Analysis of Homicides by Type in the City of Toronto

Audrey Diamantakos (500810616)

Cailin Wark (500779143)

Cavin Leth (500866656)

Jackson Parker (500852137)

Jonathan Pedias (500885739)

Jun Xian Zhou (500905394)

Sigao Li (500844153)

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Abstract

This paper explores the issue of homicide rates in the city of Toronto, Canada. In order to analyze homicide rates, a number of studies and hypotheses were created in order to seek out any possible patterns and influences that make homicides more common in certain areas of the city. Three hypotheses were used based on logic to narrow the focus down of this study. In order to accept or reject the hypotheses, a literature review based on various articles was conducted, and certain datasets were used to create multiple maps showing statistics of interest. This specific area of research is valuable to continue studying in the future because it may help pinpoint certain factors which relate to homicide rates, in which that information could be used to in turn slowly decrease the homicide rates in Toronto.

Introduction

Spatial analysis is a very important tool used throughout the world by analysts, the main purpose of spatial analysis is to allow one to make a connection and see a pattern between the area of study, the geography, and the human behaviors/status of the residences. (Franch-Pardo, Napoletano, Rosete-Verges, 2020). These patterns and connections that are found in spatial analyses may explain why there is a relationship between areas with high crime and human behavior/socioeconomic factors. You could pinpoint one thing that all residences in that area have in common, this could be from background or socioeconomic factors. For example, the Markham and Richmond Hill areas have a high demographic of people with eastern Asian origins. This could be due to areas with certain ethnic groups that can be associated with selected socio-economic factors such as income or education. This is why spatial analysis plays such an instrumental role in helping police with identifying where crime might take place. As well as plays an important role in helping to improve measures for crime prevention. The results from these crimes analyze pinpoint relationships between these different factors that might affect crime which allows analysts to have a more in-depth look at these factors. This is done to see how they connect and correlate to certain crimes and why they happen in these certain areas. As well as why it occurs more frequently in certain parts of the city than in other parts of the city. Past research on similar topics has also shown that crimes tend to be spatially connected to the geography of the area due to the socio-economic factors which influence the crime in that area leading to a higher chance of victimization making that specific area a hot spot (Giménez-Santana, Caplan, & Drawve, 2018). Furthermore, it has been observed that "several socio-economic

variables such as business density, levels of education and household income" (Persad, (2019;2020) play a significant role in why a neighborhood or area may have more crime. This could be due to the citizens who reside in these areas, who have been perceived as "less educated" and tend to have a lower average income. These citizens are more likely to reside in neighborhoods with higher levels of crime and disorder (Pleggenkuhle & Schafer, 2018). Realizing this connection between socio-economic variables and geography is the just beginning in understanding how criminals think and formulating ways to prevent these crimes from happening.

Although there are many different types of crimes and many different socio-economic factors, as well as geographic factors that determine what type of variables to consider in an analysis, the main focus of this report will be an analysis of homicides and how big of an impact socio-economic factors have on homicides rates throughout the City of Toronto. The report will also be explaining why some neighborhoods may receive higher rates of homicides than others. Homicides or murders are defined as a crime that occurs when a person directly or indirectly, by any means, causes the death of another human being. (Public Safety Data Portal, n.d). As a result, Homicide can be broken down into many different categories from shooting, stabbings, and others, and may even connect with other crimes such as gang activities, or robberies gone wrong. In this research paper, the main period that will be focused on will be the years 2010 to 2020. It is clear that homicide rates went up steadily throughout the years in the City of Toronto, especially in 2018. The total number of homicide cases within this 10-year span was 735 cases, with the majority of these homicides cases being caused by shootings. Out of the 735 homicides cases that have happened in the last 10 years, 382 of them were a result of shootings. This means about 52% of the total homicide cases in the last

10 years were gun-related. While stabbing homicide cases only made up 144 cases or 20% of the total homicide cases. And other homicide cases made up the remainder with 209 cases or 28% of the total homicide cases. The data provided by the Toronto police allows for a variety of spatial, statistical analyses to be done, yielding many results such as hot spot maps, and other methods such as spatial correlation and regression analysis. These will be used to determine the main area for high homicides cases. This will allow the Toronto police to study these areas and prepare measures to prevent even more homicides from occurring. However, even though the data provided by the Toronto police is informative and provides useful data such as the neighborhoods these homicides occurred. They do not provide us with personal information on the perpetrator or victim of these cases. Since "most crimes are committed by individuals outside their neighborhood" (Graif, Gladfelter, & Matthews, 2014). That means although the neighbors/areas of the city identified are hot spots for crimes this is not where the roots of the crime come from. This makes it very difficult to prevent these crimes. So even if measures are placed to reduce the homicide rates in that area of the city, individuals can still commit the crime in another part of the city that was not considered a hot spot. Unless the origin of where these individuals are coming from is documented, then it will be very difficult to crack down on homicides as there could be many factors fueling why people commit homicide.

The main area of focus of this study paper will be on the City of Toronto, one of Canada's biggest cities and one of the most multicultural cities in the world. Toronto is also a growing world leader in industries such as business, finance, technology, entertainment, and culture (City of Toronto, 2018, December 24). This makes Toronto a perfect area to conduct a crime analysis as Toronto can offer a wide variety of people of

different ethnicities and different perspectives on crime. The city of Toronto will also be compared to Vancouver which is another big city in Canada and the biggest city in British Columbia.

Hypotheses

Previous research and studies that have been done on homicides have helped in the development of the following hypotheses.

Hypothesis 1: Homicides are more likely to happen in areas that have lower median income, higher unemployment rates, higher poverty levels, and higher levels of gun violence in the neighborhood

Hypothesis 2: Homicides are more likely to happen in clusters, affecting the neighboring areas

Hypothesis 3: Homicides are more likely to happen in areas with a higher youth population

Hypothesis one is based on past studies and literature that all have one similar finding. Low income seems to play an important role in studies involving homicides. For instance, in a previous study done in the City of Toronto, they took a look at the spatial context and spatial distribution of homicides in Toronto neighborhoods, the result of this study was they found that neighborhoods in Toronto have become increasingly segregated with some neighborhoods having greater income and being wealthier while others were in lower-income and were poorer"(Thompson, & Gartner, 2014). The reasoning for this inequality is reinforced by the socio-economic characteristics of these

neighborhoods characteristics such as, "low income, ethnicity, immigrant status, residential instability, and age" (Thompson, & Gartner, 2014). These disadvantages are what drive crime, but each neighborhood has its own unique socioeconomic factors that contribute to a certain crime usually referred to as the neighborhood effect (De Nadai, Xu, Letouzé, González, & Lepri, 2020). Which refers to the "influences that an individual's behavior and attributes can have on a neighborhood" (Castree, Kitchin, & Rogers, 2013). This is why socio-economic factors are so significant in crime analysis as these socio-economic disadvantages are what drive and dictate the condition of a neighborhood. Ultimately it is the individual citizen that determines the status of their neighborhood and its prosperity.

