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City-Wide Firearm Violence Spikes in Minneapolis following the Murder of George Floyd: A Comparative Time-Series Analysis of Three Cities

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Abstract: This study investigates the aftermath of a high-profile violent police incident as it relates to city-wide firearm violence. Utilizing two Midwest cities (Kansas City, Missouri and Omaha, Nebraska) as comparison cities, we assess whether violent firearm incidents increased in Minneapolis after the murder of George Floyd. Multiple interrupted time-series analyses showed statistically significant increases in weekly firearm incidents in Minneapolis (AME = 10.63, $p < 0.05$) and Omaha (AME = 1.47, $p < 0.5$) following the murder of George Floyd. No significant results were found in Kansas City. Similar relationships were found when examining monthly firearm incidents. The firearm spike in Minneapolis thus represents an approximate 10-fold increase in weekly firearm incidents relative to that observed in Omaha. We conclude, therefore, that the murder of George Floyd was associated with a substantially greater increase in firearm violence in Minneapolis than in the two comparison cities. Police training to reduce police violence and public health approaches to reduce urban firearm violence will alleviate the social and economic impacts of violence on federal and state governments.

Keywords: urban violence; firearm violence; police violence; violence exposure

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1. Introduction

Police violence against unarmed Black men, such as the murder of George Floyd in Minneapolis, has brought about substantial societal discussion and has been deemed a serious public health issue [1]. For Black men 25–29 years of age, police violence is a leading cause of death (roughly 3.4 annual mortality rate, per 100,000), which is higher than HIV, cancer, diabetes, chronic lower respiratory disease, and cerebrovascular disease [2]. Community–police relations are tarnished following such events, leading to a lack of trust and confidence in the police [3]. Civil unrest may ensue as many of these high-profile incidents (e.g., those incidents that are covered nationally by media, typically involving violence against Black Americans) [4] spur protests centered around racial justice, whereby police focus their efforts to maintain public order [5]. Additionally, police violence may negatively impact the mental health of the local community and impede citizen's ability to cope with these events [6]. Therefore, high-profile police violence may lead to widespread violence, especially in jurisdictions in which these events occur.

Firearm violence is one of the leading causes of morbidity and death in the U.S., ranking highest in firearm-related homicides compared to other modernized countries [7]. Further, firearm-related deaths and injuries disproportionately affect racial/ethnic minority populations throughout the country [8]. Not only is firearm violence a public health

concern, but exposure to such violence has been deemed a social determinant of health [9]. Exposure to firearm violence can contribute to suicidal ideation, depression, and stress [10].

Using Minneapolis as the primary city of interest, the present study investigates whether violent firearm incidents (hereafter "firearm incidents") increased following the murder of George Floyd. To examine the potential of broader regional effects of the George Floyd murder, we compare Minneapolis to two similarly sized Midwestern cities. The findings from this study have implications for public health, clinical, and police outcomes.

2. Quasi-Experimental Materials and Methods

Outcome data were obtained from gunviolencearchive.org, a reputable nonprofit organization that utilizes information from over 7500 sources to triangulate the accuracy of their data collection [11]. Several steps are taken to validate a variety of firearm-related incident data, and links to every firearm incident are provided on the website. This database is often used in other scholarly research [12]. Given that the high-profile murder of George Floyd (a Black man) at the hands of police, which occurred in Minneapolis, we hypothesize that, relative to Omaha and Kansas City (two midwestern cities comparable in population size and for which data were available), we will observe the largest increase in firearm incidents in that city following the week during which Floyd's death occurred [13].

Statistical Analysis

Because firearm incidents in which no injury or fatality occurred are less likely to be captured [14], the dependent variable consists of any and all firearm incidents in which one or more persons were wounded or killed (including domestic violence incidents, inter- and intra-racial crimes, etc.) that occurred within the three cities. The timeframe for the analysis is 1 January 2015 to 16 September 2021. The unit of analysis is weeks, ranging from week 1 of 2015 to week 37 of 2021. George Floyd was killed on 20 May 2020—the 21st week of that year. Thus, the intervention point is coded as one for the week of Floyd's murder and after and zero for weeks before Floyd's murder, resulting in 280 pre-intervention and 69 post-intervention observations (total weeks = 349). We also examined monthly firearm incidents as a supplementary analysis. The timeframe for the monthly firearm incident data was October 2014 to September 2021, which provided 67 pre-intervention and 17 post-intervention periods (total months = 84).

