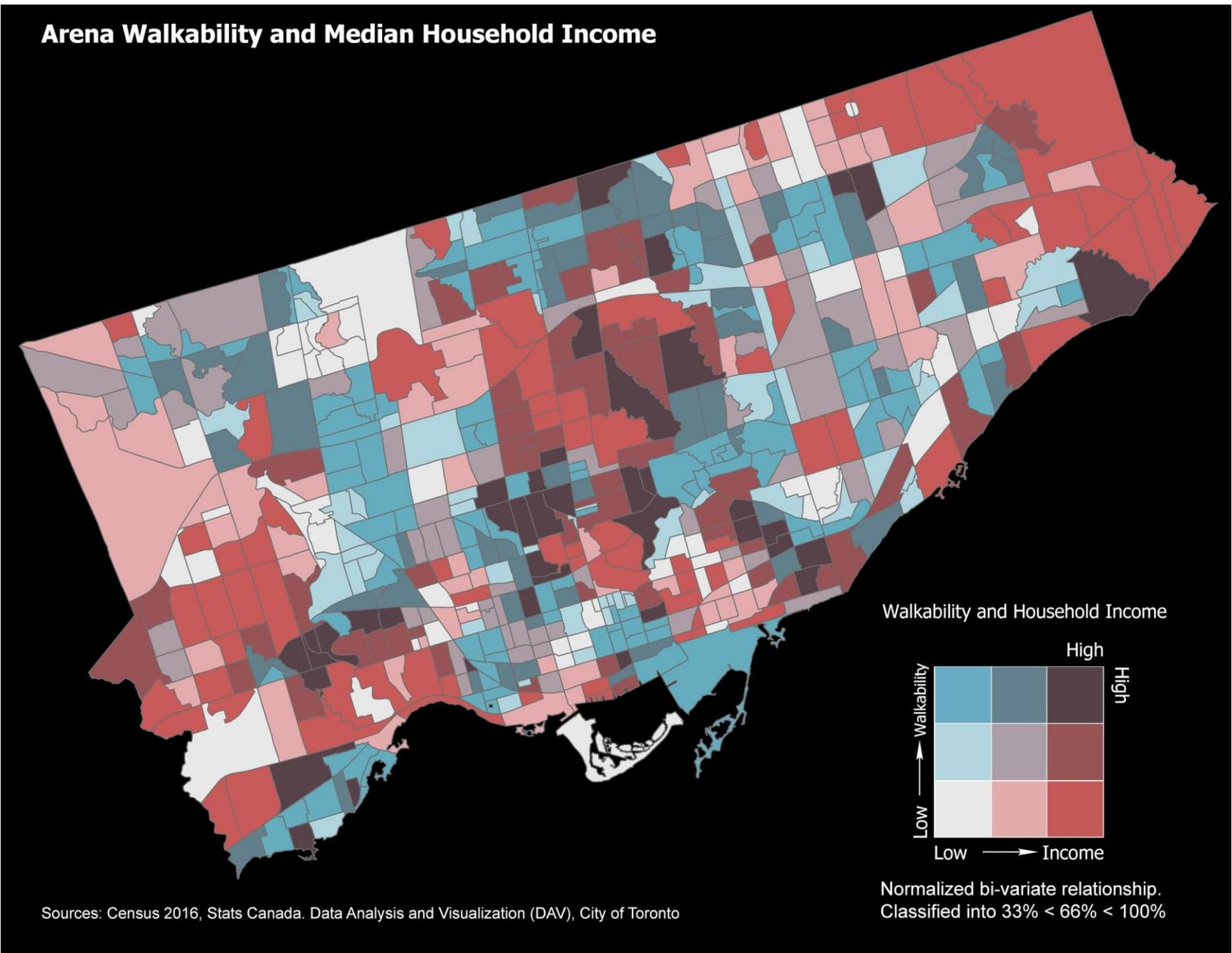
Normalized bi-variate relationship.  
Classified into 33% < 66% < 100%

## Arena Location Walkability and Household Median Income

**Definition:** Mean walking times to arenas, median household (after-tax) income, 2016. Classified into 3 percentiles for Median Household Income (\$ - 2015): Low is \$21,941 to \$52,839, Medium is \$52,840 to \$66,811, and High is \$66,812 to \$206,336.

**Interpretation:** There are 48 City owned arenas in the City of Toronto. Private arenas were not included in this study. Low walkability and low median income areas exist throughout the City of Toronto. The area bounded by Sheppard Ave W, Keele St, Finch Ave W and Jane St is an area with low walkability and low median income. Perhaps the location of a city owned arena in this area would benefit the community. Further study would have to be undertaken to determine the location criteria for arenas.

# Arena Walkability and Median Household Income



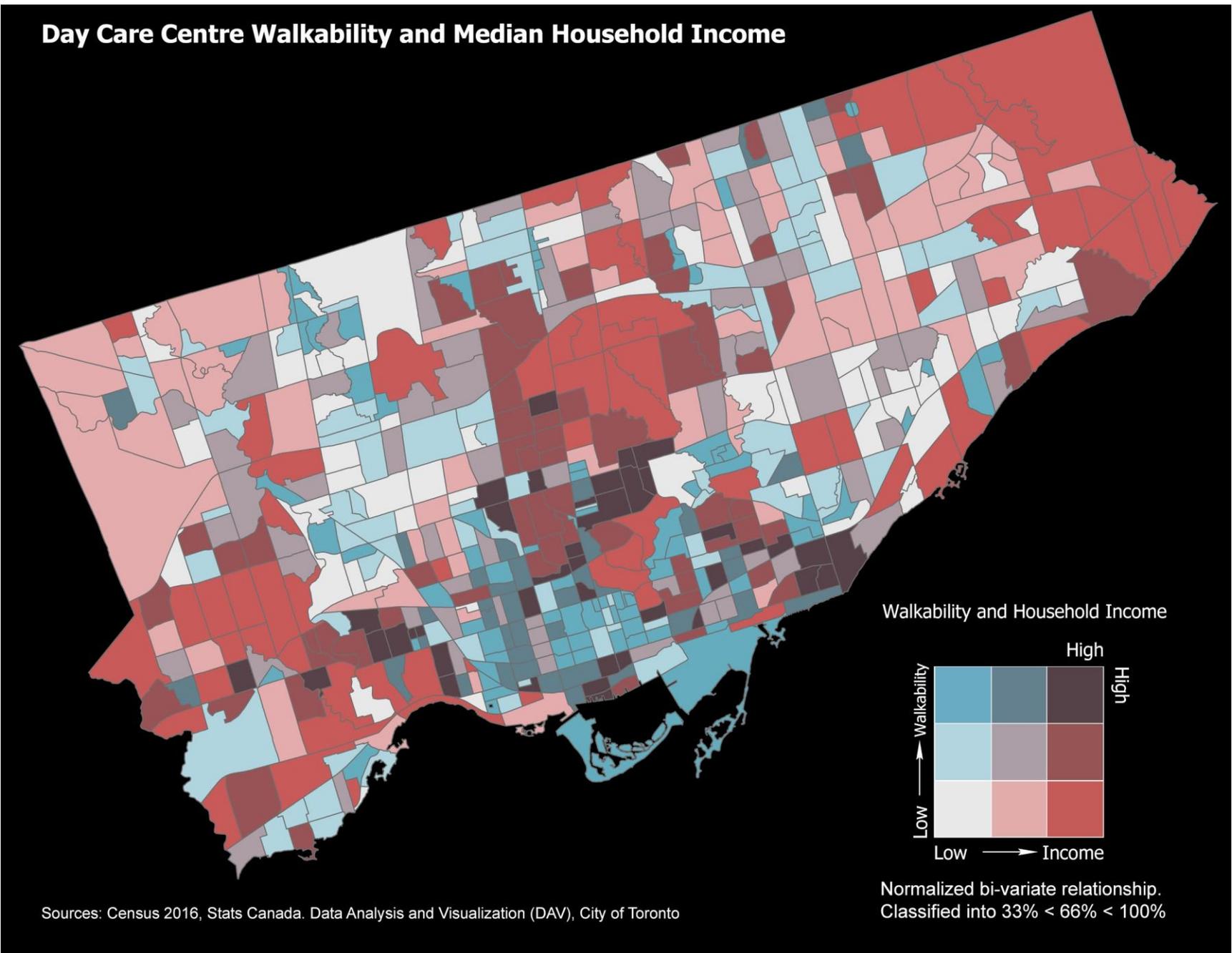
Sources: Census 2016, Stats Canada. Data Analysis and Visualization (DAV), City of Toronto

## Day Care Centre Location Walkability and Household Median Income

**Definition:** Mean walking times to day care centres, median household (after-tax) income, 2016. Classified into 3 percentiles for Median Household Income (\$ - 2015): Low is \$21,941 to \$52,839, Medium is \$52,840 to \$66,811, and High is \$66,812 to \$206,336.

**Interpretation:** Licensed day care centres are distributed throughout the City of Toronto except in northeastern Scarborough which is primarily rural. Another area of the City of Toronto without day care centres is the industrial commercial area bounded by Highway 401, Rexdale Blvd and Highway 427. Large areas of high walkability and high median income exist west of Bathurst St and Eglinton Ave W, the area centred around the Bayview Ave and Davisville Ave area, the area centred around Runnymede Rd and Annette St, the area centred around Victoria Park Ave and Kingston Rd. High walkability also exists in the downtown core where low, medium and high median income are represented. While shorter walk times to day care is certainly preferable the availability of licensed day care is even more of an issue with waiting lists for child care spots.

# Day Care Centre Walkability and Median Household Income



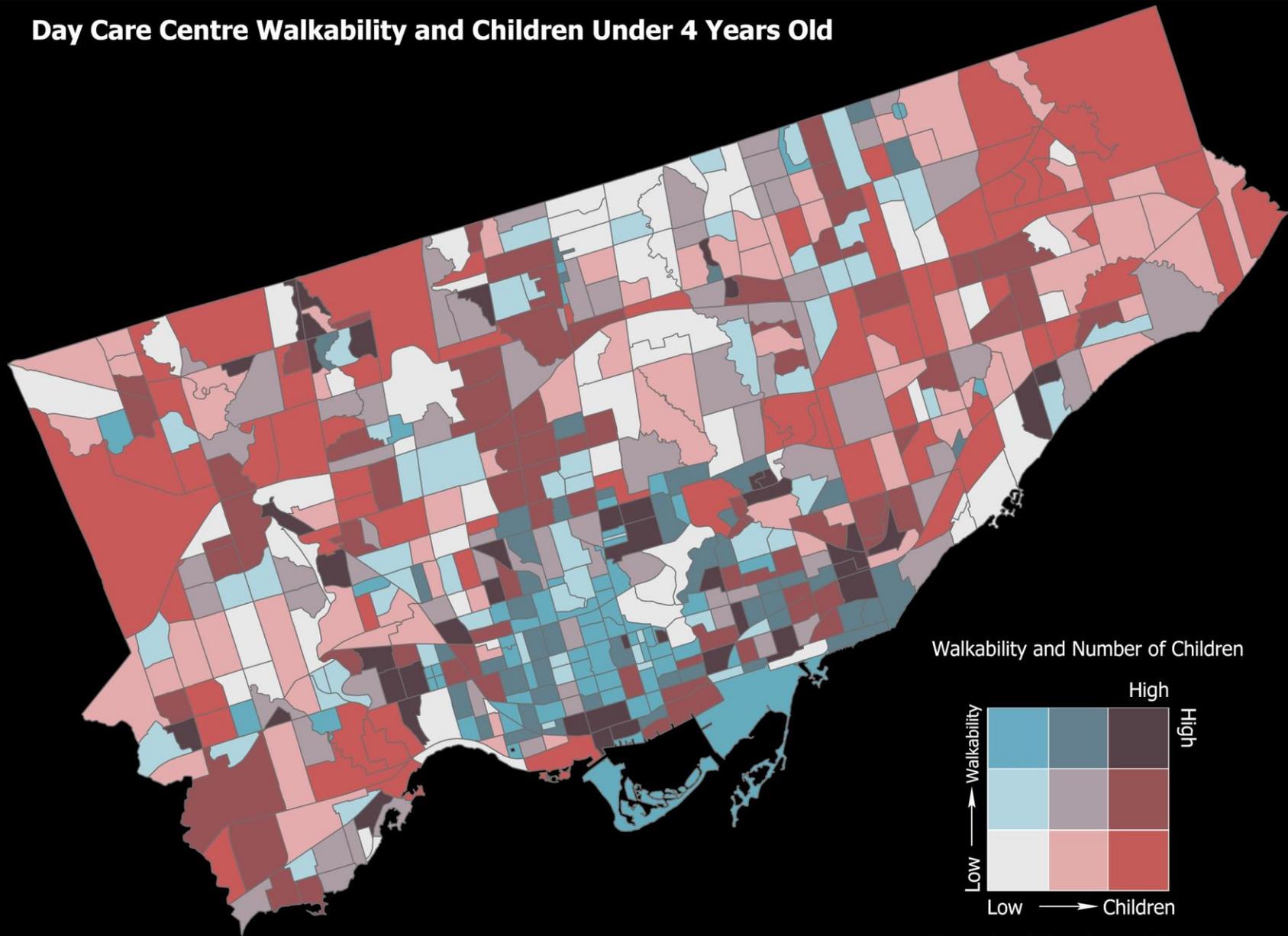
Sources: Census 2016, Stats Canada. Data Analysis and Visualization (DAV), City of Toronto

## Day Care Centre Location Walkability and Population Under 4 Years of Age

**Definition:** Mean walking times to day care centres, population under 4 years of age, 2016. Classified into 3 percentiles for Population Under 4 Years of Age: Low is 0 to 174, Medium is 175 to 274, and High is 275 to 760.

**Interpretation:** Licensed day care centres have low walkability in the suburban areas and higher population under 4 years of age. The downtown core has higher walkability but lower population under 4 except for the area in the heavily intensified condominium area south of Queen St W between Simcoe St and Strachan Ave.

