The Effect of Intensive CeaseFire Intervention on Crime in Four Chicago Police Beats: Quantitative Assessment

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Briefing

- This quantitative evaluation project analyzed two years of publicly-available data on violent crimes for the two districts targeted by City of Chicago Contract #2013-00303-00-00 to determine (1) whether the goals of the contract were accomplished and (2) whether the effects exceeded what could have been expected without CeaseFire. The results are summarized as follows:
    - Raw crime counts show a 31% reduction in homicide, a 7% reduction in total violent crime, and a 19% reduction in shootings in the targeted districts.
    - These effects are significantly greater than the effects expected given the declining trends in crime in the city as a whole.
    - Reduced levels of total violent crime, shootings, and homicides were maintained throughout the intervention year in the targeted districts.
    - Some effects, including the rate of growth in violence, differed by district, possibly due to different strategies employed by CeaseFire.
    - The effects of the intervention were immediate, appearing within the first month, when CeaseFire workers arrived in the community, and were maintained throughout the intervention year.
    - It is not likely that effects were due to increased police activity, although this cannot be confirmed because the contract called for cooperation between CeaseFire and police.
    - The extent to which the effects will be maintained in the year after the end of the city contract will be the subject of further study.

Executive Summary

CeaseFire approaches violence as a public health problem, aiming to (1) locate and interrupt local and ongoing conflicts using conflict mediation techniques, (2) change behaviors of high risk participants, and (3) organize activities and events in the community aimed at changing norms accepting of violence. City of Chicago contract (#2013-00303-00-00) as amended (#2558-001) went into effect on September 26, 2012, funding CeaseFire intervention in Chicago Police Districts 3 (Woodlawn neighborhood) and 10 (North Lawndale neighborhood) for one year. The contract set a goal of a 10% reduction in homicides and shootings in the intervention year compared to the preceding year. This document reports the extent to which the intervention achieved its original goals with respect to homicides and shootings, as well as total violent crime. Additionally, this document reports a quantitative evaluation that addresses the question of whether the effects of the intervention exceeded the changes in homicides, shootings, and violent crime experienced by the city as a whole. This quantitative evaluation uses data on police responses to crime provided by the City of Chicago and two different methods of statistical analysis.

The data used for this evaluation were crimes responded to by police covering a period that extended from the beginning of the year prior to negotiation of the contract (9/26/2010) to the end of the intervention year (9/25/2013). These data are publicly available from the City of Chicago Data Portal (https://data.cityofchicago.org/) and are part of the "Crimes: 2001 to the Present" data set (https://data.cityofchicago.org/Public-Safety/Crimes-2001-to-present/ijzp-q8t2). Each record in this data set represents a single crime incident to which the police responded. Each record contains the primary type of incident, the Illinois Uniform Crime Report (IUCR)

code for the primary type of criminal activity characterizing the incident, whether or not an arrest was made, and location information.

Were the Goals of the Contract Achieved?

CeaseFire set a goal of a 10% reduction in homicides and shootings in the intervention year compared to the preceding year. Examination of the data in Table 1 below shows that the goal of a 10% reduction was achieved overall. Homicides (including murder and manslaughter) were reduced from 86 in the year prior to intervention to 59 in the intervention year across the two targeted districts: A 31.4% reduction, which was considerably greater than the 24.1% reduction seen in the city overall. Similarly, shootings (any battery involving a firearm) were reduced from 296 in the year prior to intervention to 241 in the intervention year. This was not as substantial a decrease as was seen for homicides, but represented an 18.6% decrease, which was comparable to the decrease in the remainder of the city. Most of the decrease in shootings occurred in District 3. Notably, the number of shootings reported in District 10 actually increased slightly, although the number of homicides and the number of violent crimes decreased. CeaseFire did not set a goal for reductions in total violent crime, which includes homicides and total battery (domestic, simple, and aggravated). However, a reduction of 7.3% was observed, which was somewhat less than the 14.8% decrease seen in the remainder of the city.

Table 1

Crime in the year preceding and the intervention year, by district, overall, compared to all other districts

	District 3		District 10		Overall		Other Districts	
	N	%	N	%	N	%	Mean	%
Homicides Pre	49		37		86		22.78	
Homicides Post	34	-30.6%	25	-32.4%	59	-31.4%	17.28	-24.1%
Shootings Pre	189		107		296		78.33	
Shootings Post	131	-30.7%	110	+2.8%	241	-18.6%	62.22	-20.6%
Total Violent Crimes Pre	3816		3267		7083		2807.44	
Total Violent Crime Post	3552	-6.9%	3012	-7.8%	6564	-7.3%	2391.94	-14.8%

Note: "Pre" refers to October 2011 to September 2012 and "Post" refers to October 2012 to September 2013. "+" indicates increase and "-" indicates decrease from Pre to Post

Was the effect of the CeaseFire intervention stronger than effects that would be expected by chance in the rest of the city?

The overall decrease in violent crime in the city during the time period covered by the intervention raises the question of whether the effects seen in the CeaseFire intervention were stronger than the effects that might have occurred in the absence of intervention. The raw counts of crimes provide an ambiguous picture. On the one hand, the reduction in homicide appears to be larger than that seen in the remainder of the city districts. On the other, the reduction in total violent crime is somewhat less than the reduction seen in the remainder of the city. The quantitative analysis was undertaken to address this question.

We employed two different approaches to quantitative analysis. One was a regression point displacement design (RPDD) and the other was an interrupted time series design (ITSD). We calculated propensity scores to control for non-randomness in the selection of intervention communities, used graphical examination to assist in understanding patterns of change in the

data, and used polynomial regression to represent the patterns of change in the data mathematically.

The RPDD evaluates actual change in the unit(s) receiving intervention against the change that would be expected, based on archival data on a large and diverse group of similar units. The RPDD can answer two important questions: (1) Did the intervention units change more than would be expected by chance, and (2) Did intervention units change in an expected or unexpected direction. The RPDD analysis found evidence supporting overall positive effects of the CeaseFire intervention in the two police districts in which it was implemented, but examination by district suggested that the positive effect was stronger in District 10 (North Lawndale neighborhood) than in District 3 (Woodlawn neighborhood).

Table 2

CeaseFire Intervention Effects on Levels and Change in Total Violent Crime, Shootings, and Homicide from the Interrupted Time Series Analysis

	Violent Crime		Shootings		Homicide	
	B	SE	B	SE	B	SE
Intervention - Comparison Difference in Levels	-64.22**	13.70	-5.64**	1.57	-1.46*	0.70
Intervention - Comparison Difference in Rates of Change	-2.09	1.97	0.24	0.23	0.07	0.10

+ $p < .10$. * $p < .05$. ** $p < .01$

The ITSD answers different, but equally important questions: (1) What was the immediate effect of the intervention, and (2) What was the sustained effect of the intervention? The ITSD analysis included terms to account for curvature in the levels of crime over time.

The main results of the ITSD analyses are reported in Table 2. The first line of Table 2 reports the effects of the intervention on violent crime, shootings, and homicides, all of which are statistically significant.

The effects on levels of crime are illustrated in Figure 1. After the beginning of the city contract, the comparison districts showed decreases in total violent crime and shootings, but relative to these decreases, the CeaseFire districts saw significant additional decreases, averaging 64 fewer violent crimes per district per month, or a decrease of 32% below the previous year and a 1% greater decrease than in comparison districts; 6 fewer shootings per district per month, or 44% below the previous year and 15% greater decrease than in comparison districts; and 1.5 fewer homicides per district per month, or a decrease of 41% below the previous year and 38% below the decrease in comparison districts.

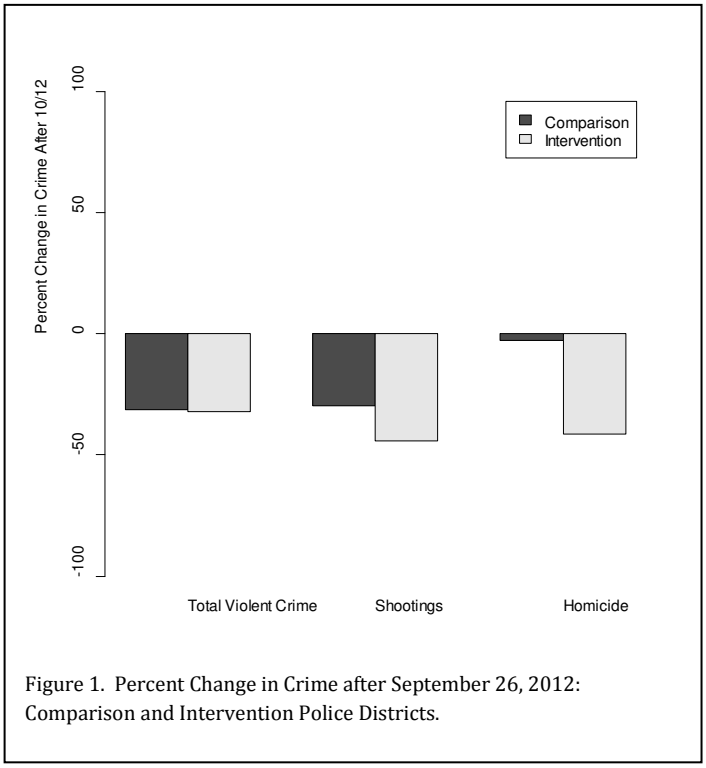

Figure 1. Percent Change in Crime after September 26, 2012: Comparison and Intervention Police Districts.

The last line of Table 2 reports the difference between intervention and comparison districts in the rate of change in the outcomes in the months following the initiation of intervention. The rates of change following the beginning of intervention in the CeaseFire districts did not differ significantly from the general rates of change in the other districts or from the rates of change prior to the beginning of intervention.

Additional analyses probed the effects by police district. Findings were generally consistent with the global analyses reported above, with the exception of a small difference in time trends during the intervention year. Specifically, District 10 (North Lawndale

neighborhood) experienced a significant decrease of 5.6 violent crimes per month in excess of the rate or change after the beginning of the contract in the comparison districts.

Summary and Conclusions

a. Raw crime counts show a positive effect of the CeaseFire intervention of 31% on homicide, 7% on total violent crime, and 19% on shootings. The RPDD and ITSD analyses were undertaken to determine the extent to which the observed community-level changes in crime were attributable to the CeaseFire intervention. Two hypotheses were proposed: 1) there would be a difference in levels of crime between intervention and comparison districts in the intervention year, and 2) there would be a difference in the rate of change in crime between intervention and comparison districts in the intervention year.
b. There is evidence from the quantitative analysis that the CeaseFire intervention had a significant positive effect on levels of homicide, shootings, and total violent crime. These effects are significantly greater than the effects that would be expected given the declining trends in crime in the city as a whole. Compared to districts that had not received intervention, CeaseFire intervention in the targeted districts was associated with a 38% greater decrease in homicides, 1% greater decrease in total violent crimes, and a 15% greater decrease in shootings.
c. Our first hypothesis (difference in levels of crime) was supported. The intervention was associated with reductions in the levels of total violent crime, shootings, and homicides that was maintained throughout the post-contract year.
d. Our second hypothesis (difference in rates of change in crime) was only partially supported. For total violent crime, the rate in District 10 decreased to a greater

extent than the rates in the comparison districts during the intervention year, but that was not the case for District 3.

e. Finer-grained RPDD analyses by district revealed that significant effects were found in District 10 (North Lawndale neighborhood) but not in District 3 (Woodlawn neighborhood). It should be remembered that this is a test of the statistical significance of a difference. Woodlawn, like North Lawndale, saw a reduction in violence in the intervention year.

f. As was noted above under item d., ITSD analyses by district revealed that both districts showed similar patterns of violent crime levels, but differed on rates of change. District 10 showed a significant declining rate of change in crime during the intervention year.

g. Effects that differed by district may have been due to differences in the strategies employed to meet the needs of both communities. In District 3, a novel CeaseFire strategy involving gang leaders in negotiations was used, whereas more traditional CeaseFire methods were used in District 10.

h. The effects of the intervention were immediate, appearing within the first month, when CeaseFire workers arrived in the community, and were maintained throughout the intervention year. The expected pattern of change, consistent with our hypotheses, was an immediate decrease of smaller magnitude, followed by a decreasing rate over time. The pattern of change that was obtained calls for further investigation and explanation.

i. The evidence from this investigation does not support the contention that effects associated with the city contract were due instead to increased police activity.

The RPDD analysis controlled for overall levels of police activity and the ITSD analysis compared effects in the intervention districts to overall effects in other districts.

j. The extent to which the effects seen in the intervention year relative to other districts will be maintained in the year after the end of the city contract is yet to be determined. It is possible that crime will return to previous levels, but it is also possible that a year of CeaseFire intervention produced normative change that will continue to be reflected in crime statistics.

k. This evaluation adds to a growing body of evidence supporting the effectiveness of CeaseFire intervention, in combination with police presence, for reducing homicide, shootings, and violent crime generally in higher risk neighborhoods. The complexity of these particular results should raise questions and provide insights for funders, CeaseFire personnel, and community intervention theorists and practitioners.

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The Effect of Intensive CeaseFire Intervention

on Crime in Four Chicago Police Beats: Quantitative Assessment

Background

The City of Chicago contract (#2013-00303-00-00) and amendment (#2558-001) were put into effect on September 26, 2012, with full presence of CeaseFire in the two beats in the Woodlawn community (Beats 312 and 313) and two beats in the North Lawndale community (Beats 1011 and 1021). These beats fall within District 3 and District 10 respectively.

