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The Spatial Risk of Assault on Police Officers in Toronto, Ontario

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by

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ABSTRACT

Since September 12th, 2022, nine police officers in Canada have been fatally assaulted in the line of duty. These officer deaths raise important questions concerning the nature of risks police face on duty, as well as the ways we can better understand those risks. Utilizing a Risk Terrain Modelling (RTM) approach, this study examined the risk of assault to police officers in Toronto, Ontario using Assault to Peace Officer data from January 1st, 2022, to December 31st, 2022. This study revealed that the risk of assault to police varies by the physical features present in each Division of the Toronto Police Service. Specifically, 7 features of the physical environment were found to increase risk of assault to police, with locations with high previous rates of robbery posing the most consistent risk. The resulting output provides The Toronto Police Service and policymakers with information and suggestions on how to utilize RTM methods to improve the safety of officers on-duty.

Keywords: Risk Terrain Modelling, Peace Officers, Police, Spatial Risk, Toronto, Assault

Introduction

On September 12, 2022, 48-year-old Constable Andrew Hong was participating in a joint training exercise in Mississauga, Ontario, when on his lunch break at a Tim Hortons, he was fatally "ambushed" and assaulted (Carter, 2022; CBC News, 2022; Toronto Police Service, 2023). Constable Hong worked as a member of the Toronto Police Service for 22 years, starting in 42 Division, and moving to the traffic services unit in 2008 serving as a motorcycle officer (Toronto Police Service, 2023). Constable Hong's murder marked the beginning of a string of fatal assaults across Canada where 8 other officers were killed in the line of duty. Const. Devon Northrup, Const. Morgan Russell, Const. Shaelyn Yang, Const. Grzegorz Pierzchala, Const. Travis Jordan, Const. Brett Ryan, Sgt. Maureen Breau and Sgt. Eric Mueller are these 8 officers (Police & Peace Officers' Memorial Ribbon Society, 2023). Of the officers killed since September 12, 2022, 5 worked within police services located in Ontario. This string of recent fatalities raises important questions concerning the nature of risks police face on duty, as well as the ways in which we can better understand those risks.

The Toronto Police Service is the fourth largest municipal police service in North America, and as such, employs many uniformed officers to serve and protect its citizens (Toronto Police Service, 2023). Utilizing Toronto Police Service Open Portal Data, an overview of the Major Crime Indicators within Toronto shows an increase in Major Crime of 17.9% between 2021 and 2022 (Toronto Police Service, 2023). Further, occurrences of assault within the city saw a 10.4% increase between 2021 and 2022, with the assault of peace officers showing a 15.2% increase within the same period. An assault on a peace officer is defined as the assault on any individual who "by act of parliament or provincial legislation has been given specified powers and authority to enforce legislative statutes, including municipal bylaws, and is

responsible for the maintenance of public order" (Statistics Canada, 2021). Police officers are included as a major component of the group called "peace officers", and as such, these terms will be used interchangeably throughout this analysis.

The recent increase of violent attacks on police officers suggests a need for research that investigates what leads to these attacks, and further, research on how to best predict and prevent these acts from occurring. There is little research in the academic literature on assaults against police officers. This problem is particularly noticeable in relation to Canadian research, with most focusing on police use of force incidents (Boivin & Lagacé, 2016; Hall et al., 2009; Stanislas, 2013). Evidence-based policing methods have become increasingly important in understanding crime prevention, as this method allows for the targeting of crime problems to specific local environments through analyzing previously collected data and information (Weisburd & Braga, 2019). To determine locations that may pose a high risk of violence against the police, risk terrain modelling (RTM) is a method used to determine the spatial crime producing features of a location, and the risks these features pose to the safety of peace officers (Marchment & Gill, 2021).

This study uses an RTM approach to study the criminogenic features and locations present in Toronto, Ontario, and determine the risks that these features and locations pose to police officers. What the results reveal is the spatial influences of physical features and risky places in a location do increase the risk of assault to peace officers in Toronto, with the level of risk varying by police division. The criminogenic features whose presence pose the highest risk of assault to peace officers in Toronto are found to vary by division, but the most consistent risk factors are found to be in areas that have a high density of previous robberies and locations with takeout food available. This paper will further discuss the implications this analysis has on

policing research, as well as important directions for future research and suggestions and takeaways for police services.

Literature Review

Risk Terrain Modelling

The use of geospatial analytics, in the form of risk terrain modelling (RTM), is a growing method of analysis that is currently being used to study the correlation between criminality and geographic locations (Caplan et al., 2011; Kennedy et al., 2016; Onat et al., 2018). Caplan and Kennedy (2011) created RTM by drawing on theories of environmental criminology (notably work on crime 'hotspots), as well as, problem oriented policing (Marchment & Gill, 2021). RTM analyses examine the linkage of spatial risk factors and crime incidences to generate a model revealing the spatial vulnerabilities of a particular location (Caplan et al., 2011; Kennedy et al., 2016; Kennedy & Dugato, 2018; Onat et al., 2018). When generating a RTM map, once environmental risk factors have been identified, a map layer for each risk is generated with each layer being weighted according to its potential influence on the outcome event (Caplan et al., 2011, 2015; Kennedy & Dugato, 2018). Individual map layers are combined with data on a particular type of crime to create a risk terrain map, within which each location is given a risk value for the likelihood that a crime of that type may occur. These risk values are identifiers of locations that pose a higher risk of criminality (crime or criminal acts) but should not be considered as the deciding factor as to whether or not a crime will occur in a given location. (Caplan et al., 2011, 2015; Kennedy & Dugato, 2018).

RTM analyses are useful in targeting policing and other approaches to crime problems. This methodological framework provides an outline of locations with features that generate

higher likelihoods of crime (Marchment & Gill, 2021). In identifying these risky locations, police agencies are better able to allocate resources to prevent and deter crime in those areas (Caplan et al., 2011, 2015; Kennedy et al., 2016; Marchment & Gill, 2021; Onat et al., 2018). For the purposes of the present study, a RTM analysis was generated to identify the risk of assault to public police officers in Toronto, Ontario. The goal of this work is to develop much needed insights into the risk that officers face in their daily duties.