Hypothesis two is derived from hypothesis one as it builds on the idea of the neighborhood effect as stated earlier. The neighborhood effect is the influence that citizens' behavior and attributes have on a neighborhood (Castree, Kitchin, & Rogers, 2013). This means that it could very likely be that if one neighborhood is impoverished compared to the other neighborhoods, not only will that specific area experience more crime, but it could also mean that the impoverished neighborhood is bordering other neighborhoods that are also more impoverished than average. This could be due to the leakage of crime being spread into nearby neighborhoods, increasing crime, and more specifically homicides within these neighborhoods. This is supported by a study done in the US on the "change of spatial clustering in poor neighborhoods and how that affected homicides rates between 1980-2010" (Baumer, Fowler, Messner, & Rosenfeld, 2021). The result of this study showed that there was a relationship between spatial clusters of highly impoverished neighborhoods and homicide levels.

Finally, the third Hypothesis was based on a previous study done in the US where they examined the "dynamic relationship between homicide rates and social, economic, and political factors from 1970 to 2000" (McCall, Parker, & MacDonald, 2008). The results of this study showed that they discovered that there was a relationship between age structure and homicide rates. The decline of youth in a certain area leads to a decline in the homicide rate as well. This signifies that if there are more youths in a neighborhood, then that certain neighborhood is also likely affected by socioeconomic disadvantages such as low income. As youth grow up in this type of environment, they will grow up with individuals with similar living conditions and backgrounds, and as they grow older they may pick up bad habits such as dropping out and turning to crime to get what they want. So as more youths are living in these types of environments, they will be more exposed to criminal activities and bad influences leading to a higher chance for youth to commit homicide.

Literature review

The following section is an integrative review that analyzes and discusses a variety of relevant literature in order to investigate hypothesis 1, 2, and 3, outlined in the Introduction. The literature being reviewed includes an assortment of methods, studies, and data used to create an understanding of the specific literature's topic, which aids in answering the hypothesis questions for this analysis. The result of this review will contribute to the development of a theory to support the hypotheses, as well the possibility of discovering applicable practices and potentially inform future research using the findings.

An article written in 2016 called *"Why Do People Kill? A Critical Review of the Literature on Factors Associated with Homicide"* is a literature review on the causes and findings associated with homicides (Botelho & Gonçalves). The review highlighted how the cause of homicides cannot be traced back to one aspect and that this crime has multifactorial origins that can often be interconnected. The information from this article supports both hypothesis 1 (homicides are more likely to happen in areas of the cities that have lower median income, higher unemployment rates, higher poverty levels, and higher levels of gun violence in the neighborhood) and hypothesis 3 (homicides are likely to happen in areas with a higher youth population).

The authors, Botelho and Gonçalves, first state that biological, developmental, psychopathological, and social factors are interconnected and are associated with an increase of violence (2016). The developmental factor (abuse, dysfunctional families, exposure to violence) supports the 3rd hypothesis as youth subjected to poor developmental conditions are associated with increased aggression. Multiple studies on

youth who have committed homicide found that the subject was raised in dysfunctional family environments or families with a history of violent crime (Botelho & Gonçalves, 2016). Youth raised in this type of environment often have different, more aggressive reactions to conflict than youth raised in a stable environment. Development factors leading to cognitive issues (anger management issues, poor critical judgment, low prosocial competencies) and lack of support for struggling youth combined with other risk factors such as drug abuse and access to weapons (specifically guns) can be a strong predictor of youth homicide (Botelho & Gonçalves, 2016). While homicide indicators are intertwined, and the causes of homicide have multiple interconnected origins, a high concentration of a youth population is a predictor for an increased homicide rate in those geographical locations. Next, the evidence on adolescents' social surroundings (poverty, unemployment, etc.) directly supports hypothesis 1. The findings state that homicides are more likely to occur where social factors like poverty are present, but these factors alone cannot explain increased homicide rates (Botelho & Gonçalves, 2016). This factor is a predictor, but it is interconnected with other factors such as developmental issues leading to poverty or unemployment. Increased rates of homicide were seen when the combination of a high youth population, absence of the elderly, higher unemployment rates, low education levels, and lack of support to reduce the effects of poverty were present (Botelho & Gonçalves, 2016). Therefore, hypothesis 1 is correct in stating that homicides are more likely to happen in areas with these factors, but it comes with complex origins. Poverty and unemployment are not true predictors on their own, as homicides that occur within these definitions are interconnected with complex origins and predictors such as psychopathological or developmental (Botelho & Gonçalves, 2016).

An article written by Rosenfeld and Fox (2019) discusses a spike in homicide rates in the United States between 2014 and 2016. A study was used to try and determine different factors on why this sudden spike may have occurred, and relates this homicide back to a previous one back in the 1980s.

The article found that although there was a slight increase in older adults during this spike compared to the one in the 1980s, the youth were still the main culprits in this spike. They discuss that cultural factors may have come into play for this spike in homicide cases, such as the unnecessary killings of African American youth by police officers during this period. Drug related homicides also spiked by 33% due to the opioid epidemic between 2014 and 2016. The spike in the 1980s was also attributed to a drug epidemic (crack cocaine). Most of the areas affected by these homicides were on the outskirts of major cities rather than within them. The homicides during the 2014-2016 period were almost exclusively firearms, showing a large decrease of sharp/blunt objects as a weapon of choice. This is likely due to firearms being easier to conceal, and takes less effort to use. The sudden spike in numbers did not last beyond 2016, which would point to most homicides being caused by different external/socio-economic factors rather than random acts of violence at any given point in time. For example, a drug or gang war. Two of the biggest contributors to youth violence are substance abuse or gang related (supports hypothesis 3).

The next article written by de Souza, T. O., de Souza, E. R., and Pinto in 2020, *"Analysis of the Correlation of Socioeconomic, Sanitary, and Demographic Factors with Homicide Deaths – Bahia, Brazil, 2013–2015"* is an analysis of the correlation of multiple factors that are related to higher homicide rates in Brazil. The findings of this study show that socioeconomic factors have a correlation to increased homicide rates in

the country. In contrast to hypothesis 1, this study found that areas with better economic conditions had a homicide rate 9.29 times higher than lower income areas (de Souza, T. O., de Souza, E. R., & Pinto, 2020). That being said, the study clarifies that the lower income areas have less information available pertaining to deaths, making it unclear if the results are fully accurate. This can explain why the homicide rates are lower in areas with poorer economic conditions since that data is not as detailed or high quality. The study then states that areas with higher poverty rates see an increase in homicides (de Souza, T. O., de Souza, E. R., & Pinto, 2020). This directly supports hypothesis 1. It was also found that more homicides occur in areas with lower education levels. The study highlights the importance of education level in relation to homicide rates (de Souza, T. O., de Souza, E. R., & Pinto, 2020). In addition, the study concluded that there was in fact, a direct relation between economic factors and high homicide rates, stating it can be somewhat explained by wealth inequality in certain areas. It advises that future efforts to diminish homicide rates should focus on socioeconomic inequality and the risks that come with it (de Souza, T. O., de Souza, E. R., & Pinto, 2020). The conclusion and findings of this study directly support hypothesis 1 as a higher correlation was found between high poverty areas and homicides as well as areas with lower income.

