Baltimore Ceasefire 365: Estimated Impact of a Recurring Community-Led Ceasefire on Gun Violence

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Objectives. To estimate the impact of recurring community-led, weekend-long ceasefires on gun violence in the City of Baltimore, Maryland.

Methods. The City of Baltimore releases detailed data on all crimes occurring in the city. We compiled daily counts of fatal and nonfatal shootings occurring between January 2012 and July 2019 and fit a Bayesian model to estimate the impact of the ceasefires on gun violence during designated weekends after accounting for yearly seasonality, day of the week, calendar days, and overall time trends. We also looked at the 3-day periods following each 3-day ceasefire weekend to test for a possible postponement effect.

Results. There was an estimated 52% (95% credible interval [CI] = 33%, 67%) reduction in gun violence during ceasefire days and no evidence of a postponement effect on either the next 3 days or the next 3-day weekend following each ceasefire weekend (incidence rate ratio = 0.88; 95% CI = 0.72, 1.06).

Conclusions. The Baltimore Ceasefire weekends may be an effective short-term intervention for reducing gun violence. Future research should aim to understand the key components and transferability of the intervention. (*Am J Public Health.* Published online ahead of print February 20, 2020: e1–e6. doi:10.2105/AJPH.2019.305513)

The homicide rate in Baltimore, Maryland, is among the highest of large cities in the United States, and the vast majority of these killings involve firearms.[1,2]

In mid-2017, community members in Baltimore called for a city-wide, weekend-long cessation of violence under the title Baltimore Ceasefire.[3] They organized 3 public meetings before the first ceasefire weekend with a statement to the city that "Nobody Kill Anybody" for the 72 hours from Friday through Sunday.[4] The movement also incorporated a proactive "peace challenge" and decided to rename itself Baltimore Ceasefire 365 to reflect the importance of peace throughout the year and to distinguish the movement from other initiatives. Since then, ceasefire weekends have occurred on a quarterly basis, with 6 to 10 public meetings held across the city between each of the weekends to coordinate planning and invite participation.

Ceasefire weekends are communicated through personal outreach on the streets of Baltimore, social media, radio, television, public events, and newspaper articles. Throughout the weekend, community members are encouraged to organize peace-building activities, including helping one another connect to resources to address root causes of violence. These activities—which are voluntary—have included rallies, resource fairs, parties, vigils, and poetry readings. In addition, "sacred space rituals" are performed when someone is killed in the city, wherein groups of people visit murder locations to pray, burn sage, and express love in the spaces where someone has lost their life to violence.[5] These efforts are directed at the city as a whole rather than any specific neighborhood.

Although Baltimore Ceasefire 365 shares the term "ceasefire" with several violence reduction initiatives from other cities, it is not modeled after these initiatives. For instance, in Boston, Massachusetts, Operation Ceasefire was part of a focused deterrence approach by criminal justice agencies aimed at gang violence.[6] In Chicago, Illinois, a program that was originally called CeaseFire is now Cure Violence, an intervention that deploys outreach professionals to specified neighborhoods to deescalate and mediate disputes that might otherwise lead to serious violence.[7–12] In 2007, the Baltimore City Health Department itself implemented a replication of Cure Violence called Safe Streets that measured reduced gun violence in 3 of the 4 target neighborhoods.[11] Baltimore also started a focused deterrence approach in 2014 called Ceasefire in which criminal justice personnel directly communicated to targeted individuals that any violence would result in a severe criminal justice response, with that group's final operation occurring in late 2015.[13] Unlike any of these aforementioned initiatives, the Baltimore Ceasefire 365 movement is entirely community-driven and calls for a literal stop to all violence across the city for

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discrete weekend-long periods—days when research suggests gun violence is heightened.[14]

Baltimore Ceasefire 365 is unique from previous and existing initiatives within Baltimore and in other cities, and researchers have not yet tried to estimate the effect of ceasefire weekends on gun violence. In fact, to our knowledge, there have been no evaluations of the effectiveness of any discrete-length ceasefire events in decreasing gun violence in the United States. In this article, we model the impact of Baltimore Ceasefire 365 weekends on gun violence in the city by using data compiled by Baltimore City.

