INVESTIGATING THE SPATIAL ASSOCIATION BETWEEN SUPERVISED CONSUMPTION SERVICES AND HOMICIDE RATES IN TORONTO, CANADA, 2010-2023

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Research in context

Evidence before this study

Scientific evidence on the association between supervised consumption sites and public order exists, with no studies have yet explored their relationship with violent crime such as homicide.

We searched PubMed and Google Scholar to identify any studies, published in English from database inception to September 25th, 2024, that explored potential associations between SCS on homicide, using the search terms ("supervised consumption services" OR "supervised injection services" OR "supervised injection services" OR "supervised injection sites" OR "overdose prevention sites") AND ("homicide" OR "shooting" OR "stabbing" OR "killing" OR "homicide rate") AND ("population" OR "neighbourhood" OR "spatial" OR "spillover") AND ("spatial analysis" OR "spatial" OR "population effects"). We placed no restrictions on the country where studies were conducted. To be included, studies had to consider associations between spatial or population/neighborhood-level homicide and SCS implementation. Studies with other outcomes, such as drug-related disorder, non-fatal violent crimes, or litter potentially associated with SCS implementation, were excluded. We also searched the references cited in relevant studies. We found one study that investigated all-cause mortality, which included homicide, among people who inject drugs in Vancouver, Canada, and which found that mortality was subsequently decreased among those that previously reported at least weekly use of a SCS. However, we could not find any studies that specifically investigated the association between homicide and SCS, nor any estimating the association of SCS with population-level homicide trends.

Added value of this study

This study, which used coroner's data from Toronto, ON, Canada, involved a spatial analysis of the association between SCS and homicides between 2010 and 2023; most SCS were implemented beginning in 2018. Overall, we found no evidence that homicide rates increased in areas near SCS. Instead, we found a minimal but significant decrease in the incidence of homicides near SCS and a minimal but significant increase in homicides in areas more than 3 kilometers away from these sites.

Implications of all the available evidence

To our knowledge, these are the first findings to explore the potential influence of SCS on population-level fatal violent crime. While these findings may be helpful for decisionmakers, more evidence from other settings with SCS is needed to assess the generalizability of our results. Additionally, further evidence is needed to investigate associations between SCS and other types of non-fatal violent crime. However, based on the results reported herein, it appears unlikely that SCS implementation will increase homicides.

ABSTRACT

Background: Supervised consumption sites (SCS) are effective at preventing overdose mortality. However, their effect on public safety remains contested. We investigated homicide rates in areas near SCS in Toronto.

Methods: We classified coroner-reported fatal shootings and stabbings (January 1st, 2010 to September 30th 2023) by geographic zone: within 500 meters ('near'), between 500 meters and 3 kilometers ('far'), and beyond 3 kilometers of an SCS ('out'). We then used Poisson regression to calculate the rate ratio (RR) across zones 18, 36, 48, and 60 months pre vs. post SCS implementation. Finally, we compared spatial homicide incidence prior to and after the date of the implementation of each SCS using interrupted time series (ITS).

Findings: Overall, 956 homicides occurred, and 590 (62%) were fatal shootings and stabbings. There was no significant change in the rate of fatal shootings and stabbings within 3 kms of SCS (near and far zones) after their implementation (all $p > 0.05$). However, between 48 and 60 months pos-implementation, we detected a significant increase in out zones ($p < 0.05$). In an ITS analysis, we observed a significant reduction in the monthly incidence in near zones ($p < 0.05$) and a significant increase in out zones ($p < 0.05$).

Interpretation: SCS implementation was not associated with increased homicide rates; instead, we observed a reduction in monthly incidence near SCS. These results may inform drug market activity responses that optimize community health and safety.