A 2012 article, "A World of Homicides" by Ouimet, investigated the socioeconomic factors that can explain increased homicide rates in 165 countries. Using regression analysis, the study demonstrates that economic development (GNI), inequality (Gini), and poverty are predictors of homicide rates (Ouimet, 2012). The analysis found that only income inequality was a reliable predictor for countries with medium level of human development (Ouimet, 2012). After the completion of the

analysis, it was found that countries with a low GNI have an increased homicide rate (Ouimet, 2012). The analysis also shows a strong relationship between Gini and high homicide rates. This shows that economic development and inequality are both factors relating to increased rates of homicides. It was shown that more economically advanced nations had lower homicide rates while nations with a poor economic level had higher rates (Ouimet, 2012). An advanced analysis was also used, and the results showed that countries with more inequality and poverty also have an increased homicide rate (Ouimet, 2012). These findings directly support hypothesis 1. In addition, it was found that countries with higher youth populations also have a high homicide rate, directly supporting hypothesis 3.

While this study takes on a very broad scope of 165 countries, the findings directly relate to the research conducted in this paper. Both hypothesis 1 and 3 are supported by these results. The factors and analysis can be applied in a smaller scope and taken into consideration. The analysis of higher levels of poverty, lower income, and high youth populations as a predictor of homicide can be applied to homicides within Toronto, Canada effectively. Each country showed similar results in this study – high youth population, high poverty level, and low-income level consistently showed a strong relation to increased homicides. Therefore, this data will be used to predict if these socio economic factors are good predictors of homicide in the City of Toronto.

Another article that supports hypothesis 1 and 3 would be an analysis done in the US. In this study, they took a look at the relationship between social-economic and political factors that had an effect on homicides rates between the period of 1970 to 2000. (McCall, Parker, & MacDonald, 2008)

In another study, the researchers analyzed a period where the US saw the largest spikes in homicides rates. The period they looked at was the 1970s- late 1990, as this period has one of the highest homicide rates in the US. (McCall, Parker, & MacDonald, 2008) The researcher theorized that based on past studies based on similar topics, the sudden increase in homicide rate within these 3 decades had some correlation to socio-economic factors. Such as "poverty, and unemployment. Population dynamics in urban centers such as population change and changing age" (McCall, Parker, & MacDonald, 2008). The results of this study showed during this period there was a reshaping of the different industries in 1970 that threw many businesses and organizations into a frenzy, causing massive layoffs. Affecting all classes from the upper class, middle class to lower class resulting in many being jobless and poverty as well as increasing racial segregation. (McCall, Parker, & MacDonald, 2008) Such a sudden change in the economy and ecosystem was directly related to homicide rates as jobs become more scarce and not everyone was able to provide for their families or themselves. Researchers found that the deprivation of resources from these cities during this period is an important factor related to homicides rates. (McCall, Parker, & MacDonald, 2008) This is significant as it supports our first hypothesis about homicides happening in areas with many socio-economic disadvantages. This relates to our research because it supports the theory that disadvantages such as being unemployed and being in poverty may play a leading factor in why people commit homicides. When people are deprived of all means to provide for themselves they will be more desperate to commit crimes to get what they need.

The other findings in this study show that there was a positive correlation between youths and homicides rates. During this era the baby boomer generation was beginning to enter the ages of 15-29, which is the time youth are most susceptible to

crime. (McCall, Parker, & MacDonald, 2008) And the results from this paper suggest that there is a positive correlation between age and homicides rates because as the youth between the ages of 15-29 increased so did the homicides rates. However when the percentage of youths between the age of 15-29 fell so did the homicide rates, this shows that there is a correlation between youth age and homicide rates. (McCall, Parker, & MacDonald, 2008) This supports our 3rd hypothesis of homicides happening in areas with a larger youths population. The study supports that it is likely that youth who are exposed to socio-economic disadvantages and disadvantaged environments, will learn and pick up bad habits that will influence them into committing crimes. Overall the correlation of socioeconomic disadvantages and higher youths populations are prevalent in many studies and suggest that they are recurring factors to consider.

Another study that supports hypotheses 1 and 3 is a study done in Toronto that looked at the spatial distribution and social context of homicides. (Thompson, & Gartner, 2014) In this study, they looked at a theory called the neighborhood effect which is the influence that citizens' behavior and attributes have on a neighborhood (Castree, Kitchin, & Rogers, 2013). The homicide cases between 1988 to 2003 were analyzed in this study. After this period, all cases were geocoded based on the census tracts in Toronto to determine the homicide rates of the city. (Thompson, & Gartner, 2014) Multivariate models were then used to determine how significant independent variables were, and if they had a positive or negative correlation to the dependent variable. The results of these models showed that there was a positive relationship between homicides rates and neighborhoods with higher immigrants. (Thompson, & Gartner, 2014) The models also show a positive relationship between residents between the ages 15-24 who are resources deprived such as having lower incomes or having other disadvantages such as

dropping out of school. (Thompson, & Gartner, 2014) As a result, these neighborhoods will have a higher homicide rate as they will be more desperate and may commit violent acts to get by. (Thompson, & Gartner, 2014).

These findings support the first and third hypotheses that are presented in this assignment, where homicides are more likely to happen in the city with less median income, higher unemployment rates, higher poverty levels. The result of this study supports that neighborhoods that experience more disadvantages correlate to a higher homicide risk. (Thompson, & Gartner, 2014) Disadvantages that contribute to a higher homicide rate include economic disadvantages, poverty, and having higher levels of immigrants in the neighborhoods. (Thompson, & Gartner, 2014) This is significant for our analysis as it will not only support our first hypothesis but also signifies that neighborhoods in Toronto are still plagued by the same issues that contributed to high homicide rates in the 1988s to 2003. The finding of this paper also supports hypothesis 3 where homicide rates occur in neighborhoods with higher youth populations. In the study, neighborhoods with a higher youth population, who also experience many socio-economic disadvantages, lead to youths being more suitable to committing homicides and being victims of homicides. (Thompson, & Gartner, 2014) This is due to not only the environment but could also be due to being resources deprived making them more desperate. (Thompson, & Gartner, 2014) Because of this strong feeling of being resources deprived, it is more likely that these youths will commit violent acts including murder to get the resources they need.

Overall, this article supports the theory that disadvantaged neighborhoods with higher youth populations are more likely to have high homicide rates because of economic disadvantages residents are more likely to face. This relates to the

neighborhood effect as the citizens and residences of these neighborhoods are what shape and drive how a neighborhood shapes out.