Theoretical Framework

To fully understand Risk Terrain Modelling it helps to have some base-level understanding of the theories upon which RTM draws. In this section, I briefly examine theories related to three important concepts: crime 'hot spots', 'risky places', and 'crime attractors' and 'generators'. Awareness of these concepts will provide a foundation for understanding the methodological choices in this study and why this work is important.

Hot spot theory is based on the claim that crime tends to concentrate in small coordinate units, clustering in certain places due to features of the location (Weisburd, 2015; Weisburd & Amram, 2014). Weisburd (2015) proposed the "law of crime concentration" to explain this process. This 'law' is based on a body of research that shows little variability in where crime concentrates. Most notably, Weisburd's (2015) study that found that 25% of crime in a city was generated by 1.5% of locations, and 50% of crime was generated by 4% of locations. Understanding how crime clusters at particular 'hot spot' locations permits policy and prevention initiatives to focalize on areas in which crime is being attracted or generated.

The law of crime concentration draws on earlier work by the Brantingham's in the field of environmental criminology. In 1993 Brantingham and Brantingham (1993) highlighted the

important impact a location's composition can have on how its elements function, specifically, on how these elements can be crime attractors or generators. Crime attractors' are locations that are recognized as providing criminal opportunities for individuals, ultimately leading highly motivated offenders to concentrate in these areas (Brantingham & Brantingham, 1993). The composition of locations such as prostitution areas and bar districts allow for illicit activities to thrive and attracts individuals with criminal intent. Crime generators' are settings in which opportunities for crime are possible due to the converging of large masses of people at a time and place (Brantingham & Brantingham, 1993). Individuals are not motivated by criminal intent to attend these locations, rather criminality is born out of opportunity that stems from concentrations of people. Examples of crime generating locations are places such as entertainment districts, sports venues, and downtown areas.

Understanding why certain locations attract or generate crime is important when dissecting the risks that these locations may present to society. Caplan and Kennedy (2016) pose the theory of risky places, a framework demonstrating how the association between vulnerability and the criminogenic features of a landscape breed crime events and generate risky places. The theory of risky places argues, that though all places are risky, some places are riskier than others due to the criminogenic features of their landscape (Caplan & Kennedy, 2016; Kennedy & Dugato, 2018). This theory also states that the combination of spatial influences of crime in a location can increase space users' vulnerability (Caplan & Kennedy, 2016; Kennedy & Dugato, 2018). These features of risky places allow for the generalizability of this criteria to other locations, as risk levels of crime can be generated for any location depending on levels of vulnerability, exposure to crime events, and concentration of criminogenic features (Caplan & Kennedy, 2016). This analysis will be developed using the theory of risky places to understand

how crime is generated and how it lingers. The theory of risky places will be the foundation for choosing which risk factor locations in Toronto will be operationalized and measured for posing the most risk to public police officers.

Risky Locations

Studying the occurrence of crime at a location, along with the criminogenic features of its environment, allows analysts to justify their labelling of certain locations as "risky". Though different types of crime have been found to have varying spatial risk factors due to a location's features and vulnerability, there are common locations in the literature that are deemed risky for many types of crime. A variety of research into risky places focus on types of locations that are found to produce many types of crime such as bars, nightclubs, and restaurants (Braga et al., 2017; Brantingham & Brantingham, 1993; Caplan et al., 2015.; Caplan & Kennedy, 2011, 2016; Gill et al., 2017; Kennedy et al., 2011; Onat et al., 2018). These locations are posited to have multiple interacting factors that generate or attract crime, such as the flow of people through locations, and the buying, selling, and consumption of alcohol. Previous arguments in the literature on assault claim that there is a positive correlation between the consumption of alcohol and the number of assaults in certain locations (Costanza et al., 2001; Drawve & Barnum, 2018; Markowitz, 2005). This is an important argument to consider when not only looking at general assault rates, but also the risk of assault to peace officers. The persistence of risk factors associated with alcohol across studies of assault reaffirms its relevance to the topic of assault on peace officers and thus will be used as a variable in this RTM analysis. Other recurring risk factors of crime present in studies of risky places are locations with parks and open green space as humans can use these spaces to conceal their criminal activities (Barnum et al., 2017; Caplan

et al., 2015; Caplan & Kennedy, 2011, 2016; Kennedy et al., 2016). In accordance with existing studies and their use of previously mentioned variables, this analysis will further utilize these variables to examine the spatial impact they have on the assault of peace officers.

Risk of Assault to Peace officers

Research on the assault of peace officers is an understudied topic, as assault literature is often focused on the excessive use of force by police (McCarthy et al., 2019; Ouellet et al., 2019; Sorg et al., 2021). Previous research on assaults of police officers has mainly either used a narrative approach or employed basic quantitative methods (Caplan et al., 2014). What has largely been missing to date, are studies focusing on spatial analyses of risk factor locations in micro places.

Existing research lacks the utilization of mapping criminogenic features of a location to look at how they correlate and produce variables of risky places. One novel study of this type is research by Caplan et al. (2014) who utilized a RTM analyses to examine the spatial risk factors associated with assault of police officers in Chicago. Findings from this study revealed that foreclosed buildings were statistically significant with an increased risk of assault to police officers, along with problem buildings, and bars (Caplan et al., 2014). This study's findings correlate to previously mentioned research, where variables of alcohol, foreclosures, and abandoned buildings are more conducive to risk of crime and assault (Barnum et al., 2017; Caplan et al., 2014, 2015; Caplan & Kennedy, 2011, 2016; Costanza et al., 2001; Drawve & Barnum, 2018; Kennedy et al., 2016; Markowitz, 2005).