# Day Care Centre Walkability and Children Under 4 Years Old



Sources: Census 2016, Stats Canada. Data Analysis and Visualization (DAV), City of Toronto

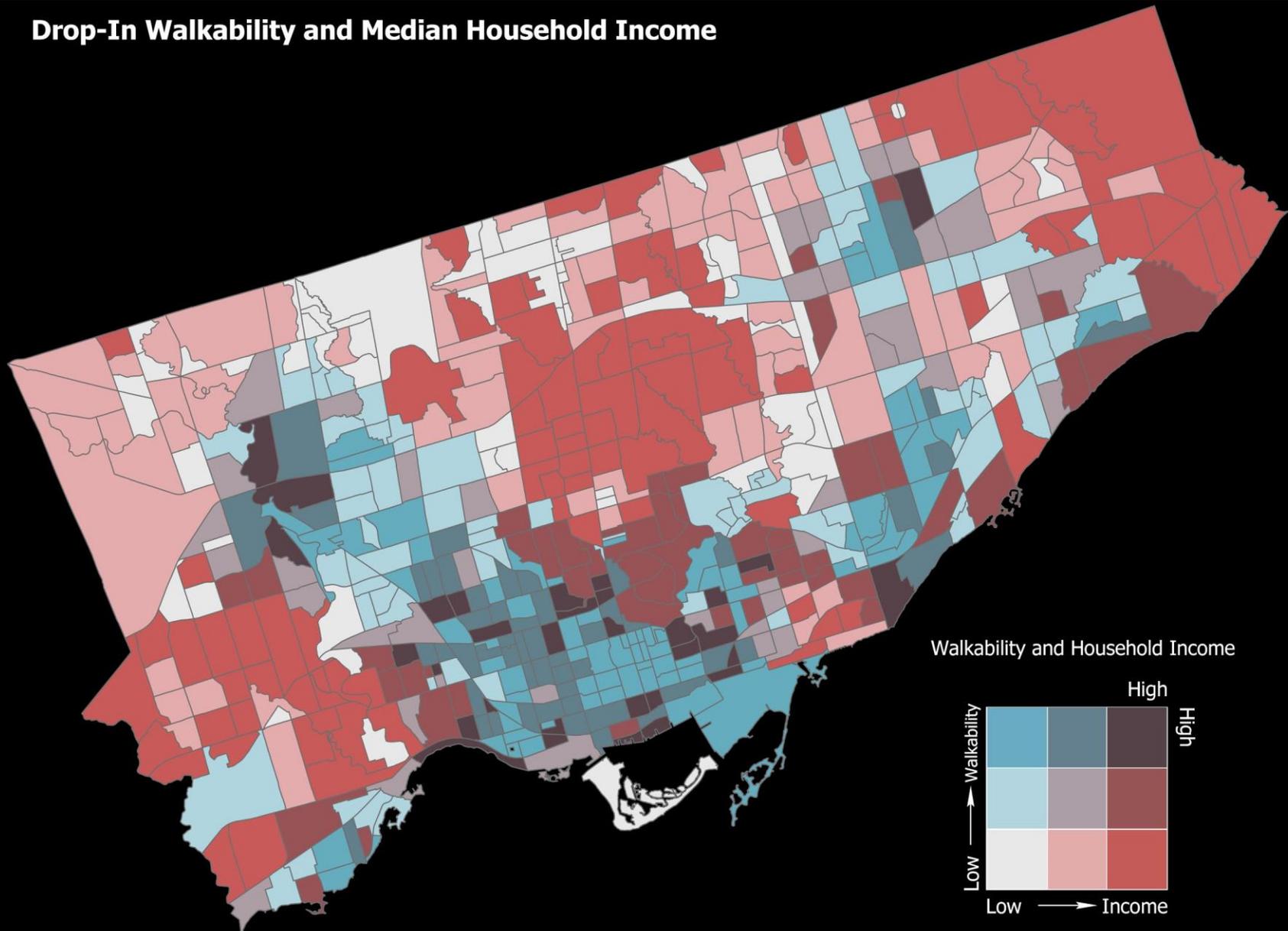
Normalized bi-variate relationship.  
Classified into 33% < 66% < 100%

## Drop-in Centre Location Walkability and Household Median Income

**Definition:** Mean walking times drop-in centre, median household (after-tax) income, 2016

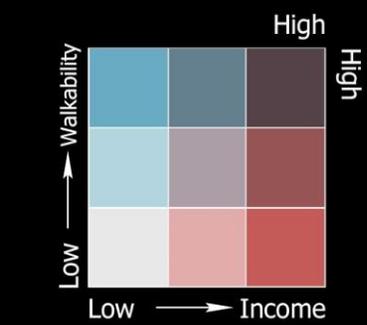
**Interpretation:** Drop-in centres are located in those areas of the City of Toronto where there is a pronounced need for such services with the primary concentration is in the old City of Toronto. Additional areas include south eastern Scarborough centred around Kingston Road and Lawrence Ave E, north central Scarborough in the Malvern community, south western Scarborough, southern Etobicoke, and the Highway 400 and 401 area. Consequently higher walkability can be found in downtown Toronto. The absence of drop-in centres in central Toronto in the area of Yonge St and Highway 401 is shown by the fact there is a large area of low walkability in the area bounded by the Don Valley Parkway, Highway 401, Bathurst St, and north of Eglinton Ave.

# Drop-In Walkability and Median Household Income



Sources: Census 2016, Stats Canada. Data Analysis and Visualization (DAV), City of Toronto

Walkability and Household Income



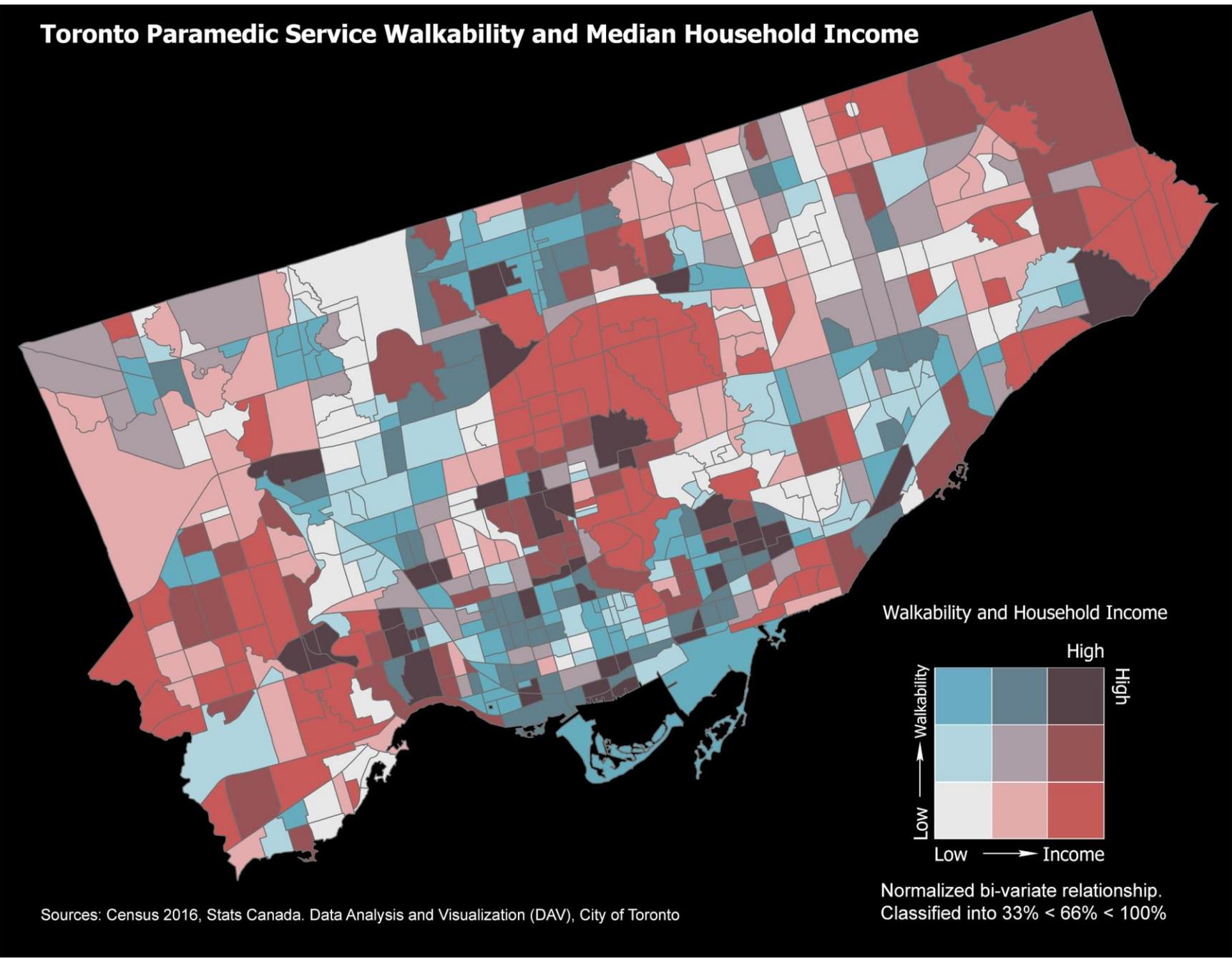
Normalized bi-variate relationship.  
Classified into 33% < 66% < 100%

## Toronto Paramedic Service Location Walkability and Household Median Income

**Definition:** Mean walking times to Toronto Paramedic Services, median household (after-tax) income, 2016. Classified into 3 percentiles for Median Household Income (\$ - 2015): Low is \$21,941 to \$52,839, Medium is \$52,840 to \$66,811, and High is \$66,812 to \$206,336.

**Interpretation:** As noted previously Toronto Paramedic Services responds to people in distress with a response time of 11.5 minutes (7). Toronto Paramedic Services are located throughout the City of Toronto and consequently higher walkability is experienced in those areas surrounding paramedic services. Since Toronto Paramedic Service locations don't offer services at the stations then low walkability is not a factor although the presence of essential services in a community does indicate a level of commitment by the City of Toronto.

# Toronto Paramedic Service Walkability and Median Household Income



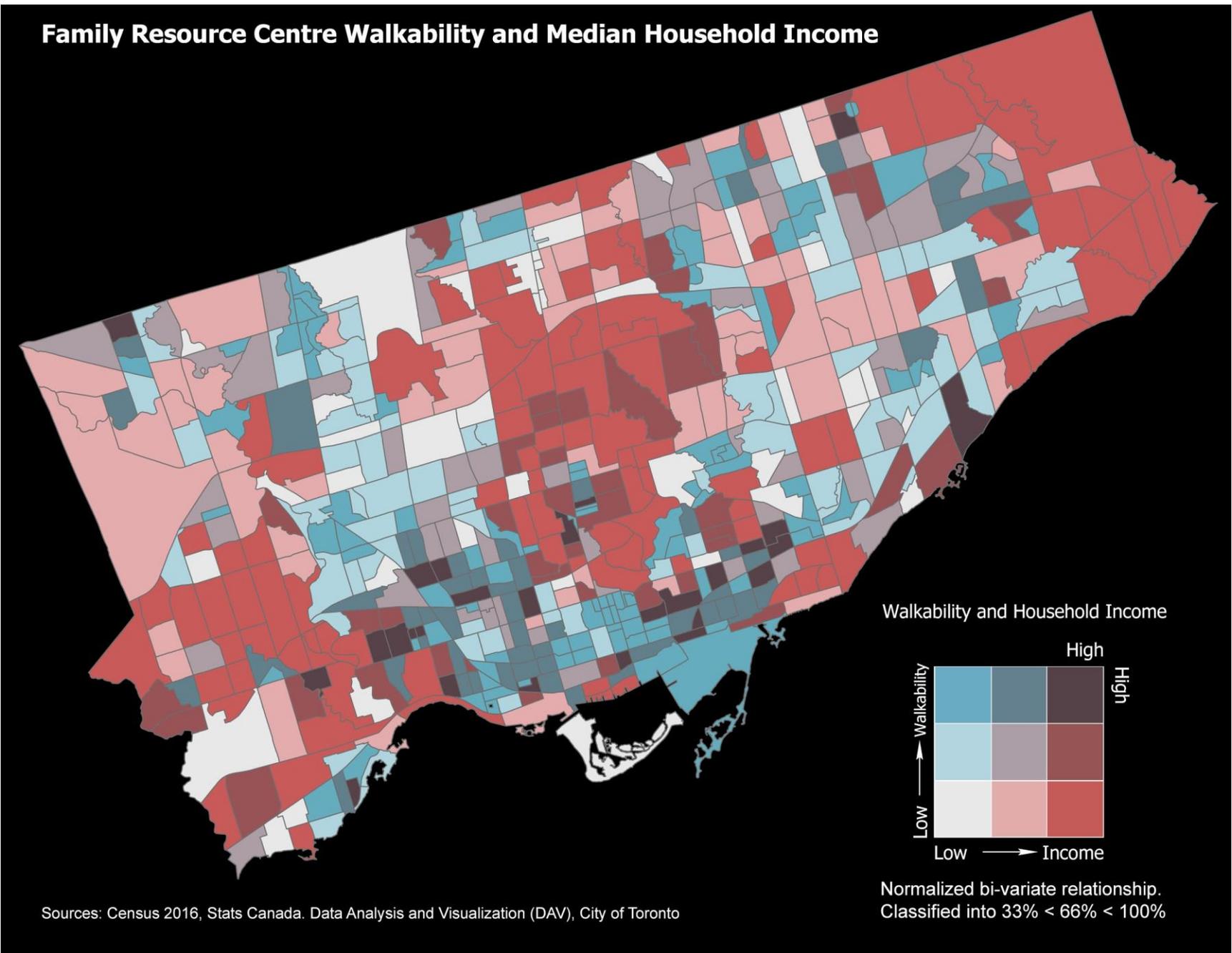
Sources: Census 2016, Stats Canada. Data Analysis and Visualization (DAV), City of Toronto

## Family Resource Centre Location Walkability and Household Median Income

**Definition:** Mean walking times to family resource centres, median household (after-tax) income, 2016. Classified into 3 percentiles for Median Household Income (\$ - 2015): Low is \$21,941 to \$52,839, Medium is \$52,840 to \$66,811, and High is \$66,812 to \$206,336.

**Interpretation:** Family Resource Centres are distributed throughout the City of Toronto with larger concentration in downtown Toronto. Family Resource Centres are not located northeastern Scarborough which is primarily rural as well as the industrial commercial area bounded by Highway 401, Rexdale Blvd and Highway 427. Higher walkability exists in downtown Toronto except for the area along Queens Quay which has low walkability and no Family Resource Centres except in the Bathurst St and Queens Quay W area.