The next article, "Age, Poverty, Homicide, and Gun Homicide" by Males looks at the high correlation between youth and homicides (2012). It delves deeper into the relationship by investigating if high homicides rates connection to high youth population is because of the age factor or the low-socioeconomic nature of youth. First, the article confirms that homicides occur within higher youth populated areas, with high rates of homicides occurring in adolescents, following an upward age-curve with the offenders age peaking at 19, then declining (Males, 2012). This data supports hypothesis 1. That being said, the study finds that when poverty rates are controlled within this demographic, this age-curve only continues for high-poverty populations where there is an over-representation of youth (Males, 2012). This also confirms hypothesis 3, where homicides occur in areas with a high poverty population. The analysis shows that the correlation of youth and poverty is a predictor of increased homicide rates, and without poverty, youth homicide rates are not as high (Males, 2012). For all ages, homicides occur among the poorest demographic, but this is much more prominent in youth. Among 15 to 24-year-olds, almost 80% of the homicides (including 83% of gun homicides) studied occurred among those with poverty levels of 20% and up (Males, 2012). Conversely, less than 2% of homicides (including 1.4% of gun homicides) occurred among youth with poverty levels below 10% (Males, 2012). This information also supports hypothesis 1 and connects poverty, high youth population and gun violence as interdependent predictors of homicides. The study goes on to state that both homicides and gun homicides rates peak at age 19 and decline afterwards, furthering supporting hypothesis 1 (Males, 2012). The results of this study found that youth

homicide rates are heavily mitigated when they are economically stable. Next, it was stated that the "age-crime curve" is consistent in two ways: (a) at all poverty levels, homicide rates decline after age 50, and (b) in high poverty levels the traditional "age-crime curve" persists (peaking at age 19) (Males, 2012). The former of the two supports the hypothesis that a high youth population is still more likely to have an increased homicide rate regardless of economic status (Males, 2012). High levels of gun homicides also occur mainly in poverty-stricken youth populations.

This study confirms that youth population and poverty are predictors of homicides as well as showing that the two are intertwined, with youth homicides being mostly dependent on poverty level.

The next article written by Leibbrand, Hill, Rowhani-Rahbar, and Rivara, "*Invisible Wounds: Community Exposure To Gun Homicides And Adolescents' Mental Health And Behavioral Outcomes" written* in 2020 investigates topics directly relating to hypothesis 1, 2 and 3. In support of hypothesis 1 the article finds that homicides, specifically gun related homicides, are frequent in urban neighborhoods with low-income adolescents (Leibbrand, Hill, Rowhani-Rahbar, & Rivara 2020). The researchers also found that gun homicides were associated heavily with adolescent mental health in these areas (Leibbrand, Hill, Rowhani-Rahbar, & Rivara 2020). The findings support hypothesis 3, as it is found that gun related homicides occur at higher rates in a youth population (Leibbrand, Hill, Rowhani-Rahbar, & Rivara 2020). This article, including various others in this literature review, has shown a correlation with gun homicides occurring in high youth population areas, meaning the two are likely interconnected variables. In addition, another variable found throughout multiple articles that also connects with the former variables is low-income. This further supports that the

hypotheses of this study are interconnected and are also occurring in the same geographical regions and neighborhoods, as well as the surrounding areas. This supports hypothesis 2. The study found that most homicides from the research in question initially occur in close proximity to adolescents' homes and schools (Leibbrand, Hill, Rowhani-Rahbar, & Rivara 2020). This shows a clustering of homicides in an area or neighborhood. Additionally, it was also found that the majority of adolescents in the sample group had at least one gun homicide occur within a mile of their neighborhood or school within the prior year of this study (Leibbrand, Hill, Rowhani-Rahbar, & Rivara 2020). It was also found that the adolescents who experience this were more likely to be socioeconomically disadvantaged and live in poorer communities than adolescence where gun homicide had not occurred in the prior year (Leibbrand, Hill, Rowhani-Rahbar, & Rivara 2020).

This article is a great example on how each hypothesis is likely to be interdependent or interconnected with the others. Given this, it can be argued that if certain variables in areas with higher rates of homicides are altered (i.e., higher median income instead of low median income) that there would be a noticeable shift or possible decline in homicide rates in these neighborhoods. Being able to identify these patterns and relationships is a resource in presenting and theorizing possible future solutions and policy changes to prevent high homicide rates in affected geographical areas.

The following study looks at how research on homicide rates in urban areas often draws upon relationships with poverty (hypothesis 1). The reasons behind this are often embedded in the status accompanied with individuals. Lee explains that low-status groups and low-status communities often experience more crime and homicide because they are so socially isolated (2000). Because law is considered a high-status institution

associated with "wealth, integration, organization, conventionality and respectability" or as the gold standard of class, low-status or low-income individuals often are seen for the negatives and stigmas that are associated with them, "poor, unintegrated, disorganized and not highly respected" (Lee, 2000). This inhibits their ability to relate or connect with the law in some cases because it is not uncommon for low-income individuals to be discriminated against by the law. This can also explain why homicides are more likely to occur in clusters and affect neighbouring areas (hypothesis 2). This research supports hypothesis 1 and 2, as it supports the notion that homicides are more likely to happen in areas of the cities that have lower median income, higher unemployment rates, higher poverty levels, and higher levels of gun violence in the neighborhood and that homicides are more likely to happen in clusters and affect the neighboring areas

Media coverage on homicides in the City of Toronto also emphasizes the notion that homicides are more likely to happen in clusters and affect neighbouring areas/neighbourhoods. Many neighbourhoods are judged based on the stigmas that they have been socially tethered to. The author notes how judgements based on communities are very similar to those we make about individual people and the people that are associated with them (Jahiu and Cinnamon, 2021). Similarly, social stigmatization affects neighbourhoods that are in close proximity to places that are negatively portrayed. This can be seen in many areas of the City of Toronto where places are associated with "poverty, ill-health, disorder, or crime" (Jahiu and Cinnamon, 2021). People may be reluctant to live nearby places that have negative connotations attached to them which can explain why the stigmatization of class, ethnicity and socio-political identity can affect where different groups of people live. That said, homicides may be more likely to occur in areas where marginalized or low-income groups are concentrated

because society has villainized these areas, often resulting in subsidized or lower costs of living which isolates these areas from the rest of society and creates an imbalance and a potential lack of opportunity.

Other studies have shown that social disorganization can play a role in these imbalances and opportunities. Parker and Pruitt note that economic status, race and mobility affect social disorganization in neighbourhoods (2000). They note that "low-socioeconomic-status communities will suffer from a weaker organizational base than higher-status communities and, therefore, these communities have less ability to engage in both social control and the appropriate socialization of residents" (Parker and Pruitt, 2000). Through this it is implied that lack of opportunity in a neighbourhood can cause social disorganization among people who reside there, whether their choice to live there is deliberate or not. This is especially prevalent in the City of Toronto where low-income neighbourhoods often have little access to services that are targeted towards the individuals who reside there. This can explain and support the hypothesis that homicides are more likely to happen in areas of cities that have lower median income, higher unemployment rates and higher poverty levels because there is a lack of social control as people are isolated from the things that they need. An interesting component of this study is how Black individuals are disproportionately represented in neighbourhoods that are poverty-ridden. The statistics show that Black individuals were almost five times more likely than White individuals to reside in areas where 40% or more of the population live below the poverty line (Parker and Pruitt, 2000). This suggests that minority groups may be more likely to face socioeconomic disadvantage.