The outcomes of research on the assault of peace officers can help to inform policies and practices for the safety of officers and the communities they serve. It is beneficial to police

services to understand locations in their cities that pose the most risk of assault, as they are better able to train and brief their officers for situational occurrences they may encounter in certain locations in their respective cities (Bierie, 2017; Bierie et al., 2016; Kaminski et al., 2003; Caplan et al., 2014). Better preparing officers for the risks and spatial features they may encounter in certain locations will optimistically alleviate risk to the health and safety of these officers.

Current Study

The increasing trend of violence against police in Canada has led to the need for research focusing on how these acts are spatially distributed, and further, what places are associated with increased risk of assault to on-duty officers. To examine the spatial risks associated with policing in certain locations in cities, I have selected a specific site- Toronto, Ontario, to examine the risks that peace officers face on-duty in this particular jurisdiction. Toronto, Ontario is Canada's largest city, with a population of 2,794,356 people residing within its city limits (City of Toronto, 2022). Tasked with protecting these citizens, the Toronto Police Service employs over 5500 sworn officers, and is Canada's fourth largest municipal police service (Toronto Police Service, 2023). Utilizing Toronto Police Service Open Portal Data, an overview of the Major Crime Indicators within Toronto shows an increase in Major Crime of 17.9% between 2021 and 2022 (Toronto Police Service, 2023). Further, occurrences of assault within the city saw a 10.4% increase between 2021 and 2022, with the assault of peace officers showing a 15.2% increase within the same time period (Toronto Police Service, 2023). The noticeable increase in Toronto of assaults on peace officers exhibits the increasing danger police officers face on-duty. Micro-level studies looking at the spatial association of assault on officers are important to understand

the dangers associated with policing in different environments (Bierie, 2017; Kaminski et al., 2003). Developing a deeper understanding of the locational and spatial risks associated with this form of assault in Toronto is necessary to reduce the danger to officers within the Toronto Police Service.

Data and Methods

Research Questions

1. Does the presence of spatial risk factors in Toronto, Ontario pose a risk of assault to peace officers?

2. What locations in Toronto, Ontario pose a higher risk of assault to peace officers?

Data and Spatial Risk Factor Operationalization

Location data for this study was collected from the Toronto Police Service Public Safety Data Portal and The City of Toronto Open Data Portal databases. The information used in this model looks at the most recent data on "Assault Against Public Peace Officer", "Assault Against Peace Officer with a Weapon or Causing Bodily Harm", and "Aggravated Assault Against Peace Officer", that are coded as 1460, 1461, and 1462 in the Uniform Crime Reporting Survey. This "Assault" data shapefile was collected from the Toronto Police Service Public Safety Data Portal and contains locational data and attributes for individual incidents within the City of Toronto between January 1st 2022 and December 30th 2022. This shapefile data set was used to map the location of each incident of peace officer assault, which was 779 assaults (N = 779) within this time frame. Further, the City of Toronto Open Data Portal database was used to obtain base map layers for the boundary data for the City of Toronto, as well as to gather locational data for

spatial risk factors that are included in this analysis. The boundary data for Toronto was further reduced into the 17 divisions of the Toronto Police Service (11 Division, 12 Division, 13 Division, 14 Division, 22 Division, 23 Division, 31 Division, 32 Division, 33 Division, 41 Division, 42 Division, 43 Division, 51 Division, 52 Division, 53 Division, and 55 Division) to determine which locations in each division pose most of a risk to peace officers on duty. For this analysis, running a RTM for all of Toronto was not possible using the RTMDx software, as such a large boundary file with multiple risk factors overwhelmed the system, and did not produce an output. Ultimately to work around this issue, a file containing boundary data for the 17 police divisions in Toronto was used, that produces specific RTM outputs for each division.

The spatial risk factors included in this model were identified through consulting existing literature. Restaurants and fast-food locations were identified for this analysis as a potential spatial risk factor due to the frequent turnover of people in these locations, as well as the potential for alcohol consumption (Caplan et al., 2011, 2015; Drawve & Barnum, 2018). Toronto Dinesafe data is used from the City of Toronto Open Data Site to create a comprehensive list of every eating and drinking location within the City of Toronto. Establishments such as restaurants and fast-food locations are especially important for this model due to the recent climate of assault on peace officers, as these are places where police officers may go on their breaks.

Other spatial risk factors explored in this model relating to alcohol consumption, are locations serving liquor such as bars and nightclubs, or locations that facilitate the sale of alcohol. Previous literature on spatial risk factors have found that locations permitting the sale of alcohol are conducive to higher rates of crime, and risk of assault, due to the effects of alcohol, but also due to the large sums of cash on site (Barnum et al., 2017; Caplan et al., 2015.; Drawve et al., 2016; Drawve & Barnum, 2018; Kennedy et al., 2011). Locational data for bars and

nightclubs were collected using the Toronto Dinesafe data, as it holds the longitude and latitude coordinates for each location. For locations permitting the sale of alcohol such as LCBOs or grocery stores, locational information was obtained from the LCBO website, as well as through the Alcohol and Gaming Commission of Ontario.

Schools are also deemed to have significant spatial correlations with crime as they have been included as risky places in various models and spatial correlations of crime and place (Barnum et al., 2017; Caplan et al., 2015; Drawve & Barnum, 2018; Kennedy et al., 2016; Willits et al., 2013). The correlation between the presence of schools and the levels of crime in a neighbourhood have been causally linked in previous research using routine activities and social disorganization theories (Willits et al., 2013). School environments lead to the convergence of groups of adolescents and have large amounts of foot traffic by different individuals. These theories argue that the due to the attributes of individuals within these locations, these locations are more conducive to generating or attracting crime, as adolescents are more likely to be offenders or victims of crime (Willits et al., 2013). A shapefile containing the locations of all known schools (public and private) in Toronto was accessed using the Toronto Open Data Portal website, and the locational data for these risk factor locations are utilized for this model.

