

1) Introduction

As people get older, they are more likely to suffer from chronic conditions. However, it could be possible that these chronic conditions aren't just related age but also access to hospitals as some people may not be willing to travel as far to receive treatment or diagnosis. This is important to public health as access to health care resources such as hospitals is critical in maintaining good health. Without access to such resources, it is possible that people may end up with chronic conditions. There is some slightly related literature on this topic such as how distance to hospitals did not have much of an effect on cardiac arrest survivals (Cudnik et al., 2010), or where women in South Africa who lived farther away from cities had generally higher rates of breast cancer (Dickens et al., 2014). Meanwhile, another study found an inverse relationship to hospitalization rates and distance to hospitals (Lin et al., 2002).

The purpose of these studies has been to show how there are potential relationships between access to hospitals and the health conditions that people face. Through these studies we can see that there does seem to be some relationship, however it is not fully conclusive, and more research needs to be done. These gaps in the literature are where my research question fits in as there have not been any studies done on the relationship of distance to hospitals and chronic diseases, along with the fact that there is a lack of studies assessing hospital distance in Canadian cities such as Toronto.

The Canadian Institute for Health Information has released a document with the same thematic priority as my topic which discusses the impact of chronic conditions and some of their causes (Canadian Institute for Health Information, 2011). In the document, they raise

concerns about the growing number of Canadians with chronic conditions and how there are gaps in access to healthcare which could be worsening conditions.

The policy scale and health delivery service scale of my topic is the city of Toronto and their public health unit. The Toronto public health unit is responsible for the health of the residents in the city of Toronto by overseeing and setting health safety protocols and policies as well as providing access to health care and services.

The target audience for this report is the Toronto public health unit as well as the Toronto city council as the building of new hospitals must be approved by the council. The public health unit is responsible for identifying gaps in access to healthcare and resolving them. This report will provide insight as to where people could be suffering from chronic conditions due to a lack of access to hospitals and where they could be built.

2) Research Question

Does the distance of neighbourhoods in Toronto, Canada to their nearest hospitals have a relationship with the age standardized rate of having 2+ chronic conditions for those aged 20+?

3) Data

For this research topic, built and health data was obtained through secondary sources. The 2+ chronic conditions dataset is an excel file from the Ontario Community Health Profiles Partnership which includes information about the number of chronic conditions in 2016/17 and their rates (Ontario Community Health Profiles Partnership, 2017). I used the “Age-

Standardized prevalence rate (/100) of patients with 2+ Chronic Conditions (2016/17±,), All Ages 20+ (Both Sexes)” variable. The Toronto neighbourhoods shapefile is from the University of Toronto Map & Data Library which was developed by the City of Toronto Community & Neighbourhood Services Department (University of Toronto Map & Data Library, n.d). It contains the shapefile boundary of the neighbourhoods in Toronto. The hospital locations shapefile is from the Government of Canada and contains data points of health-related facilities locations across Canada (Government of Canada Open Data, 2020). I filtered it down to just hospitals in Toronto using the select by attributes function in ArcGIS to only select hospitals using the “SERV_TYPE” variable and Toronto in the “Community” variable. All of the data is free to use as it is open-source data and was developed by public organizations.

The sample population the study is all people in Toronto neighborhoods aged 20+. This population is being studied since it represents the adult population and adults are generally the ones at risk of developing chronic conditions. A type of bias that might exist in the data is that some neighborhoods may have a higher elderly population which will naturally have higher rates of chronic conditions. Therefore, I am using age standardized rates to avoid this type of bias. There may also be biases in sex which is why I am using the standardized rates of both sexes combined. There could also be social determinants of health that affect having chronic conditions such as some neighborhoods being more impoverished than others or having lower education rates. With impoverishment, some people may have limited access to hospitals since they cannot afford cars and education rates may be at fault for some people who make bad health choices that increase their likelihood of getting chronic conditions.