The following article supports hypothesis 3, the authors in this article are identifying populations at risk and the upstream determinants of homicide are

important for addressing inequalities (Lachaud et al. 2017). Focusing on areas in the City of Toronto will allow a demographics to be investigated (i.e., age) as well as discover what areas homicides are taking place at high rates. The authors state that the mortality rates are high relatively among young people aged between 15 and 29 years old and also young male adults 30 and 44 years old (Lachaud et al. 2017). This connects to hypothesis 3 which states homicides are more likely to happen in areas with a higher youth population. The authors argue that homicides are a key contributor to health inequalities as they disproportionately affect young males and those living in poorer neighbourhoods in Ontario. In the authors results, it showed young males 15–29 years old, were the main victims of homicide with a rate of 3.85 [IC 95%: 3.56; 4.13] per 100,000 population and experienced an upward trend over the study period (Lachaud et al. 2017). With the results found in this article, it will allow us to focus on census tracts with these demographics. These census tracts should have a higher homicide rate than the census tracts with an older age population. The authors states that the age-sex pattern of homicide deaths in high-income countries, such as Canada, is well documented in the violence literature and that young males 15-29 and young male adults (30–44 years old) have typically been the primary victims in all geographic regions during the last decade (Lachaud et al. 2017).

Methodology

The purpose of this study was to examine the location distribution of homicides in Toronto, emphasizing the relationship between homicides and the demographic

characteristics of the city. This study aims to elucidate three hypotheses: (1) Is there a link between the location of the homicide and the level of poverty? (2) Are homicides clustered? (3) Is there a correlation between homicides and the regional population's age?

Statistics Canada, Toronto Police Service and Public Health Ontario provided the dataset for this study. The first step is to compile a homicide list with geographic coordinates. The Toronto Police Service provides detailed data on various types of crime in the Public Safety Data Portal on its website, but since this study only focuses on 2010-2020 cases, some data cleaning is required before use. Event ID, time of occurrence, jurisdictional zone, crime type, address, longitude and latitude are included in the cleaned data.

Step two, download demographic data: First, download the 2016 census data from Statistics Canada. This study used Census Tract (CT) level data, which provides a detailed view of the population and characteristics of this study. The variables required for the analysis are then selected from this dataset.

The third step is to perform Multi-Criteria Decision Analysis(MCDA), Stepwise Regression Analysis, and Spatial Correlation Analysis. The MCDA method presents the analysis results in a visual way. Since the proportion data is required for the MCDA method, the ratio must be calculated before use, and the obtained data will be normalized by the maximum score method. The stepwise regression analysis results are obtained through linear regression in SPSS, the spatial correlation was analyzed by GeoDa by using local moran's method.
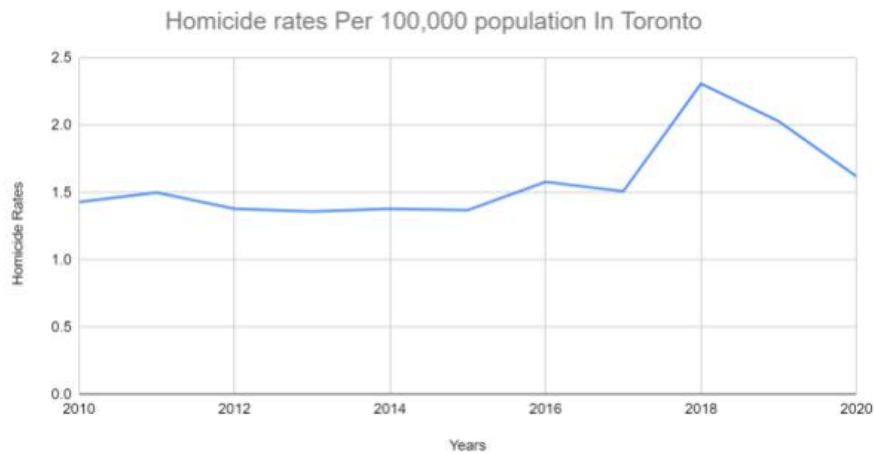
Table 1

Composite Index

RESIDENTIAL INSTABILITY	MATERIAL DEPRIVATION	DEPENDENCY
Indicator	**Indicator**	**Indicator**
Proportion of the population living alone	Proportion of the population aged 20+ without a high-school diploma	Proportion of the population who are aged 65 and older
Proportion of the population who are not youth (age 5-15)	Proportion of families who are lone parent families	Dependency ratio (total population 0-14 and 65+ / total population 15 to 64)
Average number of persons per dwelling	Proportion of total income from government transfer payments for population aged 15+	Proportion of the population not participating in labour force (aged 15+)
Proportion of dwellings that are apartment buildings	Proportion of the population aged 15+ who are unemployed	
Proportion of the population who are single/divorced/widowed	Proportion of the population considered low-income	
Proportion of dwellings that are not owned	Proportion of households living in dwellings that are in need of major repair	
Proportion of the population who moved during the past 5 years		

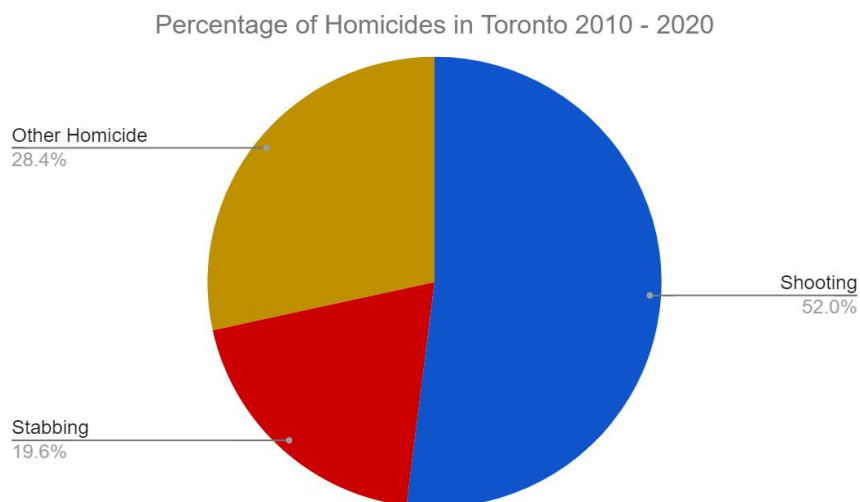*Note.* Adapted from Public Health Ontario.

Data Analysis

There were 735 homicides in Toronto from 2010 to 2020, of which 382 were shootings, 150 were stabbings, and 203 were by unknown methods. This shows that the

number of gun killings in Toronto is very high, reaching 52% of the overall number (see

Figure 1 and 2).

Homicide rates Per 100,000 population In Toronto

(Statistics Canada, July, 27, 2021)

Figure 1

Percentage of Homicides in Toronto 2010 - 2020

Other Homicide
28.4%

Shooting
52.0%

Stabbing
19.6%

Figure 2

Between 2010 and 2015, the number of homicides in the Toronto area has been steady at around 60 per year. After 2016, the number of homicides started to rise and reached a peak in 2018 (98). In the following two years, the number began to gradually decline (see Table 2 & Figure 3) to 71 in 2020 (preliminarily speculated to be related to the pandemic lockdown).

