

Geographies of Sexual Assault: A Spatial Analyses to Identify Neighborhoods Affected by Sexual and Gender-Based Violence

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Abstract

Emergency departments are a common access point for survivors of sexual and gender-based violence (SGBV), but very little is known about where survivors live and the neighborhoods they return to. The objectives of this study were to describe the patient population that present for a sexual or partner-based assault and explore the geographic distribution of cases across the Ottawa-Gatineau area. Data for this study were extracted from the Sexual Assault and Partner Abuse Care Program (SAPACP) case registry (January 1 to December 31, 2015) at The Ottawa Hospital. Spatial analyses were conducted using six-digit postal codes converted into Canadian Census

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Tract units to identify geographic areas with concentrated cases of SGBV. Concentrated areas were defined as Census Tracts with seven or more SGBV cases within a single calendar year. In 2015, there were 406 patients seen at the SAPACP and 348 had valid postal codes and were included in the analyses. More than 90% of patients were female and 152 (43.68%) were below 24 years of age. More than 70% knew their assailant and the most common locations of the assault were at the survivors' home (31.03%), assailants' home (27.01%), or outdoors (10.92%). Eight concentrated areas were identified including three in the downtown entertainment district, three lower income areas, one high-income neighborhood, and one suburb more than 20 km from downtown. The findings from this study describe the typical clinical presentation of sexual and domestic assault survivors and also challenge geographic stereotypes of where survivors live and what areas of the city are most affected by SGBV. Using residential information provides a survivor-centric approach that highlights the widespread nature of SGBV and supports the need for population-based approaches to improve care for survivors.

Keywords

sexual assault, domestic violence, geographic information system (GIS), emergency medicine, sexual reproductive health

Introduction

Sexual and gender-based violence (SGBV) continues to be one of the most complex problems facing the health care and public health systems (World Health Organization, 2014a). It is a population-level issue that affects everyone, while also heavily concentrating among specific vulnerable populations (Abrahams et al., 2014). It is a condition that has both acute components (e.g., immediate injury treatment, safety planning) and long-term physical and psychological consequences. SGBV is difficult to systematically and routinely measure. Many cases go unidentified, and only a fraction of survivors of violence ever present for care in the health care system (Ceccato, Wiebe, Eshraghi, & Vrotsou, 2017; Johnson, 2015). With millions of people coming forward, prompted by social movements such as #MeToo in October 2017, it has never been more important to investigate patterns of SGBV within our communities.

Understanding how violence affects individuals and their social and physical environment is both a challenge and priority for violence prevention and care (Baker & Li, 2012). From a place-based perspective, the geographic distribution of violence is often informed by crime and police data, which

provides critical information on the crime scene (e.g., location) and the offender, including their sociodemographic information and previous criminal record (Black & Park, 2012; Mazerolle & Ransley, 2012; Steenbeek & Weisburd, 2016; Weisburd, 2012, 2015). Ambulance dispatch data have also been used to geocode the location where the injury occurred (Cusimano, Marshall, Rinner, Jiang, & Chipman, 2010). There are fewer geographic studies with information that is survivor or victim focused, including their sociodemographic characteristics, where they live, and what kind of injuries they sustain (Weisburd, 2015).

From an injury prevention perspective, spatial analyses have been successfully used to reduce unintentional or accidental injuries. For example, research surrounding the impact of traffic density, intersection design, and residential dwellings have been used to reduce motor vehicle collisions, cycling, and pedestrian injuries (Dai & Jaworski, 2016; Quistberg et al., 2015; Schuurman, Cinnamon, Crooks, & Hameed, 2009). There is less information on the spatial distribution of violence and intentional injuries; however, using analytic techniques successfully used to prevent unintentional injuries presents an innovative opportunity to learn across disciplines and content areas.

Admissions data from emergency departments are a common source of information on injuries and routine health care utilization patterns (Droste, Miller, & Baker, 2014; Long, Fone, Gartner, & Bellis, 2016; Quigg, Hughes, & Bellis, 2012; Stone, Morrison, & Smith, 1999). However, emergency admissions only account for a small proportion of violent events and are usually biased toward severe injuries requiring hospital treatment. Survivors of sexual violence face tremendous barriers to care including victim blaming and stigmatization when seeking health service (Campbell, Greeson, Bybee, & Fehler-Cabral, 2012; Ingemann-Hansen & Charles, 2013). As a result, many sexual assault survivors never access care and their injuries go undocumented and untreated. Among the fraction of survivors who do seek medical care, the emergency department is one of the most common entry points into the health care system (Campbell et al., 2012; Delgadillo, 2017; Kelty, Julian, Bruenisholz, & Wilson-Wilde, 2018). Despite limitations, emergency department admissions data are one of the best sources of routinely collected data for examining the epidemiology of SGBV.