# Family Resource Centre Walkability and Median Household Income



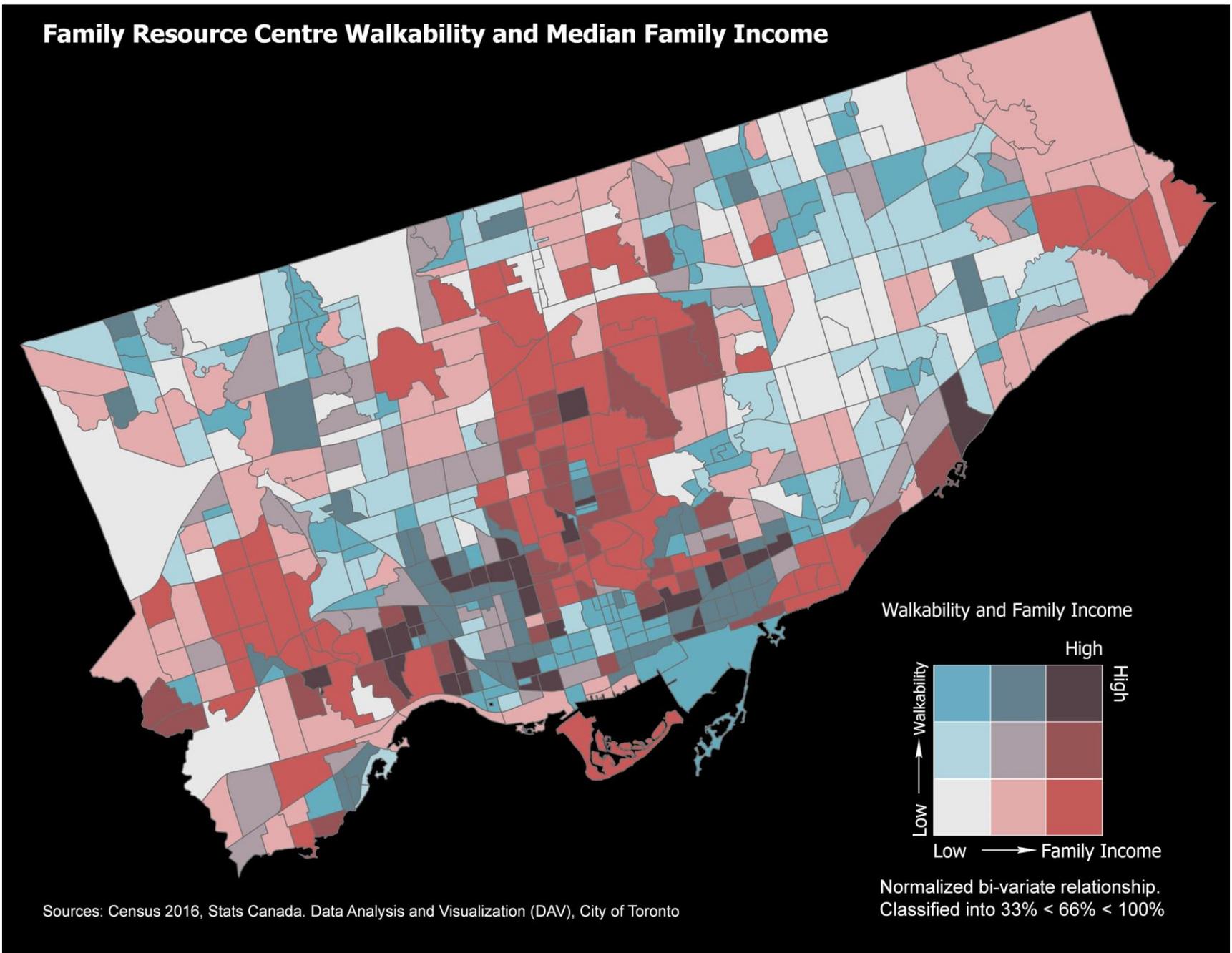
Sources: Census 2016, Stats Canada. Data Analysis and Visualization (DAV), City of Toronto

## Family Resource Centre Location Walkability and Median Family Income

**Definition:** Mean walking times to family resource centres, median family income (after-tax) income, 2016. Classified into 3 percentiles for Median Family Income, after tax (\$ - 2015): Low is \$0 to \$79,030, Medium is \$79,031 to \$102,000, and High is \$102,001 to \$322,970.

**Interpretation:** Family Resource Centres are distributed throughout the City of Toronto with larger concentration in downtown Toronto. Family Resource Centres are not located northeastern Scarborough which is primarily rural as well as the industrial commercial area bounded by Highway 401, Rexdale Blvd and Highway 427. Higher walkability exists in downtown Toronto except for the area along Queens Quay which has low walkability and no Family Resource Centres except in the Bathurst St and Queens Quay W area.

# Family Resource Centre Walkability and Median Family Income



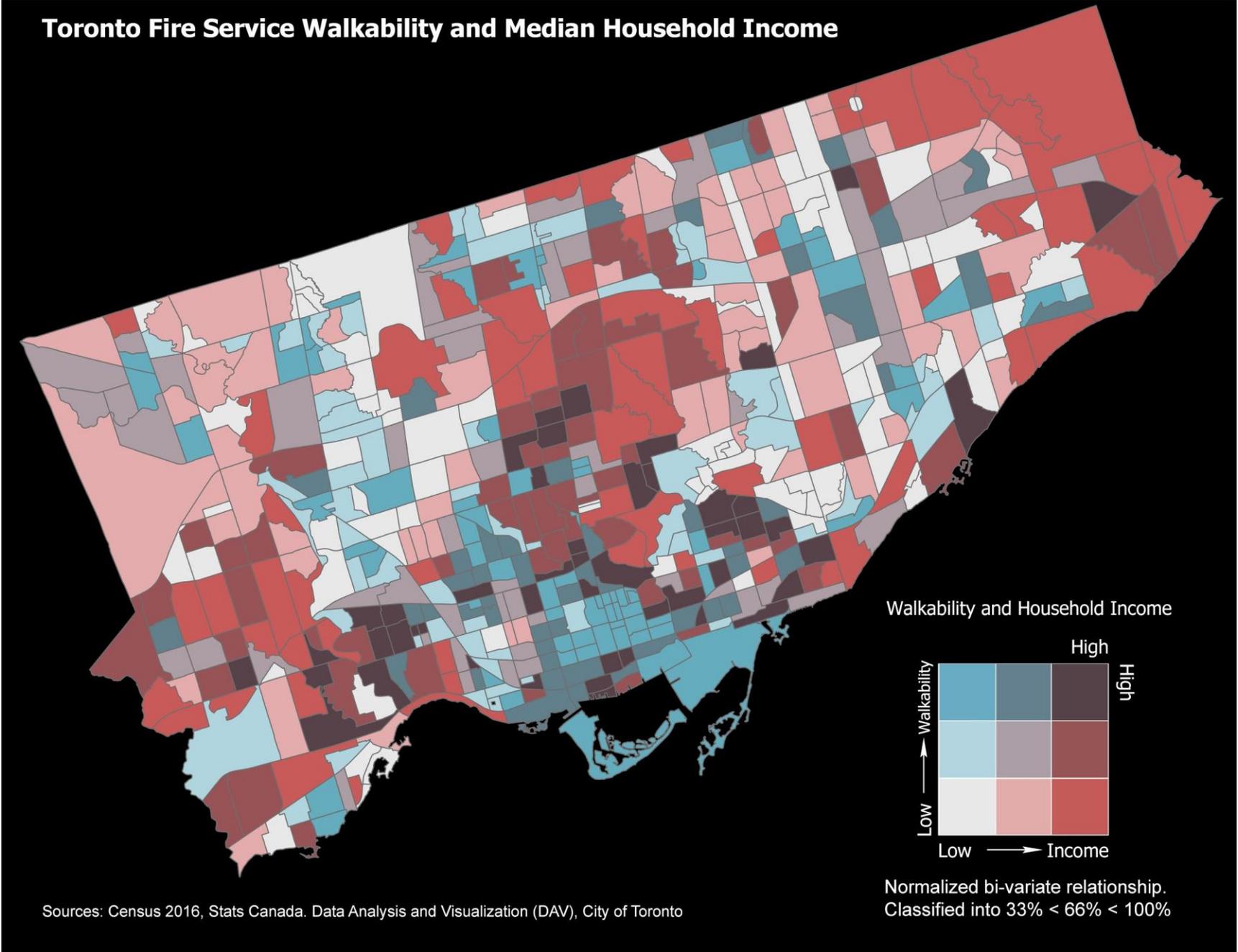
Sources: Census 2016, Stats Canada. Data Analysis and Visualization (DAV), City of Toronto

## Toronto Fire Service Centre Location Walkability and Household Median Income

**Definition:** Mean walking times to Toronto Fire Service Centres, median household (after-tax) income, 2016. Classified into 3 percentiles for Median Household Income (\$ - 2015): Low is \$21,941 to \$52,839, Medium is \$52,840 to \$66,811, and High is \$66,812 to \$206,336.

**Interpretation:** As indicated previously Toronto Fire Services response time from initial call to arrival is 7.03 minutes while the Effective Firefighting Force is 10.29 minutes as of 2017 [\[8\]](#). Consequently Toronto Fire Services are distributed throughout the City of Toronto to minimize travel time and to take into account population density where there is a greater concentration of stations in downtown Toronto. The proximity of a Toronto Fire Service station like other essential public services indicates a commitment to the community.

# Toronto Fire Service Walkability and Median Household Income

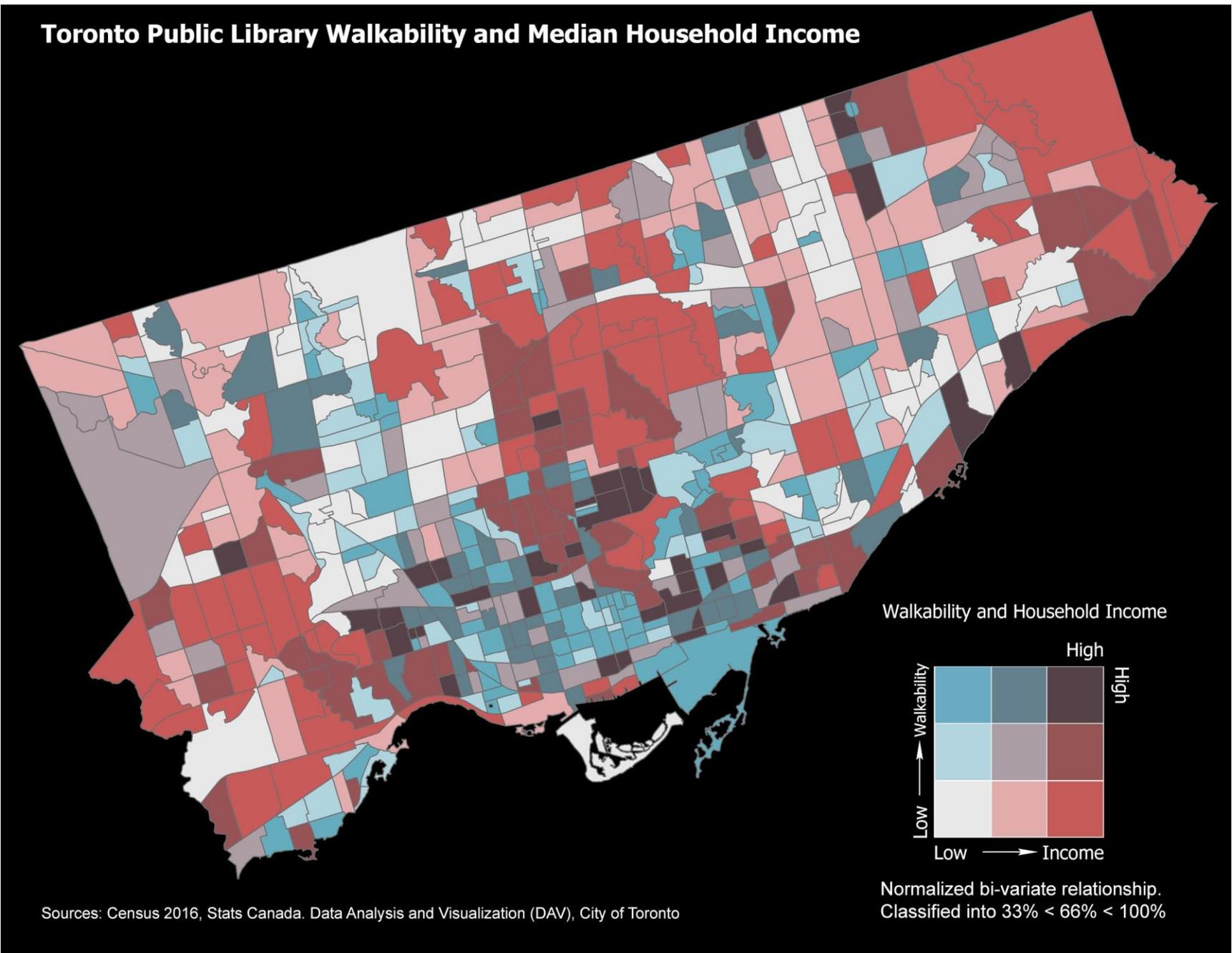


# Toronto Public Library Centre Location Walkability and Household Median Income

**Definition:** Mean walking times to Toronto Public Libraries, median household (after-tax) income, 2016. Classified into 3 percentiles for Median Household Income (\$ - 2015): Low is \$21,941 to \$52,839, Medium is \$52,840 to \$66,811, and High is \$66,812 to \$206,336.

**Interpretation:** Public libraries are located throughout the City of Toronto with the larger concentration in the city centre. Consequently, there is high walkability for the downtown core except along the Queens Quay area. Higher median income areas with lower walkability scores, for example, the area bounded by Yonge St, Highway 401, Don Valley Parkway and Lawrence Ave can access the public libraries with the use of personal vehicles.