Locations with similar crime attraction and generation patterns as schools, are homeless shelters. Homeless shelters attract populations of individuals who are lacking resources. Research has found that shelters have been found to increase crime rates in the direct neighbourhoods surrounding these locations, thus making shelters risky places due to the convergence of suitable targets, motivated offenders and an absence of capable guardians; tenets of the routine activities theory (Faraji et al., 2018; Sherman et al., 1989). The locations of

shelters within Toronto are gathered from the Toronto Open Portal Data which holds locational data shapefiles on shelters within the city.

Parks and green spaces are also locations with crime attraction and generation properties, as they are spaces with a lack of supervision, which attract theft, property, and drug crimes (Barnum et al., 2017; Braga et al., 2019; Caplan et al., 2015; Kennedy et al., 2011). The tendencies associated with these locations make them important spatial risk factors, due to the levels of crime that occur in their direct vicinities. Locational data for City of Toronto parks were collected in shapefile format using the City of Toronto open portal data website.

Convenience stores are other important risk factors seen in analyses of spatial risk factors, as these locations are seen to be associated with large amounts of crime (Barnum et al., 2017; Braga et al., 2019; Caplan et al., 2015; Drawve & Barnum, 2018; Kennedy et al., 2016; Sherman et al., 1989). Characteristics such as holding late hours, low prices, and cash on site, give these locations higher likelihoods of having a crime occur in their vicinity. The locational data for convenience stores were collected through the ArcGIS Online portal, where this data had already been collected using the Toronto Business Directory (ArcGIS, 2023).

The final risk factor locations that are under review in this model are cannabis dispensaries and robberies. As the legalization of cannabis is relatively recent in Canada, there is a lack of literature on the impacts of cannabis dispensaries on crime rates. In the US, there are opposing views on the impacts that dispensaries have on neighbourhood crime, with some research pointing to positive correlations, while some argue that no correlation exists at all (Hughes et al., 2020; Kepple & Freisthler, 2012). This spatial risk factor will thus explore the association between assault and cannabis dispensaries to deem if there are correlations within a

Canadian context. The spatial data for cannabis dispensaries are collected from the Alcohol and Gaming Commission website (Alcohol and Gaming Commission of Ontario, 2023).

Past robberies from the year 2021 have been included as a potential risk factor in this analysis, as prior crime activity is often a good predictor of future risk (Johnson & Bowers, 2004). Using routine activities theory and the concept of crime attractors, we can think of past robbery locations as places with environments that are conducive to higher rates of crime due to their attributes and opportunity for criminality (Irvin-Erickson, 2015). The density of previous robbery incidences in this analysis, will exemplify locations with environments that offer a high amount of criminal opportunity.

Measures

For this analysis I have utilized the RTMDx software created by Rutgers University to conduct a RTM on the spatial vulnerabilities of assault on peace officers in Toronto, Ontario. RTM analyses examine the linkage of spatial risk factors and crime incidents to generate a model that reveal the spatial vulnerabilities of a particular location (Caplan et al., 2011; Kennedy et al., 2016; Kennedy & Dugato, 2018; Onat et al., 2018). The RTMDx software has automated the RTM process, making risk terrain modelling more accessible to the lay person through automatically performing necessary statistical calculations such as Poisson regressions, Binomial regressions, and Bayesian probabilities (Caplan et al., 2021). The process of using RTMDx for this analysis are as follows: 1) Set the basic boundary parameters for the city of Toronto (In this case the boundary data for all Toronto Police Service Divisions) and the type of model; 2) Input desired units of measure for raster cell calculations (City block lengths); 3) Input topic data of interest and set filters (Assault on peace officer data and set date ranges); 4) Upload risk factors

of interest and set operationalization and measurement parameters; 5) Run the RTM and analyze

the output of significant risk factors, and the relative risk of each factor included.

Table 1 Potential Risk Factors

Environmental Factors	Operationalization	Standard Value Multiplier/ Analysis Increment	Standard Value
Robberies	Density	3/ Half	400m
Bars and Clubs	Proximity or Density		
LCBO's	Proximity or Density		
Restaurants	Proximity or Density		
Schools	Proximity or Density		
Parks and Green Space	Proximity or Density		
Homeless Shelters	Proximity or Density		
Cannabis Stores	Proximity or Density		
Convenience Stores	Proximity or Density		
Takeout Places	Proximity or Density		
Retail Alcohol Stores	Proximity or Density		

The risk factors included in this study are shown above in Table 1. These factors,

identified from existing research and literature, pose potential risks of criminal behaviour that

could result in assaults on peace officers. Though this topic of research has not been conducted

in Ontario thus far, these factors have been seen to generate risk in studies of assault within

different contexts.

To meaningfully capture the size of city blocks within Toronto, grid cell sizes are set to a standard value of 200m to represent a city block, with the place size being set to 100m (a half block). The model is set to "Aggravating" which ensures that the analysis tests for positive spatial relationships and assumes that the inputted risk factors will correlate with outcome event locations (Simsi, 2021). The purpose of this aggravating model is to identify what crime attractors are present at known hot spots. To determine the present crime attractors, the risk factors in this analysis were operationalized according to each factor's individual characteristics of spatial influence. Past robberies are chosen to be operationalized as "Density", as this method assumes that areas with high concentrations of the listed risky feature create a distinctive environment for criminality (Simsi, 2021). This means that it is the concentration of past robberies that best demonstrates the importance of environmental setting, rather than the actual location point of where the robbery was committed. All other environmental factors are operationalized as "Proximity or Density" to allow the program to select the most optimal method of operationalization. These 11 risk factors at operationalization levels of "Density" and "Proximity and Density" are tested at half block increments (100m) and at up to 3 block increments (600m).