METHODS

The City of Baltimore has released data on every victim-based crime reported by police since January 2012. We used this data set (ranging from January 1, 2012, to July 6, 2019) to count the number of shootings observed on each day (fatal and nonfatal). We then fit a Poisson regression model of daily shooting counts by using the Stan software via the *rstanarm* R package (https://mc-stan.org/rstanarm), which allows for the estimation of multilevel Bayesian models with Hamiltonian Monte Carlo.

The statistical model incorporates the following covariates: a spline for the overall time trend in shootings,[15] a cyclical spline to capture yearly seasonality, a random effect for the day of the week (Monday–Sunday), a random effect for the 366 calendar days of the year (including February 29) to adjust for the effects of special days such as Christmas, a floating indicator for Mother's Day, and a binary predictor for ceasefire days. Baltimore Ceasefire 365 days are the first weekends (Friday, Saturday, and Sunday) of February, August, and November, and the Mother's Day weekend of May, with the first ceasefire weekend occurring in August 2017.

One might raise the concern of a "postponement effect" such that violence that would otherwise have occurred during ceasefire is simply delayed until the weekend is over. We tested this hypothesis by adding an indicator for the 3 days immediately following each 3-day ceasefire weekend as well as the 3-day weekend following each ceasefire weekend.

We did not include demographic or neighborhood-specific covariates (e.g., poverty rates, median household income) in any of these models. Although there are data sources that provide information on long-term trends in such geospatial variables, none of these sources measure short-term changes that would allow us to attribute variance in shootings during single weekends to variance in these factors, and in any case it is not theoretically plausible for geospatial trends to have impacts that are reliably restricted to such brief 3-day time periods. We also did not include separate dummy variables for specific historical events that have influenced trends in gun violence in Baltimore, such as the in-custody death of Freddie Gray and subsequent community and police reaction,[16] the trial of police officers involved in Gray's arrest and transport,[17] or ongoing problems within local law enforcement.[18,19] These events have certainly had a causal impact on gun violence in Baltimore, but their medium- or long-term impacts are captured by the spline time trend in our model, and we are not aware of short-term impacts that coincide with ceasefires.

Please see the data file (available as a supplement to the online version of this article at http://www.ajph.org) for the full data set and an R script markdown that enables the complete reproducibility of our data preparation and analyses.

RESULTS

There were 6024 shootings observed between January 1, 2012, and July 6, 2019. The time series decomposition (excluding the calendar day effect, which can be found in the online supplement but suggests little evidence of consistent changes in number of shootings on specific calendar days) is given in Figures 1 through 3. The long-term time trend (Figure 1) suggests an increase in shootings beginning
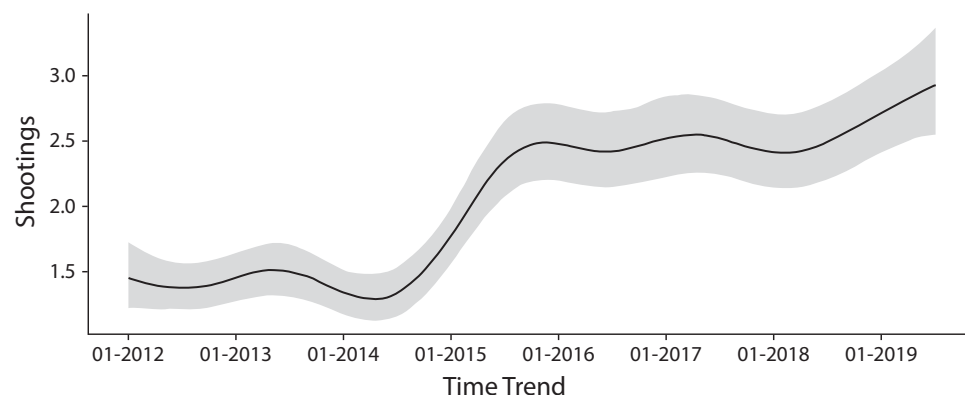
Note. Shaded area depicts 95% credible intervals. Reference date for y-axis is mid-April. The deseasonalized time trend indicates an overall increase in 2015—which is likely associated with events surrounding the death of Freddie Gray, and another increase in mid-2018—which may be an artifact of the automated "ShotSpotter" system, which has led to increased police detection of shootings since its introduction in June 2018.