Table 2

Year	Type			Total
	Shooting	Stabbing	Other	
2010	32	13	20	65
2011	28	8	15	51
2012	34	7	16	57
2013	22	14	21	57
2014	27	16	15	58
2015	26	18	15	59
2016	41	9	25	75
2017	39	11	15	65
2018	51	20	27	98
2019	44	16	19	79
2020	38	18	15	71
Total	382	150	203	735

*Homicides in the City of Toronto in 2010-2020*

Note. Adapted from Toronto Police Service. Darker colour indicates a higher value.
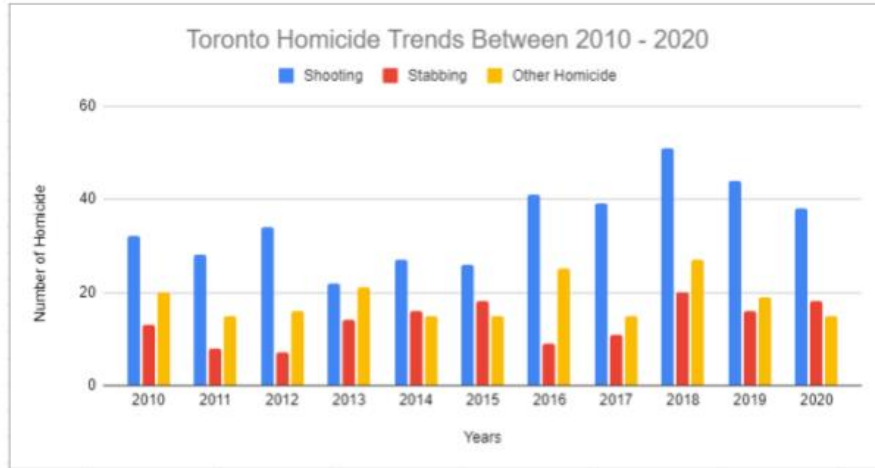
(Public Safety Data Portal, n.d)

Figure 3

Homicide in Toronto is widely distributed, but there are significant clusters in some areas. The obvious areas are the southern part of the city of Toronto (downtown), as well as the east and west sides of the city (see Figure 4).

Figure 4
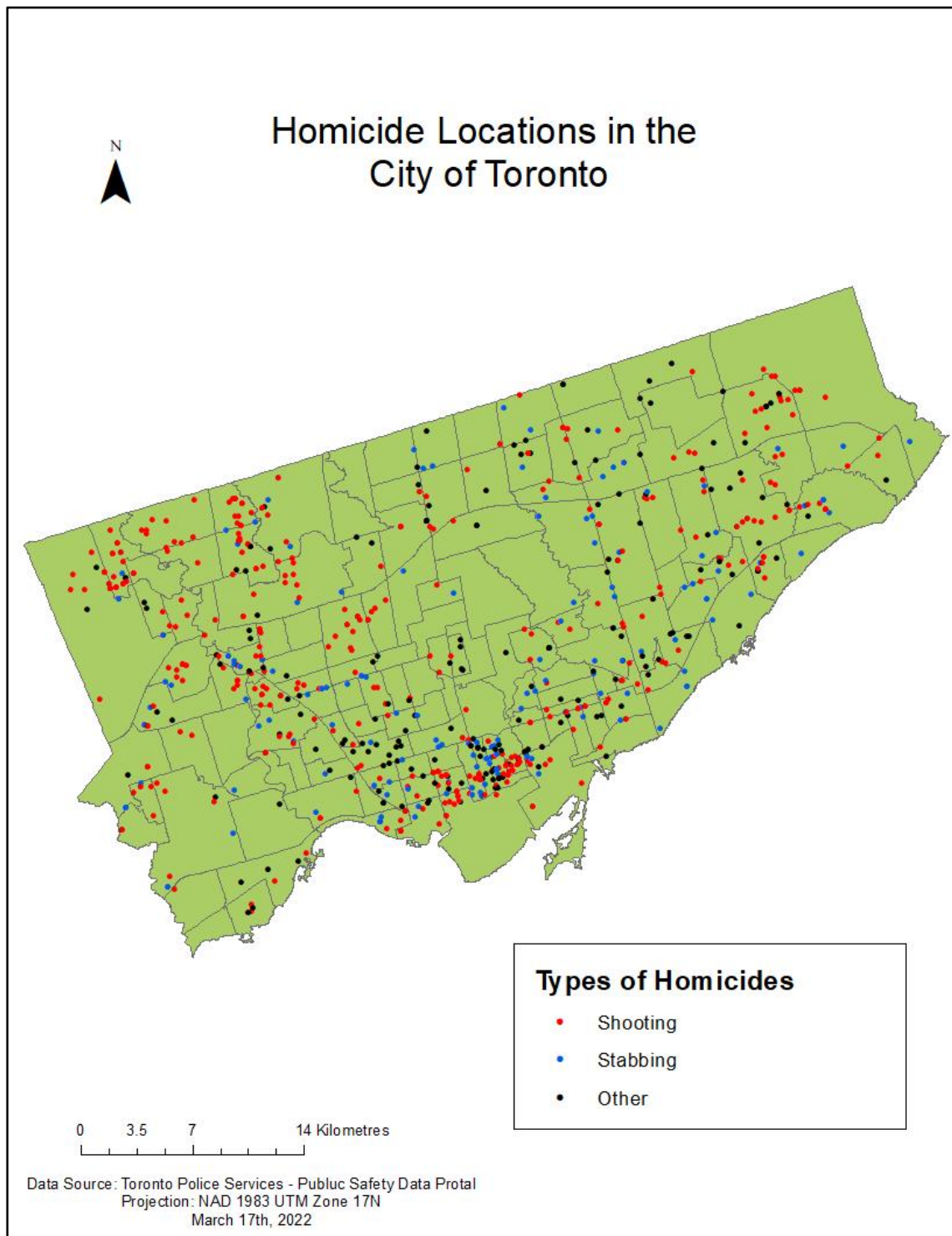
The results of the MCDA show that homicides in Toronto are related to demographic characteristics. Among them, the most obvious is the Material Deprivation