Several neighborhood characteristics are associated with increased levels of violence. Violence is heavily correlated with low socioeconomic status and deprivation (Long et al., 2016; Melorose, Perroy, & Careas, 2015; Sanz-Barbero, López, Pereira, Barrio, & Vives-Cases, 2018). An investigation of routinely collected hospital admissions data in the United Kingdom found that residents of the poorest quintile neighborhoods (approximate

population 1500 per unit) had 5.5 times higher odds of being admitted to the emergency department for violent assaults (Bellis, Hughes, Anderson, Tocque, & Hughes, 2008). Violent events are also commonly documented in entertainment and shopping districts (Cusimano et al., 2010), at times exacerbated by alcohol and substance use (Droste et al., 2014; Ray et al., 2008). Neighborhood features are informative for designing interventions and understanding where violence is concentrating and exploring potential contributing and mediating factors.

The aim of this study is to further understand the spatial distribution of SGBV cases. The specific objectives were to (a) identify the number of SGBV cases presenting to hospital and characterize the sample in terms of demographic information, admissions information, and assault-related characteristics and (b) identify geographic areas where SGBV cases are concentrating.

Method

Setting

This study takes place at The Ottawa Hospital (TOH), a large multicenter tertiary-care facility with a population catchment of 980,000 people in Ottawa–Gatineau (Canadian Ministry of Health, 2017). Ottawa–Gatineau is a bilingual (English–French) region that straddles the Ontario–Québec provincial border. Health care is administered provincially; however, hospital services are available to anyone presenting for care. This is a unique feature of Ottawa–Gatineau and allows for cross-border investigation of SGBV.

The Sexual Assault and Partner Abuse Care Program (SAPACP) is located in the TOH emergency department. The SAPACP provides private, safe, and confidential trauma-informed services (24/7) to any person above 16 years of age who has experienced sexual or partner-based violence. Patients who are below 16 years of age are transferred to the pediatric sexual assault clinic at the Children's Hospital of Eastern Ontario. The SAPACP is the only facility in the region that administers the Sexual Assault Evidence Kit (SAEK, also known as the "rape kit") and is a main point of care to transition from the health care system into the legal system to pursue prosecution (Muldoon, Drumm, Leach, Heimerl, & Sampsel, 2018). The SAPACP works closely with several community-based programs including Ottawa Victim Services and the Ottawa Rape Crisis Center to ensure that survivors are supported following their encounter with the hospital. Our research team brings experts from epidemiology, health sciences, medicine, sexual assault nursing, geography, and victimology.

Data Source

Data were extracted from the SAPACP clinical case registry (January 1 to December 31, 2015). The case registry includes detailed assault-based information collected from the SAPACP clinic charts including information on the assault (e.g., perpetrator, location of assault, drug facilitated sexual assault). Supplemental information is extracted from hospital electronic health records, including admissions information (e.g., method of arrival, time of arrival, address, postal code). A medical research assistant (A.R.) was carefully trained to review all charts and extract clinical and assault-related data from the patient charts. Each chart takes between 1 and 3 hours to review. To ensure data quality assurance, 10% of the patient charts were randomly selected and double-checked by the medical director (K.S.). The interrater reliability was strong, and the kappa statistic was 0.94 (95% confidence interval = 0.88, 0.97).

Inclusion criteria for this analysis were patients presenting in the 2015 calendar year with a valid six-digit postal code. Cases were excluded if the postal code was not provided or if the postal code was from outside the Ottawa–Gatineau Census metropolitan area.

Measures

Routine information was extracted from the hospital electronic medical records. Sex/gender compared female versus male/trans cases. Of note, the majority of sexual assault cases are female; however, there are a growing number of trans or non-binary people and male patients presenting for sexual assault. Due to small cell sizes, male and trans cases were grouped together and compared with female cases. We recognize that this creates a heterogeneous variable, however felt that it was important to include this under-recognized group. Age was measured both continuously and categorically to identify youth cases (24 years and younger). Residential addresses were captured from six-digit postal codes that indicate where the survivor lives or resides, but not necessarily where the assault happened.