FIGURE 1—Deseasonalized Time Trend in Number of Shootings: Baltimore, MD, January 1, 2012–July 6, 2019

around 2015, which likely reflects the events surrounding Freddie Gray's death[16] (preceding Baltimore Ceasefire 365 by about 2 years). Another increase is visible in June 2018, which is possibly artificial and attributable to the introduction of the automated "ShotSpotter" system at that time, which increased rates of detection of gunshots in the city.[20] The yearly seasonal trend (Figure 2) confirms that summers display relatively high rates of shootings and the cold winter months of February and March have relatively low rates. There is no real evidence of a weekday effect (Figure 3). The model suggests that Mother's Days (which intersect the May Ceasefire weekends) tend to see a relative increase in shootings on average rather than a decrease, though that effect is not statistically significant (incidence rate ratio [IRR] = 1.28; 95% credible interval [CI] = 0.79, 1.96).

The full model is plotted over the observed data in Figure 4, with model estimates in black and 80% posterior predictive intervals shaded in gray. Ceasefire weekends are visible to the naked eye as 8 downward spikes beginning with the first ceasefire event in August 2017. The model estimates a 52% (95% CI = 33%, 67%) reduction in shootings on ceasefire days. For example, during the out-of-sample ceasefire day of August 2, 2019, the model predicted that there would be approximately 2 shootings (50% posterior predictive interval ranging from 1 to 3) versus the approximately 4 shootings that would be expected on the same day in the absence of a ceasefire (50% posterior predictive interval ranging from 3 to

5). The actual number of shootings observed on August 2, 2019, while this article was in preparation, was 3.

To test for a possible postponement effect, we refit the model with an additional binary predictor for the 3 days following each 3-day ceasefire weekend and the 3-day weekend following each ceasefire weekend. However, we estimated no increase in shootings on these days (IRR = 0.88; 95% CI = 0.72, 1.06).

DISCUSSION

In this study, we evaluated the impact of Baltimore Ceasefire 365 and found that ceasefire weekends feature dramatic reductions in gun violence. While Baltimore Ceasefire 365 organizers have stated that the success of the movement cannot be solely measured by the murder rate and that, even if a murder is committed during the ceasefire weekend, this does not necessarily mean that the effort is a failure, decreasing gun violence is an essential goal of the campaign.[21,22] Although there are no signs of an overall decreasing trend in gun violence in Baltimore, this study suggests a one third to two thirds reduction in gun violence during ceasefire weekends, with no evidence of postponed violence.

This "ceasefire effect" is consistent with or better than estimates from other gun violence initiatives.[23,24] However, it is important to acknowledge unique

characteristics of Baltimore Ceasefire 365 that render direct comparison difficult. Ceasefires represent just 12 days per year across the entire city, whereas most other programs are intended to have a year-round effect on specific neighborhoods, which is a substantively different target. In addition, the Ceasefire Weekend intervention is repeatedly activated for a limited time and then deactivated, producing a natural "ABAB" design that allows for extremely robust causal inference and mostly rules out the influence of lurking geospatial trends.

This unique feature of Baltimore Ceasefire 365 has technical ramifications that make program evaluation easier than it is for other violence prevention programs. For example, a team at Johns Hopkins recently evaluated a Safe Streets program and measured a 2-fold increase in monthly homicides in the Baltimore neighborhood of Elwood Park following the introduction of Safe Streets.[25] However, it is plausible that this measured increase in violence was attributable to independent background trends that were specific to this neighborhood and that would have produced a measurable increase in homicides regardless of the presence of Safe Streets (e.g., gentrification, increasing poverty, or other unknown factors).