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INTRODUCTION

Supervised consumption services (SCS) provide a supervised environment for people to use and/or inject drugs, which evidence consistently demonstrates can reduce the risk of fatal drug overdoses and infectious disease transmission.[1,2] Since the initial opening of two SCS in August 2017, the City of Toronto, Canada, has witnessed an increase in the number of sites, with nine community SCS in operation as of September 2024 (see **Figures 1** and **2**).[3]

On July 7th 2023, a fatal shooting within 100 meters of an SCS amplified concerns regarding the potential public safety impact of these facilities.[4] This prompted a provincial SCS audit across Ontario, which focused on the potential relationship between SCS operations and drug market activity, including homicide.[5] On August 20th, 2024, the Government of Ontario announced the closures of 10 of the 17 SCS operating in the province, including 5 SCS in Toronto, with the provincial Minister of Health suggesting that the closures were needed because the sites led to increasing shootings, stabbings, and homicides in surrounding areas.[6] However, no evidence was provided to support this assessment.

There is a need to optimize drug policy approaches amidst North America's intersecting drug toxicity and housing crises, which have led to unprecedented levels of mortality and housing precarity. In that context, while SCS have been shown to prevent overdose mortality[7] and public injecting,[8] data are needed regarding their potential negative spillover effects on public safety to inform communities considering the implementation, expansion, or continuation of SCS.[9,10] We therefore investigated the spatial association between the location of SCS and homicides within the City of Toronto. Specifically, we sought to determine whether there was any change in the

monthly rate of homicides potentially related to drug market activity in areas proximal to SCS after their implementation.

METHODS

We used the REporting of studies Conducted using Observational Routinely-collected health Data (RECORD) guidelines in designing this study.[11] We obtained all homicide files from the Chief Coroner's Office of Ontario for events that occurred in Toronto between January 2010 and September 2023. We initially extracted homicides by shooting or stabbing. This was done to reduce potential misclassification of other fatalities not likely related to drug market activity (e.g., those caused by intimate partner violence). First, we performed a singular spectrum analysis to identify the overall trend in fatal shootings and stabbings across the entire study period[12] by removing random noise and oscillation related to seasonality. To analyze the spatial distribution of fatal shootings and stabbings relative to SCS location, we expressed the primary outcome as a crude homicide incidence rate per 100 000 people, which we calculated by extracting population size data for Toronto from the 2011, 2016, and 2021 Canadian census.[13] For other years, population estimates were interpolated using a spline model. We then obtained the physical addresses of SCS from the City of Toronto's service directory and determined the geographical proximity of homicides to SCS using three mutually exclusive zones: 1) "near zone", defined as 0 to 500 m from an SCS; 2) "far zone", defined as 500m to 3km from an SCS; and 3) "out zone", defined as areas beyond 3km of an SCS, consistent with previous research on the spatial impacts of SCS in Toronto.[7] On the date of each SCS implementation, we reclassified

previous zones if they overlapped with the boundaries of the newly implemented SCS to avoid any potential spatial misclassification.

We included nine SCS in the model that were opened at six distinct time points (August 2017, November 2017, February 2019, March 2018, April 2018, and June 2018). We then calculated the rate ratio (RR) and 95% confidence intervals (CI) of deaths in each zone 18 and 36 months before and after the implementation of each SCS using a Poisson regression model. We undertook multiple comparison adjustment using the Šidák method,[14] which addresses the increased potential for Type I (false positive) error when multiple tests are undertaken on datasets with rare events.[15] We also undertook a sensitivity analysis by varying the observation period to 48 and 60 months before and after SCS implementation. Next, we calculated the independent effect of SCS implementation on the monthly incidence of fatal shootings and stabbings across the entire study period for each distinct zone. This was done via interrupted time series using autoregressive models to address differing implementation dates for each of the sites. This approach accounts for autocorrelation of the errors as well as heteroscedasticity in the distribution of outcomes.[16] Finally, in an effort to further address potential misclassification, we undertook two sensitivity analyses. First, we expanded our analysis to include all homicides in Toronto. Second, we restricted to fatal shootings and stabbings that occurred outdoors (thereby removing homicides potentially related to intimate partner violence rather than drug market disputes). All analyses were undertaken using SAS Version 9.4 and R Version 4.3. DW and YN had full access to all data. This study was approved by the Unity Health Toronto Research Ethics Board.