# Toronto Public Library Walkability and Median Household Income



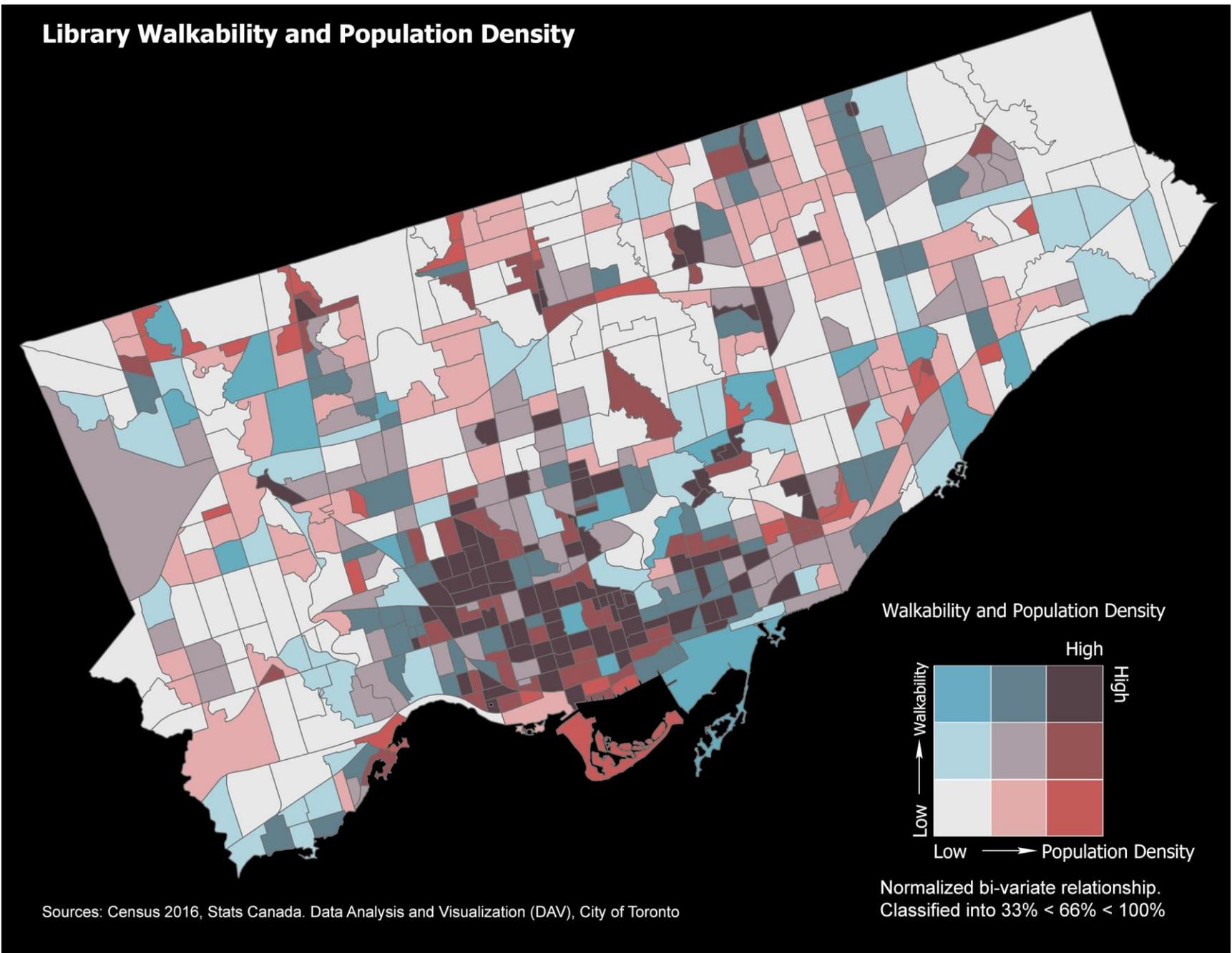
Sources: Census 2016, Stats Canada. Data Analysis and Visualization (DAV), City of Toronto

## Toronto Public Library Centre Location Walkability and Population Density

**Definition:** Mean walking times to Toronto Public Libraries, population density, 2016. Classified into 3 percentiles for Population density per square kilometre: Low is 14 to 4,083, Medium is 4,084 to 7,536, and High is 7,537 to 82,434.

**Interpretation:** Public libraries are located throughout the City of Toronto with the larger concentration in the city centre. Consequently, there is high walkability for the downtown core except along the Queens Quay area. Large areas of the City of Toronto exhibit low population density and low walkability in eastern and central Scarborough, central and western Etobicoke, central and northern North York which are traditional single family residences.

# Library Walkability and Population Density



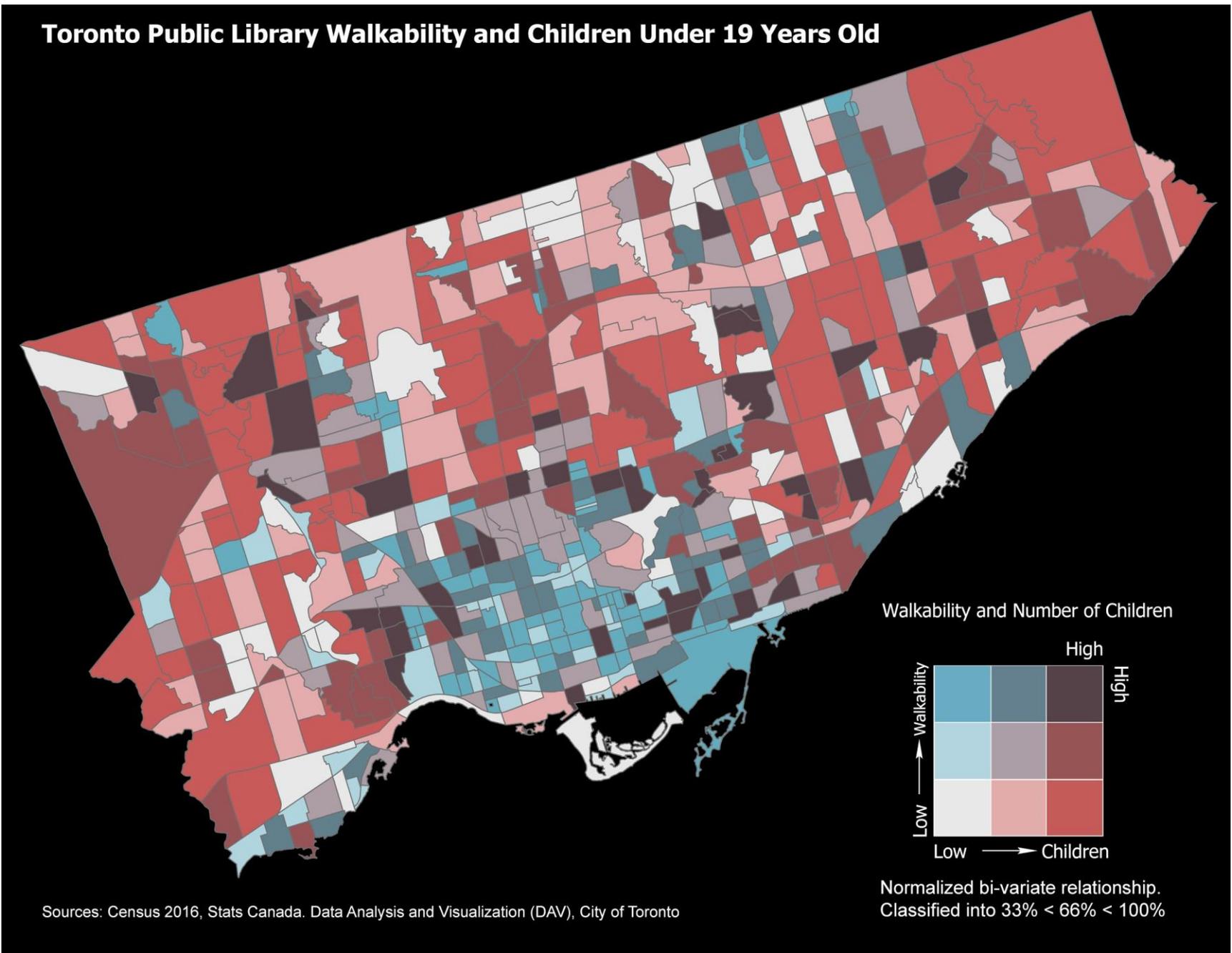
Sources: Census 2016, Stats Canada. Data Analysis and Visualization (DAV), City of Toronto

# Toronto Public Library Centre Location Walkability and Population Under 19 Years of Age

**Definition:** Mean walking times to Toronto Public Libraries, population under 19 years of age, 2016. Classified into 3 percentiles for Population Under 19 Years of Age: Low is 5 to 718, Medium is 719 to 1,114, and High is 1,115 to 2,540.

**Interpretation:** Public libraries are located throughout the City of Toronto with the larger concentration in the city centre. Consequently, there is high walkability for the downtown core except along the Queens Quay area. Small areas of the City of Toronto exhibit low walkability and low population under 19 years of age including an area north of Bluffers Park in Scarborough.

# Toronto Public Library Walkability and Children Under 19 Years Old



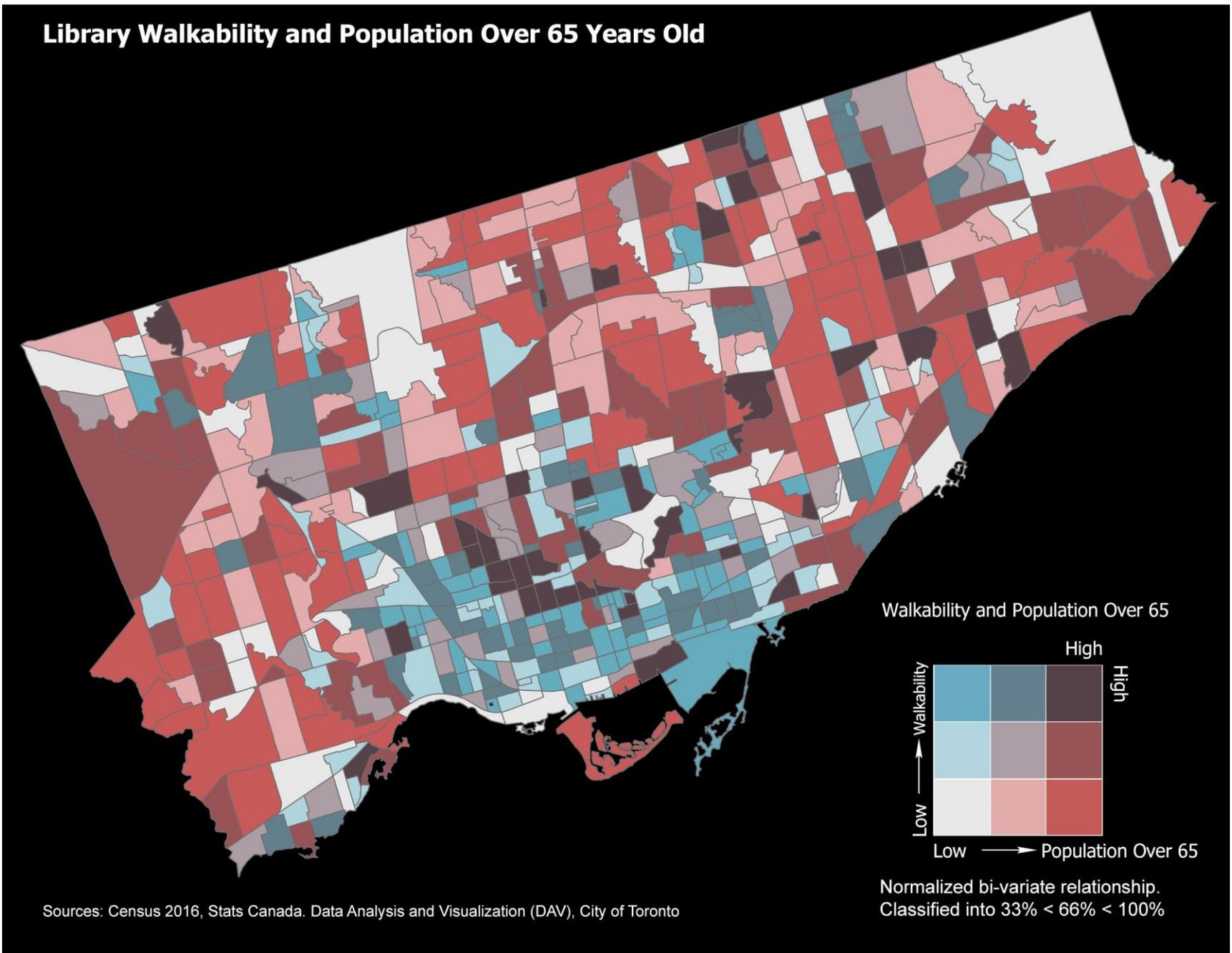
Sources: Census 2016, Stats Canada. Data Analysis and Visualization (DAV), City of Toronto

# Toronto Public Library Centre Location Walkability and Population Over 65 Years of Age

**Definition:** Mean walking times to Toronto Public Libraries, population over 65 years of age, 2016. Classified into 3 percentiles for Population Over 65 Years of Age: Low is 10 to 559, Medium is 560 to 874, and High is 875 to 2,350.

**Interpretation:** Public libraries are located throughout the City of Toronto with the larger concentration in the city centre. Consequently, there is high walkability for the downtown core except along the Queens Quay area. Large areas of the suburban Toronto exhibit high population over 65 years of age including an area north of Bluffers Park in Scarborough.