By contrast, because the Baltimore Ceasefire intervention is repeatedly applied for 3-day periods across the city and then removed, most of these confounding variables are trivially ruled out, and it becomes unnecessary to include demographic or
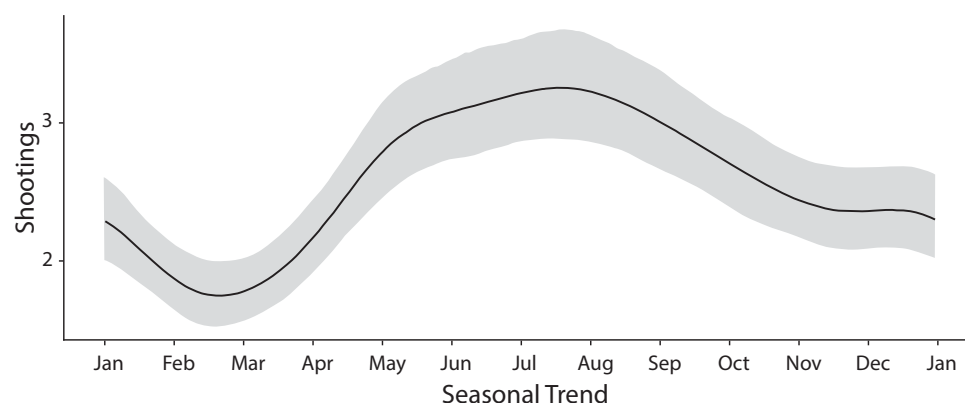
Note. Shaded area depicts 95% credible intervals. The yearly seasonal effect is striking, with summer months showing relatively high rates of shootings and the winter months of February and March featuring relative decreases.

FIGURE 2—Seasonal Trend in Number of Shootings: Baltimore, MD, January 1, 2012–July 6, 2019
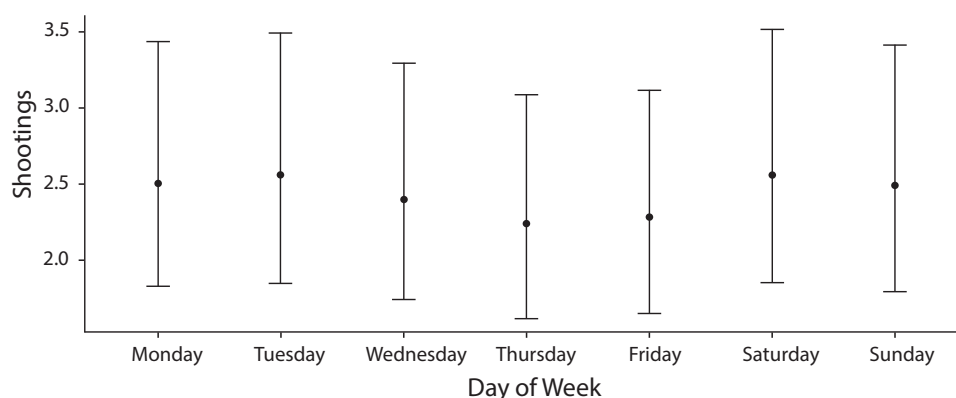
Note. Whiskers indicate 95% credible intervals. There is little evidence of greater or fewer shootings on different days of the week.

FIGURE 3—Weekday Trend in Number of Shootings: Baltimore, MD, January 1, 2012–July 6, 2019

neighborhood-specific covariates in the model (e.g., while poverty is associated with increased violence, it does not cause violence in a series of contained 3-day stretches). The contingent design of the Baltimore Ceasefire 365 movement is thus uniquely amenable to program evaluation and it is therefore easier to cleanly measure its impact.

There are several mechanisms that might explain the success of the Baltimore Ceasefire 365 movement. First, unlike other gun violence interventions, Baltimore Ceasefire 365 is an entirely community-driven approach not affiliated with any agency or government body. By contrast, the Philadelphia One Vision initiative—which was modeled after several focused deterrence and public health strategies but was not found to be effective at reducing violence—was also described as a grass-roots effort, but it collaborated with law-enforcement officials.[12] Gun violence initiatives that are driven by law enforcement may be shaped by these frameworks, which can lead to competing goals and priorities that conflict with community concerns, program ownership, and sustainability.[26,27]