Once the program has run its calculations, it produces an output that assigns a Relative Risk Value (RRV) to the significant environmental factors that are discovered. Further, the software produces a Relative Risk Score (RRS) that it assigns to each place location in the study area. RRS allows for the comparison amongst places that can be seen on each risk terrain map, whereas RRV can be understood as risk factor weights that can help to compare amongst risk factor types.

Table 2
RTM Results for Assault on
Peace Officers

Division		Robbery	Convenience Stores	Bars and Clubs	Parks/ Green Space	Restaurants	Homeless Shelters	Takeout Places	Unknown
11	O/SI	D/100	-	-	-	-	-	-	P/100
	RRV	13.497	-	-	-	-	-	-	10.967
12	O/SI	D/100	-	-	-	-	-	-	P/600
	RRV	28.648	-	-	-	-	-	-	8.16
13	O/SI	-	P/200	-	-	-	-	-	-
	RRV	-	9.433	-	-	-	-	-	-
14	O/SI	D/100	-	P/100	-	-	D/500	P/200	-
	RRV	7.728	-	4.043	-	-	2.165	5.535	-
22	O/SI	D/100	-	-	-	-	-	P/300	-
	RRV	11.493	-	-	-	-	-	4.652	-
23	O/SI	D/100	-	-	-	-	-	-	-
	RRV	103.928	-	-	-	-	-	-	-
31	O/SI	D/100	-	-	-	-	-	-	P/400
	RRV	63.13	-	-	-	-	-	-	12.316
32	O/SI	D/100	-	-	-	-	-	-	-
	RRV	35.931	-	-	-	-	-	-	-
33	O/SI	-	-	-	-	-	-	-	-
	RRV	-	-	-	-	-	-	-	-
41	O/SI	D/100	-	-	-	-	-	-	-
	RRV	32.486	-	-	-	-	-	-	-
42	O/SI	D/100	-	-	-	-	-	-	-
	RRV	22.529	-	-	-	-	-	-	-
43	O/SI	D/100	-	-	-	-	-	-	-
	RRV	61.51	-	-	-	-	-	-	-
51	O/SI	D/100	-	-	P/400	-	-	P/300	-
	RRV	7.358	-	-	1	-	-	20.108	-
52	O/SI	D/100	-	-	-	-	-	P/100	-
	RRV	6.075	-	-	-	-	-	10.102	-
53	O/SI	D/100	-	-	-	-	-	P/200	-
	RRV	27.01	-	-	-	-	-	8.448	-
54	O/SI	D/100	-	-	-	P/500	-	D/300	-
	RRV	31.97	-	-	-	1	-	5.405	-
55	O/SI	D/100	-	-	-	-	-	-	-
	RRV	38.275	-	-	-	-	-	-	-

Note: O=Operationalization (P=Proximity, D= Density), SI= Spatial Influence (in Meters), RRV= Relative Risk Value, Divisions 33 was omitted due to no risk values found, and risk factors of Cannabis Stores, LCBO's, Retail Alcohol Sales, and Schools were omitted due to a lack of influence.

Results

The final RTMDx output reveals that the 17 policing divisions in Toronto have significant differences in the spatial risk factors that are associated with the greatest risk of assault to peace officers. Table 2 displays the significant risk factors associated with assault of peace officers in each policing division in Toronto, as well as their operationalizations, and risk factor RRV's (Relative Risk Values). Of the 17 police divisions in Toronto, 16 were found to be significantly spatially impacted by the risk factors that were identified, while Division 33 was not found to have its levels of assault on peace officers be spatially impacted by the risk factors tested in this analysis. The results in Table 2 establish that the most consistent risk factor in Toronto that poses risk of assault to peace officers, is the factor of robbery. Locations with high density of previous robberies were found to be the most common risk factor across these analyses, having the highest Relative Risk Value (RRV) across 13 of the 17 police divisions in Toronto, with two other divisions also having previous robbery as an important risk factor. Table 2 shows that locations within 100m of areas with a high concentration of previous robberies raised the risk of assault to peace officers ranging from 7.4 times riskier (51 Division) to 103.9 times riskier (23 Division) across divisions.

Takeout places were also found to be significant risk factors for assault on peace officers within Toronto, with locations within 100m of takeout locations being 10.1 times riskier in 52 Division than locations farther than 100m from takeout locations. Locations within 200m of takeout locations are 8.4 times riskier in 53 division for assaults to peace officers, and 5.5 times riskier within 14 Division. Finally, locations within 300m of takeout places are 4.7 times riskier in 22 Division for potential assault on peace officers and 20.1 times riskier in 51 Division. In 54 Division it is the density of takeout places that pose most of a risk to the safety of police officers,

finding that being within 300m of locations with high takeout place density poses a 5.4 times greater risk to officers.

The results also reveal other locations of significance, such as: locations within 200m of a convenience store posing 9.4 times more risk to assault of peace officers than in places beyond 200m in 13 Division, and an increased risk of assault by 4 times when within 100m of a bar or club in 14 Division. The results also indicated an increased risk of assault by 2.2 times when within 500m of areas with high concentrations of homeless shelter in 14 Division.