Hospital admissions data included method of arrival (ambulance vs. walk-in) and acute presentation (within 24 hr of the assault). Injury severity was measured through the Canadian Triage Acuity Score (CTAS), a 5-point score assigned at the time of admission to enable emergency departments to prioritize patients according to the type and severity of presenting signs and symptoms (Canadian Association of Emergency Physicians, 2016). A variable was derived to compare Resuscitation and Emergent (Levels 1 and 2) versus Urgent/Semi-Urgent/Non-Urgent (Levels 3, 4, and 5).

Assault-related information was a combination of self-report and clinical assessment. It included sexual, physical, or verbal assault. Drug-facilitated sexual assault (DFSA) included “proactive DFSA,” where someone is either covertly or with force administered a disinhibiting substance for the purposes of sexual assault (e.g., date rape drug), or “opportunistic DFSA,” where a perpetrator engages in sexual activity with a person who is intoxicated and incapable of providing informed consent (Anderson, Flynn, & Pilgrim, 2017). Toxicology tests are only requested in specified circumstances and not available for this analysis. Assailant information included known assailant (yes vs. no) and a substring of questions for relationship to the known assailant including current intimate partner, former intimate partner, family member/step-parent, and friend/casual acquaintance. Injury information included strangulation during the assault (yes vs. no), use of a weapon (yes vs. no), and loss of consciousness (yes vs. no). A series of binary variables were used to record location of assault including the patients’ home, assailants’ home, friends’ home, outdoors, or in a college or university dorm room.

Statistical Analyses

Descriptive analyses were conducted using SAS software 9.4 (SAS Institute Inc, 2017) and included frequencies and proportions for categorical variables and median and interquartile ranges (IQRs) for continuous variables.

Geographic Analyses

Spatial analyses were conducted using six-digit postal codes. Statistics Canada administers the Canadian Census and provides a freely available conversion file called the Postal Code Conversion File (PCCF+) and the associated SAS program for PCCF+. The program provides correspondence between six-digit postal codes and standard geographical units, including Census Tract (approximately 4,000 dwellings) and Dissemination Areas (approximately 700 people; Statistics Canada, 2017). Both are relatively stable geographic units utilized during the administration of the Canadian Census and often used as geographic units representing neighborhoods for research purposes (Duncan et al., 2014). In this study, the Census Tract unit is used as a proxy for neighborhood.

Patient’s six-digit postal codes were geocoded using the PCCF+ file and then masked on the analytic file. It is of utmost importance that the identity and privacy of the patients, particularly assault survivors, be protected. In the event of small cell sizes, cells were suppressed or merged with neighboring units to meet the confidentiality requirements of the Statistical Act (Statistics

Canada, 2012). Suppressed data can be included in the appropriate higher aggregate subtotals and totals.

Assault frequency within each Census Tract in 2015 was visualized using ArcGIS software and categorized as 0, 1-3, 4-6, and 7+ individual assaults. Concentrated areas were defined as Census Tract units with seven or more assaults within a single calendar year. The 7-point cutoff point was chosen in consultation with community stakeholder of SGBV organizations and informed by investigating the general distribution of cases across the city.

This study was approved by TOH Research Ethics Board (protocol number: 20170390-01H).

Results

In 2015, there were 406 patients seen at the SAPACP; of them, 348 (85.7%) had valid postal codes and were included in the analyses. Out of the 58 excluded cases, 16 had nonvalid or missing postal codes. The remaining 42 were from outside of Ottawa–Gatineau including Nunavut (5), British Columbia/Alberta/Saskatchewan (6), Ontario (24), and Québec/Nova Scotia (5).

Table 1 presents the characteristics of the analytic sample. There were 320 (91.95%) female patients and 28 (8.05%) male/trans patients. The median age was 26.40 years (IQR: 21.44-38.10 years) and ranged from 16 years to more than 80 years. There were 94 (27.01%) patients who arrived by ambulance and 157 (45.11%) cases had police involvement.

There were 218 (62.64%) cases that involved sexual assaults, 125 (35.92%) with physical assaults, and 39 (11.21%) with verbal assaults. The majority of assaults were from known assailants (70.11%), the most common being a current intimate partner (46.31%), former intimate partner (12.70%), and friend/casual acquaintance (17.22%).