The data being used answers the research question since we can compare the number of chronic conditions in each neighbourhood and number of hospital locations. We can also conduct spatial analysis to see the distance from neighbourhoods to hospitals and whether there is clustering of hospitals or chronic conditions in specific neighbourhoods. This will help provide us with a relationship/association or some visual trend.

Dataset	Data Type	Polygon/Point/Table	Measurement Type	File Type	Field Type
2+ Chronic Conditions	Quantitative (Ratio)	Table	Numeric	.csv	Long
Toronto Neighbourhoods	Qualitative (Nominal)	Polygon	String	.shp	Text
Hospital Locations	Qualitative (Nominal)	Point	String	.shp	Text

Table 1: Categorized Data

4) Analytical Methods

The three tools used in my analysis was the “spatial join” tool, the “near(analysis)” tool, and the “hotspot analysis (Getis-Ord Gi*)” tool. The spatial join tool combines similar attributes between features into one feature class, the near tool measures the distance to the closest input features based on a directional line, and the hotspot analysis tool determine high and low spatial clusters within the data.

These tools generate information to help answer my research question as they provide spatial information about chronic conditions in relation to hospitals. The spatial join tool helps to provide information about the number of hospitals within each neighbourhood which shows where there is a lack of resources and where we can build hospitals to solve this problem. The near tool shows the closest distance from the neighbourhoods to a hospital which can help further show where there is a lack of access and can be compared to the data of which neighbourhoods have the highest rate of chronic conditions and see if there is an association. The hotspot analysis tool provides information about areas which may be of interest that have high or low rates of chronic diseases which can then be compared to access to hospitals.

The tools I selected were appropriate for the data sources I selected as the data only provides rudimentary information about the topic such as rates and locations. By selecting analysis tools they helped to quantify the information and create associations within the data.

In order to transform my files and analyze my data to generate information, I had to conduct a variety of steps. First, I organized the 2+ chronic conditions excel file to only include the “Age-Standardized prevalence rate (/100) of patients with 2+ Chronic Conditions (2016/17±,), All Ages 20+ (Both Sexes)” variable and then added an FID number variable that was the same as the one in the Toronto neighbourhoods shapefile so that they can be joined together in ArcGIS. After joining them I then filtered the hospital locations shapefile using the select by attributes and selecting all locations that were not hospitals in Toronto and deleted them. I then used the “spatial join” tool to combine the neighbourhoods shapefile and the Toronto hospital locations to count the number of hospitals in each neighbourhood. After, I used the “near” analysis tool to calculate the distance from each neighbourhood to the nearest

hospital. Finally, I used the “hotspot analysis” tool of the chronic condition rate so I could compare it to the hospital locations and see if the chronic condition hotspots are away from hospitals. I chose these methods since they give a good visual and spatial understanding of where hospitals are and how they compare to the location of the highest rates of chronic diseases. Other studies have used somewhat similar methods such as when looking at the relationship between breast cancer diagnosis and distance to hospitals (Dickens et al., 2014) or how transport distance to hospitals affects survival rates among cardiac patients (Cudnik et al., 2010) which used network distance from houses to hospitals, while other studies such as those examining distance effects on hospitalizations (Lin et al., 2002) used Euclidean distance. These studies also applied other methods such as linear regression models in order to measure the strength and reliability of their studies. Essentially, as long as we have some sort of distance analysis such as “near”, “euclidean distance”, or “network distance” we can compare the distances to the potential dependent variable either visually through maps or through statistical analysis.

5) Results

There seems to be a large number of hospitals near downtown Toronto neighbourhoods while other neighbourhoods range from 0-1 (Figure 1). The distance to hospitals seems to be generally farther away near the east side and the mid-west side of the city with the least distance near the center and downtown (Figure 2). There seem to be hotspot clustering of 2+ chronic conditions near the east and north-west of the city with cold spots near the center (Figure 3).