CeaseFire, which was recently rebranded as Cure Violence in some locations, uses a public health approach to violence prevention by employing a three-step disease control method. First, CeaseFire staff work to locate and interrupt local and ongoing conflicts using conflict mediation techniques, then they work to change norms and behaviors of high-risk participants, and finally they organize activities and events to change community norms concerning acceptance of violence. For a more complete description of CeaseFire see Skogan, et al. (2009) or visit their website (cureviolence.org).

This evaluation report describes the results of a one-year CeaseFire intervention in two police districts targeted because of high levels of firearm-related homicide. The evaluation focuses specifically on outcomes of homicide and shootings as well as total levels of violent crime. This evaluation was funded through a contract with the McCormick Foundation and carried out independently by the Institute for Health Research and Policy at the University of Illinois at Chicago.

Targeted Districts and Beats

The City of Chicago funded CeaseFire services in police districts 3 (Woodlawn) and 10 (North Lawndale), with two police beats selected from each (Woodlawn: 312 and 313, North

Lawndale: 1011 and 1021). Terms of the contract stated that CeaseFire would maintain a fully active presence for one year, ending September 30, 2013. A fully active beat has at least three outreach workers and one violence interrupter. Outreach workers mentor high-risk individuals and assist them to obtain needed services, such as job training, while also conveying an anti-violence message. Violence interrupters work in the community to identify areas where conflict may be escalating. Violence interrupters are often ex-gang members with a unique ability to access the population at highest risk of shootings. Furthermore, CeaseFire staff had weekly contact with employees of the Chicago Police Department (CPD) to evaluate violence reduction strategies in the aforementioned beats, but they did not serve as informants and were not employed by CPD.

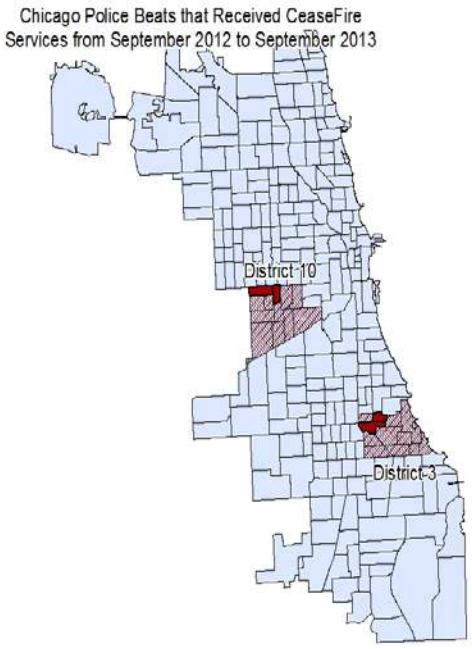

Figure 2. Map of Chicago Showing Police Districts 3 (Woodlawn) and 10 (North Lawndale)

Evaluation Strategy

The purpose of this evaluation was to determine the effectiveness of the intensive CeaseFire implementation in four city beats in reducing violence generally and homicide specifically. Two approaches were used: Regression point displacement design (RPDD) and the interrupted time series design (ITSD). Both are described below.

Regression Point Displacement Design (RPDD). The RPDD, described in detail in Wyman, Henry, Knoblauch & Brown (in press), is a little-used variant of the Regression

Discontinuity Design (RDD, Campbell, Stanley & Gage, 1963) that is useful for evaluating outcomes of prevention trials and understanding intervention effects in community research, where the sample sizes are often small and randomized controlled trials (RCTs) may not be feasible or ethical. Using archival data, the RPDD creates an expected posttest score for each treatment unit and then compares the expected posttest score to the actual posttest score. The RPDD design has high statistical power when the correlation between the pretest and posttest scores is very strong. In its most basic form, the RPDD is a simple linear model, but that model can be expanded in several ways to meet the specific needs of the situation and to accommodate multiple treatment units. For this evaluation, we hypothesized that crime rates will be lower than expected in districts with a CeaseFire presence than in districts without the CeaseFire program, controlling for the likelihood of these districts being selected for this implementation of CeaseFire. We conducted the RPDD with crime data for the 2010-2011 year as the pretest score and crime data from the 2012-2013 year as the posttest score.

Interrupted Time-Series Design (ITSD). A time series is a sequence of consecutive observations or values of measurements taken over a period of time. The "interruption" is the event or intervention (in this case the beginning of the city contract) that occurs during this observation time period that divides or segments the time series into two or more portions or phases (Wagner, Soumerai, Zhang, & Ross-Degnan, 2002). The ITSD has more statistical power to assess longitudinal intervention effects than most quasi-experimental designs because it provides assessment of the outcome of interest multiple times prior to and after the intervention is implemented. Adding a comparison group to the interrupted time series design permits comparing the change in crime levels at the beginning of the city contract in the intervention group with change of levels in the comparison group, and it permits comparing the rate of

change after the beginning of the city contract between the intervention and comparison groups. For this evaluation, we aggregated incident-level crime data monthly for one year prior to the intervention as well as for the full twelve months of the intervention year, and included terms in the models to account for curvature in the trend of violent crime over time. We hypothesized that the presence of CeaseFire intervention in the targeted police districts would result in a reduction in crime at the beginning of intervention due to an interruption in current practices, as well as a reduction in the linear growth rate during the intervention year as CeaseFire staff gained a greater understanding of the community and greater influence within the community.

Method

Data Sources

Propensity scores. Propensity scores estimating the probability that a police beat would ever be selected for CeaseFire services were calculated for each police beat in the city of Chicago for another study (Gorman-Smith, 2014). Because the statistical models assume random assignment and selection of communities for CeaseFire is not random, propensity scores can help control for the non-randomness of selection. The propensity scores in this evaluation were based on data from the U.S. Census Bureau, the American Community Survey (ACS), calls to the city's non-emergency (311) number indicating police activity, police beats recommended for CeaseFire services by influential politicians, and the presence of major gangs in each beat. An ROC analysis showed that the propensity score model had an area under the curve (AUC) of .72 for predicting which beats would ever receive CeaseFire intervention.

CeaseFire activity. CeaseFire staff provided information on CeaseFire involvement in the targeted beats as well as other beats in the City of Chicago by month during the time frame of

interest (i.e. 2011 to 2013).

City of Chicago Data Portal crime statistics. All outcome data were downloaded from the Chicago City Data Portal on March 18, 2014. These data represent crimes to which police responded from September 1, 2010 to January 31, 2014. Each crime report included the Uniform Crime Reporting (UCR) code for the offense, information on the time, date, and exact location (latitude and longitude) of the crime. These incident-level data were aggregated as required for the RPDD and ITSD analyses. Specific crimes included in these analyses were as follows.

Homicide. Homicide is any crime coded as a homicide by CPD, including first and second degree murder, manslaughter, and reckless homicide. The Illinois Universal Crime Reporting (IUCR) codes for homicide are 0110, 0141 and 0142.

***Shootings*.** Shootings are identified as any instance of battery that involved a handgun or firearm and were selected using IUCR codes. IUCR codes included in this category were 0480, 0481, 0450, 0451, 041A and 041B.

Total violent crime. Total Violent Crime includes instances of homicide and total battery. Total battery includes simple, domestic, and aggravated battery. IUCR codes include homicide and shooting codes listed above as well as 0420, 0430, 0440, 0452, 0453, 0454, 0460, 0461, 0462, 0475, 0479, 0482, 0483, 0484, 0485, 0486, 0487, 0488, 0489, 0495, 0496, 0497, and 0498.

Total number of police responses. Number of police responses is an aggregate category including the crime types described above as well as any other crime documented and reported to the Chicago Data Portal. It was included in the RPDD analysis to account for a general level of police presence.

Data Management and Transformation

CeaseFire services are implemented at the beat level, however, the beats involved in this

implementation of CeaseFire were closely clustered within two police districts, Districts 3 in the Woodlawn neighborhood and District 10 in the North Lawndale neighborhood. A previous study (Gorman-Smith, 2014) created propensity scores using census and other data at the police beat level. For this study we aggregated the beat-level propensity scores and the incident-level crime data to the district level, and created indicator variables for the targeted districts.

Types of Analyses: Regression point displacement design (RPDD)

Selection of the pretest time period. The homicide rates in Districts 3 and 10 prompted the negotiation of the contract between the City of Chicago and CeaseFire. These districts had relatively high homicide rates in 2010 and had no prior significant CeaseFire involvement. Figure 3 plots the homicide rates in the 25 Chicago police districts, with the filled bar identifying districts 3 and 10. With 31 and 32 homicides respectively, only four Chicago districts had higher homicide rates in the period from October 2010 to September 2011. Because the City of Chicago contract was based on the 2010-2011 homicide rates, we conducted the RPDD analysis using the 12-month period from October 2010 to September 2011 as the pretest value.

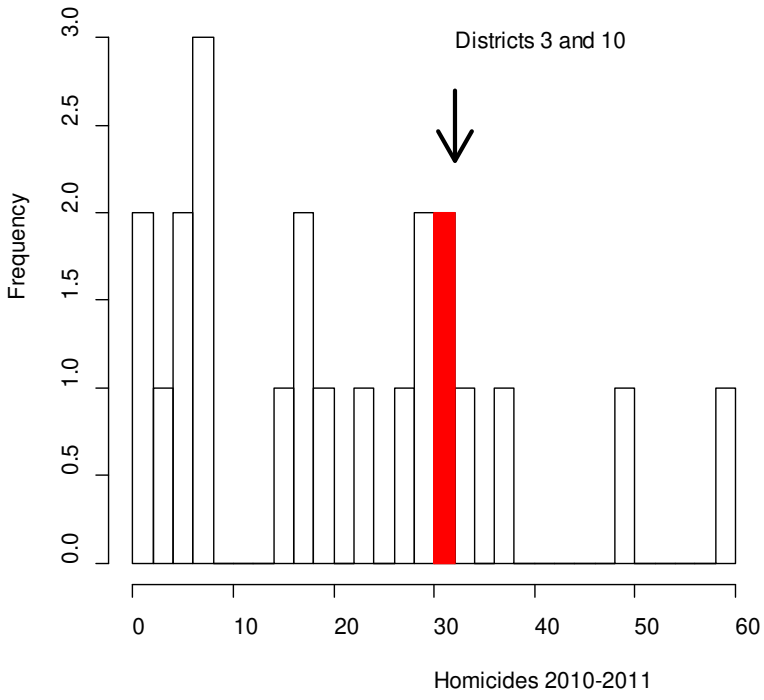

Figure 3. **2010-2011 Homicides for Chicago Police Districts**

Control Variables. Selection of the intervention beats in districts 3 and 10 was not random. In order to infer that observed effects were due to the

CeaseFire intervention, we needed to control for alternative explanations. First, changes in the crime rate may be due to pre-existing differences between districts that lead to certain communities being selected for CeaseFire in the first place. We control for this explanation, to the greatest extent possible, by including the propensity scores described above in the intervention analysis.

Another possible alternative explanation was increased police responsiveness in the target districts. Indeed, the contract between CeaseFire and the City of Chicago called for close cooperation between police and CeaseFire personnel, which may well have resulted in increased calls to police. CeaseFire community activities such as peace summits, "CeaseFire week," and town hall meetings are aimed at increasing citizen response to crime, which also may have resulted in increased police calls. For this reason, the total number of police responses was also entered as a control variable in the RPDD analysis.

RPDD Analysis. The analysis for the regression point displacement design predicted homicide, total violent crime, and shootings in the period from September 26, 2012 to September 25, 2013, controlling for levels of these variables during the period from September 26, 2010 to September 25, 2011. Also entered as control variables were a propensity score representing our best estimate of the probability that these two districts would be selected for CeaseFire intervention given the predictor variables listed above, the total number of police responses for each of the 25 Chicago Police districts, and the interaction between pretest and intervention. Additionally, we entered a term identifying the 9 other districts that had CeaseFire services during the same time period.

Analyses were completed in the computer program *R* using generalized linear mixed models that were fit using the glmer function in the lme4 package. The model contains both

fixed and random effects with the fixed effects representing the best estimate for all districts.

Types of Analyses: Interrupted time series design (ITSD).

Selection of pre-intervention time period. We based the interrupted time series on data aggregated by month for the year immediately prior to the intervention (Sept 2011-Sept 2012) and comparing that to monthly data from the intervention year (Sept 2012-Sept 2013). The ITSD is designed to compare consecutive time measures in order to assess whether the implementation of CeaseFire in the targeted communities created a noticeable change in the rate of crime.

Covariates. It is well known that crime has an element of seasonality and that factors such as gang recruitment tend to intensify at specific times of year. These factors produce curvature in the relation between time and crime levels. For this reason, we included two polynomial terms, the square and the cube of centered time in months in the ITSD analysis. Including the squared value of centered time models curvature in the relation between time and crime, and including the cube of centered time models the rotated "S" shape that would be expected for seasonal variation and is apparent in the trends of crime over a year's time.