Figure 1 displays the SGBV assaults by Census Tract. There were eight concentrated areas identified in both urban and suburban areas of the city. Neighborhoods in the downtown core included China Town (Census Tract ID: 5050041), Center Town (Census Tract ID: 5050038), and the Byward Market (Census Tract ID: 5050056). Adjacent neighborhoods between 7 and 10 km from downtown included Carlingwood (Census Tract ID: 5050045), Carlington (Census Tract ID: 5050021), St. Laurent (Census Tract ID: 5050061), and Westboro (Census Tract ID: 5050045); known to be a high-income neighborhood. The suburban neighborhood of Barrhaven (Census Tract ID: 5050140), located approximately 20 km from downtown, was also identified.

Please see the Supplemental video file 1 for a short video displaying the results of this project. This video was developed in collaboration with our community partners as a part of the knowledge translation plan.

Table 1. Demographic, Clinical, and Assault-Related Characteristics of SAPACP Patients ($n = 348$).

Variables	Total, N (%)
Admission information	
Female	320 (91.95)
Age (median, IQR)	26.40 (21.44-38.10)
Youth case (≤ 24 years)	152 (43.68)
CTAS: resuscitation/emergent vs. urgent/semiurgent/nonurgent	200 (57.47)
Ambulance vs. walk-in	94 (27.01)
Time from assault ≤ 24 h	281 (80.75)
Police involvement	157 (45.11)
Assault characteristics	
Sexual assault	218 (62.64)
Physical assault	125 (35.92)
Verbal assault	39 (11.21)
Drug-facilitated sexual assault	112 (32.18)
Known assailant	244 (70.11)
Relationship to known assailant ($n = 244$)	
Current intimate partner	113 (46.31)
Former intimate partner	31 (12.70)
Family member/step parent	4 (1.64)
Friend/casual acquaintance	42 (17.22)
Other	54 (22.13)
Multiple assailants	23 (6.61)
Use of weapon	25 (7.18)
Strangulation during assault	36 (10.34)
Loss of consciousness	20 (5.75)
Location of assault	
Patient's home	108 (31.03)
Assailant's home	94 (27.01)
Friend's home	14 (4.02)
Outdoors	38 (10.92)
Dorm	5 (1.44)

Note. SAPACP = Sexual Assault and Partner Abuse Care Program; IQR = interquartile ranges; CTAS = Canadian Triage Acuity Score.

Discussion

This study was designed to combine clinical information from hospital charts with geographic information from the Canadian Census to provide a survivor-focused investigation of patterns of SGBV across the Ottawa–Gatineau