Second, Baltimore Ceasefire 365 is led by Baltimore community members who have been affected by gun violence and who may therefore be more effective interventionists given their background and knowledge. Other gun violence initiatives have also
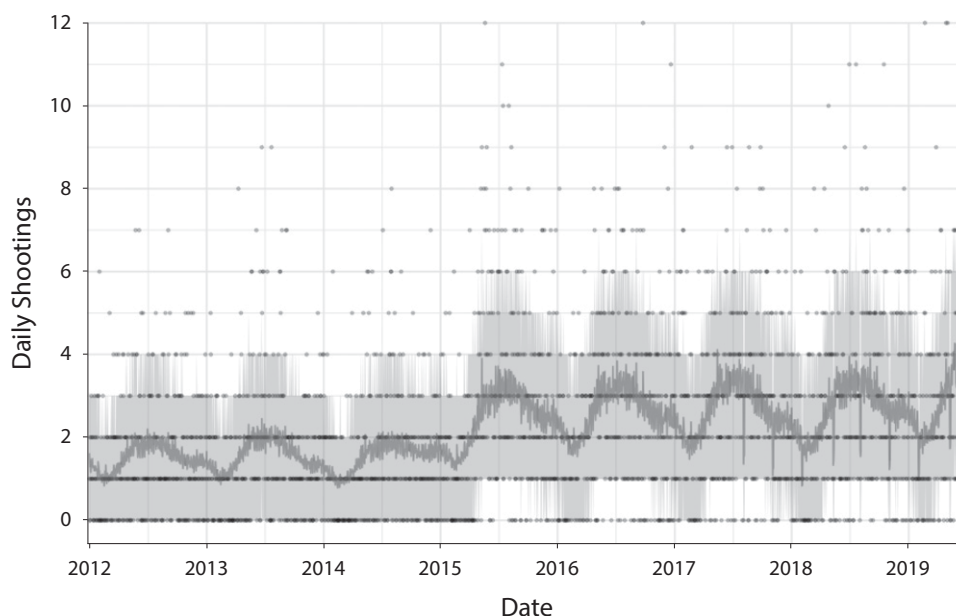
Note. Observed shooting counts are plotted as points. The model estimate is overlaid in dark gray with 80% posterior predictive intervals shaded in light gray. Ceasefire weekends are visible as 8 downward spikes beginning in August 2017.

FIGURE 4—Full Model of Daily Number of Reported Shootings in the City of Baltimore, MD: January 1, 2012–July 6, 2019

attempted to employ members of the target population among their interventionists. For example, Chicago's Cure Violence program uses violence interrupters who reside in the community and who sometimes have a history of gang membership or incarceration.[28] Replication of the Cure Violence model has proven difficult with variable estimates of its effectiveness,[9,11,29] but a study of one of these replications found that successful violence mediation required the outreach worker to have credibility and a presence in the community.[30] Thus, having strong ties to the community may be a key component of effective gun violence initiatives that is amplified in the community-driven Baltimore Ceasefire 365 movement. An additional potential mediating factor is the promotion of peace-building efforts and events that might serve to target and intensify antiviolence messages and produce a stronger impact.

Limitations

One of the key limitations of the present analysis is that we did not measure potential causal factors that could mediate the strength of this ceasefire intervention. We have attempted to create a research design that can be easily replicated with publicly available data, but contextual factors often interact with public health interventions, and transferability of the Baltimore Ceasefire 365 model could be challenging. Future research should aim to understand the key components and mechanisms of action in this intervention that are associated with reductions in gun violence; for example, awareness of the weekend among those at highest risk, credibility of the organizers, perceived social pressures to avoid using violence on those weekends, and the type of violence threatening a city may all affect the strength of this style of intervention, and the importance of these specific factors could be estimated in future research programs.

Researchers and community activists should also consider ways of expanding the impact of this style of intervention beyond specified days. Ceasefire members consciously engage in peace-building activities year-round[31] including providing trainings at schools about conflict management, emotional intelligence, and the effects of trauma; going to murder sites year-round to perform

Sacred Space Rituals; and engaging in community outreach; and some of the ceasefire weekend activities such as resource fairs may help address root causes of violence and, therefore, have an impact beyond the weekend itself. But this data set does not allow us to test the impact of these practices empirically.

Public Health Implications

Gun violence is a pervasive public health problem in the United States, and there is evidence that certain measures are effective at reducing these harms, including limiting access to firearms[32–34] and engaging in focused deterrence and public health initiatives.[6–12] Baltimore Ceasefire 365 offers a rare example of a community-driven, discrete-length intervention to reduce gun violence. We found that this initiative produced a substantial reduction in shootings during designated weekends. While communities wait for effective policies to prevent gun violence, this movement has the potential to reduce harms, and future research should aim to build a roadmap for potential replication of this intervention in other jurisdictions. AJPH

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