ITSD Analysis. The analysis for the interrupted time series design compared monthly instances of crime from September 2011 to September 2012, before the CeaseFire intervention was implemented (pre-contract phase) to monthly instances of crime during the following year of intervention (October 2012 to September 2013: post-contract phase). Mixed-effects regression models predicted levels of crime with time, phase (pre- and post-contract), intervention vs. comparison, and appropriate interactions as predictors. The main analyses employed data from the two police districts receiving CeaseFire intervention compared with 9 districts that did not receive CeaseFire intervention during the time of the study. We also conducted analyses that

compared the two targeted districts with 6 police districts whose average beat-level propensity scores for CeaseFire intervention were above .05, the median propensity score.

Model selection proceeded as follows. First a model that included three-way interactions between the polynomial terms, phase, and intervention was fit. Higher-order terms that were not significant were dropped from the model. The final statistical model may be expressed as follows in hierarchical linear model notation:

Level 1:

$$Y_{ij} = \pi_{0j} + \pi_{1j}(\text{month-12}) + \pi_{2j}(\text{month-12})^2 + \pi_{3j}(\text{month-12})^3 + \pi_{4j}(\text{phase}) + \pi_{5j}((\text{month-12})*\text{phase}) + \pi_{6j}((\text{month-12})^2*\text{phase}) + \pi_{7j}((\text{month-12})^3*\text{phase}) + r_{ij}$$

Level 2:

$$\pi_{0j} = \beta_{00} + \beta_{01}\ (\text{intervention}) + e_{0j}$$

$$\pi_{1j} = \beta_{10} + \beta_{11}\ (\text{intervention}) + e_{1j}$$

$$\pi_{2j} = \beta_{20}$$

$$\pi_{3j} = \beta_{30}$$

$$\pi_{4j} = \beta_{40} + \beta_{41}\ (\text{intervention})$$

$$\pi_{5j} = \beta_{50} + \beta_{51}\ (\text{intervention})$$

$$\pi_{6j} = \beta_{60}$$

$$\pi_{7j} = \beta_{70}$$

Level 1 models district-level crime at each month as a function of a district intercept (π_{0j}), slope terms for linear, quadratic, and cubic time in months, centered at October, 2012 (π_{1j}, π_{2j}, π_{3j}), a dummy code indicating whether the month in question was in the pre- or post-contract phase (π_{4j}), the effect of the product of phase and terms for centered linear, quadratic, and cubic time (π_{5j}, π_{6j}, π_{7j},), which are used to model change after October, 2012, and a residual term (r_{ij}).

At Level 2, levels of the outcome before October 2012 are estimated by β_{00} for comparison districts and β_{01} estimates the difference between intervention and comparison districts. Change in the outcome prior to the contract is estimated by β_{10} for comparison districts and β_{11} estimates pre-contract slope differences between intervention and comparison districts. Levels of the outcome following initiation of the contract are estimated by β_{40}. β_{41} estimates the difference between comparison and intervention districts in outcome levels post-contract. Change in the outcome for comparison districts post-contract is estimated by β_{50}, and the difference between intervention and comparison districts on change in the outcome post-contract is estimated by β_{51}. β_{60} and β_{70} model differences in quadratic and cubic trend between the pre- and post- contract phases, but, as noted above, no intervention effect on these parameters was included in the final model. **The effects of the intervention are estimated by β_{41} for levels of crime and β_{51} for differences in rates of change in the post-contract phase. These effects are bolded in the outcome tables.**

A second set of analyses used the six comparison districts whose average beat-level propensity scores for selection for CeaseFire intervention were above .05. District-level propensity scores ranged from .004 to .38 and were approximately normally distributed with a mean of .057. Propensity scores for the targeted districts were .13 and .38.

We also examined differences in outcomes by district. This multilevel model was similar to the model for overall intervention effects detailed above, except that the single intervention term in that model was replaced with terms representing each of the two districts compared to comparison districts.

Results

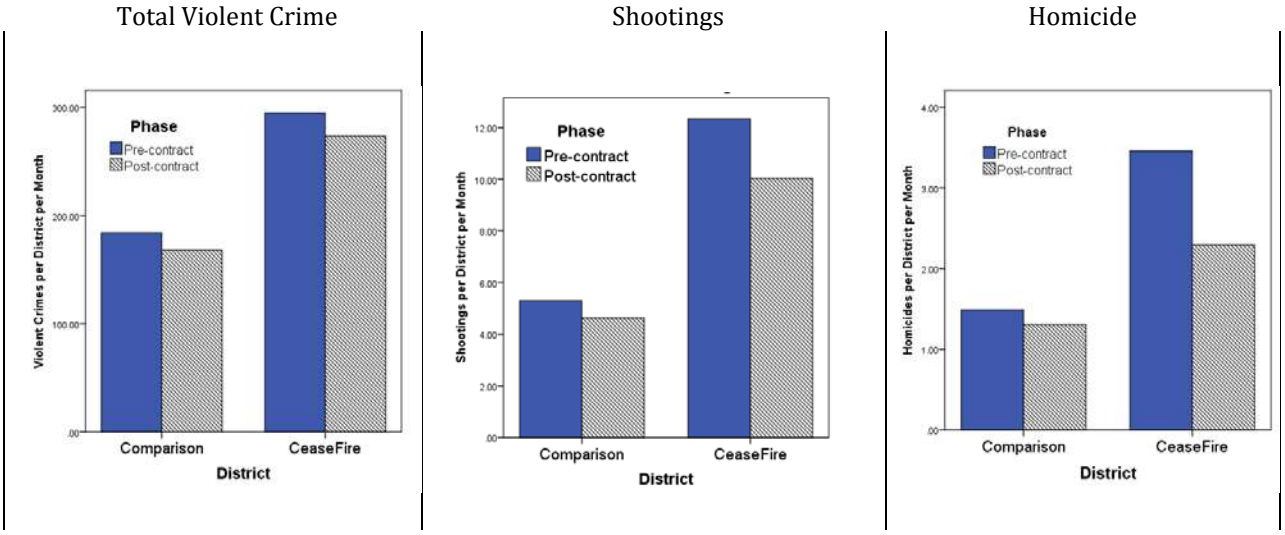

Figure 4. Pre- and post-contract Levels of Total Violent Crime, Shootings, and Homicide: Comparison and CeaseFire Districts

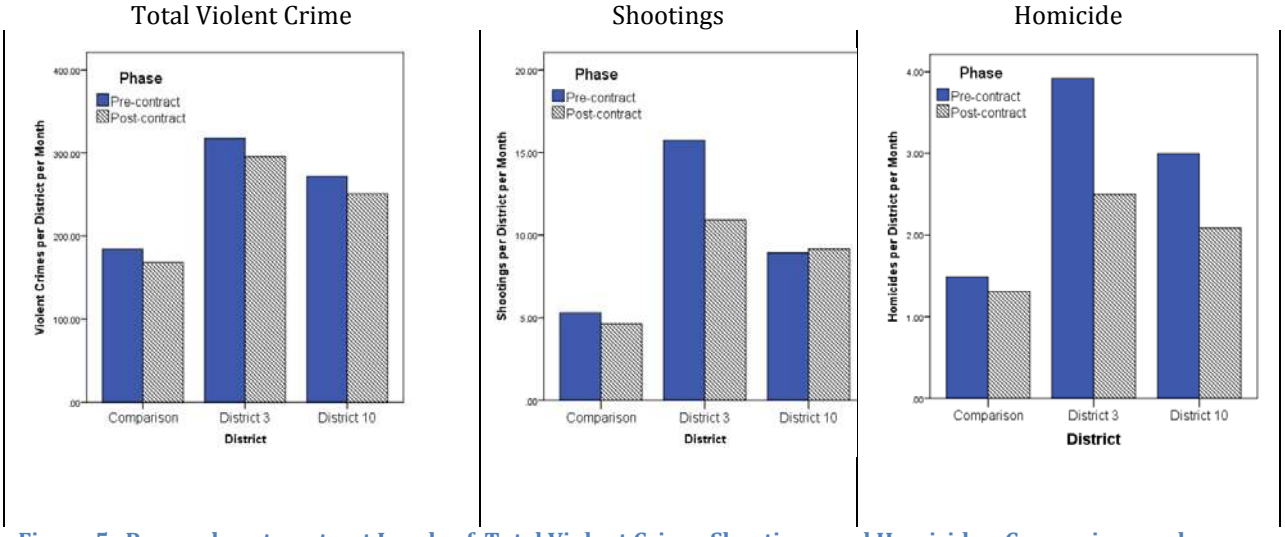

Figure 5. Pre- and post-contract Levels of Total Violent Crime, Shootings, and Homicide: Comparison and Individual CeaseFire Districts

Pre-contract and post-contract levels of total violent crime, shootings, and homicides in the targeted districts and in the comparison districts are displayed graphically in Figure 4, and by district in Figure 5. As can be seen there, in each case, the decrease in crime between the pre-contract and post-contract phases were greater in the targeted districts than in the comparison districts. The only exception is the level of shootings in district 10, which were slightly higher than in the pre-contract phase. The RPDD and ITSD analyses evaluate the extent to which the reductions in crime in the targeted districts exceed the levels expected given crime trends in these districts and in other districts in the city.

Regression Point Displacement Design

The numeric results of the regression point displacement design are reported in Table 3 for both targeted districts and in Table 4 for the two targeted districts separately. Results are included that use 2010-2011 (the data on which the contract was based) as the comparison year. We believe that global tests for both districts taken together are misleading unless supplemented with results by district, because of differences between the police districts, both in the intervention strategy applied and in the results of the RPDD analysis.

Table 3
Results of the Regression Point Displacement Analyses - Both Districts Taken Together

Outcome	B	SE	Z	*p*
Total Violent Crime	-0.87	0.25	3.44	< .01
Shootings	2.40	1.04	2.32	.02
Homicide	-24.5**	12.0	2.04	.04

+ $p < .10$. * $p < .05$. ** $p < .01$

Violent Crime. Total violent crime was significantly reduced below expected levels overall (B = -0.87, SE = 0.25, z = 3.44, p < .01) with some variation by police district (see

below). Analyses by district found reduction below expected levels for total violent crime only in District 10 (North Lawndale neighborhood). In District 3 (Woodlawn neighborhood) the decrease in total violent crime was significantly less than expected.

Shootings. There were significantly more shootings (any type of battery involving discharge of a firearm) reported than would have been expected based on the performance of non-CeaseFire districts (B = 2.40, SE = 1.04, $p < .05$). This effect was moderated by somewhat lower levels for the district with higher initial shootings (District 3).

Homicide. Using the year of the city contract as a comparison, the RPDD analysis found a significant overall reduction in homicide below what would have been expected by chance for the two districts contracted by the City for CeaseFire services (B = -24.5, SE = 12.0, z = 2.04, p = .04). This significant effect was primarily due to the effect in District 10.

Table 4
Results of the Regression Point Displacement Analyses, by District

	B	SE	z	*p*
Total Violent Crime				
d3	0.06	0.02	3.03	<.01
d10	-0.11	0.03	3.71	<.01
Shootings				
d3	0.39	0.10	3.73	<.01
d10	0.24	0.17	1.39	.16
Homicide				
d3	0.51*	0.21	2.46	.01
d10	-0.71*	0.35	2.01	.04

Note: d3 = District 3, d10 = District 10.

Interrupted Time Series Design (ITSD)

Early in this process we conducted an interrupted time series analysis using data from the two targeted districts without any comparison districts. Such an analysis evaluates the extent to which the trend of crime changes in the intervention phase. The results of this analysis are included in the Appendix. Here we report the analysis described in the Method section above,

namely an interrupted time series analysis that includes comparison districts and bases expected values on trends in the comparison districts as well as on the trend in the pre-contract phase.

The results of the analyses considering the two intervention districts together are reported in Table 5 and plotted in the three panels of Figure 6. The vertical axes in the figures record the number of crimes in a month's time in each district, and the horizontal axes track the 12 months prior to and the 12 months following the initiation of the contract.

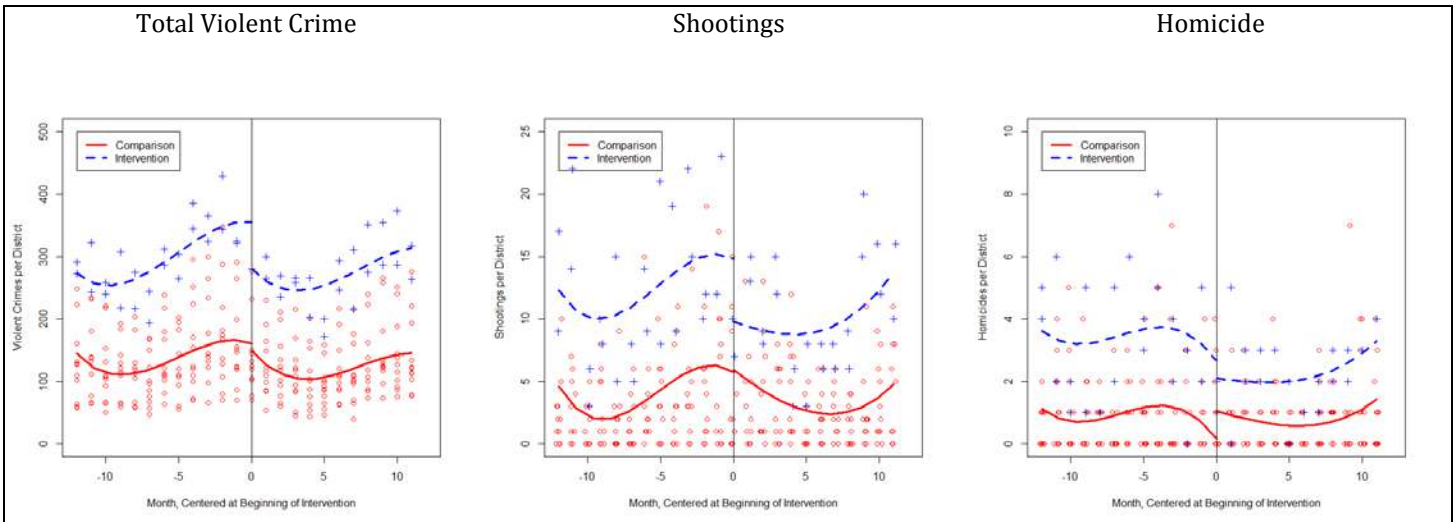

Figure 6. Trends in Levels of Total Violent Crime, Shootings, and Homicide over Two Years: Comparison and CeaseFire Districts

The zero point on the horizontal axis with the solid vertical line marks the beginning of the CeaseFire intervention in targeted districts on September 26, 2012. The red circular points are levels of crime in the districts not receiving CeaseFire intervention during this time period. The blue plus signs are crime levels in the two targeted districts. Plotted over the data are the results of the statistical models. The solid (red) line marks the predicted trend of crime in the comparison districts and the dashed (blue) line marks trends in the targeted districts.