It is also especially important to know which specific locations within each police division pose the highest risk of assault to peace officers, and this can be seen through looking at the Relative Risk Score's (RRS's) that this model generates for each division. To determine specific locations that pose the highest risk of assault to officers in Toronto, I focused on the four divisions that recorded the highest number of assaults on peace officers in 2022, which are: 14 Division, 51 Division, 52 Division, and 55 Division (22 Division recorded a large number of assaults on peace officers, but further investigation deemed that most of these records were of assaults that took place within Jail/ Detention centres, which are not part of this scope of analysis). These chosen divisions adjoin in the southern part of the city and encompass/ surround the downtown core of Toronto. As can be seen in Figure 1 and 2 below, the risk factors found in each division compound to create risky areas within cities that generate areas with different Relative Risk Scores (RRSs). These maps displayed are categorized as the "highest risk", with dark red locations having RRS two standard deviations or more above the mean, and bright red showing places with RRS equal or greater than the top 5% value. These maps represent the combined risk within each division of the important environmental risk factors within each

division. The dark red locations are most pertinent to this analysis, as they show locations that pose the most risk of assault of peace officers.
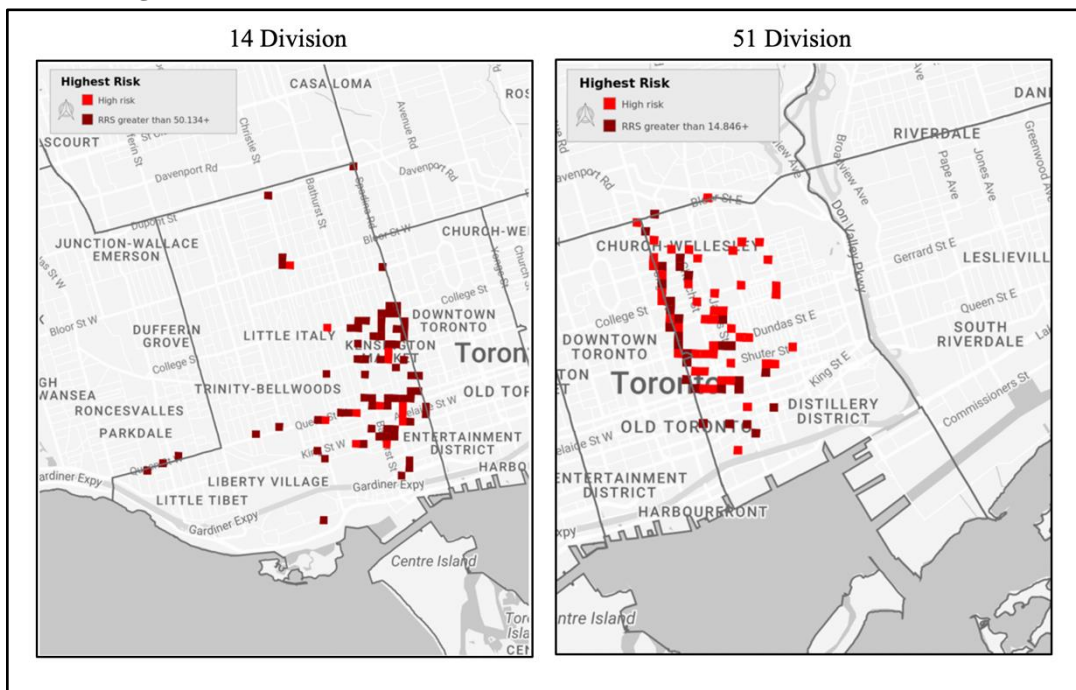
14 Division

The risk factor locations found to increase risk of assault to peace officers within 14 Division include being within 100m of areas with a high density of previous robberies, being within 100m of bars/clubs, being within 200m of takeout food locations, and being located within 500m of areas that are densely populated with homeless shelters. Using the RTMDx application to determine the three locations with highest risk of assault to peace officers in 14 Division, I determined that the locations of Queen Street West at Spadina Avenue, King Street West at Portland Street, and Bathurst Street between Wolseley and Willis Street pose the highest risk to safety of peace officers in this division (As can be seen in Figure 1 below). Further, utilizing the priority places function in the application (that shows locations with RRS two standard deviations or more above the mean that intersect with recent past exposure to show exceptionally risky places) shows that Queen Street West between Spadina Ave and Portland Street are considered exceptionally risky places to the safety of peace officers in 14 Division.

51 Division

Risk factor locations posing a risk of assault to peace officers in 51 Division are as follows: being in close proximity (within 100m) to locations characterized by a significant concentration of past robberies, being within 100m of takeout locations, and being in close proximity, within 600m, of areas highly concentrated with restaurants. The three locations that pose most risk of assault to peace officers in 51 Division due to the combined risk of

environmental risk factors are Dundas Street East between George and Mutual Street, Wellesley Street East at Chechalk Lane, and King Street East at Yonge Street, as can be seen in Figure 1 below. The priority places function for 51 Division found one of the most exceptionally risky places in this division to be Yonge Street between Carlton Street and Queen Street West. It can be noted that the riskiest locations tend to congregate in similar locations due to the environmental risk features that these locations are comprised of.

Figure 1

52 Division

Within 52 Division the risk factors posing significant risk of assault to peace officers are: being within 100m of locations that have significant concentrations of previous robbery and being at locations within 100m of food takeout places. Looking at locations with above average risk in 52 Division, the three locations that pose most risk of assault to peace officers are Harbour Square Park, the corner of Spadina Ave and Dundas Street West, and the location between Bremner Boulevard, York Street, and the Gardiner Expressway (See Figure 2 below).

Looking at the priority places output for 52 Division, this analysis found one of the most exceptionally risky locations in the division to be on Yonge Street between Wellesley and Queen Street East. This street segment is densely packed with areas of exceptional risk due to the combination of environmental risk factors, namely having a high density of previous robbery and close proximity to takeout locations.

55 Division

For 55 Division, there is one risk factor found to significantly impact the risk of assault to peace officers: robbery. Locations within 100m of areas with high concentrations of previous robbery are found to pose an increased risk to the safety of peace officers, with locations of most likely concern being: Carlaw Ave at Lakeshore Boulevard East, Eastern Ave at Carlaw Ave, and the plaza between Lakeshore Boulevard East and Leslie Street, as can be seen by looking at Figure 2 below. The priority places output for 55 Division shows no locations of exceptional risk (meaning areas 2 standard deviations above the mean that intersect with recent exposure) but, does show a high priority area being along the stretch of Danforth Avenue. High priority areas are still extremely important to consider when understanding risks associated with policing in certain locations, as these are locations that are greater than or equal to the top 1% of RRS values.