# Library Walkability and Population Over 65 Years Old



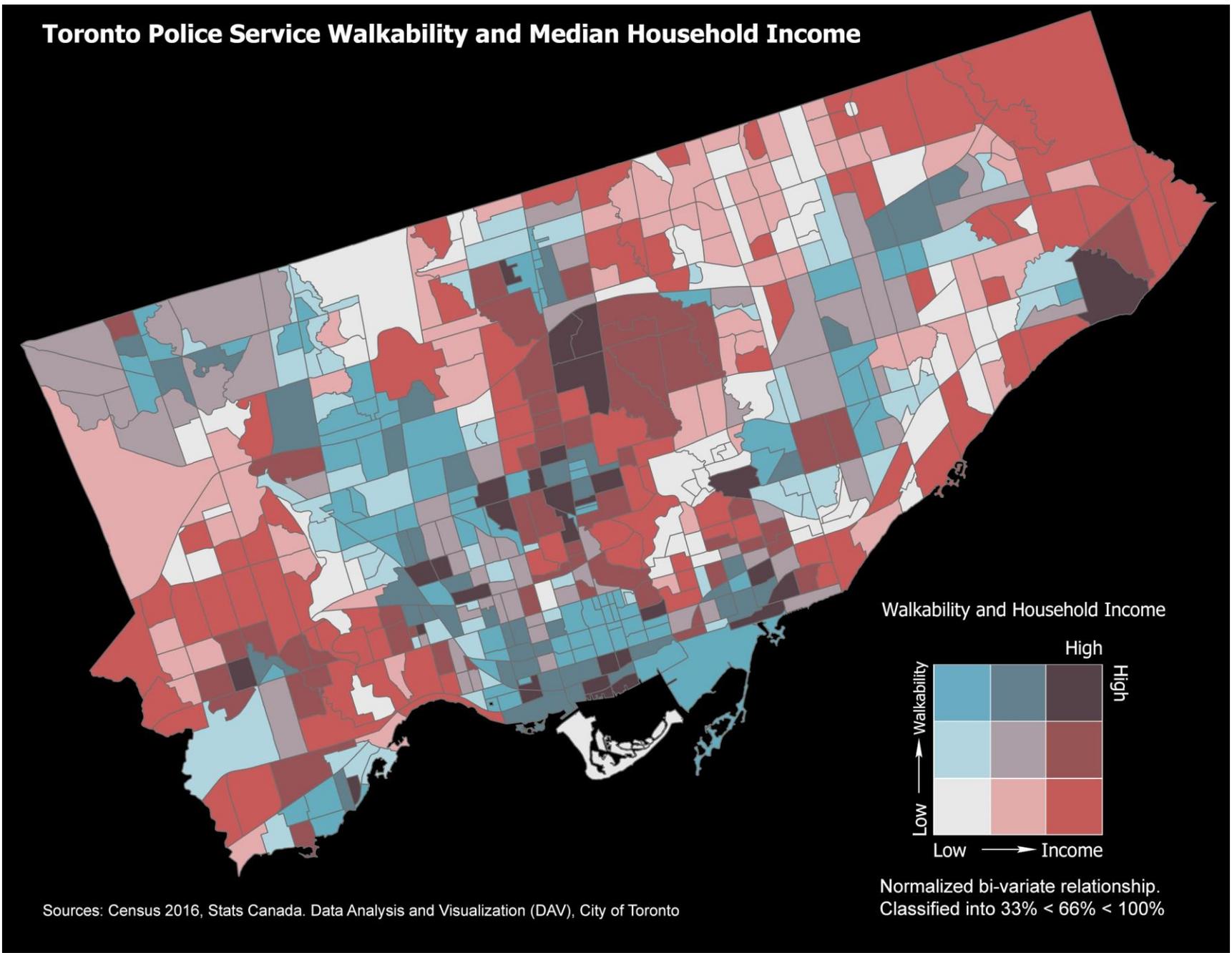
Sources: Census 2016, Stats Canada. Data Analysis and Visualization (DAV), City of Toronto

# Toronto Police Service Centre Location Walkability and Household Median Income

**Definition:** Mean walking times, median household (after-tax) income, 2016. Classified into 3 percentiles for Median Household Income (\$ - 2015): Low is \$21,941 to \$52,839, Medium is \$52,840 to \$66,811, and High is \$66,812 to \$206,336.

**Interpretation:** There are only 32 Toronto Police Service facilities that also include headquarters, administrative and support services. Shorter walktimes to Toronto Police Services are clustered around the service locations. Toronto Police Services deploy most of their services from vehicles and therefore large areas of the City of Toronto are not within walking distance to a police station and thus would require other transportation options to access services provided at Police stations.

# Toronto Police Service Walkability and Median Household Income



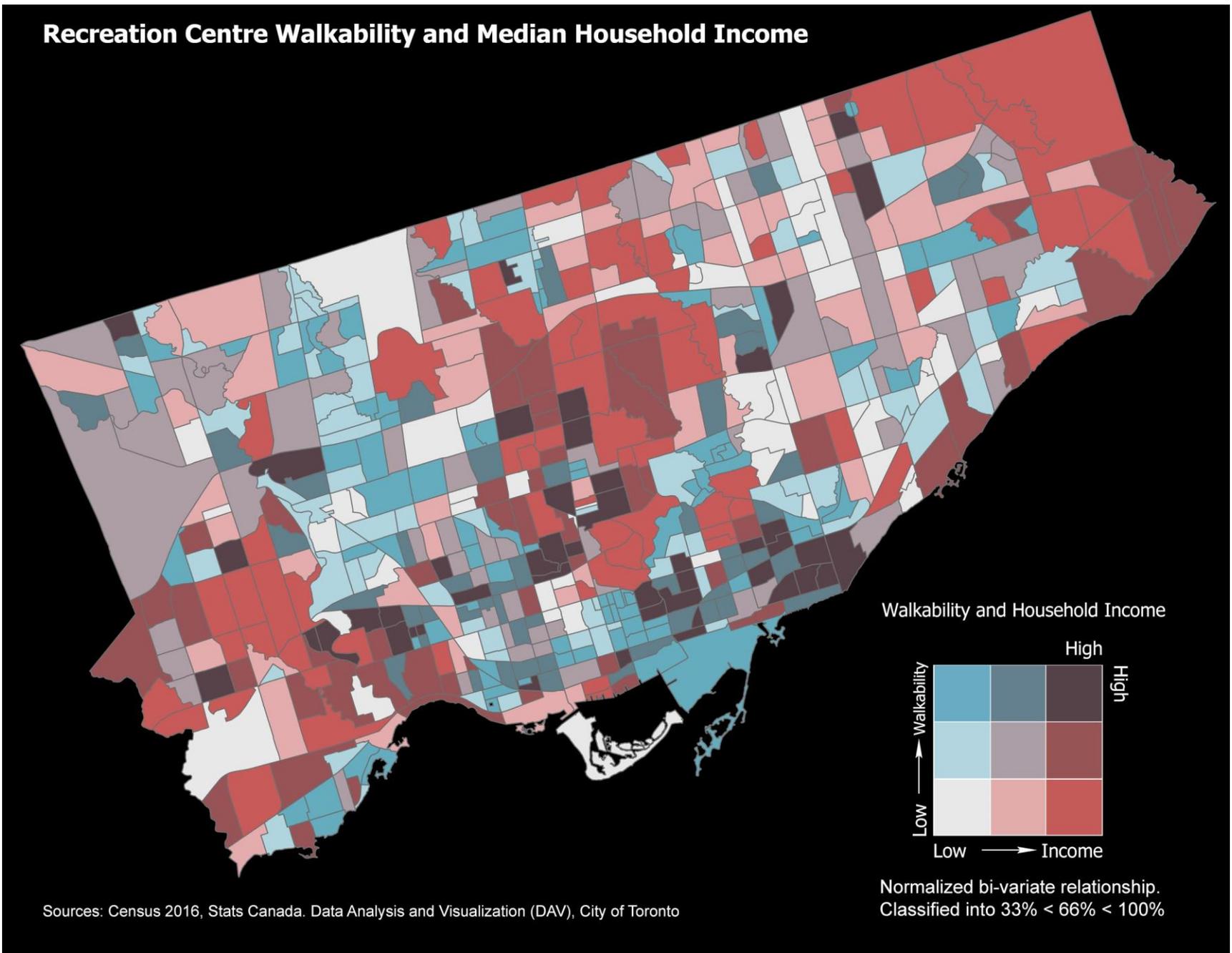
Sources: Census 2016, Stats Canada. Data Analysis and Visualization (DAV), City of Toronto

## Recreation Centre Location Walkability and Household Median Income

**Definition:** Mean walking times to recreation centres, median household (after-tax) income, 2016. Classified into 3 percentiles for Median Household Income (\$ - 2015): Low is \$21,941 to \$52,839, Medium is \$52,840 to \$66,811, and High is \$66,812 to \$206,336.

**Interpretation:** There are 261 recreation centres in the City of Toronto. The centres also include schools that the City of Toronto's Parks Forestry and Recreation (PF&R) division offer programs out of including swimming at school pools. In some cases the programs offered by PF&R are seasonal. Low median income areas having low walkability could be the focus of the location of recreation centres or programs offered at appropriate schools. Census tracts that are primarily industrial/commercial areas should be excluded from any further location exercises.

# Recreation Centre Walkability and Median Household Income



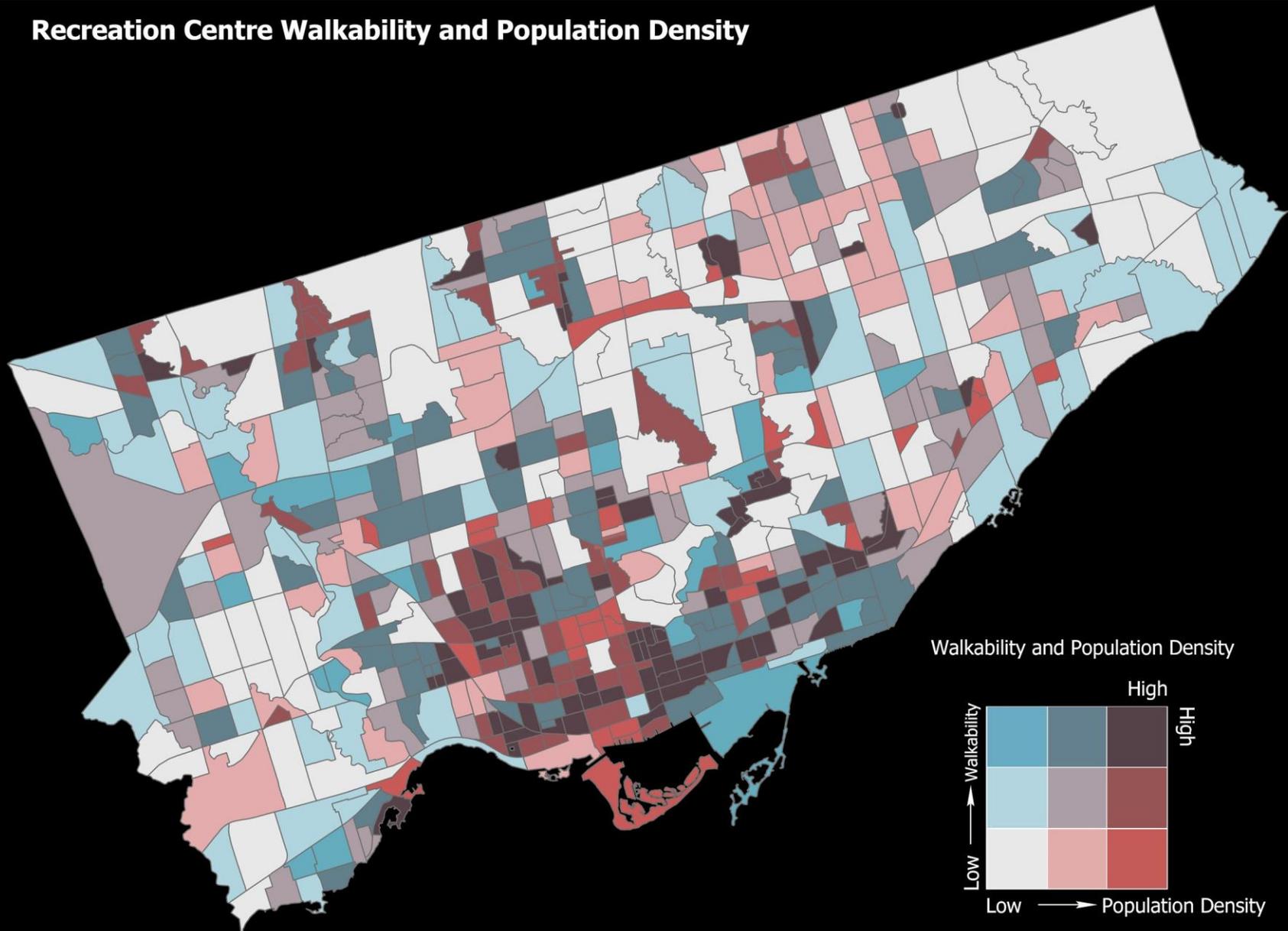
Sources: Census 2016, Stats Canada. Data Analysis and Visualization (DAV), City of Toronto

## Recreation Centre Location Walkability and Population Density

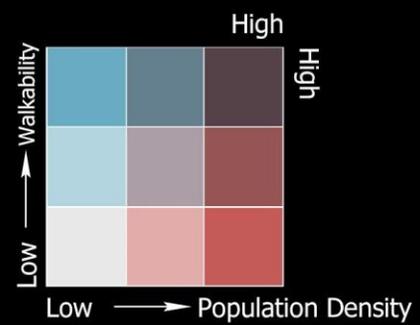
**Definition:** Mean walking times to recreation centres, population density, 2016. Classified into 3 percentiles for Population density per square kilometre: Low is 14 to 4,083, Medium is 4,084 to 7,536, and High is 7,537 to 82,434.

**Interpretation:** There are 261 recreation centres in the City of Toronto. The centres also include schools that the City of Toronto's Parks Forestry and Recreation (PF&R) division offer programs out of including swimming at school pools. The traditional low density residential areas in the suburbs have low population and walkability. The downtown core has higher population density and more connectivity. Interestingly, the area west of Queens Park Crescent has low density and low walkability is an anomaly as it is located in the grounds of the University of Toronto without a City of Toronto recreation centre. However, on the campus there is a large recreation centre for students.