Table 5

CeaseFire Intervention Effects on Levels and Change in Total Violent Crime, Shootings, and Homicide

	Violent Crime		Shootings		Homicide	
	B	SE	B	SE	B	SE
Levels						
β_{00}: Pre-contract comparison levels	160.73**	18.83	5.43**	1.44	0.16	0.56
β_{40}: Post-contract change in comparison levels	-11.95	11.36	-1.16	1.31	0.89	0.58
β_{01}: Intervention - Comparison Levels Pre-Contract	194.84**	41.98	10.46**	2.52	2.52*	0.79
β_{41}: Intervention - Comparison Change in Levels Post-Contract	**-64.22****	**13.70**	**-5.64****	**1.57**	**-1.46***	**0.70**
Slopes						
β_{10}: Time Slopes in Comparison Districts Pre-Contract	-8.44	6.31	0.08	0.72	-0.64*	0.32
β_{11}: Intervention - Comparison Time Slopes Pre-Contract	5.49**	1.59	0.17	0.16	0.00	0.07
β_{50}: Time Slopes in Comparison Districts Post-Contract	-18.56	7.64	-0.21	0.88	0.51	0.39
β_{51}: Intervention - Comparison Time Slopes Post-Contract	**-2.09**	**1.97**	**0.24**	**0.23**	**0.07**	**0.10**
Random Effects						
Intercept (District)	3130.50**		11.61**		0.79**	
Month(District)	[a]		0.00006		[a]	
Residual	603.60		8.15		1.62	

+ $p < .10$. * $p < .05$. ** $p < .01$

[a] Random effect was removed because it was equal to zero.

Note: Quadratic and cubic effects are not shown

As can be seen in the second line of Table 5, before the beginning of the city contract, levels of total violent crime ($\beta_{01} = 160.7$, $p < .01$), and shootings ($\beta_{01} = 5.4$, $p < .01$) were significantly higher in the intervention districts than in the comparison districts, as might have

been expected given that these districts were chosen because of their higher rates of violent crime. Comparison districts showed stable levels of shootings ($\beta_{10} = 0.08$, *ns*) prior to the beginning of the city contract, and intervention districts had still higher rates of growth in total violent crime ($\beta_{11} = 5.5$, $p < .01$) prior to the beginning of the city contract.

After the beginning of the city contract, the intervention districts saw significant decreases in homicide ($\beta_{41} = -1.46$, $p < .05$), total violent crime ($\beta_{41} = 64.2$, $p < .01$), and shootings ($\beta_{41} = -5.6$, $p < .01$) beyond expected levels. These effects are reported in the bolded line labeled β_{41} in Table 5.

The lines labeled β_{50} and β_{51} in Table 5 report the rates of increase or decrease in the outcomes in the post-contract phase. Comparison districts had non-significant linear decreases of 8.4 per month in total violent crime, were nearly level in shootings, and had a significant decrease of 0.64 homicides per month on average. The rates of change following the beginning of intervention in the intervention districts did not differ from the general rates of change in the other districts.

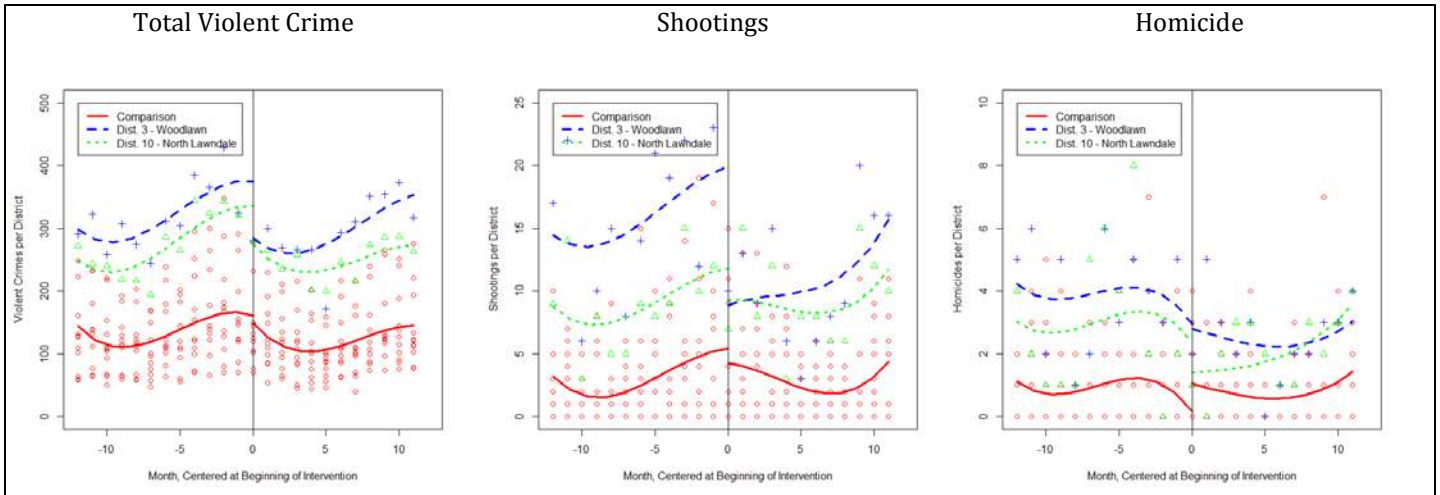

Figure 7. Trends in Levels of Total Violent Crime, Shootings, and Homicide over Two Years: By CeaseFire Districts and Comparison Districts

Table 6

CeaseFire Intervention Effects on Levels and Change in Homicide, Total Violent Crime, and Shootings, by District

	Violent Crime		Shootings		Homicide	
	B	SE	B	SE	B	SE
Levels						
β_{00}: Pre-contract Comparison Levels	160.73**	19.22	5.43**	1.43	0.16	0.56
β_{01}: Pre-contract Woodlawn - Comparison levels	214.77**	58.70	14.54	3.42	2.80*	1.10
β_{02}: Pre-contract North Lawndale - Comparison levels	174.91*	58.70	6.39	3.42	2.23+	1.10
β_{40}: Post-contract Change in Comparison Levels	-11.95**	11.28	-1.16**	1.28	0.89*	0.58
β_{41}: Post-contract Woodlawn - Comparison Change in Levels	**-79.00****	**18.49**	**-9.95+**	**2.10**	**-1.05**	**0.95**
β_{42}: Post-contract North Lawndale - Comparison Change in Levels	**-49.44****	**18.49**	**-1.33**	**2.10**	**-1.87***	**0.95**
Slopes						
β_{10}: Pre-contract Time Slopes in Comparison Districts	-8.44	6.27	0.08	0.71	-0.64*	0.32
β_{11}: Pre-contract Woodlawn - Comparison Time Slopes	5.04*	2.18	0.27	0.21	-0.02	0.10
β_{12}: Pre-contract North Lawndale - Comparison Time Slopes	5.95**	2.18	0.07**	0.21	0.03	0.10
β_{50}: Post-contract Time Slopes in Comparison Districts	-18.56*	7.59	-0.21	0.86	0.51	0.39
β_{51}: Post-contract Woodlawn - Comparison Time Slopes	**1.52**	**2.66**	**0.34**	**0.30**	**0.01**	**0.14**
β_{52}: Post-contract North Lawndale - Comparison Time Slopes	**-5.70***	**2.66**	**0.14**	**0.30**	**0.14**	**0.14**

+ $p < .10$. * $p < .05$. ** $p < .01$

Note: Quadratic and cubic effects and random effects are not shown

Results by District

Table 6 reports the results for each intervention district separately. Trends over time for each outcome in each district are plotted in the three panels of Figure 7. On total violent crime,

the results were comparable between the districts, with both showing significant decreases in the post-contract phase (β_{41} = -79.0, p < .01; β_{42} = -49.4, p < .01). On shootings, District 3 (Woodlawn neighborhood) showed a marginally significant decrease of approximately 10 shootings per month (B = -9.95, p < .01). Levels in District 10 (North Lawndale neighborhood) decreased as well (B = -1.33, *ns*), but not significantly. On homicide, only District 10 (North Lawndale neighborhood) showed a significant decrease (β_{42} = -1.87, p = .05) although the change in District 3 was also negative (β_{41} = -1.05, p = .27). On time trends during the post-contract phase, District 10 (North Lawndale neighborhood) showed a significantly decreasing trend in total violent crime relative to the comparison districts of approximately 6 violent crimes per month (β_{52} = -5.70, p < .05). This pattern can be clearly seen by examining the (green) dotted line in the first panel of Figure 5. The post-contract time trend in Woodlawn did not differ significantly from the time trend in the comparison districts.

Discussion

The City of Chicago contracted with the University of Illinois at Chicago to provide CeaseFire services in police districts 3 and 10 in hopes that applying a public health approach to the problem of violent crime would, when added to police presence, reduce levels of violent crime, specifically homicides and shootings. This quantitative evaluation and its qualitative counterpart were undertaken to provide an assessment of the extent to which the goals of the contract were met. The results reported here should be considered in light of the overall crime trends in the targeted districts and in the remainder of the city. These trends show that the intended reduction in homicides and shootings did in fact take place in the targeted districts.

During the intervention year, the city of Chicago saw a general downward trend of violence, which in these data is reflected in the negative pre-contract time trends in the comparison districts. This general trend makes it difficult to determine the extent to which the reduction in crime found in the targeted districts was due to the effects of the CeaseFire intervention or to the overall trend. The RPDD and ITSD analyses used in this evaluation were designed to differentiate change due to intervention from change due to overall trends. The two types of analyses addressed the question of intervention effects from different perspectives. The RPDD analysis assessed improvement beyond expectations over the levels that motivated the contract and the ITSD analysis tracked the pattern of change, as it was able to differentiate immediate intervention effects from sustained levels or continued improvement.

Overall Effects

The results of the quantitative evaluation present a generally positive assessment of the effects of the CeaseFire intervention, with some complexity. Despite evidence of variation of effects between the two targeted districts, levels of violent crime, shootings, and homicide declined to a greater extent in the intervention districts than in the comparison districts. Statistical analysis showed that these declines were significantly greater than would have been expected based on the pre-contract levels and the levels in the comparison districts. These effects were found in the RPDD analysis and were corroborated and clarified by the ITSD analysis. They appeared within the first month after initiation of the city contract, corresponding with the arrival of the CeaseFire workers.

When seasonal variation in crime was taken into account it became clear that the reductions in levels of crime were maintained through the post-contract year, during which the

intervention was taking place. In sum, the intervention lowered the level of violence overall, but with the exception of a single outcome variable in one district, the intervention did not change the trend of crime, or modify the normal seasonal increases and decreases in crime.

Results of Hypothesis Tests

We posed two hypotheses to be tested in this quantitative evaluation. The first was that **levels** of crime in the targeted districts would be reduced as a result of CeaseFire intervention. The results of the RPDD analysis supported this hypothesis for total violent crime and for homicide, but not for shootings. The results of the ITSD analysis supported this hypothesis for all three outcome measures, total violent crime, shootings, and homicide.

Our second hypothesis was that the **rates of change** in crime would be reduced following the beginning of the intervention. In other words, this hypothesis predicted that the levels of crime would continue to decrease throughout the intervention year. This hypothesis was tested by the overall ITSD analysis. Only a single effect was consistent with this second hypothesis. During the post-contract period, District 10 (North Lawndale neighborhood) had a significant decreasing trend on total violent crime. Other than that, there was no evidence that the intervention changed the seasonal patterns of crime.

Differences in Effects by District

The RPDD analysis, conducted by district, found significant intervention effects in District 10, but not in District 3. The ITSD analyses reveal some possible explanations for this difference. They show a generally consistent pattern in the direction of effects between districts for **levels** of all three outcome variables. Differences in statistical significance are, most likely, a function of differences in statistical power and are not of substantive importance. On tests of

time trends following the beginning of intervention, the only significant effect is the decreasing trend in District 10 (North Lawndale neighborhood). It is possible that this time trend difference is what is being picked up by the finding of district variation in the RPDD analysis.