Map	Range	Key Results
Number of Hospitals	0 – 6	Large number of hospitals near downtown, rest fairly dispersed.
Nearest Distance to Hospitals	0 – 3702 (m)	Farther away on the east and mid-west side, closer distances near center and downtown.
2+ Chronic Condition Clusters	Cold Spots with 99% Confidence – Hot Spots with 99% Confidence	2+ chronic conditions hot spots near east and north-west, cold spots near center/downtown

Table 2: Results Summary

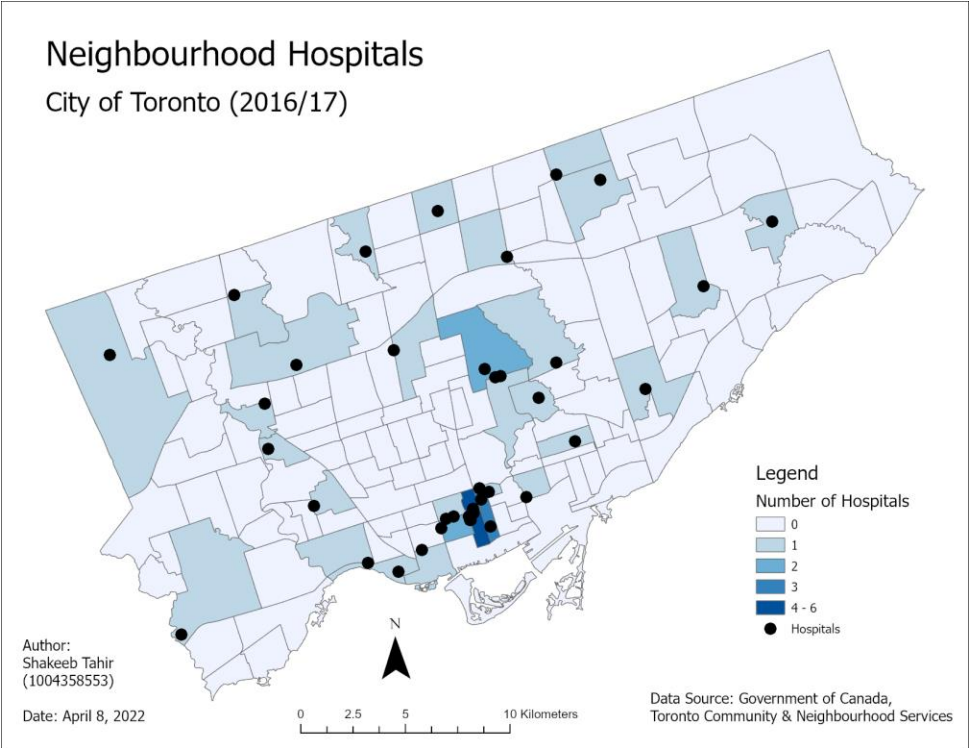


Figure 1: Number of hospitals in each neighbourhood

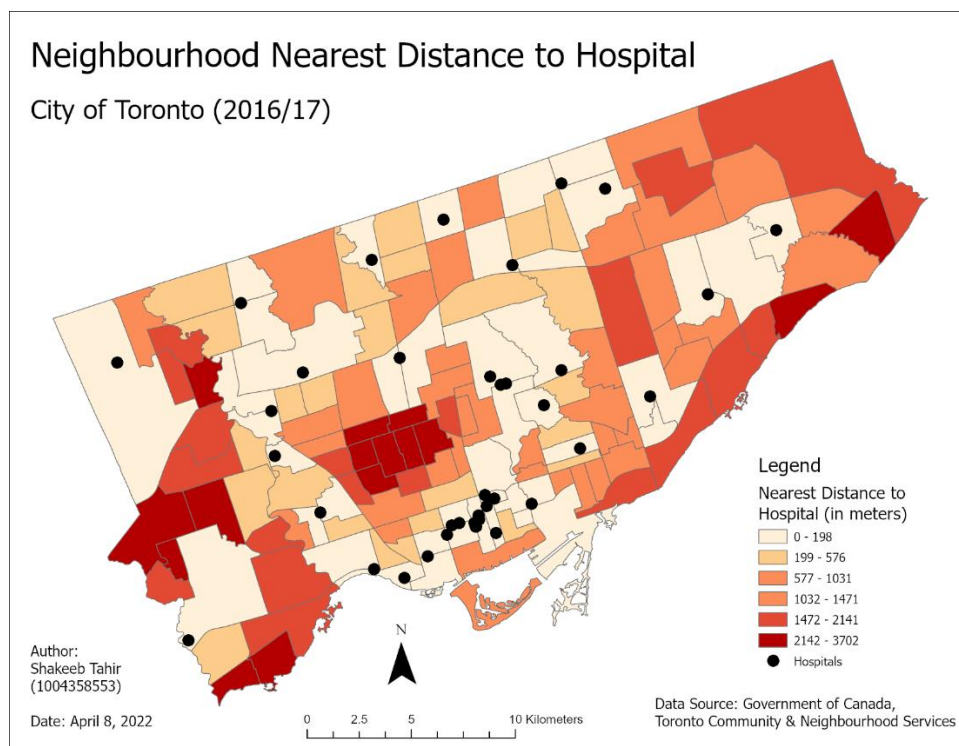


Figure 2: Nearest distance to hospital from each neighbourhood

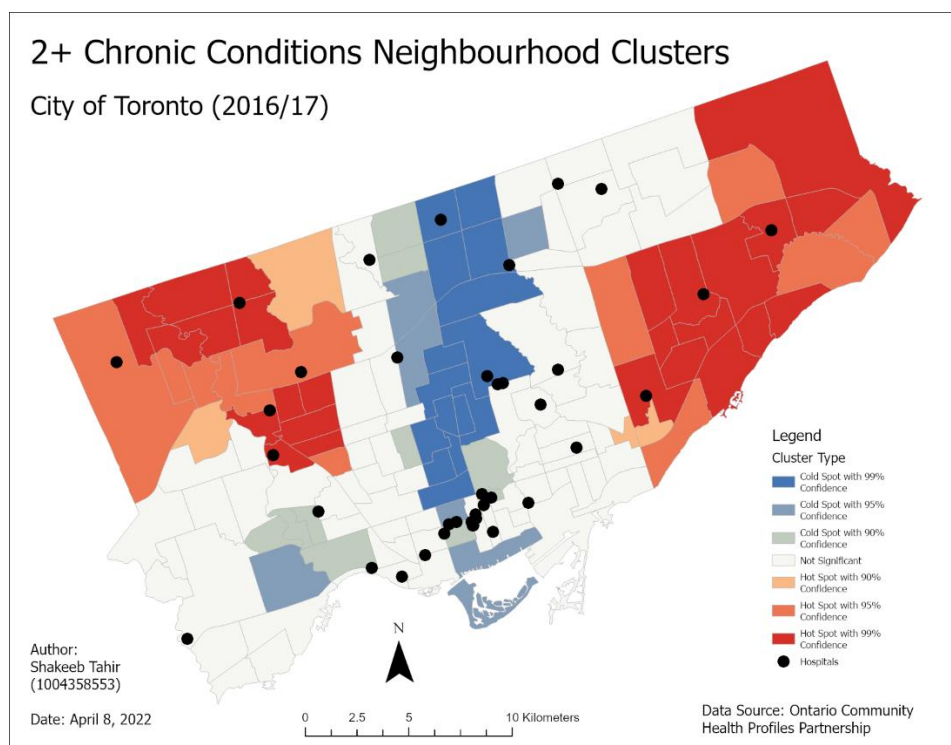


Figure 3: 2+ chronic condition neighbourhood clusters

6) Discussion

The results answer the research question as we can now see where there are significant clusters of 2+ chronic conditions and compare them to the distance to hospitals and the number of hospitals. We see that there seems to be some relation between having 2+ chronic conditions and the distance to hospitals as well as the number of hospitals. Majority of the hospitals are located downtown or near the center of the city, this is also where having 2+ chronic conditions seems to be a cold spot. We can also see that there is slight relation to the distance to hospitals and having more chronic conditions, specifically near the east side of the city where the distance is farther and there are hot spot clusters. The results may be somewhat limited in answering the research question as they are merely visually and not statistical, so we do not know the true strength of this association and whether it is significant or not. In some areas such as the south-west side of the city, there are few hospitals and some greater distances, yet not hot spots for 2+ chronic conditions.