Because the dependent variable consists of the number of firearm incidents per week, we utilized interrupted time series count models for the analysis [15,16]. The inclusion of Omaha and Kansas City serve as a check for history effects, a major threat to internal validity in interrupted time series models [13,17]. Even more, comparative interrupted time series designs allow researchers to control for history bias of co-interventions (e.g., COVID-19 lockdowns/policies) that run parallel with the intervention of interest [13]. As is typical for such analyses, initial models included a linear trend variable and 11 indicator variables for months to adjust for seasonality (with January as the referent month) [15,18]. To address concerns regarding overdispersion, heteroskedasticity, and serial correlation, we estimate negative binomial regression count models using Newey–West 'HAC' (Heteroskedasticity and Autocorrelation Consistent) standard errors with a first-order temporal lag [19,20]. Models were initially estimated using Poisson regression, but the Pearson dispersion statistic ranged from 1.20 to 1.75 across models indicating substantial violations of the Poisson mean-variance equality assumption (overdispersion). Though some overdispersion remained across cites when estimating negative binomial regressions, it was substantially reduced (see Table 1). All estimates are presented as average marginal effects (AMEs). Estimates from the monthly analyses are noted in the results section.

Table 1. Interrupted time-series analyses of the impact of the murder of George Floyd on the average number of weekly violent firearm incidents in three cities.

	AME	*P*	SE	95% CI	Pearson Dispersion Statistic
Minneapolis					1.051
Intervention	10.634	0.000	1.014	4.408, 8.452	
Quadratic Trend [a]	1.006	0.002	0.002	1.002, 1.009	
Omaha					
Intervention	1.469	0.019	0.242	1.064, 2.028	1.050
Linear Trend	1.000	0.006	0.001	0.998, 1.000	
Kansas City (MO)					
Intervention	0.944	0.620	0.110	0.752, 1.185	1.061
Linear Trend	1.001	0.091	0.000	1.000, 1.001	

Notes: AME = average marginal effect. Month indicators not shown. Pearson dispersion statistic = 1/model degrees of freedom. [a] The linear trend represents the lower-order term in the presence of the nonlinear (quadratic) effect; margins does not display the nonlinear term as a point estimate.

3. Results

During the timeframe of the study, Minneapolis experienced a total of 1351 firearm incidents (3.87 incidents per week on average, 16.15 per month), Omaha experienced 858 firearm incidents (2.46 incidents per week on average, 10.70 per month), and Kansas City experienced 1640 firearm incidents (4.70 incidents per week on average, 20.02 per month). In Minneapolis, the average number of firearm incidents per week was 2.16 (9.01 per month) pre-intervention and 10.81 post-intervention (44.29 per month). The sharp increase in the average number of weekly (and monthly) incidents observed in Minneapolis was not observed in Omaha or Kansas City. Specifically, Omaha experienced an average of 2.39 firearm incidents per week pre-intervention (10.51 per month) and 2.74 incidents per week post-intervention (11.47 per month), while Kansas City experienced an average of 4.66 incidents per week pre-intervention (19.75 per month) and 4.87 incidents per week on average post-intervention (21.12 per month). Figure 1 presents graphically five-week moving average time series plots of the weekly counts of firearm incidents pre- and post-intervention for all three cities. Clearly, Minneapolis experienced the largest and most abrupt increase in the number of shootings following Floyd's murder.

Table 1 presents the results from the best fitting models for all three jurisdictions based on Akaike information criterion (AIC), Bayesian information criterion (BIC), likelihood ratio tests, and Pearson dispersion statistics [21]. For Minneapolis, adding a quadratic trend variable provided the best to the data, while linear trend variables provided the best fit to the data for the other two cities. Models also were estimated with varying temporal lags and seasonality effects, though conclusions remained the same.

Results from Minneapolis indicate a statistically significant and large increase in the average number of firearm incidents per week following the George Floyd murder. Specifically, compared to the pre-intervention period, Minneapolis experienced an increase of 10.63 firearm incidents per week on average following intervention (AME = 10.63; $p < 0.001$; 95% CI = 4.41, 8.45). The best fitting model for monthly firearm incidents in Minneapolis also showed statistically significant ($p < 0.001$) increases in 48.07 average monthly firearm incidents, following the murder of George Floyd. While the increase in the average weekly number of firearm incidents observed in Omaha post-intervention was much smaller than in Minneapolis, the effect was statistically significant (AME = 1.47; 95% CI = 1.06, 2.03). Results for the Omaha monthly firearm incidents model, however, did not show a significant effect. In Kansas City, there was no statistically significant effect or a substantive difference in the average weekly number of firearm incidents (AME = 0.94; 95% CI = 0.75, 1.19). Like Omaha, the Kansas City monthly firearm incidents model showed no statistically significant effect.