It is also possible that the district differences found may be at least partly due to variation in strategy. CeaseFire intervention in the two police districts varied in tactics somewhat in order to fit specific neighborhood characteristics that influence violence. In District 3 (Woodlawn neighborhood), CeaseFire workers negotiated an agreement with local gang leaders that gang members would stay in their territories, that gang members would not start violence, and that CeaseFire workers would be alerted to brewing violence. CeaseFire workers in District 10 (North Lawndale neighborhood) used more typical CeaseFire tactics, which relied on the "street intelligence" of outreach workers who were a consistent neighborhood presence.

Immediate Effects

The differences in levels of total violent crime, shootings, and homicides appeared within the first month after initiation of the contract, which provided support for our first hypothesis. Presumably these effects occurred during the time period that CeaseFire workers began operations in the targeted districts. Although we hypothesized that there would be an immediate effect, we believed initially that the pattern of change would consist of a smaller immediate effect followed by a declining trend. Instead, the pattern seems to have been a relatively large immediate effect that was sustained during the post-contract year. The graphical depictions of the results suggest an increase in crime as the post-contract year progressed. The statistical results do not support this impression, and we believe that this graphical pattern is the result of the graphing method used to illustrate the effects (plotting polynomial trends). The unexpected pattern of effects is another issue that will be important for CeaseFire personnel to consider.

What is the expected pattern of change when CeaseFire services are initiated in a community? What is it about the arrival of CeaseFire workers in a community that can produce an immediate effect on violence? Why does continued CeaseFire operations not result in declining trends of violence?

Were the Effects the Result of Increased Police Activity?

The suggestion has been made that any obtained effects of the city contract might be due instead to increased police activity in the targeted districts. The city contract with CeaseFire encouraged cooperation between CeaseFire workers and police, thus, it is impossible to completely disentangle the effects of the CeaseFire intervention from increased police activity. However, the evidence from this evaluation makes it unlikely that increased policing accounts for the effects obtained under the city contract. First, the RPDD analysis controlled for total police responses and controlled for the propensity for districts to be selected for CeaseFire intervention and still found positive effects of CeaseFire. It should be emphasized that because of the intended cooperation between police and CeaseFire, this is a very conservative test, and is unlikely to produce results favorable to CeaseFire. Second, the districts that were not selected for intervention showed significant decreases in violent crime in the time period following initiation of the city contract. This decrease in overall violent crime may be the result of increased police activity throughout the city in response to the spike in violent crime that prompted negotiation of the contract with CeaseFire. It should be noted that the decrease in violent crime and shootings in the intervention districts exceeded the decreases seen in the comparison districts and in the cases of shootings, was double the decrease in the comparison districts. Assuming that changes in police activity in response to city-wide increases in violence would not have been limited to the districts engaged in the CeaseFire contract, the fact that these

districts showed change exceeding that seen in the remainder of the city strengthens the conclusion that the change seen in the intervention districts was due to the addition of the CeaseFire intervention. Moreover, only the intervention districts experienced a significant drop in homicides in the intervention phase.

What will happen in the targeted communities after city contract ends?

Violence interrupters who work to defuse conflicts and outreach workers who mentor high risk youth may have immediate and positive effects on violence, but CeaseFire also aims to foster lasting change by affecting community norms. The extent to which this has occurred in the targeted neighborhoods will be important to assess once a full year has elapsed following the end of the city contract. The analysis to do this will be very similar to the ITSD analysis applied here. It will include terms to control for the seasonality of crime along with terms defining a post-contract year in addition to the pre-contract and contract years in these analyses. There are several possible findings. One is that crime in the targeted districts will return to pre-contract levels. Such an outcome would strengthen the evidence that CeaseFire intervention was responsible for decreased crime levels in the intervention year, but would also argue against there having been any lasting effect. It is also possible that reductions seen in the intervention year will be maintained in the post-contract year, that is, no change in levels or rates of change will be seen. Such an outcome would provide evidence for change in community norms, but would also strengthen the argument than changes in policing were at least partly responsible for the effects seen in the intervention year.

Limitations

A limitation of this evaluation is its relatively short time span. Community level change takes time and violence is a complex phenomenon. As is noted above, we plan to repeat the analyses conducted here once a full year of post-intervention data are available in order to evaluate effects after discontinuation of the intervention.

A second limitation is our inability to fully evaluate the role of police activity in the effects observed. We controlled for total police responses in the RPDD analysis and still found some positive effects. However, because the outcomes were included within total police responses, this is a very conservative strategy that decreases the likelihood of finding any effects of the CeaseFire intervention. A far better method would have been to make use of data on police staffing levels or patrol frequency, but such data were not available for this evaluation.

Conclusions

These findings add to a growing body of evidence supporting the effectiveness of CeaseFire intervention for reducing violence, including homicide (cf., Gorman-Smith, 2014; Skogan, Hartnett, Bump, & Dubois, 2009; Webster, Whitehill, Vernick, & Curriero, in press). Other evaluations employing interrupted time series designs similar to the analyses employed here have produced results that are, in their general findings, consistent with the results of this quantitative evaluation.

The complexity and somewhat contradictory findings should not be neglected, however. The patterns of these results raise important questions and potentially provide important insights into the workings of community-level public health approaches to violence such as CeaseFire, and what contextual processes might contributed to differing effects across two communities experiencing outbreaks of violence. Some of these questions, such as the reception and

recognition of CeaseFire workers in the communities, can be addressed by close examination of the qualitative results that accompany this quantitative evaluation. Other questions, such as the likelihood that effects will maintained beyond the boundaries of the contract, will require longer-term studies and studies that directly assess change in community norms about violence. Still other questions will require close examination of the methods used by CeaseFire in each community, and others, such as the expected pattern of change when an intervention is initiated in a community setting, should engage theorists in the science of community intervention.

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Appendix 1

Interrupted Time Series Design (ITSD): City Funded CeaseFire Beats Only.

Violent Crime. Violent crime (homicide and all instances of battery) showed a marginal reduction in linear growth during the full two-year period of study (IRR=0.96, 95% CI [0.91, 1.00], p = .0504). Additionally, there was a general increase in instances of violent crime in the spring (IRR=30.69, 95% CI [25.88, 36.40], p < .001) and in the summer (IRR = 38.13, 95% CI [28.70, 50.66], p < .001) compared to the winter (IRR=20.23, 95% CI [13.33, 30.63], p < .001), which demonstrates the seasonality of crime. There was no evidence of a phase effect or a reduction in violent crime over time during the intervention period, which limits causal links between violence reduction and CeaseFire presence.

Shootings. Shootings (any instance of battery involving a discharge of a firearm) showed a slightly higher occurrence in District 3 (IRR=1.86, 95% CI [1.09, 3.26], p <.05) relative to District 10. Although District 3 saw a reduction in shootings when comparing the previous year (2011-2012) to the intervention year (from 189 to 131), the decrease was not significant.

Homicide. During the year before program implementation, beats in District 3 were more likely to have an instance of homicide (IRR=0.69, 95% CI [0.25, 1.91], p <.05) than beats in District 10 (IRR=0.24, 95% CI [0.07, 0.72], p <.05). However, once CeaseFire was implemented, incident rates of homicide dropped in District 3 (IRR=0.09, 95% CI [0.02, 0.49], p <.05) but not in District 10. As is mentioned above, both districts saw a decrease in homicide during the intervention year, but the drop in District 3 was the only one that was statistically significant.

Appendix 2

Full-Size Copies of Figures

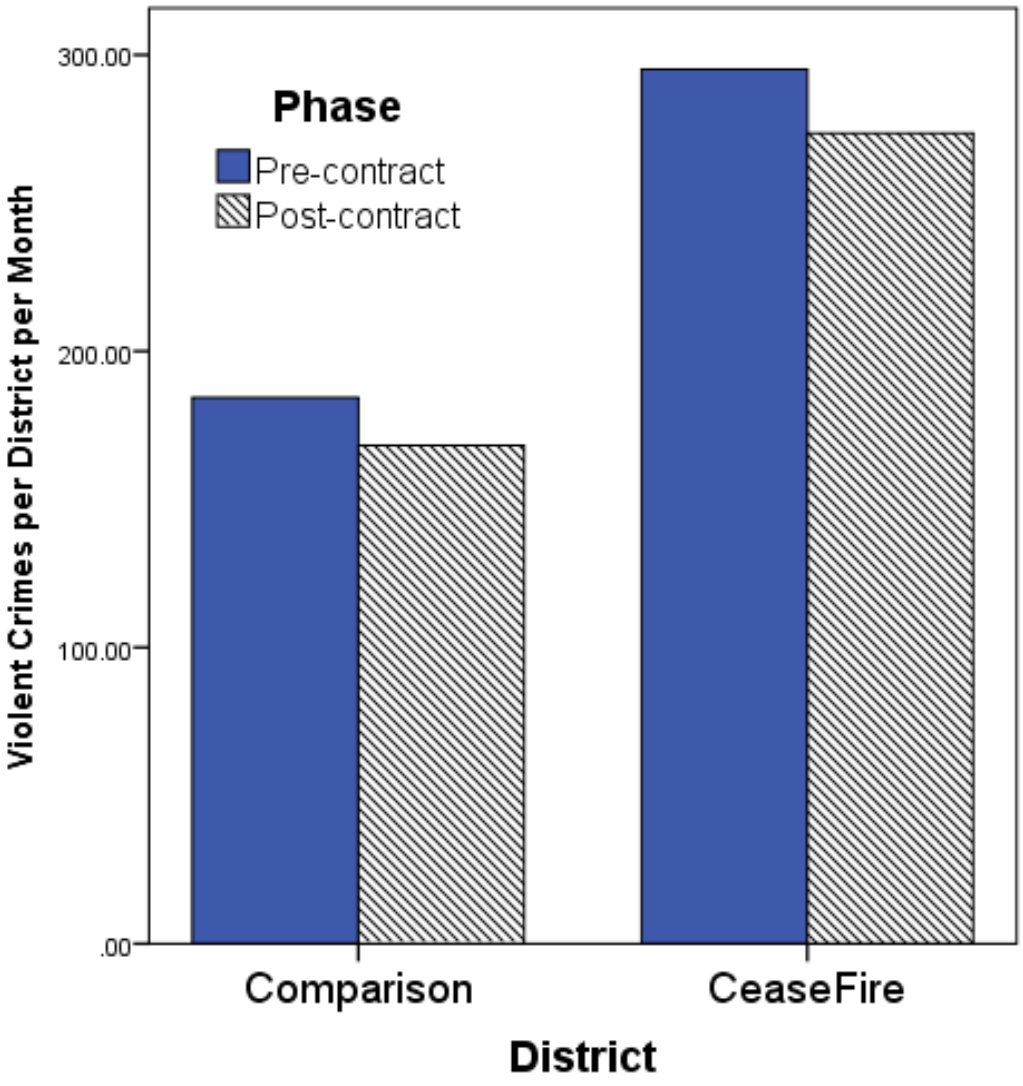

Figure 4a: Pre- and post-contract Levels of Total Violent Crime: Comparison and CeaseFire Districts

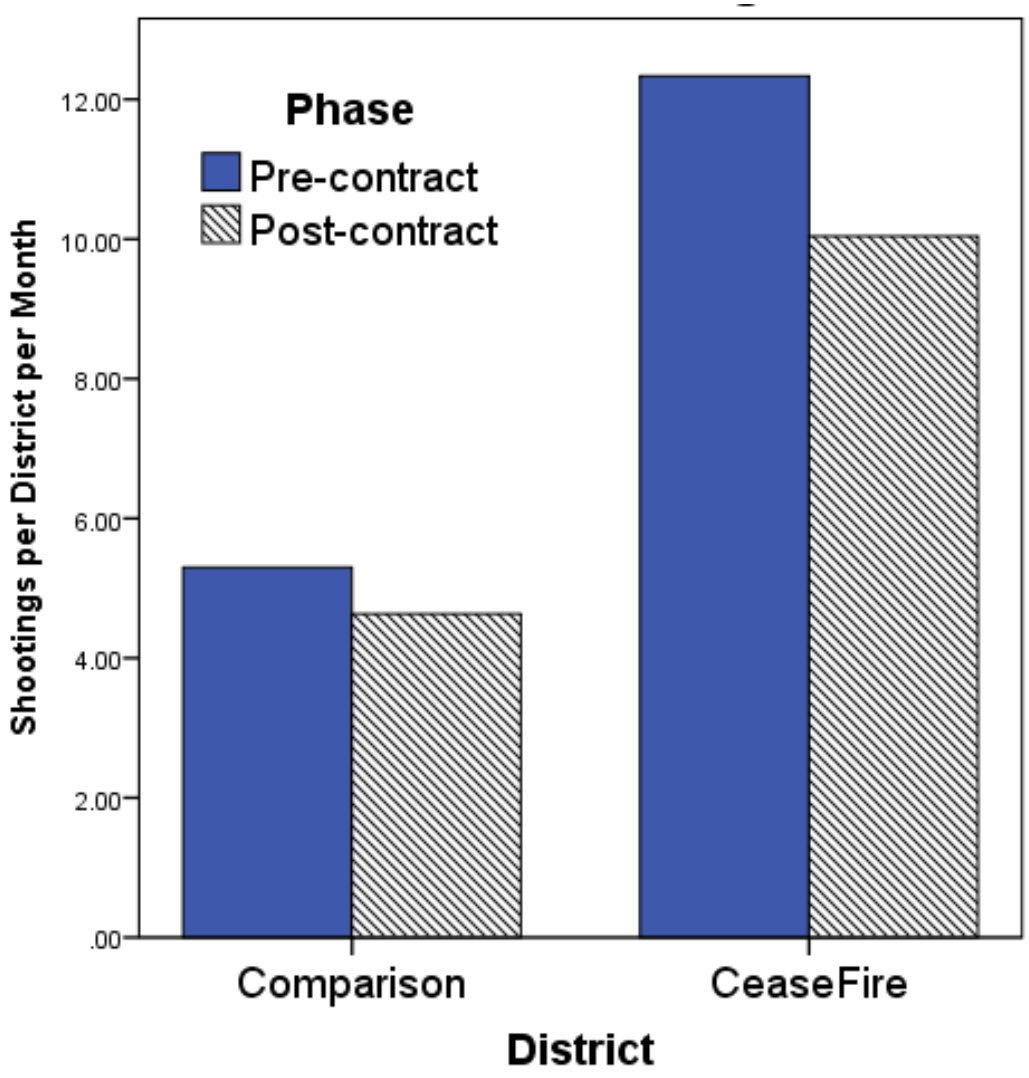

Figure 4b. Pre- and post-contract Levels of Shootings: Comparison and CeaseFire Districts