My results were somewhat similar to other studies relating to hospital distance and health conditions. For instance, a study done in South Africa found that women living farther away from hospitals in South Africa had higher rates of breast cancer (Dickens et al., 2014). Meanwhile some other studies differed from my results as they found distance to hospitals to not affect cardiac patient survival (Cudnik et al., 2010) or hospitalization rates (Lin et al., 2002). This could be for a number of reasons, perhaps the reason my study differed from these two studies is because they were done during earlier time periods while the study that I had similar results too was done more recently. As our society evolves, so do our health conditions and a

variety of other factors that could affect whether distance to hospitals might now be more related to health conditions than they were in the past.

There are equity and bias concerns in the results found as people downtown and near the center of Toronto seem to have lower rates of 2+ chronic conditions compared to other parts of the city. Downtown Toronto and the center of the city is generally where people with higher incomes and wealth live. This raises concern for bias and equity as there seems to be more hospitals built near these neighbourhoods while other parts of the city have no hospitals and have much farther distances to hospitals. The city seems to be biased towards wealthier neighbourhoods causing an imbalance in equity and access to healthcare.

7) Recommendations

Based on the information I have found towards my research, I would recommend that the city of Toronto should build more hospitals in the east and west parts of the city in order to increase equity and access to hospitals which seems like a reason some of these neighbourhoods have higher rates of 2+ chronic conditions. I would recommend this to the Toronto Public Health Unit and the Toronto City Council as they are the ones that must oversee and approve the process of building new hospitals. My recommendations can take place at the municipal scale as my research is focused on the city of Toronto. The next research and data analysis steps I would take to improve the information generated would be to conduct statistical analysis such as a regression model between the distance to hospitals of Toronto neighbourhoods and their rates of 2+ chronic diseases. This would more accurately and

completely answer the research question as the regression model can tell us whether our results are significant or not ($p < 0.05$) and the reliability of the association (R-Squared).

8) Study Limitations

The limitations of the data I used is that it is somewhat old as it is from 2016/17 but due to availability it was the only data that could be used. There is also a possibility that the neighbourhood scale might be too large as some Toronto neighbourhoods are much bigger than others so perhaps census tracts would have been more suitable if they were available as they are much smaller and more similar in size. There are also some limitations to answer the research question with the data available as there are multiple variables to distance to hospitals such as traffic times and congestions or sidewalk and road networks within the city of Toronto. We would need this data available in order to get a more accurate answer to the research question. The limitations of the analysis that I encountered is that the neighbourhood scale might be too big and the results of a local neighbourhood within the neighbourhood could be aggregating the outcomes. It's possible there is only one specific area within the neighbourhood that has a higher rate of 2+ chronic conditions but since we only have neighbourhood data it could mislead us into thinking the entire neighbourhood all suffers from high rates of 2+ chronic conditions. Therefore, these limitations impact the results and the recommendations that can be suggested as the west and east side of the city might not need as many hospitals as we think and only need hospitals within a certain area of a neighbourhood.

9) Esri ArcGIS Online WebApp Link

<https://arcg.is/1Sb8Lm1>

Appendix

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- 2+ Chronic Conditions (Ontario Community Health Profiles Partnership, 2017)
- Toronto Neighbourhoods (University of Toronto Map & Data Library, n.d)
- Hospital Locations (Government of Canada Open Data, 2020)

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