Figure 2
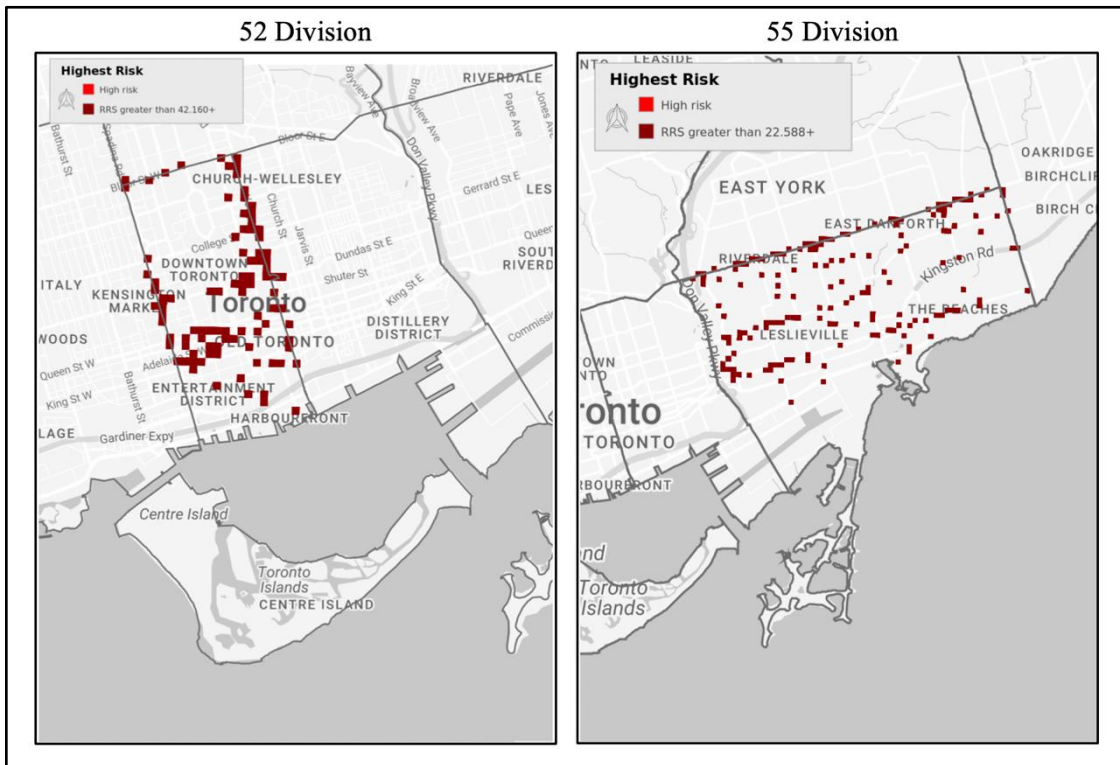
Discussion

This study examined the locational and spatial risks associated with the assault of peace officers in Toronto, Ontario by taking a micro-level approach and investigating the individual risks present in each Toronto Police Service division. Based on these results, it is apparent that the spatial influences of physical features and risky places in a location do increase the risk of assault to peace officers in Toronto. Further, the risks within certain police divisions in Toronto vary depending on the physical features of its environment and its previous history of criminal offences. One of the most apparent findings from this analysis is the presence of risk of assault to peace officers when within an area with a high concentration of past robberies. These findings concur with existing research and literature that state that previous criminal activity in a location is often a good predictor of future risk due to the environmental conditions or opportunities present being more conducive to crime i.e.. Routine Activities Theory, Theory of Risky Places,

and the Law of Crime Concentration (Brantingham & Brantingham, 1993; Caplan & Kennedy, 2016; Garner & Clemmer, 1986; Irvin-Erickson, 2015; Johnson & Bowers, 2004; Kennedy & Dugato, 2018; Weisburd, 2015). These findings support the notions of Johnson and Bowers (2004) in that the clustering of a specific criminal activity such as burglary or robberies creates elevated risk for future crime. The four divisions with the highest recorded number of assaults on peace officers in 2022 all were found to have robbery as important risk factors within their analyses. Within the divisions, Relative Risk Values showed an increased risk of assault to peace officers by 7.7 times in Division 14 when within 100m of areas in which previous robberies had occurred, 7.4 times in Division 51, 6.1 times in Division 52, and 38.3 times in Division 55, then when compared to being outside of 100m from these locations. These findings are important to consider, as locations that are found to have high densities of these types of crime can be understood as locations that pose an increased risk of assault to peace officers. The increased risk faced by officers in areas with high levels of robbery, may be due to the purposeful and violent characteristics that are often associated with these offenders, as they are also found to have attitudes that are favourable to law violation (Correctional Service Canada, 1995; Garner & Clemmer, 1986). Research into robbery and police officer homicide has found that actions of violence against the police are often goal motivated, meaning that individuals use any means necessary to complete their goal, may that be fleeing or the completion of a crime (Margarita, 1980). Further, 69% of robberies in Canada involve weapons, meaning that the presence of an armed suspect in locations with high densities of robbery is likely, increasing the risk to peace officers due to the presence of armed and violent offenders with high criminal motivation (Cotter, 2021). Areas with high levels of previous robbery are concentrated with armed and highly motivated criminals, thus presenting an increased risk of assault to police.

Similar to previous research findings, results from within this analysis find that being with a 100-300m proximity of takeout locations can increase risk of assault to peace officers from 4.7 to 20.1 times more risk across divisions. These findings align with previous theories that the frequent turnover of people and currency in takeout locations/ fast food are due to the crime generating characteristics of the environment, where criminality is born out of the opportunity that arises from a continuous flow of people and goods (Brantingham & Brantingham, 1993). These findings are especially important to consider, as takeout and fast-food locations are places where officers frequent for easily accessible food (Gu et al., 2012; Tewksbury & Copenhaver, 2015). The increased risk to the safety of peace officers within close proximity to these locations may occur when officers are on break, raising questions surrounding the safety of officers when they are not on a call. The two variables of robbery and takeout places are the most consistent risk factors across the divisions. Together these risk variables raise a potential risk narrative where crime attraction and generation properties of takeout locations lead to increased levels of robbery and criminality, which ultimately increases the risk of assault to peace officers when on call or when on break. These narratives are important to consider when it comes to when, and where, police services decide to distribute their officers, as these results can hopefully inform decisions and brief the Toronto Police Service as to where their officers are most at risk of assault while on duty.