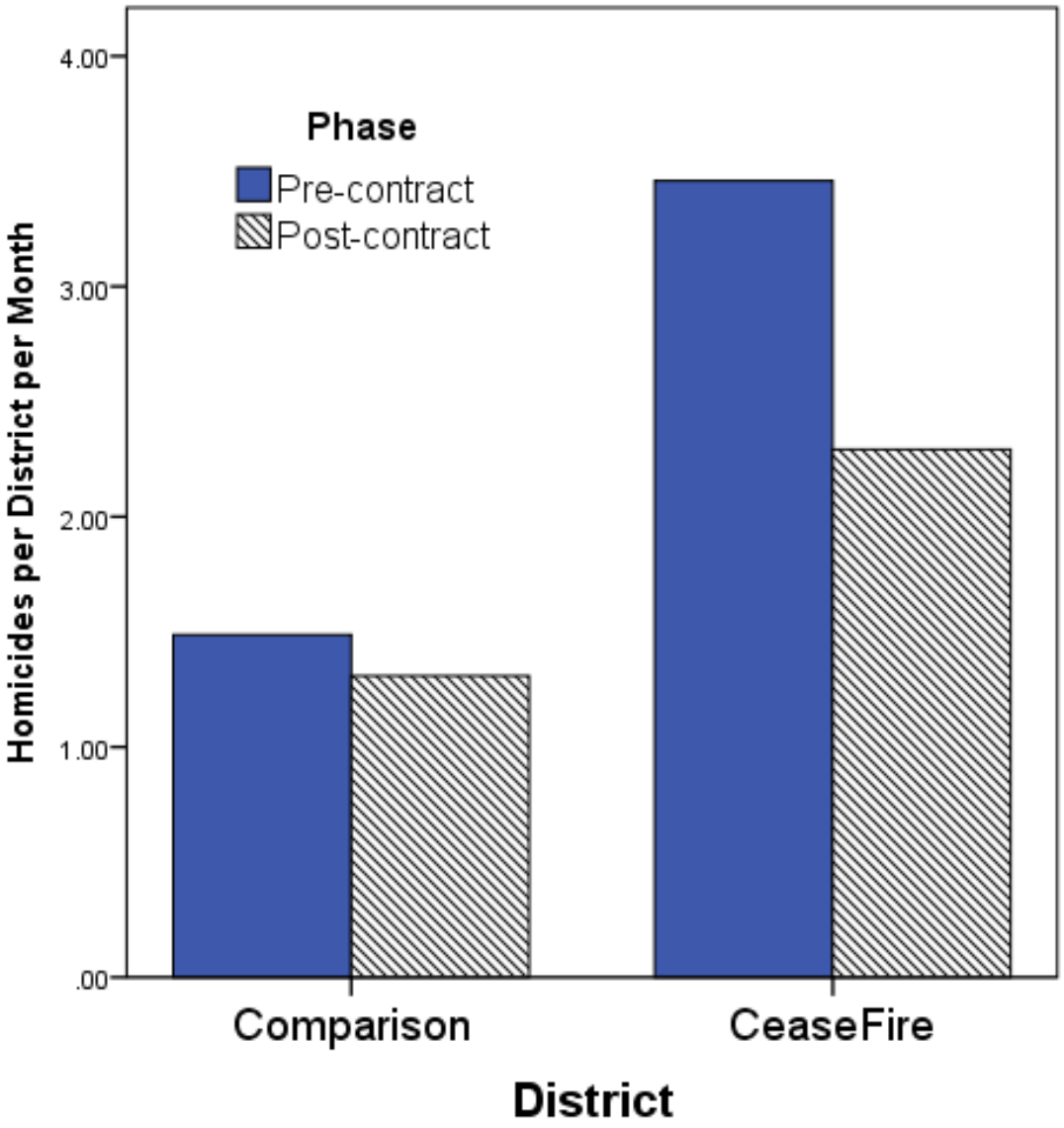

Figure 4c. Pre- and post-contract Levels of Homicide: Comparison and CeaseFire Districts

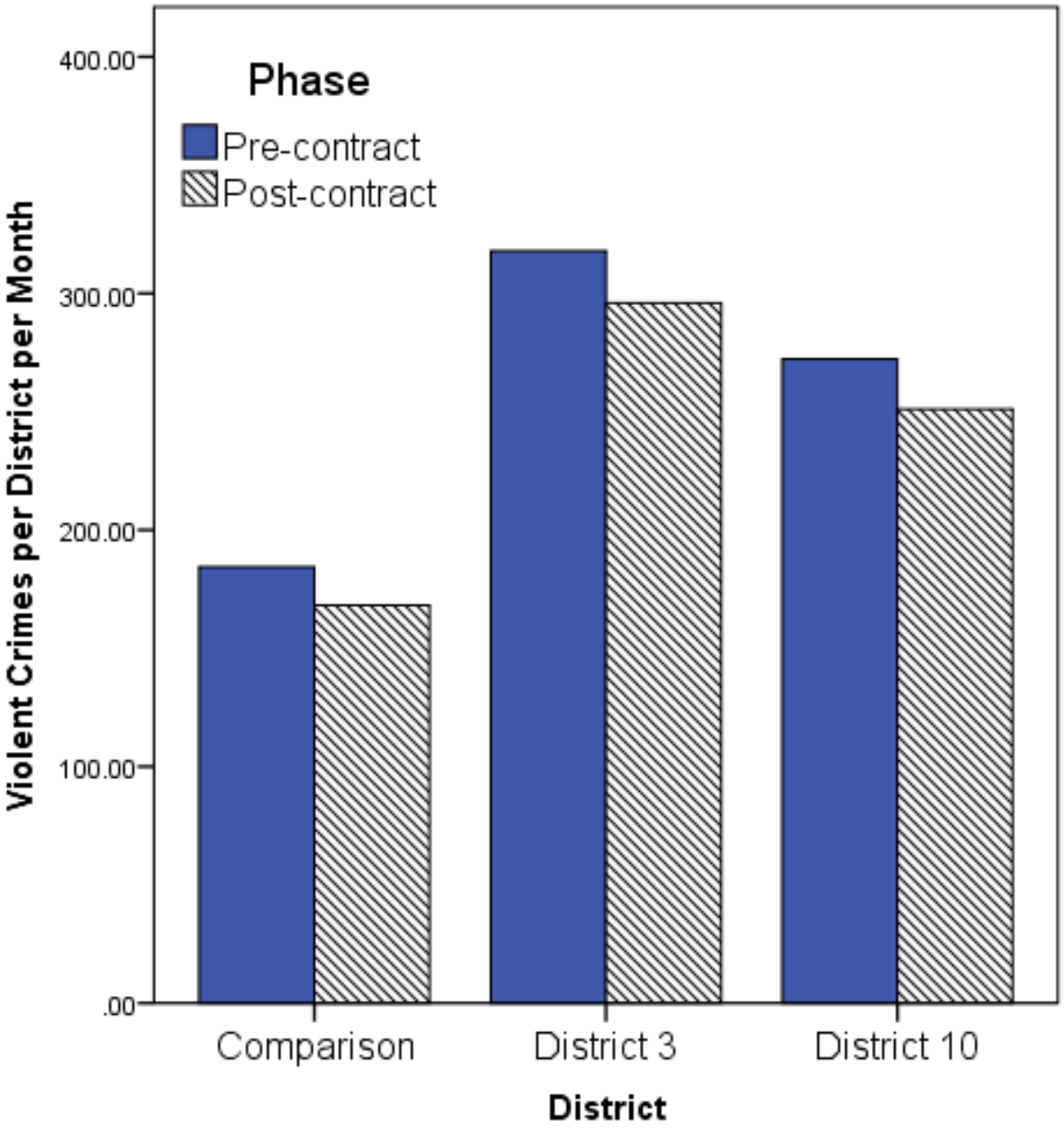

Figure 5a. Pre- and post-contract Levels of Total Violent Crime: Comparison and Individual CeaseFire Districts

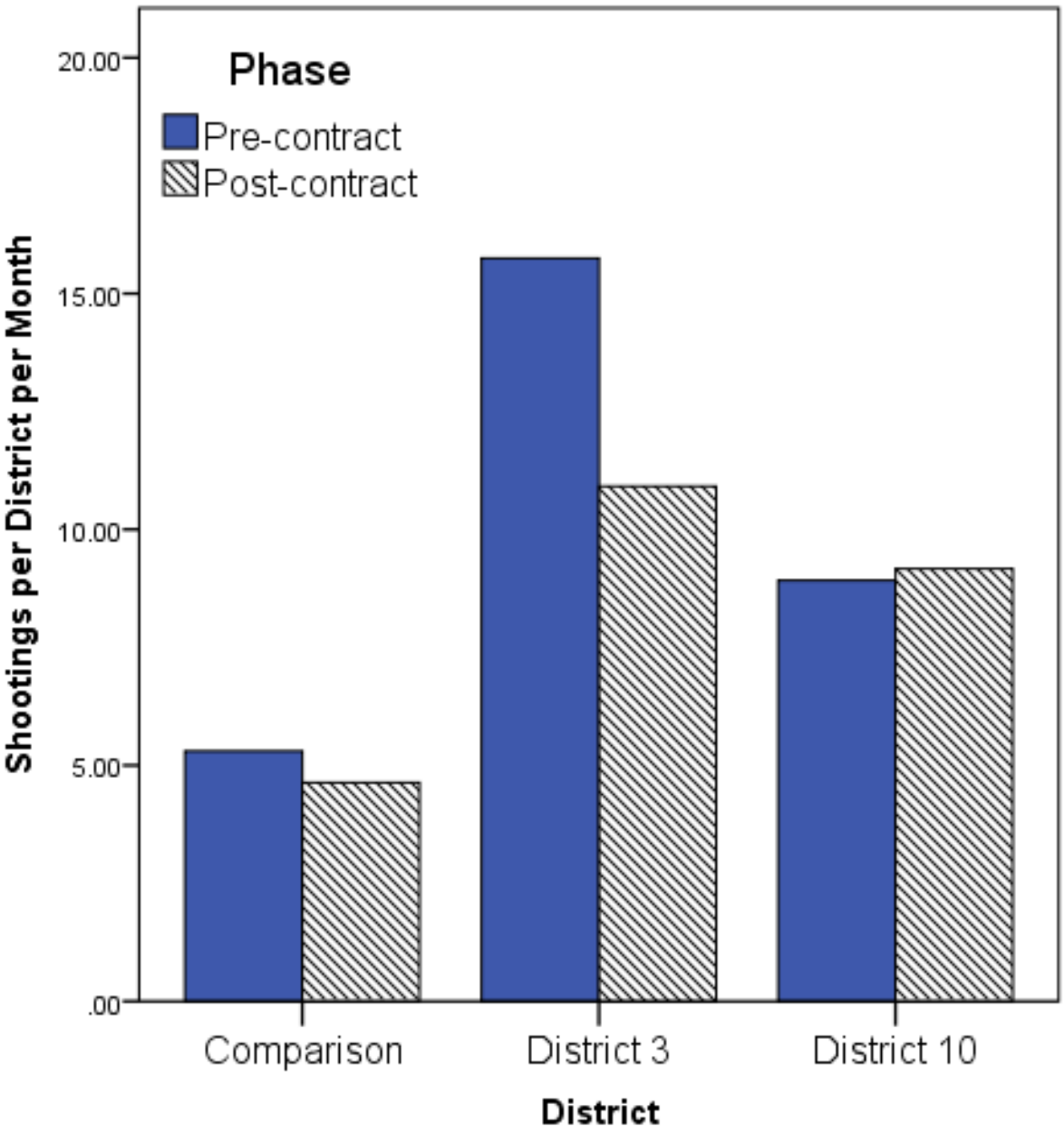

Figure 5b. Pre- and post-contract Levels of Shootings: Comparison and Individual CeaseFire Districts