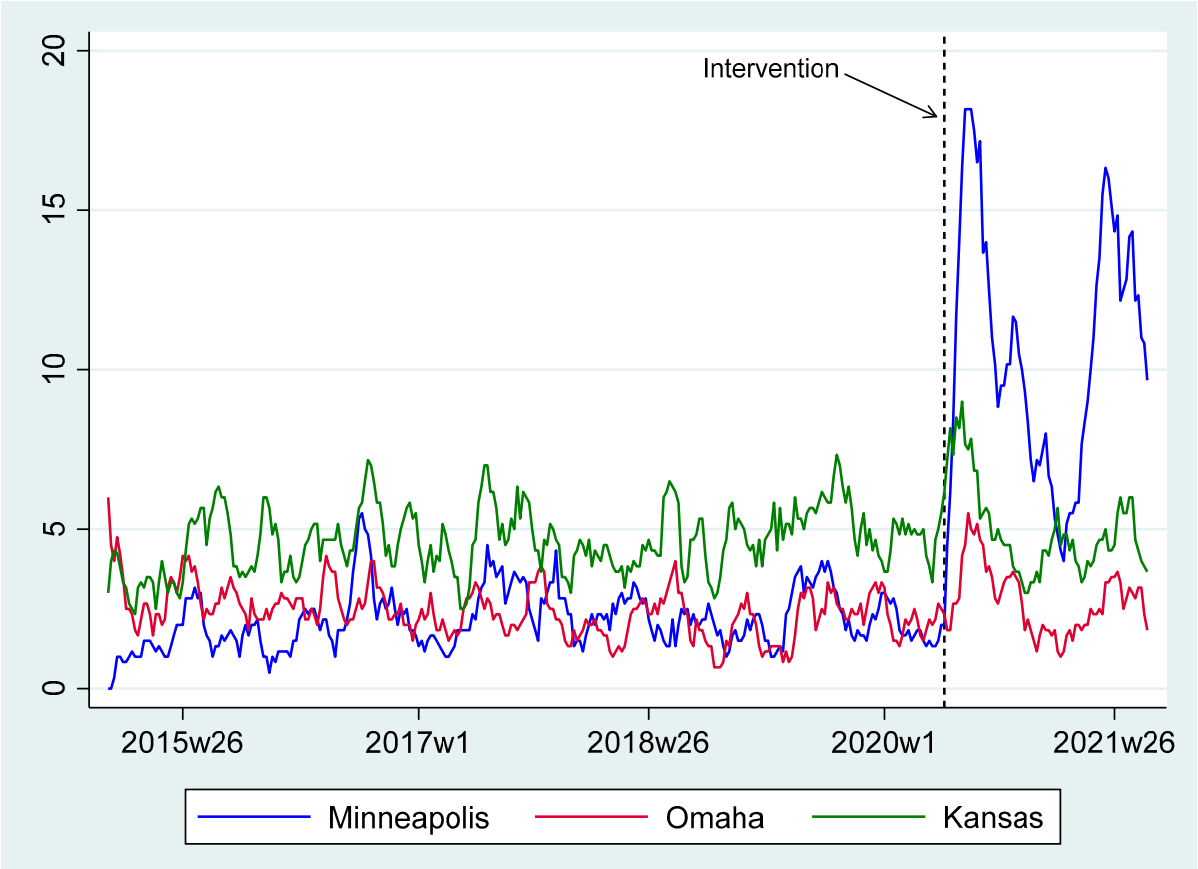

Figure 1. Five-week moving average time series plot of weekly counts of firearm incidents. Note: The dashed line represents the week in which George Floyd was killed (the 21st week of 2020).

4. Discussion

This study tested whether a high-profile incident of police violence affected city-wide firearm violence within the city in which the event occurred, compared to two other geographically proximate cities with similarly sized resident populations. Specifically, we tested whether the murder of George Floyd by former police officer Derek Chauvin impacted firearm violence within Minneapolis compared to Kansas City and Omaha. In Minneapolis, we found a significant and substantially abrupt spike in firearm violence following the murder of George Floyd. While we did not find a statistically significant change in firearm violence in Kansas City, we did find a statistically significant increase in weekly (but not monthly) firearm violence in Omaha. However, compared to the modest increase found in Omaha, the city in which George Floyd was murdered experienced over a 9-fold increase in average weekly firearm incidents (10.63/1.47 = 9.16) and an almost 12-fold increase in average monthly firearm incidents in relation to the comparison states post intervention. To emphasize, during the 69 weeks following the George Floyd murder, Minneapolis experienced an average of over 9 additional firearm incidents per week (and an average increase of roughly 43 incidents per month). Thus, the three Midwestern cities examined in this study were impacted differently, with the city in which the murder of Floyd by police occurred being impacted the most. While (sometimes violent) protests over the murder of George Floyd occurred across the U.S. and even internationally, we might expect that increases in firearm violence in response to such incidents to be most pronounced in the jurisdiction in which they occur.