Risk factor locations in this analysis that were not significant in any of the TPS division risk terrains were Cannabis Store's, Liquor Control Board Ontario (LCBO) locations, retail stores selling alcohol, and schools. These findings were noteworthy as a large amount of research on the topic of assault finds that this crime is often correlated with drug or alcohol usage (Costanza et al., 2001; Drawve & Barnum, 2018; Markowitz, 2005). This raises the question as

to whether assault on peace officers differs from regular assault, in that these assaults arise out of opportunity, rather than inebriation. 14 Division did see a risk of assault to peace officers when within 100m of Bar and Club establishments and was the only division to see alcohol consumption have an impact on risk factor locations. These findings limit the hypothesis that alcohol consumption contributes to assault on peace officers in Toronto as much as it does in other assault cases seen in literature (Barnum et al., 2017; Caplan et al., 2015.; Drawve et al., 2016; Drawve & Barnum, 2018; Kennedy et al., 2011).

Limitations

It is evident when looking into the assault of police that there is a large gap in the literature surrounding this topic. This gap widens when looking for data on this topic in a Canadian context, and even more so when looking for data on criminogenic features within particular jurisdictions. To my knowledge, this is the first study looking into the risk of assault to peace officers in Toronto, Ontario using Risk Terrain Modelling. While this study found useful data to predict future crimes against peace officers, this study does not come without limitation. Access to, and accuracy of, data are the most prominent limitations and constraints in this analysis. First, this study utilized Toronto Open Portal Data for information on the location of each recorded incident of assault on peace officers. These data are geocoded to the closest street corner to protect the identity of, and ensure the confidentiality of, those individuals involved in the incidents. This results in less precise representation of exact assault coordinates, with certain locations having many incidences geocoded to the same street corner. To counter this inaccuracy of assault locations, block parameters within the analysis were set to ensure the accuracy of the measurements of risk. Second, this dataset holds poorly geocoded sections labelled "Not

Specified Areas", whereby data collected was missing pertinent coordinate information that is used to locate where assaults occurred. Missing data and inaccurate data collection creates a risk to the accuracy of studies of this sort, and due to the serious nature of this crime, it is important that police services ensure they are accurately collecting data and locational information on crime incidents. Though this study looks at 11 risk factor locations informed by existing research and literature, the final limitation of this study is that there are other relevant possible risk factors that could have been pertinent to these analyses. Future research looking at risk factors such as foreclosed buildings, abandoned lots, and poorly lit streets, that were not included in this analysis due to insufficient data, would be beneficial to gain more understanding of the risks associated with policing in different environments in Toronto. These locations are of interest as they are places where suspects may hide from officers, heightening risk of ambush, and distracting officers from the offender's location (Caplan et al., 2014). Future research using these risk factors could inform policies of how vacant lots are secured from the public and require increased street lighting for locations with high levels of foreclosures and vacant lots. Prospective research should also look at the risk of assault posed to other groups, like the public, and determine if similar risk locations do present similar risk across groups. These findings would reveal if locations deemed as "risky" or dangerous to officers, also present a risk to the safety of the public.

Conclusion

This analysis, despite these limitations, offers a novel approach to the study of crime in Ontario. These findings aim to inform as to where police face the greatest risk of violence to officers within the divisions studied. This study thus represents a starting point to understanding

the benefits of a RTM approach in revealing the spatial vulnerabilities that are present within cities in Canada.

The key takeaway message for police services from this analysis is understanding that the risk of assault to police varies by location, or the division, in which officers are on-duty. It is imperative to officer safety that officers are briefed on the exact street locations that pose the highest levels of risk, as well as the types of risk factors that pose the highest risk to their safety within their unit. It is also important that the Toronto Police Service is aware that areas with high density of previous robberies, or being located in close proximity to takeout locations, pose the highest overall risk to officers across all divisions in Toronto. The dissemination of this information is important, as officers should be made aware of locations within their patrol area's that have high robbery rates and be cognisant of the fact that they may be at a higher risk when on duty or on break at a takeout location. To that end, I recommend the introduction of a category for data that accounts for whether an officer was assaulted while on break. This collected data could bare insight into the question as to why officers face such high risk of assault within close proximity to takeout locations, ultimately benefitting future research to further explore this hypothesis.

Further, this study brings awareness to policymakers of the importance of ensuring that operational research is being conducted into the safety of police officers. Police can only act to the best of their ability while on duty, and if they face doubt about their safety, they will not be operating at their best capacity (Ranalli, 2020). It is pertinent that policies are put in place that mandate consistent analysis of statistical and locational data that focus on the safety of police officers within their divisions, maintaining up to date information on locations that pose most of a risk to officers. The utilization of consistent RTM outputs by the TPS would benefit officer

safety within the organization, to stay up to date with fluctuating risk factor locations that vary within a dynamic environment. Accurate data collection ensures the validity and reliability of the outputs that are being generated, and this is crucial to directly inform officers to potential dangers they may face on duty. Accurate data collection ultimately helps to inform policy and procedure on how policing resources and personnel need be distributed to offer support to officers who may be at risk in certain locations in Toronto. The study of spatial attributes that increase the risk of assault to peace officers is especially important in Canada following the spike in fatal assaults to officers while on duty, and as such, risk terrains such as this should be consistently run to stay up to date with the most recent risks to the safety of officers across all police services.

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