index, and it can be clearly seen that some homicides are clustered in the darker colour
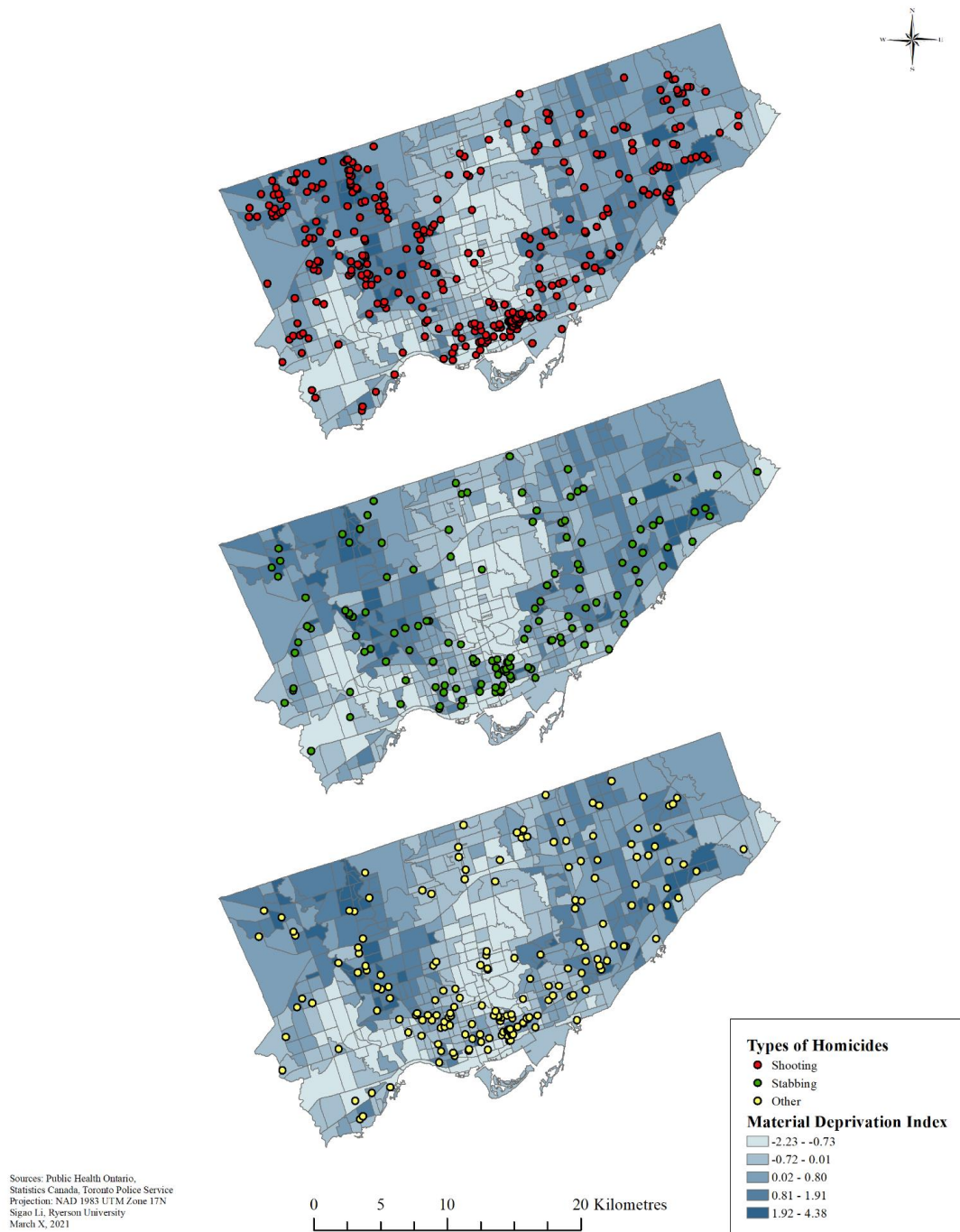
areas (see Figure 5 & 6).

Figure 5
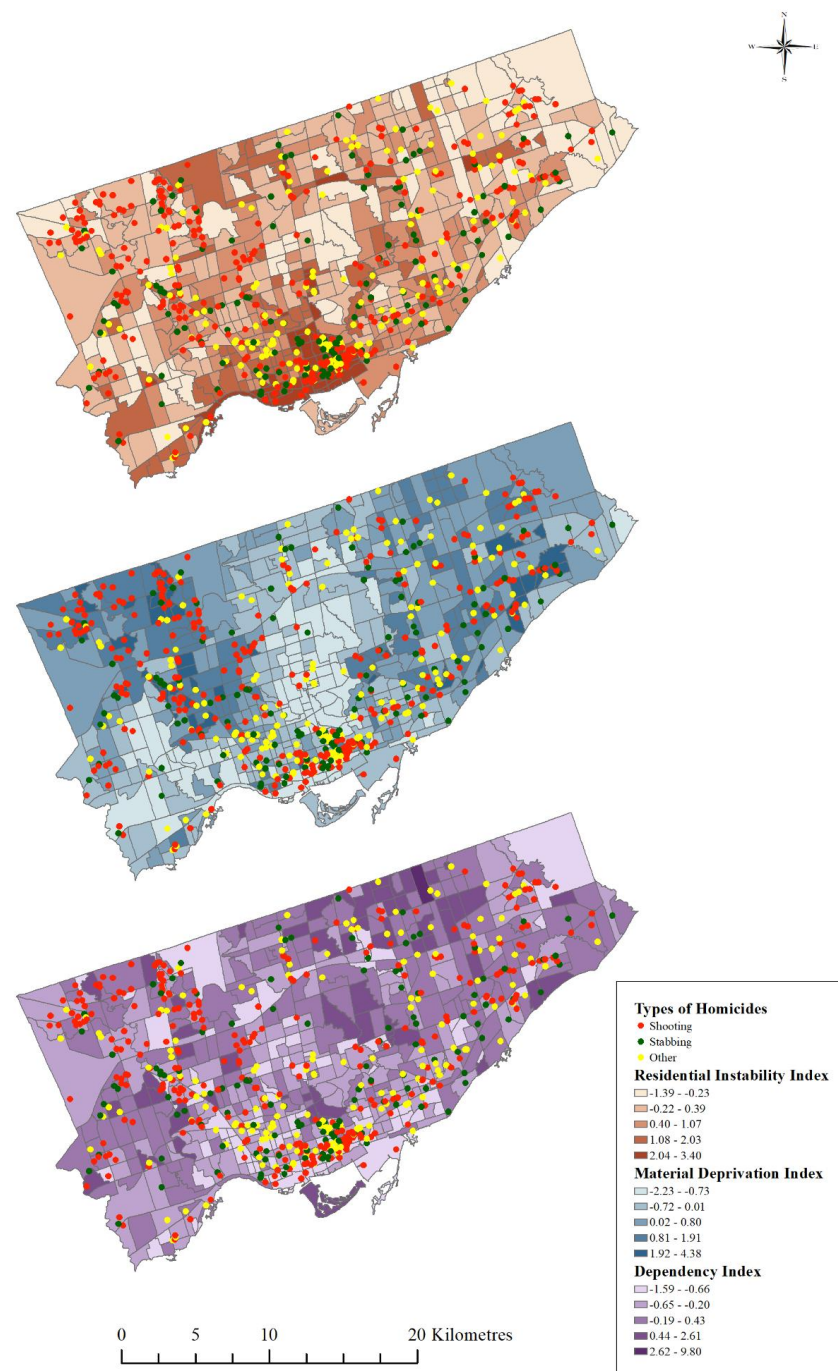
Map of Residential, Material Deprivation, Dependency Index in the City of Toronto

Figure 6

Map of Homicides in the City of Toronto in 2010-2020 (Material Deprivation)

For Hypothesis 1, Data analysis of the Indexes was done to use all indicators of the three indexes as separate variables. This allowed us to test more variables while creating a stronger analysis but strengthening the regression model through a stepwise analysis to eliminate any variables that were not statistically significant and create the strongest linear regression model possible.

The results for Hypothesis 1 between 2010-2015, using the stepwise regression analysis excluded all but 4 variables which were, Proportion of the population single/divorced or widowed, proportion of the population not between the ages of 5-15, proportion of the population who are renting and proportion of the families that are single parent household.

The results created a linear regression model that was statistically significant at 99% and had no multicollinearity of VIF score above 3 which suggests our variables are not correlated.   Though the model was statistically significant, the Adjusted R square value was only .146 suggesting the variables were only able to predict the amount of homicides at a statistically significant rate 14.6% of the time. In this case even though that model was statistically significant it was not able to predict values at a high accuracy so we will reject the null hypothesis.