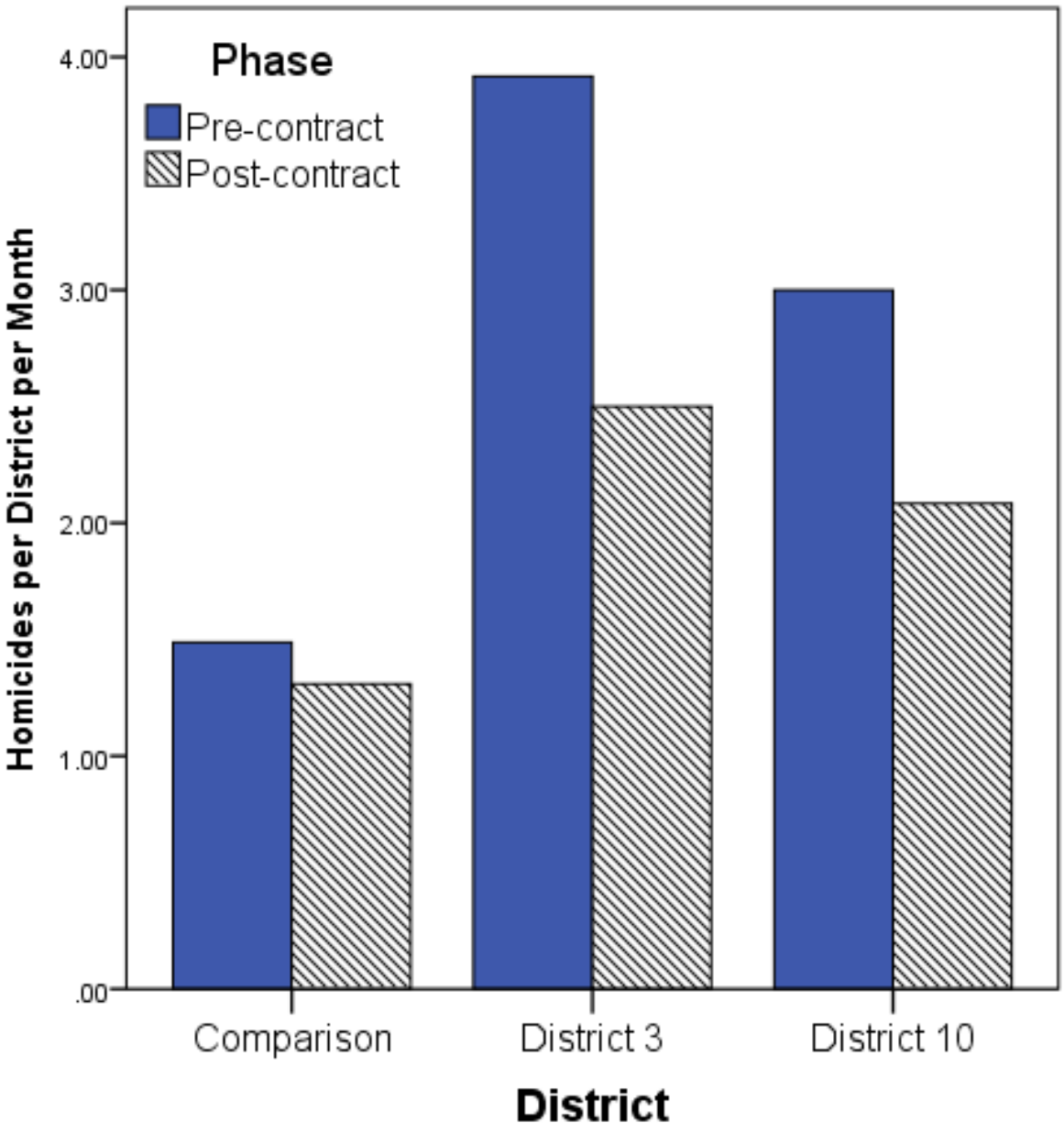

Figure 5c. Pre- and post-contract Levels of Homicide: Comparison and Individual CeaseFire Districts

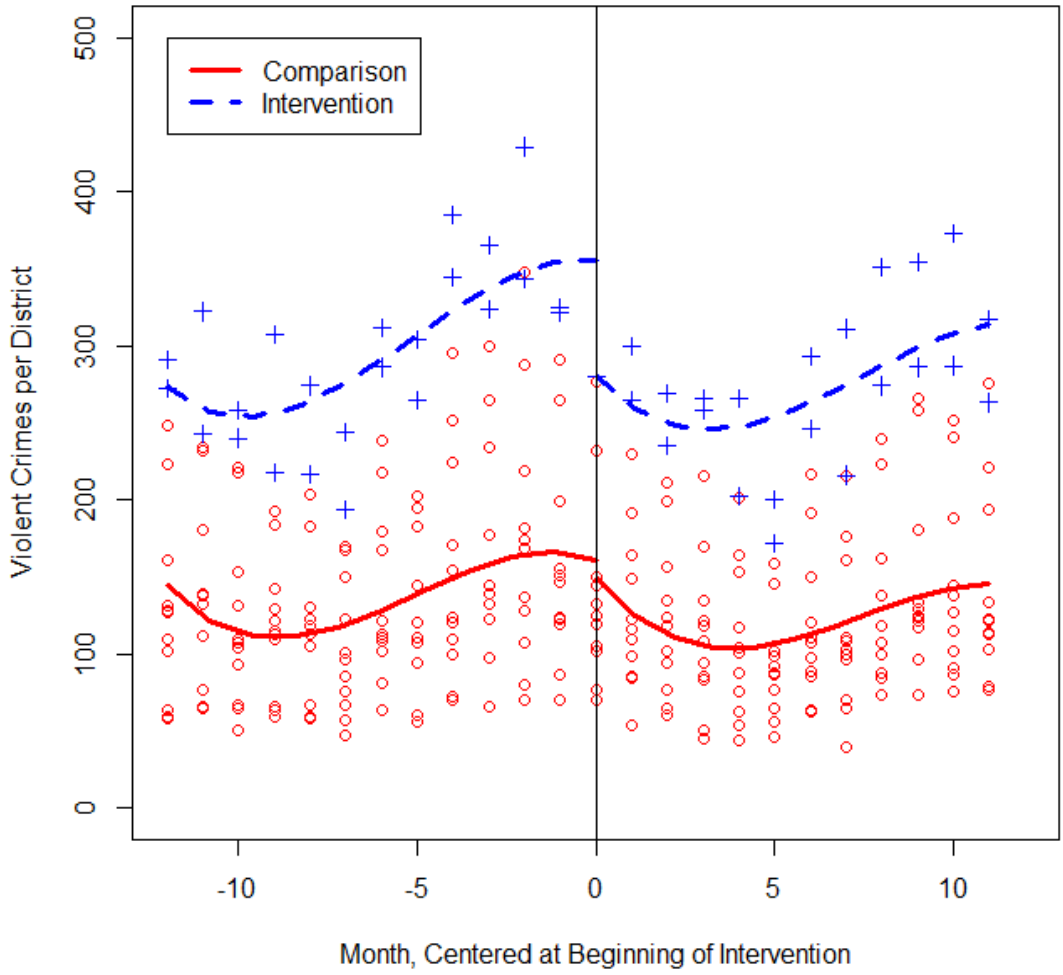

Figure 6a. Trends in Levels of Total Violent Crime over Two Years: Comparison and CeaseFire Districts

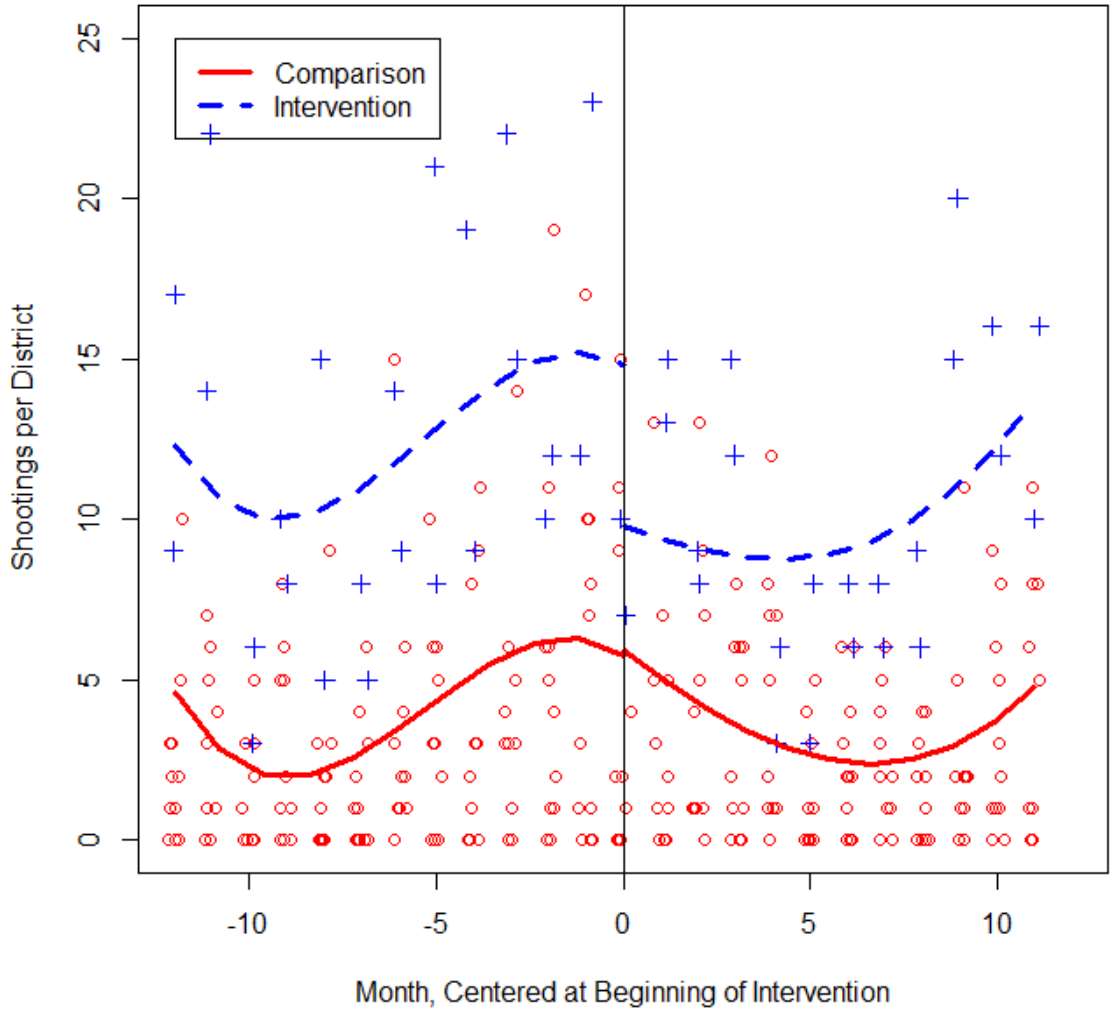

Figure 6b. Trends in Levels of Shootings over Two Years: Comparison and CeaseFire Districts

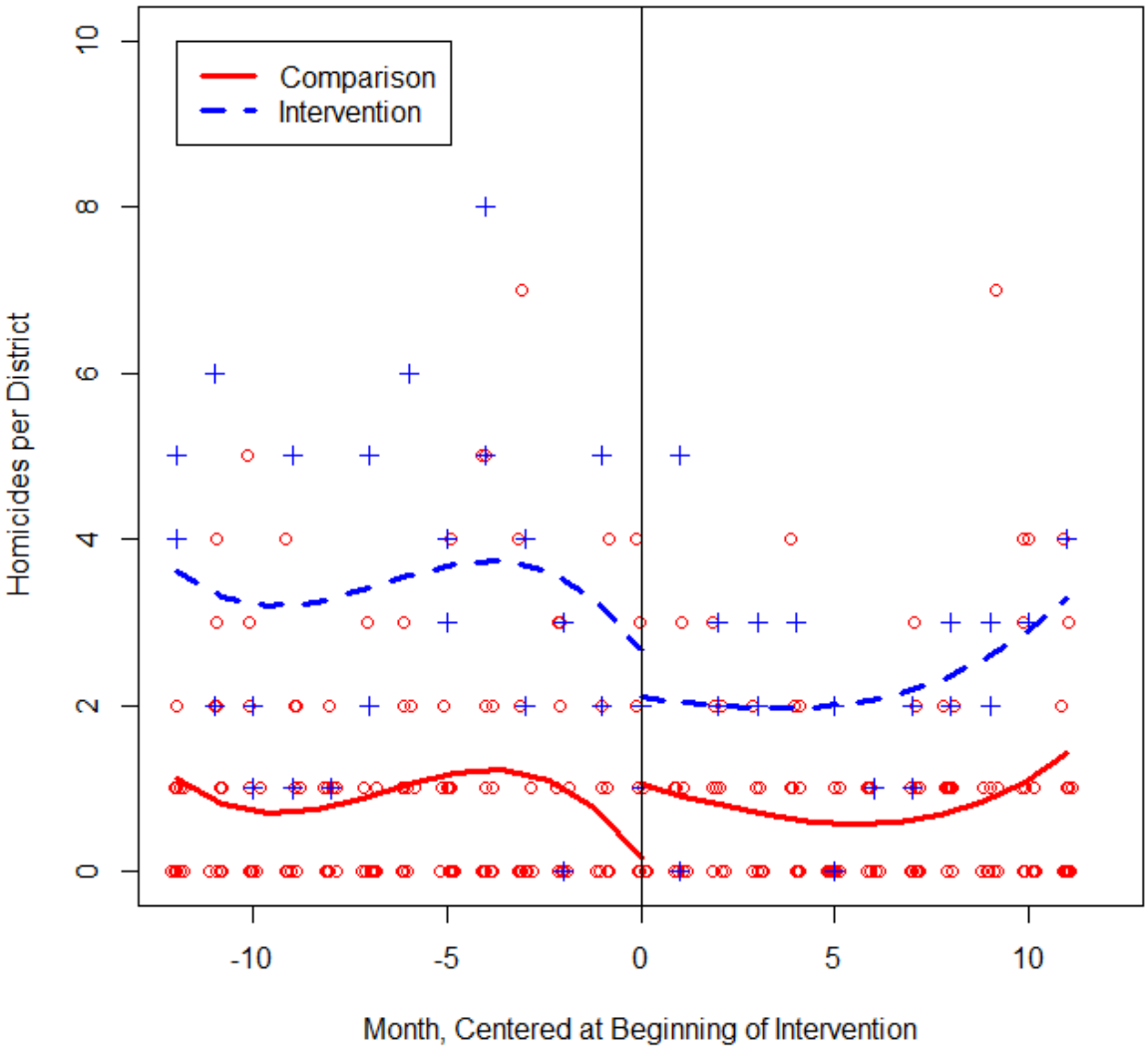

Figure 6c. Trends in Levels of Homicide over Two Years: Comparison and CeaseFire Districts