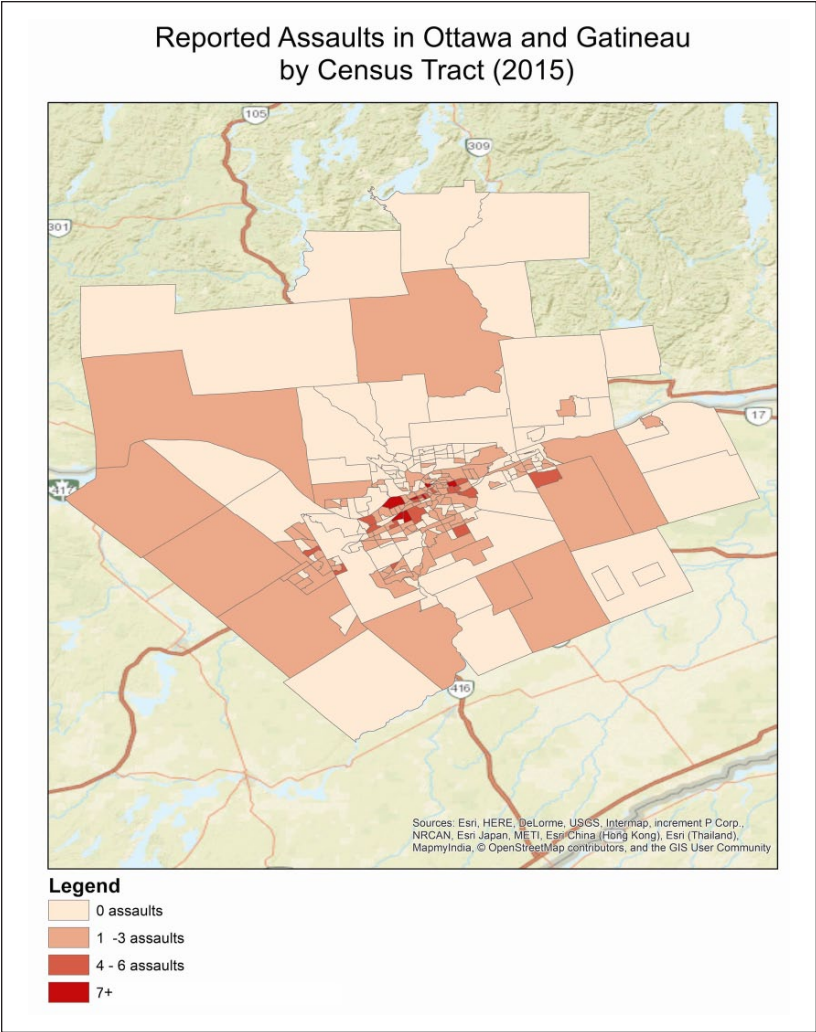


Figure 1. Spatial analyses using ArcGIS to visualize the distribution of SGBV cases across the Ottawa–Gatineau area in 2015.

Note. SGBV cases include sexual assault, physical assault or domestic abuse, and verbal abuse or threats. All cases were treated in the emergency department and between the ages of 16 and 80 years. SGBV = sexual and gender-based violence.

metropolitan area. It has identified areas where survivors live or return to after they were assaulted. The majority of the survivors knew their assailants (70%) and many were assaulted in their own home (31%) or the assailant’s

home (27%). The spatial analyses identified expected concentrated areas (e.g., downtown and entertainment districts), but an unexpected finding was a concentration of cases in one suburban and one high-income neighborhood. This study contributes a combination of detailed clinical characteristics with spatial information to gain a deeper understanding of the multidimensional issue of SGBV and its geographic distribution across the city.

The nature of injuries and violence vary considerably by age, sex/gender, and income (World Health Organization, 2014b). As this study had detailed information on each survivor and the assault, we were able to investigate the demographic characteristics of the survivors and the clinical details of the assaults they sustained. This sample had 91% female cases; however, there were also male and trans/non-binary cases—populations that are often missing from SGBV data sources. A similar study using emergency department data and postal code data was conducted in Southern Alabama; however, it used all-cause assault as the outcome of interest (Lasecki et al., 2018). The study found that the majority of all-cause assault cases were among men. The mortality rate for violent injuries is consistently higher among males; however, stratified analyses will show that sexual violence is most common among females, and stratification by injury type is essential to explore the gendered patterns of violence (Breiding, Basile, Smith, Black, & Mahendra, 2015; Centers for Disease Control and Prevention, 2016; Pike, Richmond, Rothman, & Macpherson, 2015; Strong, Shipper, Downton, & Lane, 2016).

The connection between where a survivor lives and where the assault happens is an important distinction. We found that 31% of assaults occurred in the survivor's home, 27% in the assailant's home, and 10% outdoors. Location of assault is an important indicator as it captures areas where the violent incident occurred and is of particular importance to urgent care and response teams. Ambulance dispatch data include geocoded location information where the injury occurred (Cusimano et al., 2010). Police data also include the specific location information of the assault (Lipton et al., 2013). The visibility of ambulance and police presence can identify areas affected by crime and violence. Our community-based stakeholders found residential information to be the most informative as it is survivor-focused and brings attention to neighborhoods that may be experiencing heightened levels of violence but are not identifiable through crime and urgent care sources. Ultimately, a combination of both sources will improve the understanding of SGBV across the municipality.

There are several factors that may contribute to the geographic concentration of SGBV cases in specified neighborhoods. Alcohol and substance use are often associated with increased rates of harm and violence, and areas with a concentration of bars and clubs have been documented as risk factors for aggression and violence (Lipton et al., 2013; Ray et al., 2008). Entertainment

and shopping districts have been associated with increased rates of interpersonal violence, however there is less information on the nature of the assault (e.g., sexual, physical) or assailant (e.g., intimate partner, friend) (Cusimano et al., 2010; Long et al., 2016). Our study results contribute evidence to this trend with concentrated areas occurring in entertainment districts and adjacent areas. Three anticipated concentrated areas were identified in the downtown core (i.e., Byward Market, Center Town, China Town). Other commonly documented neighborhood features include low-income, residential instability, higher immigrant population, and more densely populated urban regions (Johansson, San Sebastian, Hammarström, & Gustafsson, 2015). Injury and violence research has consistently shown a social class gradient where those from lower socioeconomic classes have higher rates of injury (Baker & Li, 2012; Pike et al., 2015; Riley et al., 2015; World Health Organization, 2014b). In our analyses, we did not have individual-level data on socioeconomic status; however, the spatial analysis allowed for a proxy investigation by linking it to neighborhood-level characteristics.