FINDINGS

Among 956 homicides committed in the City of Toronto between January 1st, 2010 and September 30th, 2023, 590 (62%) were fatal shootings and fatal stabbings. The annual incident rate of fatal shootings and stabbings fluctuated between 1.11 per 100,000 population (2011) and 2.1818 per 100, 000 population (2018). **Figure 3** presents results of a singular spectrum analysis, demonstrating the overall fatal shooting and stabling trend line and patterns of seasonality. **Table 1** presents the results of a Poisson regression comparing the rate of fatal shootings and stabbings in the 18, 36, 48, and 60 months before and after SCS implementation in Toronto. As can be seen, we detected no significant change in the incident rate of fatal shootings and stabbings in areas within 500 meters (near zone) and between 500 meters and 3 kilometers (far zone) of SCS after they were implemented (all $p > 0.05$). However, we detected a significant increase in the rate of fatal shootings and stabbings in areas more than three kilometers away (out zone) from SCS in the 48- and 60-month periods after their implementation compared to the periods before (all $p < 0.05$). **Table 2** and **Figure 4** present the results of an ITS analysis of the effect of SCS implementation on the monthly incidence of fatal shootings and stabbings across the entire study period. As can be seen, the period after SCS implementation experienced a minimal but significant decrease in the monthly incidence of fatal shootings and stabbings in near zones (Level Change Post-SCS Implementation = -0.52, Standard Error (SE): 0.18; $p < 0.01$), no significant difference in far zones ($p > 0.05$), and a minimal but significant increase in out zones (Level Change Post-SCS Implementation = 0.06; SE: 0.03; $p = 0.03$) compared to the period before SCS were implemented. A sensitivity analysis that included all homicides in Toronto was entirely consistent with the results of the main findings. Additionally, in a sensitivity analysis

restricted only to outdoor fatal shootings and stabbings, we found no significant differences in rate ratios across all three zones (all $p > 0.05$), while an ITS analysis yielded a minimal but significant decrease in fatal shootings and stabbings in near zones, a minimal but significant increase in far zones, and no significant change in out zones after SCS were implemented.

INTERPRETATION

Over a 13-year period in Toronto, we did not detect an increase in fatal shootings and stabbings in areas close to SCS. Instead, we found that the monthly incidence of these events decreased near SCS and that there was a minimal but significant increase in fatal shootings and stabbings in areas farther away. These results can inform an ongoing review of SCS in the province of Ontario as well as efforts to improve community health and safety in settings impacted by drug market activity.[9] These findings add to a small body of evidence that has found no association between SCS implementation and increased crime rates.[2,17-19] However, the results presented herein are the first, to our knowledge, to investigate the association between SCS implementation and homicides.

SCS in Toronto and elsewhere are implemented in hotspots of drug market activity. Given that substance use-related harms such as overdose increased in Toronto during the study period, we anticipated that these areas might have also naturally experienced an increase in other drug market-related events such as fatal shootings and stabbings. As such, it is somewhat surprising that there were no significant increases in areas near SCS, and that we in fact detected decreases. Our analyses did include the COVID-19 pandemic period, however, during which people experiencing homelessness were relocated from Toronto's downtown core (where the city's SCS

are located) to COVID-19 shelter hotels in Toronto's northern neighborhoods (where no SCS have been implemented).[20] These exogenous factors may have reduced the population density in areas proximal to SCS more than in other areas, and thereby could have had a deterrent effect on homicides as a result of reduced drug market activity. However, the majority of SCS were implemented in the years 2017 and 2018 in our setting, and we did not observe any significant differences in rate ratios across zones 18 months pre vs. post SCS implementation, an observation period that preceded the imposition of COVID-19 restrictions beginning in March 2020.[21]

This study has limitations. Given that we performed ecological analyses, we cannot assume a causal relationship between SCS and homicides; in particular, caution is warranted in interpreting results demonstrating relative increases in homicides in areas further away from SCS after their implementation. Data were also restricted to fatal shootings and stabbings, and did not include all drug market-related threats to public safety (e.g., non-fatal violent crime). This is important as we cannot assume that fatal shootings are a proxy for these phenomena, and future research should investigate the spatial association between SCS and other threats to public safety in Toronto. Finally, while we employed population-level data across the city of Toronto, our findings cannot be assumed to be generalizable elsewhere.

In sum, we did not detect a significant spatial association between the implementation of SCS and the rates of fatal shootings and other homicides in Toronto across a 13-year period. These findings should be helpful in informing SCS policy and responding to community public safety needs.