# Recreation Centre Walkability and Population Density



Walkability and Population Density



Normalized bi-variate relationship.  
Classified into 33% < 66% < 100%

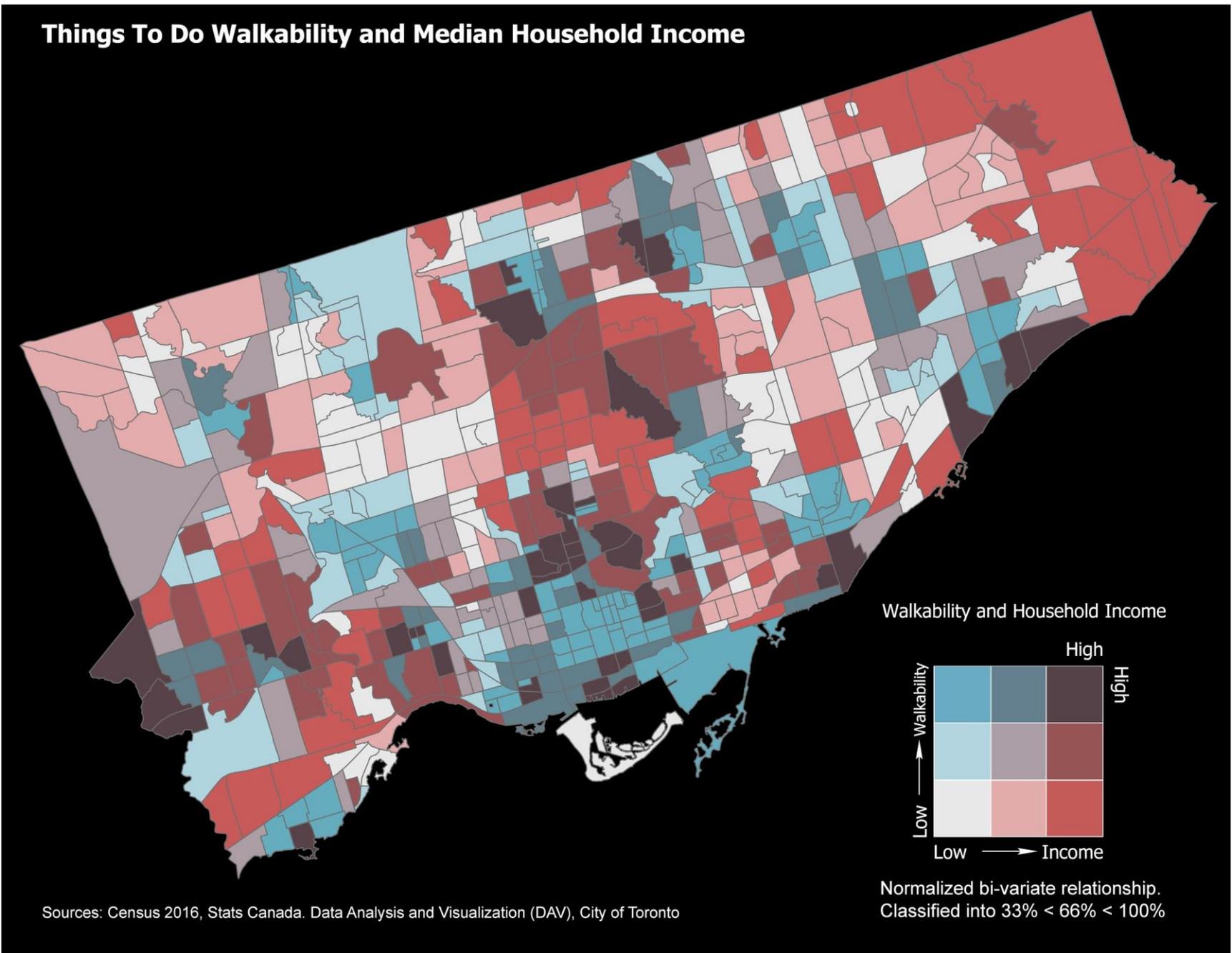
Sources: Census 2016, Stats Canada. Data Analysis and Visualization (DAV), City of Toronto

## Things To Do Location Walkability and Household Median Income

**Definition:** Mean walking times to Things to Do, median household (after-tax) income, 2016. Classified into 3 percentiles for Median Household Income (\$ - 2015): Low is \$21,941 to \$52,839, Medium is \$52,840 to \$66,811, and High is \$66,812 to \$206,336.

**Interpretation:** The majority of the 110 Things to Do are located in the downtown core including museums, sporting facilities, art galleries and retail. Another concentration is in the Yonge St and Shepard Ave area. Consequently, there is high walkability for low, medium and high median income in the downtown core and in the Yonge St and Sheppard Area. However, depending on the type of venue disposable income should be considered for those venues that charge high entrance fees, for example sporting events. An area with low walkability is the area bounded by Bathurst St, Lawrence Ave W, Jane St and Highway 401. Perhaps the location or creation of an attraction would increase the walkability in this area. While not included as a Thing to Do, shopping centres do offer a space, albeit private property, where people can shop for retail items and socialize especially during cold winters and hot and humid summers. Perhaps these shopping centres or retail shopping areas along roadways should be studied.

# Things To Do Walkability and Median Household Income



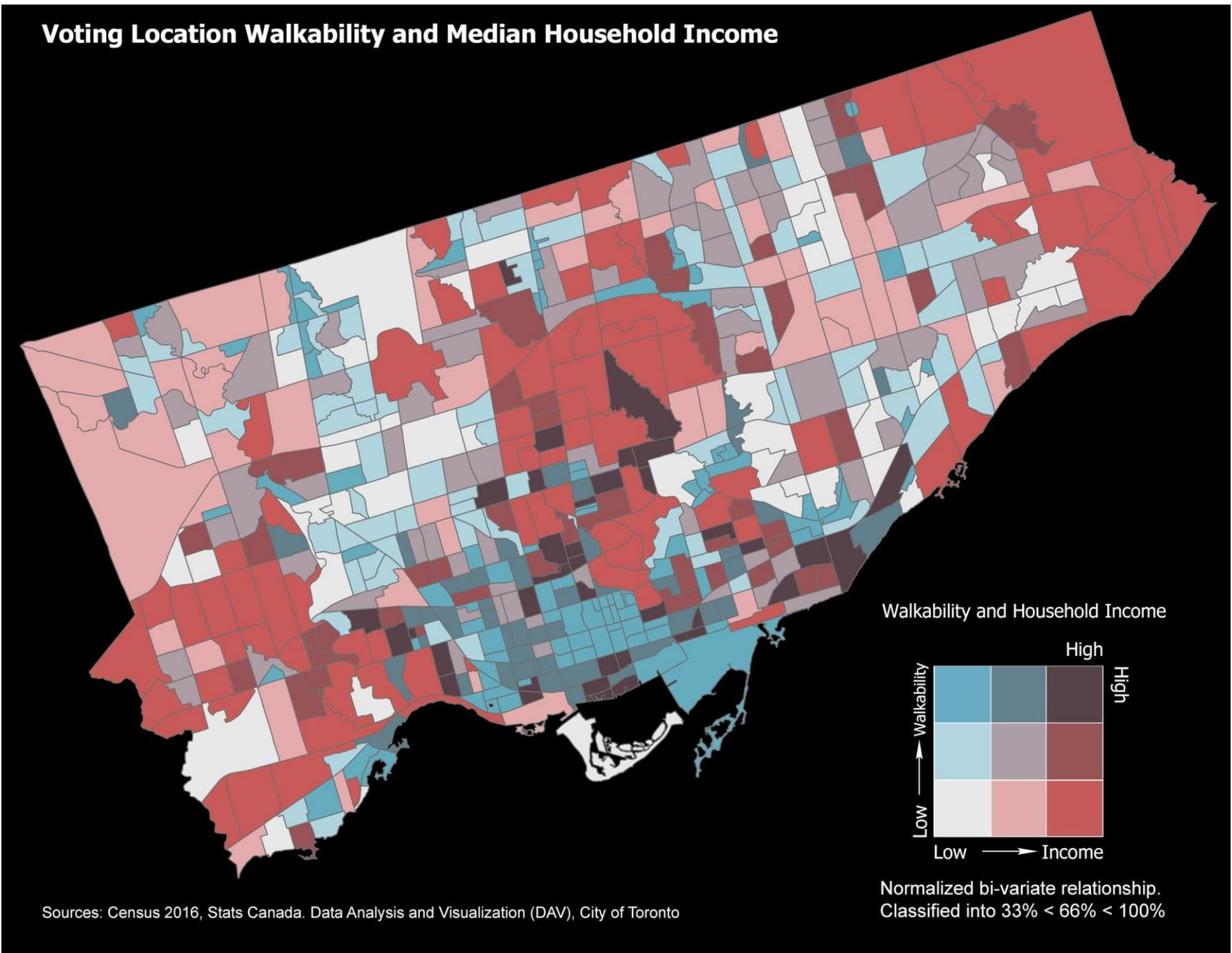
Sources: Census 2016, Stats Canada. Data Analysis and Visualization (DAV), City of Toronto

## Voting Location Walkability and Household Median Income

**Definition:** Mean walking times, median household (after-tax) income, 2016. Classified into 3 percentiles for Median Household Income (\$ - 2015): Low is \$21,941 to \$52,839, Medium is \$52,840 to \$66,811, and High is \$66,812 to \$206,336.

**Interpretation:** There were 1,700 voting locations for the City of Toronto 2018 municipal election. The City Clerk considers the convenience of electors [\[10\]](#) when establishing these locations. Higher walkability can be seen in the downtown core due to the interconnectivity of the pedestrian network while more suburban areas, for example eastern Scarborough, have lower walkability due to a less connected pedestrian network.

# Voting Location Walkability and Median Household Income



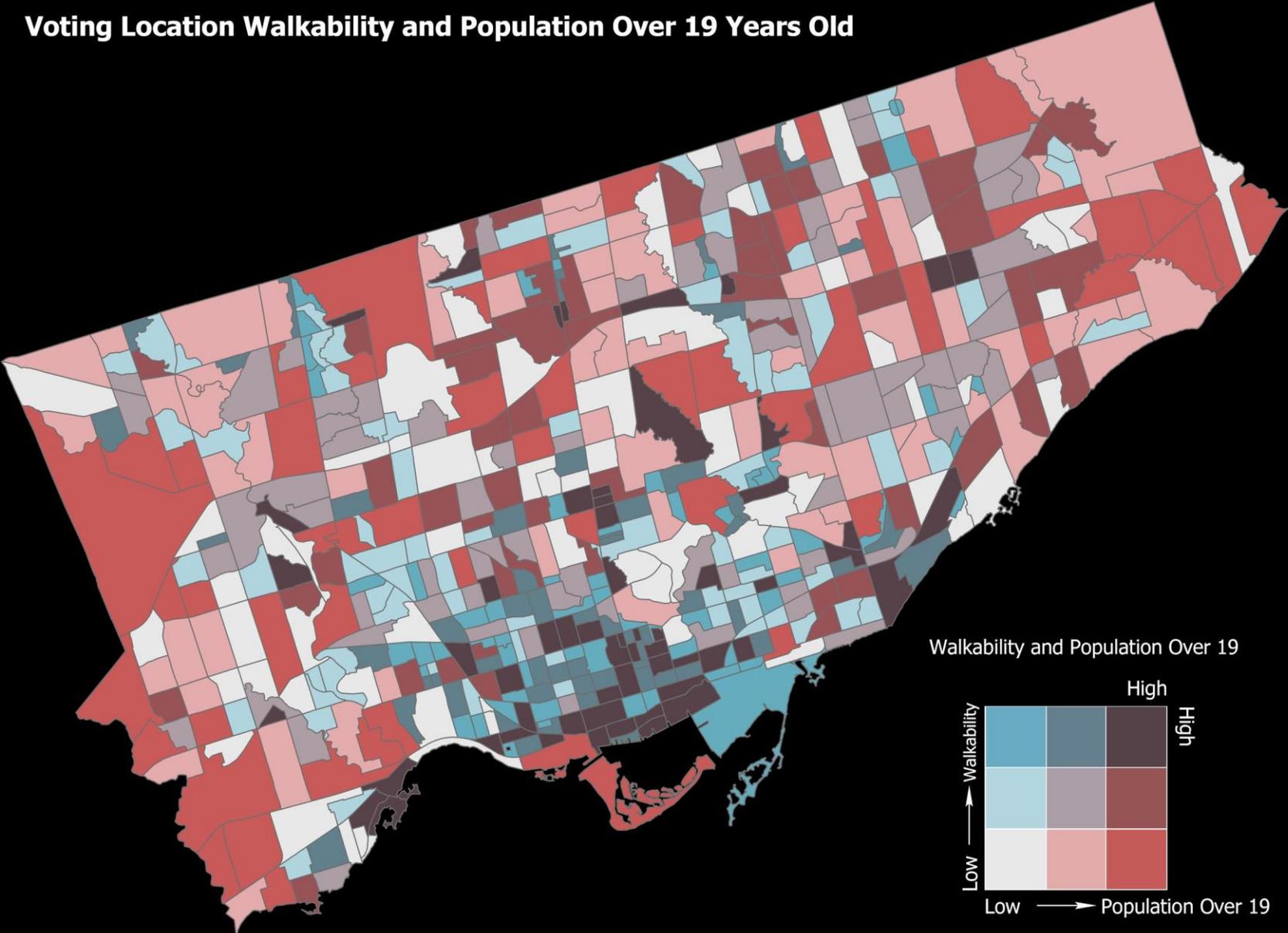
Sources: Census 2016, Stats Canada. Data Analysis and Visualization (DAV), City of Toronto

# Voting Location Walkability and Population Over 19 Years Old

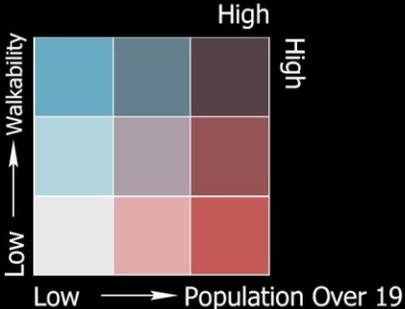
**Definition:** Mean walking times, population over 19, 2016

**Interpretation:** Population over 19 years was identified as an area of study. The voting age is 18 plus however the Statistics Canada data could only be extracted for 19 years plus. Higher walkability with more 19 years plus potential voters can be seen in the downtown core due to the interconnectivity of the pedestrian network and greater population densities, especially with condominium development. The suburban areas typically have a higher population over age 19 but the walkability is lower due to the interconnectivity of the pedestrian network. Several areas of the city have low walkability and low population over 19 due to the industrial commercial nature of the census tract.