In our study, one unexpected finding was the concentration of cases found in a high-income neighborhood (i.e., Westboro). This finding can be examined through both a victim-centric and offender-centric lens (Mazerolle & Ransley, 2012). Through a victim-centric approach, survivors who live in high-income neighborhoods may be more trusting of services and willing to access emergency care following an assault (Olive, 2007). Higher socioeconomic status may create social conditions (and a reporting bias) where people are more empowered to report their experiences. This can capture a trend where there is a higher concentration of reported cases, however not necessarily a higher volume of crime or violence compared with lower socioeconomic neighborhoods (Braithwaite, 2012). Through an offender-centric approach, 30% of survivors were assaulted in their homes. This finding might be identifying a group who are assaulted elsewhere and return to a high-income neighborhood that would not be identified through crime data (Black & Park, 2012). Conversely, the most common assailant was a current intimate partner, and this finding could be identifying a subpopulation experiencing intimate partner violence and living with or near the offender. Ultimately, a deeper understanding of the association between the victim, offender, and place is needed.

We additionally identified a suburban neighborhood (i.e., Barrhaven) located 20 km from the downtown core that had more than seven cases of SGBV in a year. There is very little information about SGBV in suburban areas. An Australian study identified patterns of suburban youth traveling to the city center at night and found the rates of assault, as both the offender and the victim, were higher in comparison to the rates among youth from the

inner urban areas (MacLean, Ferris, & Livingston, 2013; MacLean & Moore, 2014). Key vulnerabilities identified included traveling longer distances to go to bars or clubs, difficulty getting home if intoxicated, or running out of money and sleeping in unfamiliar places (MacLean & Moore, 2014). Our study contributes to the limited information on SGBV risk factors for suburban populations; however, further investigations are warranted.

An important benefit of identifying neighborhoods with concentrated levels of violence is that it has the potential to inform neighborhood-level interventions. Proximity to specialized support services has been shown to be a critical aspect for women fleeing violence (Coy, Kelly, Foord, & Bowstead, 2011). Improving resource availability, as well as education and access to services, can help encourage survivors to seek help. This highlights the importance of neighborhood-targeted interventions to help reduce SGBV. Evaluating the geographic distribution of violence is beneficial because as our results have shown, it challenged norms and assumptions that violence exclusively affects low-income or downtown areas. However, it is critical to consider possible biases including the populations who are absent from the source data but known to be high risk for violence.

Future Research Considerations

Moving forward, it is our intention to expand the scope of the research to include multiple years of data. This will allow for assessment of dynamic changes in both the hospital-based population and how the rates of assaults in Ottawa–Gatineau evolve over time. Additional complementary information can also be sourced from the Canadian Census data, including Census Tracts sociodemographic characteristics, police crime reports, or ambulance dispatch data to create a comprehensive visualization of SGBV geographic patterns in the city. This would enable a more nuanced picture of the burden, risk factors, and geographic distribution to inform potential interventions.

Limitations

This study uses residential postal codes to identify concentrated areas at a cutoff of seven or more SGBV cases per Census Tract per year, and the results represent residential patterns and not assault location patterns. Selection bias is introduced through the use of hospital-based data that is limited to severe cases requiring hospital attention or to survivors who are willing to overcome barriers of presenting to the emergency department. This leads to underestimations of the frequency of sexual assault cases in the general population, however may not influence the generalizability of the results to other hospital-based populations. Results of this study were also limited to 1 year of data.

Conclusion

This study has highlighted that SGBV is a wide-reaching public health issue that affects people across the Ottawa–Gatineau region. Our study identified more than 400 SGBV cases that presented at the emergency department for urgent care following an assault. This study contributes to the literature on the association between increased levels of SGBV within entertainment districts and lower income neighborhoods. It has also identified the less common pattern of SGBV in higher income and suburban neighborhoods diversifying the narrative surrounding place, class and violence. This sheds light on the need to investigate factors shaping risk for SGBV and ensure that support, education, and access to trauma-informed care are widely available.

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Authors' Contributions

K.M. wrote the first draft. K.M. and L.G. conducted the statistical and geographic analyses. A.R. collected the case registry data. T.L. and K.S. provided clinical care and K.S. supervised clinical data collection. L.G., A.R., T.L., M.H., and K.S. critically reviewed and revised the manuscript. K.M. and K.S. have primary responsibility for the final content. All authors read and approved the final manuscript.

Declaration of Conflicting Interests

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Supplemental Material

Supplemental material for this article is available online.

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