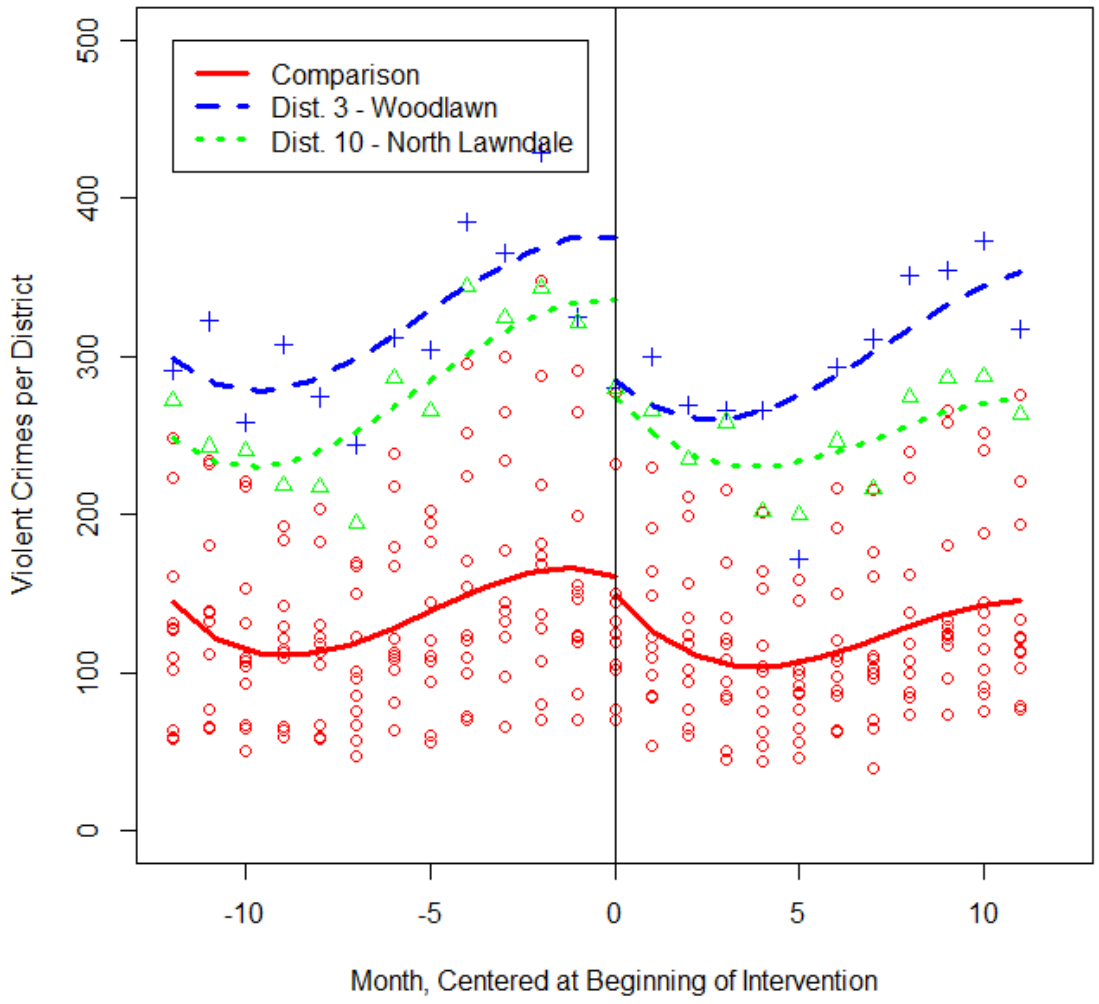

Figure 7a. Trends in Levels of Total Violent Crime over Two Years: By CeaseFire Districts and Comparison Districts

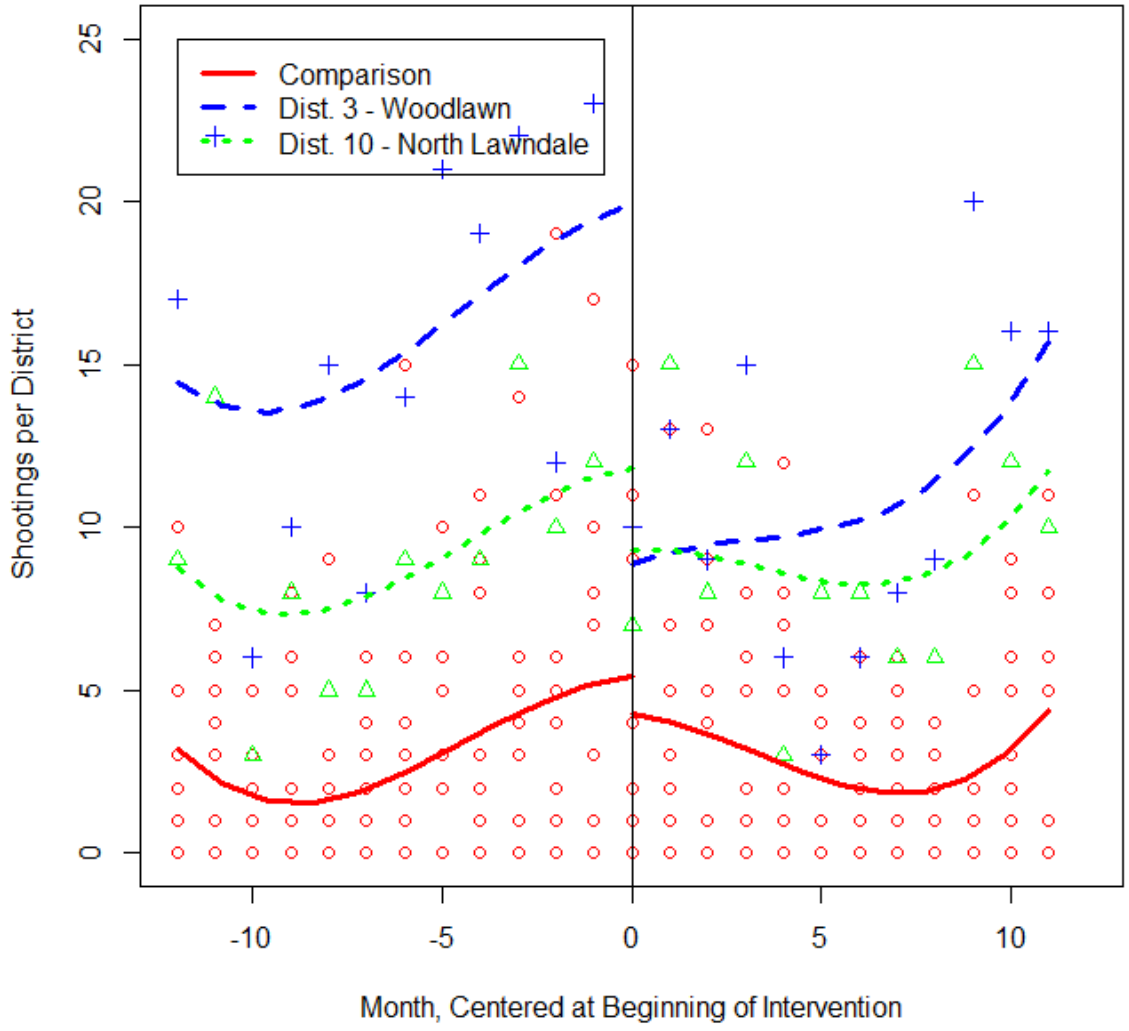

Figure 7b. Trends in Levels of Shootings over Two Years: By CeaseFire Districts and Comparison Districts

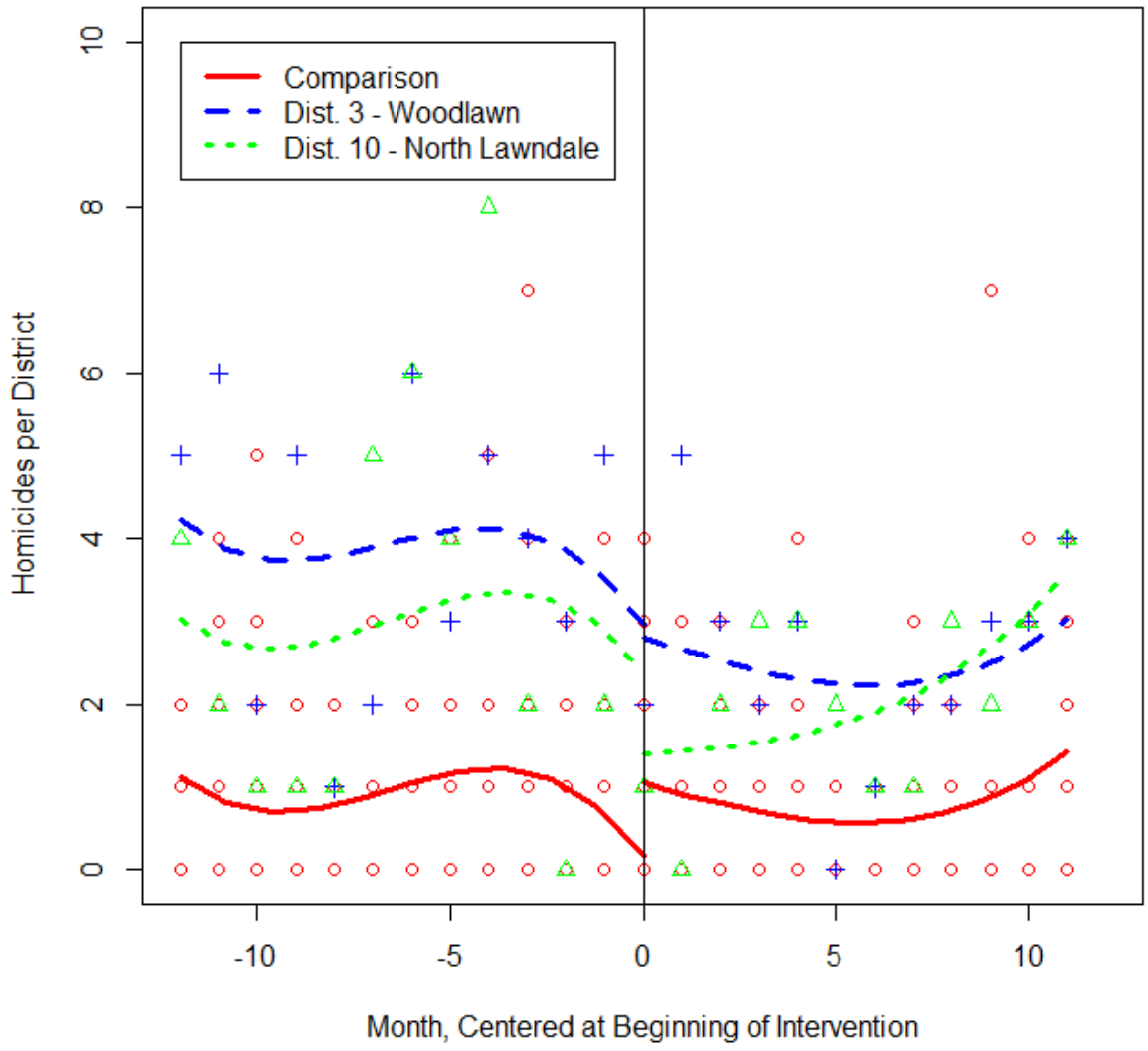

Figure 7c. Trends in Levels of Homicide over Two Years: By CeaseFire Districts and Comparison Districts