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Accessibility: Individual data from this study are restricted by a data sharing agreement with the Office of the Chief Coroner of Ontario. The study protocol and statistical analysis plan will be shared on request following publication to investigators whose proposed use of the data has been approved by an independent review committee identified for this purpose, to achieve aims in the approved proposal. Individuals can request to become an approved investigator, or to learn more about conditions of data access, by contacting the Centre on Drug Policy Evaluation at info@cdpe.org.

Declaration of interests

DW holds an equity position in a private company developing a mobile drug checking technology. All other authors declare no competing interests.

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Table 1. Rate ratio of fatal shootings and stabbings in areas proximal to supervised consumption services (SCS) prior to and after their implementation in Toronto, Canada, 2010-2023				
18 months before and after SCS implementation by distance				
		95% Confidence Interval		
Effect	**Rate Ratio (RR)**	**Lower limit**	**Upper limit**	**p-value**
Near (< 500 m): after vs. before	0.5000	0.1515	1.6499	0.4192
Far (500 m - 3 km): after vs. before	1.8889	0.7059	5.0546	0.3252
Out (> 3 km): after vs. before	1.3191	0.8313	2.0934	0.3904
36 months before and after SCS implementation by distance				
		95% Confidence Interval		
Effect	**Rate Ratio (RR)**	**Lower limit**	**Upper limit**	**p-value**
Near (< 500 m): after vs. before	0.4050	0.1575	1.0419	0.0656
Far (500 m - 3 km): after vs. before	1.1976	0.6273	2.2863	0.8790
Out (> 3 km): after vs. before	1.3574	0.9778	1.8843	0.0763
48 months before and after SCS implementation by distance				
		95% Confidence Interval		
Effect	**Rate Ratio (RR)**	**Lower limit**	**Upper limit**	**p-value**
Near (< 500 m): after vs. before	0.4093	0.1666	1.0054	0.0519
Far (500 m - 3 km): after vs. before	1.0551	0.5860	1.8998	0.9949
Out (> 3 km): after vs. before	1.4347	1.0777	1.9099	0.0077
60 months before and after SCS implementation by distance				
		95% Confidence Interval		
Effect	**Rate Ratio (RR)**	**Lower limit**	**Upper limit**	**p-value**
Near (< 500 m): after vs. before	0.4660	0.2015	1.0779	0.0864
Far (500 m - 3 km): after vs. before	1.0143	0.5843	1.7606	0.9999
Out (> 3 km): after vs. before	1.3196	1.0166	1.7128	0.0330

Table 2. Interrupted time series analysis of the effect of supervised consumption service implementation on shooting/stabbing rates by distance in Toronto, Canada, 2010-2023				
Distance	**Parameter**	**Estimate**	**Standard Error**	***p*-value**
Near (< 500 m)	Intercept	0.8436	0.1154	<.0001
	Month	0.008332	0.001997	<.0001
	Level Change Post SCS	-0.5227	0.1832	0.0049
Far (500 m - 3 km)	Intercept	0.1391	0.0305	<.0001
	Month	0.000340	0.000529	0.5221
	Level Change Post SCS	0.0958	0.0490	0.0521
Out (>3 km)	Intercept	0.1267	0.0184	<.0001
	Month	0.000420	0.000317	0.1870
	Level Change Post SCS	0.0618	0.0286	0.0321