The results for Hypothesis 1 between 2015-2020, using a stepwise regression analysis it excluded all variables but 5 variables which were proportion of the population single/divorced or widowed, proportion of the population below the low income cut off, proportion of renters, proportion of families in lone parent households and proportion of income from government transfer payments.

The results created a linear regression model that was statistically significant at 99% and no multicollinearity of VIF scores above 3 which suggest our variables are not

correlated. Though the model was statistically significant, the adjusted R square value was only .120 suggesting the variables were only able to predict the amount of homicides at a statistically significant rate 11.2% of the time. In this case even though the model was statistically significant it was not able to value at a high accuracy we will reject the null hypothesis.

Hypothesis 2 was a test of clustering using a local moran's I to test for clustering of homicides in both 2010-2015 and 2015-2020.

Figure 7 below shows the significance of clustering in both the downtown area at 99.9% (p=0.001) as well as some clustering in the north west portion of the city at 99% (0.01) and 95%(0.05). This clustering was also identified by the Moran's I value of 0.082. In this case we have proved there is significance in our clustering hypothesis and we will accept the null hypothesis.

Figure 8 below shows the significance of clustering in both the downtown area at 99.9% (p=0.001) as well as some clustering in the north west portion of the city at 99% (0.01) and 95%(0.05). This clustering was also identified by the Moran's I value of 0.103 In this case we have proved there is significance in our clustering hypothesis and we will accept the null hypothesis.

For Hypothesis 3 the analysis created a regression model for proportion of the youth population per census tract between 15-29 youth was described as these years (StatsCan). While both regression models were statistically significant at 99% in years 2010-2015 and 2015-2020 the R square values were .024 or 2.4% (2010-2015) and .036 or 3.6%(2015-2020). In the case of hypothesis for both 2015-2020 and 2015-2020 we will reject the null hypothesis as the models were not strong enough to predict variables at an accurate level.

Figure 7

Homicides Clustering in 2010-2015
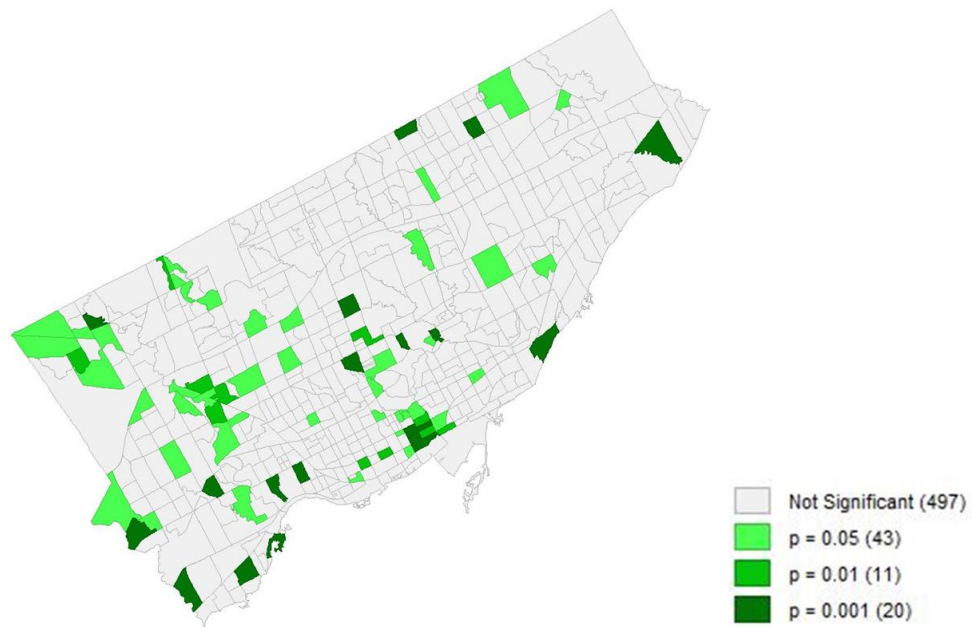
Figure 8

Homicides Clustering in 2015-2020
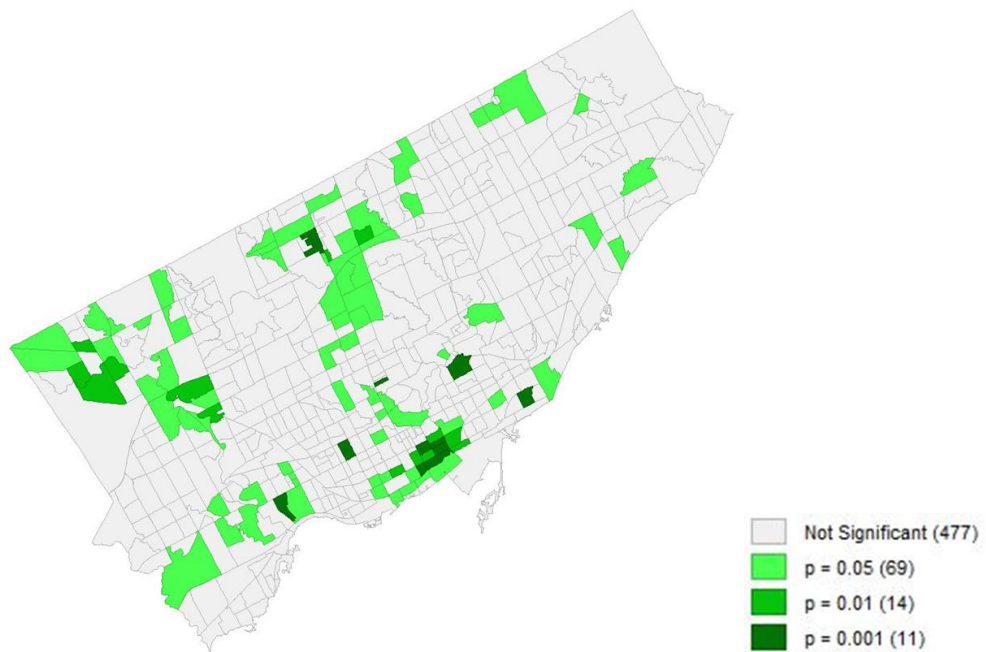
Conclusions

Based on the results of the homicide analysis conducted, it can be concluded that in the City of Toronto, homicides are not more likely to occur in areas with lower median income, higher unemployment rates, higher levels of poverty and high levels of gun violence in the neighbourhood (hypothesis 1). The findings also show that homicides are not more likely to happen in areas with a higher youth population (hypothesis 3). Therefore, we reject the null hypothesis for both hypothesis 1 and 3. In contrast, for our second hypothesis, the null is accepted and it can be concluded that homicides are more likely to happen in clusters, and affect neighbouring areas. Some limitations to our analysis are that we did not have access to the homicide data classified as "other," we also did not take cause into consideration (ex. theft, robbery, etc) which could be useful information to have for future analysis in homicide prevention strategies. In addition, some next steps could be looking at comparable Canadian cities and comparing patterns among cities with similar populations.

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