# Voting Location Walkability and Population Over 19 Years Old



Walkability and Population Over 19



Normalized bi-variate relationship. Classified into 33% < 66% < 100%

Sources: Census 2016, Stats Canada. Data Analysis and Visualization (DAV), City of Toronto

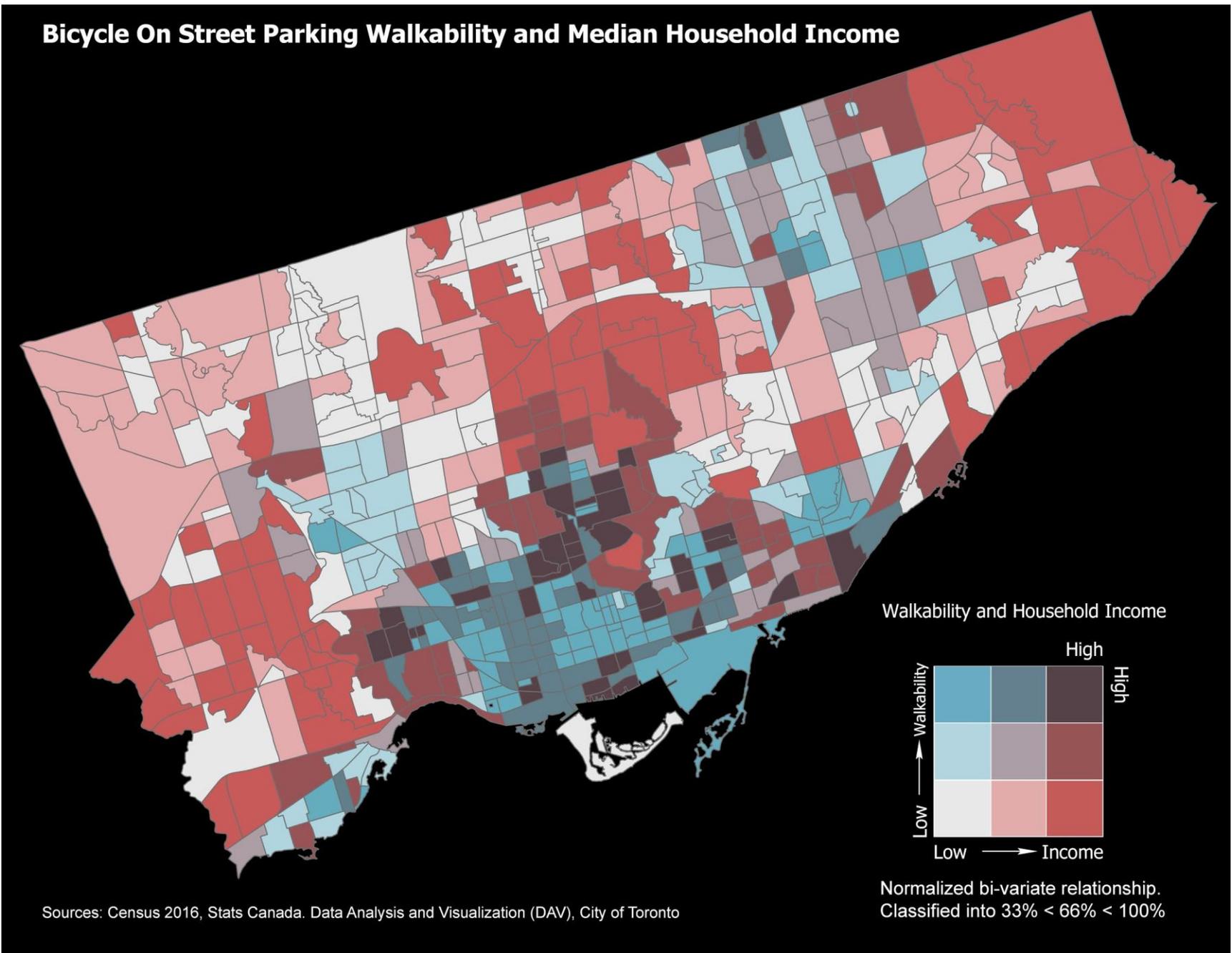
## Transit

### Bicycle Parking On Street Location Walkability and Household Median Income

**Definition:** Mean walking times to bicycle parking on street, median household (after-tax) income, 2016. Classified into 3 percentiles for Median Household Income (\$ - 2015): Low is \$21,941 to \$52,839, Medium is \$52,840 to \$66,811, and High is \$66,812 to \$206,336.

**Interpretation:** The majority of the on street bicycle parking is located in the downtown core with a few locations in central and northern Scarborough. Consequently, walkability is strongly influenced by this displacement of on street bicycle parking.

# Bicycle On Street Parking Walkability and Median Household Income



Sources: Census 2016, Stats Canada. Data Analysis and Visualization (DAV), City of Toronto

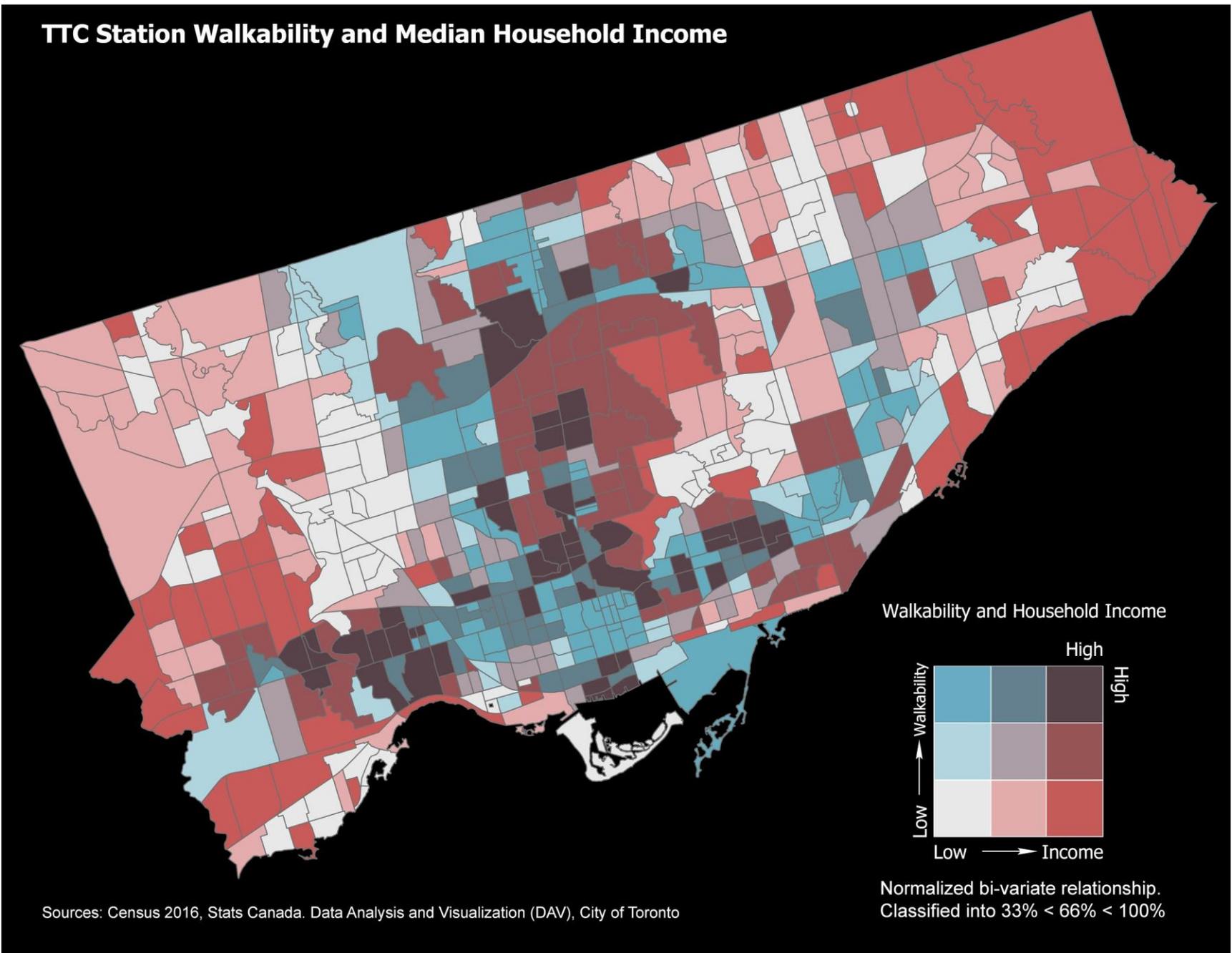
## TTC Station Location Walkability and Household Median Income

**Definition:** Mean walking times to TTC station locations, median household (after-tax) income, 2016. Classified into 3 percentiles for Median Household Income (\$ - 2015): Low is \$21,941 to \$52,839, Medium is \$52,840 to \$66,811, and High is \$66,812 to \$206,336.

**Interpretation:** TTC stations are located along the Bloor St Danforth Ave line, Yonge St and University Ave line, and the Sheppard Ave E line. Higher walkability can be seen along these lines. Large areas of the City of Toronto have low TTC station walkability and citizens would have to rely on the bus/street car network or private transportation to a commuter lot in order to access a subway station. Large portions of eastern Scarborough and central and northwestern Etobicoke have low walkability as the absence of TTC stations is most pronounced. There are several pockets of high walkability and high household median income along Danforth Ave and surrounding High Park. Recent studies by Zoocasa have looked at the sale prices of homes in 2018 and their proximity to the all of the TTC subway stations <sup>[16]</sup> and their study found that the most affordable TTC stops appear to be in Scarborough.

Not taken into account in this walkability study was the impact of the GO Train network (19 stations) would have on walkability in the City of Toronto especially in the suburban areas. However, the Go Train network is less frequent than the subway service and on some lines it is a morning and evening rush hour service only.

# TTC Station Walkability and Median Household Income



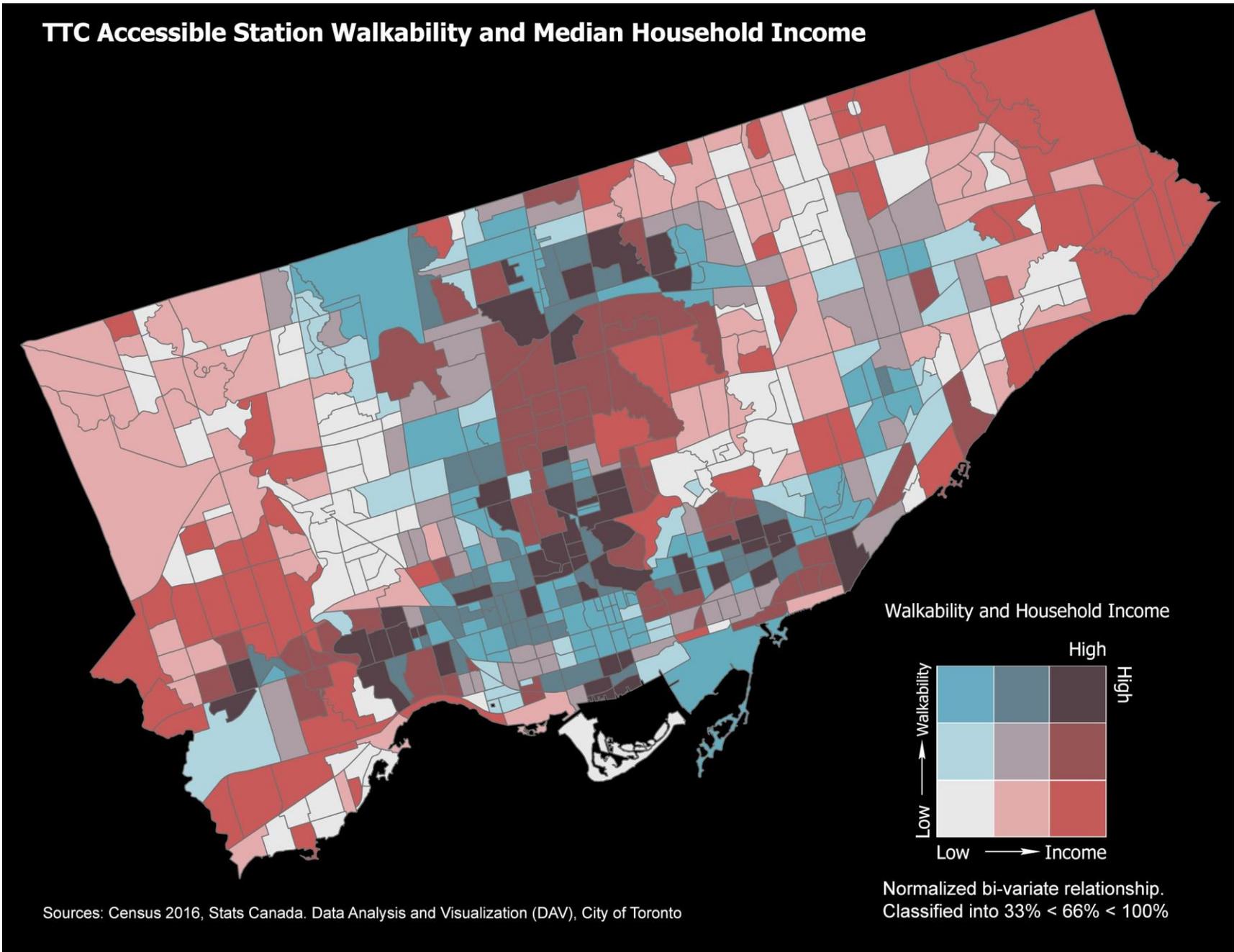
Sources: Census 2016, Stats Canada. Data Analysis and Visualization (DAV), City of Toronto

## TTC Accessible Station Location Walkability and Household Median Income

**Definition:** Mean walking times to TTC accessible station locations, median household (after-tax) income, 2016. Classified into 3 percentiles for Median Household Income (\$ - 2015) : Low is \$21,941 to \$52,839, Medium is \$52,840 to \$66,811, and High is \$66,812 to \$206,336.

**Interpretation:** There are 43 TTC subway stations that have elevators. The TTC continues to work to provide a barrier-free transit system in support of the Accessibility for Ontarians with Disabilities Act (AODA) goal of an accessible Ontario by 2025 [\[13\]](#). The TTC initiatives include the retrofitting of subway stations for accessibility. The downtown core has higher walkability as there are more accessible stations in the downtown core. With the increase in the number of accessible stations those areas in suburbs where there are subway stations will eventually have higher walkability.