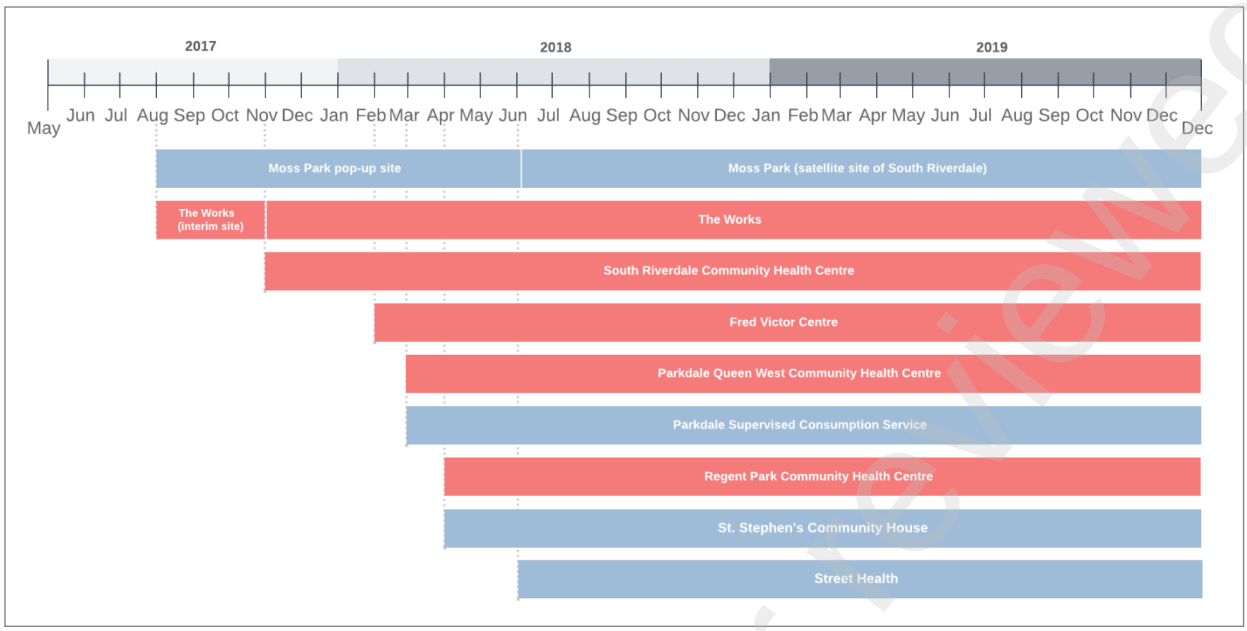

FIGURE 1 Timeline of integrated supervised consumption site (red) and overdose prevention site (blue) implementation in Toronto.