There may be some environmental and societal factors that may contribute to increased firearm violence rates throughout American cities in response to high-profile incidents of police violence directed against Black Americans. First, in the midst of a high-profile violent

police incident such as the murder of George Floyd, the city where the event happened (as well as other American cities) may experience a number of protests. Such civil unrest may spur a number of violent incidents in cities of protests. Second, scarce police resources may be deployed to the areas of the protests, leaving other areas of cities vulnerable to violent encounters. Third, levels of trust and confidence in police may be decreased, whereby citizens are less likely call the police to report a violent incident [22]. Four, following tragic incidents like that in Minneapolis, American communities may experience psychological distress, anger, and aggressive feelings, which are emotions that may contribute to firearm violence [23]. Finally, at the time of this event, America was, and still is, suffering from a global pandemic, which in conjunction with police violence may adversely affect mental health and inspire civil unrest [24]. A mixture of these factors may all contribute to increased firearm violence following a high-profile violent police incident.

Several policy implications are proposed based on the findings from this study. First, our results indicate there was a substantial increase in the number of firearm incidents in the 69 weeks (17 months) following the high-profile violent police incident in Minneapolis. Second, it is estimated that from 2015 to 2018, the government paid over 39 billion dollars to victims or their families due to police violence [25]. Similarly, it is estimated that firearm violence costs federal, state, and local governments over 34 million dollars a day in social costs [26]. Therefore an increased emphasis on police training emphasizing de-escalation techniques and accountability is needed to help prevent future police violence [27,28]. Although police training is expensive and requires additional resources, the cost of proactive in-service training is cost-effective by avoiding the social costs and payouts to victims and their families [29]. Thus, it may be logical to conclude that reducing police violence may affect city-wide firearm violence, which inevitably takes a toll on the economy and public health/medical resources [30]. That is, firearm violence contributes to excessive and costly emergency room visits that further stresses an already burdened healthcare system [31]. In sum, reducing police violence may not only help alleviate economic stress for police, medical, and public health agencies, but it may also may free up other important community resources that may help prevent violence within communities (e.g., funding schools, nonprofit organizations). Reducing police violence will allow more funding for public health approaches to violence reduction, such as Cure Violence, which has been shown to be an effective violence reduction strategy [32]. Further, studies have shown that communities that experience police violence may later struggle with negative outcomes (e.g., PTSD, substance abuse); therefore, disseminating public health resources to these communities in the aftermath of such incidents may ameliorate the negative consequences of such trauma [4,33]. In the aftermath of police violence, the historically strained relationship between police and communities of color [34] will worsen and potentially negatively affect police-community relationships, which may contribute to greater under-reporting of crime by residents of minority communities. Reducing police violence would likely help mitigate this tense relationship.

Scholars have deemed firearm violence as a public health issue, and research should consider factors including personal, societal, environmental, and political influences that may contribute to firearm violence [35]. Additionally, the death of Black men at the hands of police is not only a public health issue but also a civil rights issue. One in 1000 Black men are killed within their lifetime by the police in the United States [2]. Tragic events like the killings of Michael Brown and George Floyd at the hands of the police not only victimize those individuals but potentially their communities as well. This study provides new insight on the effects of police violence and community firearm violence, both which disproportionately affect the Black community [36]. Continuing to uncover factors that may contribute to increases in firearm violence throughout cities, such as police violence, may help prevent or reduce community firearm violence. This research is one step in that direction.

Like all scientific research studies, the current study does not come without its limitations. First, we were unable to assess whether other cities of the United States, especially

those that experienced extensive protests, experienced increases in firearm violence following the murder of George Floyd. Second, we did not assess whether other cities that experienced high-profile violent police actions against Black Americas (e.g., Michael Brown, Philanda Castile), also saw increases in firearm violence. Third, while we collected data through September 2021, we were unable to assess whether the increase in shootings continued through the present. Future research should attempt to address these limitations to further understand the negative consequences that may occur after a high-profile incident of police violence.

5. Conclusions

Shortly after a city experiences a high-profile violent police incident, public health resources such as mental health services, outreach initiatives, and nonprofit organizations should be deployed to help mitigate the negative effects of such incidents [37]. Such efforts also may help prevent increases in firearm violence. Proactive, evidence-based police training and improving police–citizen interactions are tools that could help prevent excessive morbidity and mortality caused by the police violence, especially against Black men and women. In the aftermath of a high-profile violent police incident, cities that are directly affected may need greater governmental and nonprofit support.

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