# TTC Accessible Station Walkability and Median Household Income

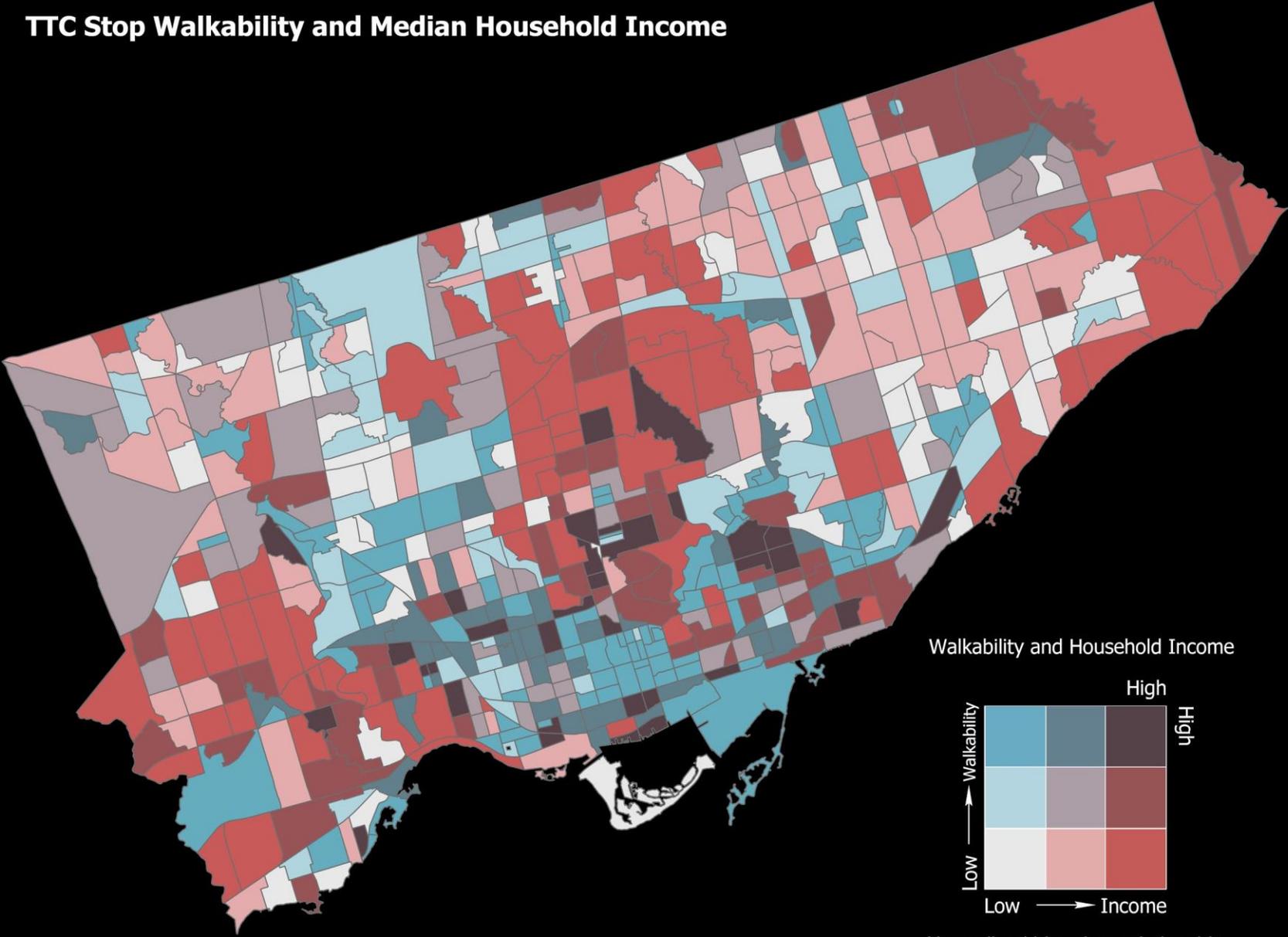


## TTC Stop Location Walkability and Household Median Income

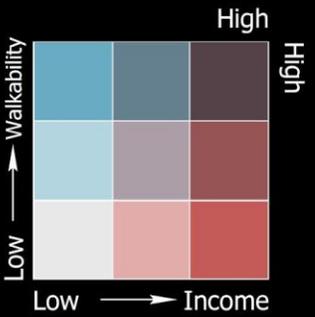
**Definition:** Mean walking times to TTC stop locations, median household (after-tax) income, 2016. Classified into 3 percentiles for Median Household Income (\$ - 2015): Low is \$21,941 to \$52,839, Medium is \$52,840 to \$66,811, and High is \$66,812 to \$206,336.

**Interpretation:** The TTC All-Day, Every-Day network strategy is designed so that 90% of the population is within a 400 metre (5 minute) walk of transit service (subway, streetcar and bus service) seven days a week [\[15\]](#). TTC stops in suburban areas typically follow major arterials and collectors. The compactness of the TTC stops locations in the downtown core including subway station stops has made the made walkability higher.

# TTC Stop Walkability and Median Household Income



Walkability and Household Income



Normalized bi-variate relationship. Classified into 33% < 66% < 100%

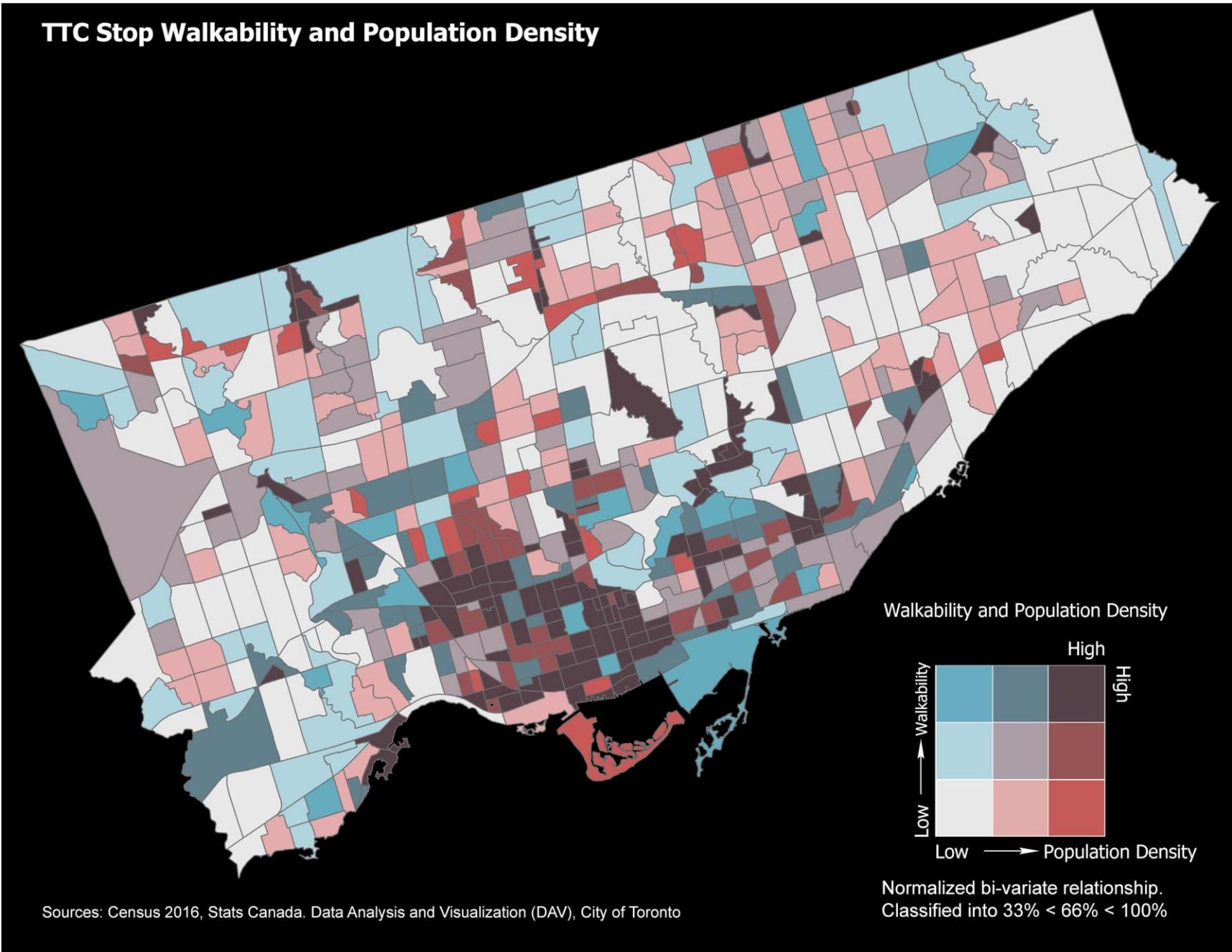
Sources: Census 2016, Stats Canada. Data Analysis and Visualization (DAV), City of Toronto

## TTC Stop Location Walkability and Population Density

**Definition:** Mean walking times to TTC stop locations, population density, 2016. Classified into 3 percentiles for Population density per square kilometre: Low is 14 to 4,083, Medium is 4,084 to 7,536, and High is 7,537 to 82,434.

**Interpretation:** The TTC All-Day, Every-Day network strategy is designed so that 90% of the population is within a 400 metre (5 minute) walk of transit service (subway, streetcar and bus service) seven days a week [\[15\]](#). As expected the suburban areas of the City of Toronto have low population densities and low walkability to public transit. In the downtown core where population densities are higher and warrant more frequent TTC stops the TTC stop walkability is higher.

# TTC Stop Walkability and Population Density

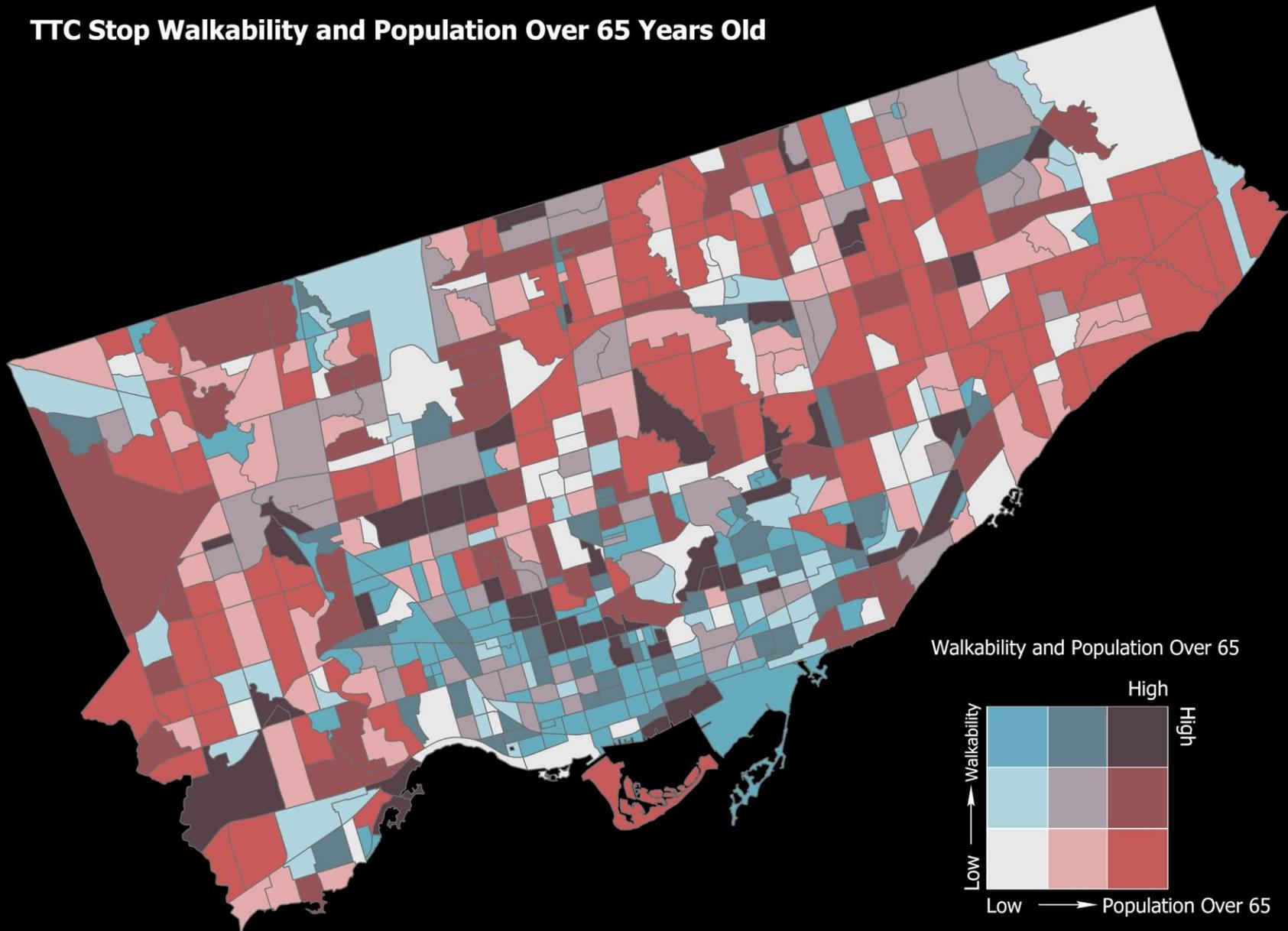


## TTC Stop Location Walkability and Population Over 65 Years Old

**Definition:** Mean walking times to TTC stop locations, population over 65, 2016. Classified into 3 percentiles for Population Over 65 Years of Age: Low is 10 to 559, Medium is 560 to 874, and High is 875 to 2,350.

**Interpretation:** The suburban areas of the City of Toronto have higher population over 65 with low to high walkability to public transit. Higher population over 65 with high walkability to public transit is in the Lawrence Ave W area between Allen Rd and Black Creek Dr. As the population of a given area ages TTC stop adjustments should be investigated. TTC Wheel-Trans or vehicle ride sharing may be employed by users who are unable to operate private vehicles. Areas that have low walkability to TTC stops may have to move to an area that supports public transit.

# TTC Stop Walkability and Population Over 65 Years Old



Sources: Census 2016, Stats Canada. Data Analysis and Visualization (DAV), City of Toronto

Normalized bi-variate relationship.  
Classified into 33% < 66% < 100%

## Glossary

Term	Definition
Betweenness	a form of centrality, describes how "between" a place is among other places - that is, how often a place is traversed when traveling between other origins and destinations.
Choice	Choice is calculated by counting the number of times each street segment falls on the shortest path between all pairs of segments within a selected distance.
Degree	<b>Degree</b> is the simplest and the most common way of finding important nodes. A node's degree is the sum of its edges.
Connectivity	A measure of how well a given place is connected to surrounding nodes; also, the number of links connecting into a given link. Better-connected places have higher in-degree and out-degree, and typically have lower depths from other nodes.
Crosswalks	Marked crossings at intersections or mid-block crossings
Edge	An edge (or <a href="#">link</a> ) of a <a href="#">network</a> (or <a href="#">graph</a> ) is one of the connections between the <a href="#">nodes</a> (or <a href="#">vertices</a> ) of the network.
Integration	Integration is a normalised measure of distance from any a space of origin to all others in a system. In general, it calculates how close the origin space is to all other spaces, and can be seen as the measure of relative asymmetry (or relative depth).
Pedestrian Network	Pedestrian Network is created by the <a href="#">DAV</a> team at the City of Toronto. It is built based on pedestrian sidewalks of Toronto city. It is integrated with centerlines and centerline intersections including traffic signals, pedestrian crosswalks and crossover, traffic signal data of Toronto city.
PostGIS database	PostGIS is a spatial database extension for <a href="#">PostgreSQL</a> object-relational database. It adds support for geographic objects allowing location queries to be run in SQL. In addition to basic location awareness, PostGIS offers many features rarely found in other competing spatial databases such as Oracle Locator/Spatial and SQL Server.
Python	Python is an open-source <a href="#">interpreted</a> , <a href="#">high-level</a> , <a href="#">general-purpose programming language</a> .
Sidewalks	Linear paths, usually adjacent to public streets
Space syntax	is a set of techniques for analysing spatial layouts and human activity patterns in buildings and urban areas. It is also a set of theories linking space and society. Space syntax addresses where people are, how they move, how they adapt, how they develop and how they talk about it.

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