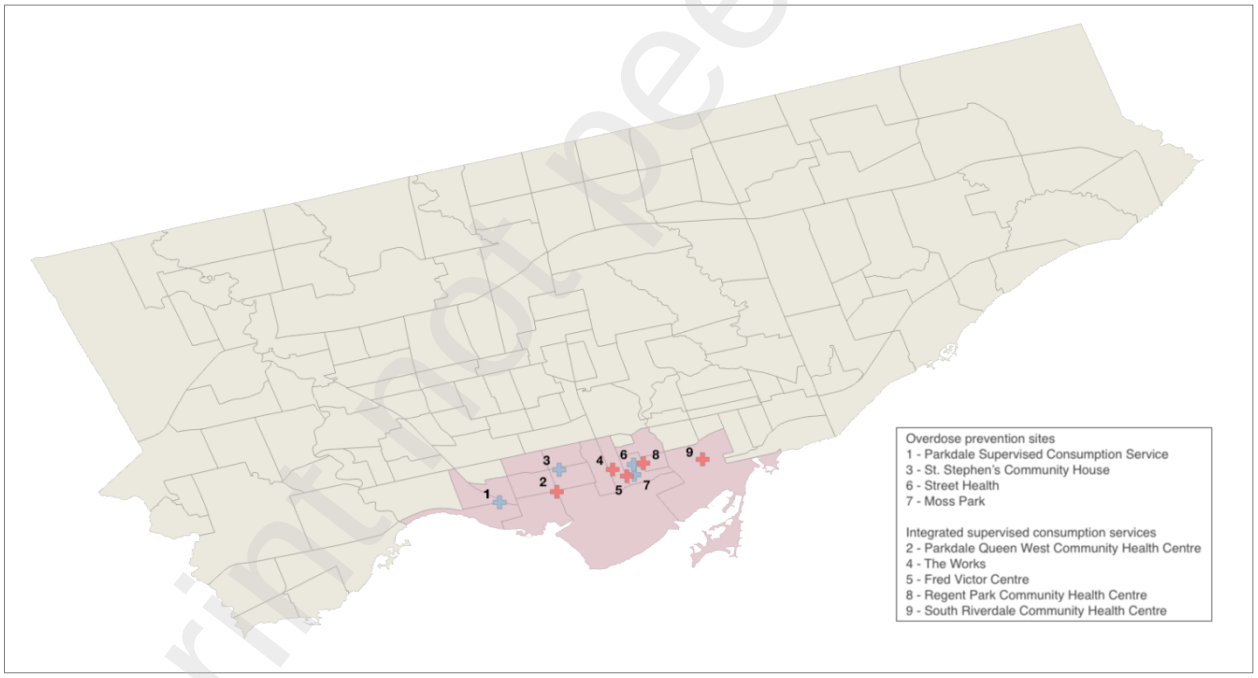

FIGURE 2 Integrated supervised consumption sites (red) and overdose prevention sites (blue) in Toronto, Canada. Shaded areas indicate neighbourhoods within 500 m of a site.

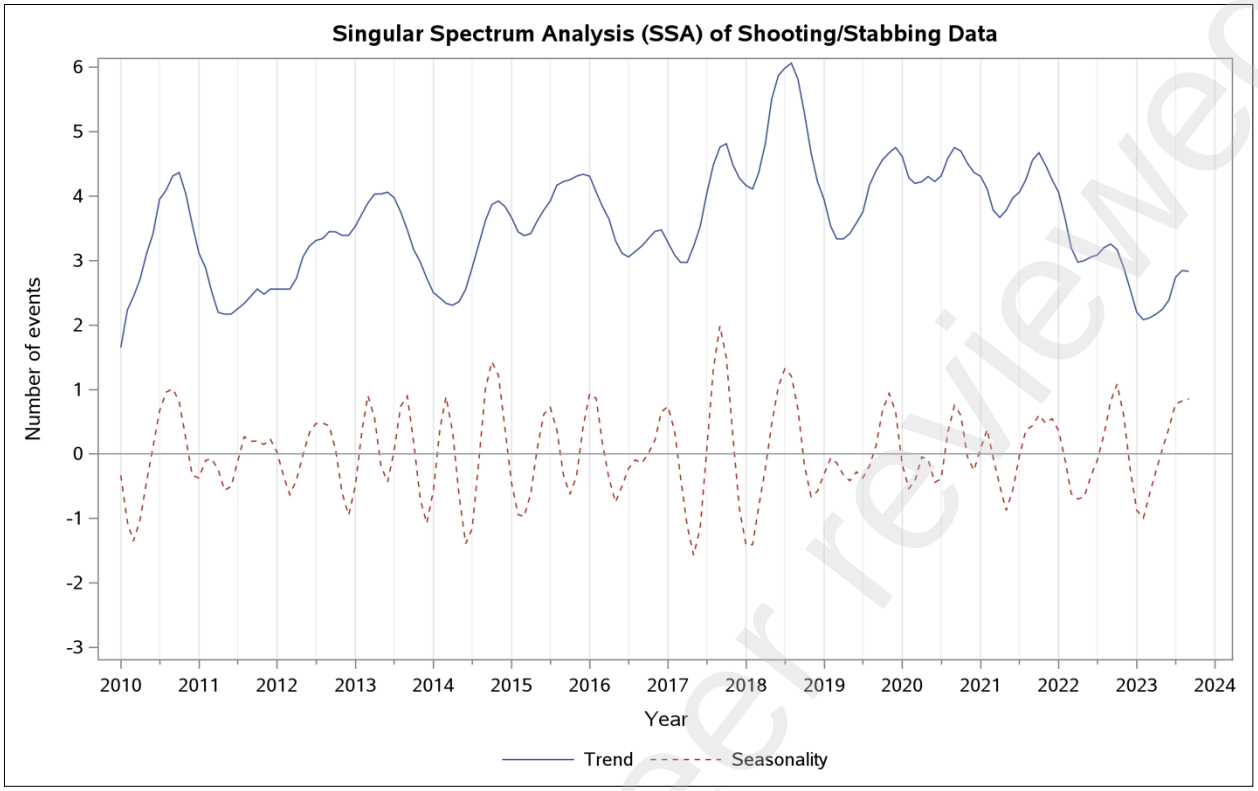

Figure 3. Singular Spectrum Analysis of Fatal Shootings and Stabbings in Toronto, Canada, January 2010-September 2023

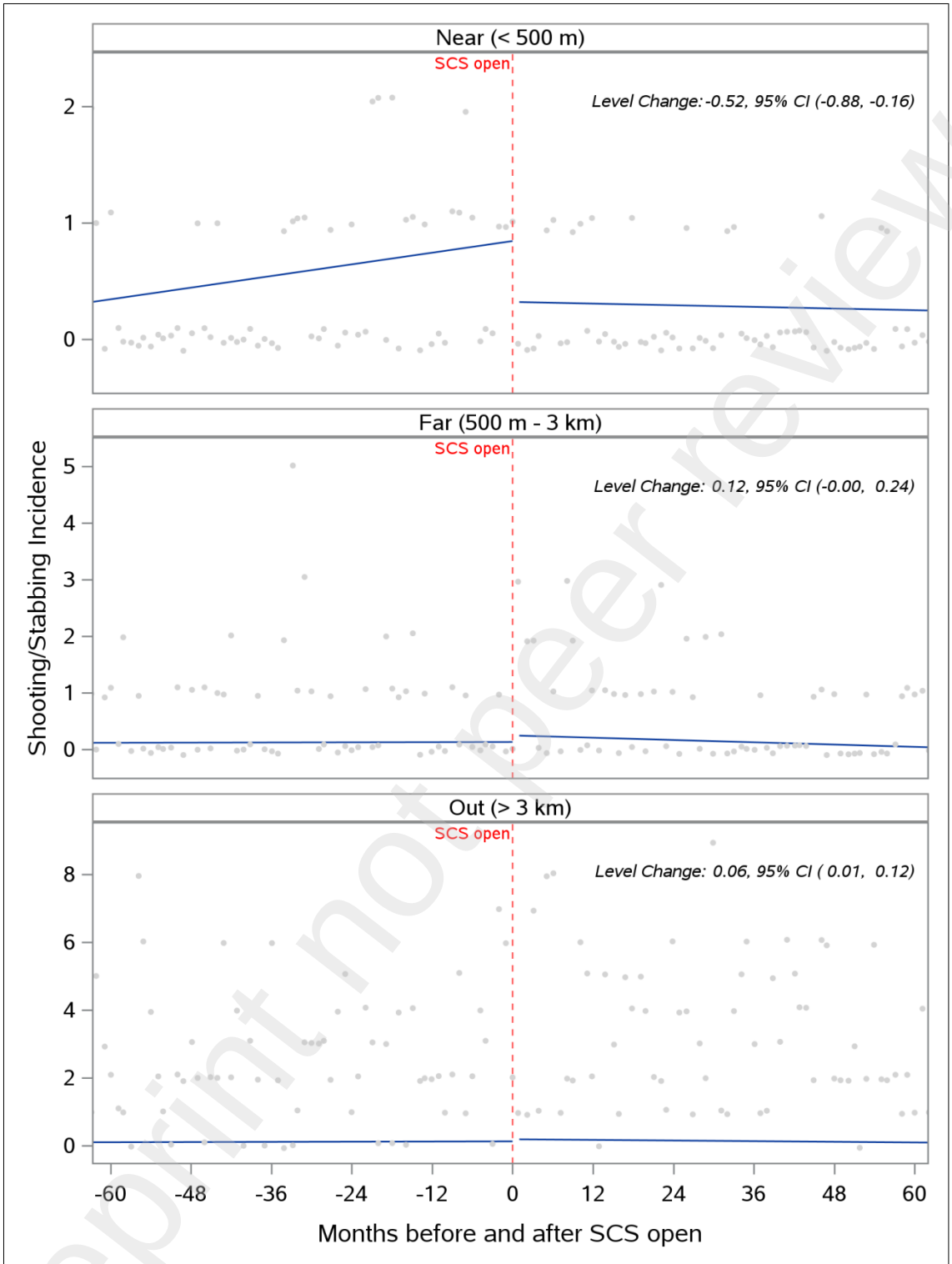

Figure 2. Interrupted Time Series of Fatal Shootings and Stabbings by Distance from Supervised Consumption Services in Toronto, Canada, January 2010-September 2023