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Examining the immediate effects of COVID-19 on residential and commercial burglaries in Michigan: An interrupted time-series analysis

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ABSTRACT

Purpose: Research assessing the relationship between COVID-19 lockdown restrictions and crime is growing. Attention to the nuances of burglary and intra-state variation in lockdown restrictions has received less attention. The current study contributes to this ongoing body of research by investigating the relationship between COVID-19 lockdown restrictions and burglary across four cities in Michigan.

Method: We use an interrupted time-series design to analyze weekly counts of residential and non-residential burglary from 2018 to 2020 in four Michigan cities: Detroit, Grand Rapids, Kalamazoo, and Lansing.

Results: Findings demonstrate that the relationship between the lockdown and weekly counts of burglary vary by the type of burglary and the city being analyzed. Residential burglaries in half of the sampled cities declined during the Michigan lockdown order. Commercial burglaries increased during the lockdown order in only one of the four cities examined.

Conclusions: City-wide crime trends following lockdown orders during the pandemic are not shared equally and vary according to the type of burglary under examination. In studying the effects of COVID-19 on crime, researchers should account for crime- and city-specific dynamics which may influence crime trends. Further, practitioners and policymakers should consider the impact of similar lockdown orders on burglary trends during public health emergencies.

The COVID-19 pandemic brought about an unprecedented time in recent history. In the United States, efforts to reduce the spread of the novel coronavirus were centered around “social distancing,” a phrase that progressed from a recommended pattern of behavior to an institutionalized way of life through stay-at-home orders. Citizens nationwide experienced fundamental changes to their daily routines, with people working from home, opting for take-out meals rather than dine-in, and overall limiting their time spent away from their homes. Moreover, businesses deemed non-essential suspended their operations or mandated their employees to work from home, resulting in several establishments increasingly left unattended.

In Michigan, for example, the “Stay Home, Stay Safe” order went into effect on March 24th, 2020 and, like many other lockdown orders nationwide, dictated that residents may only leave their homes for a prescribed set of activities, including but not limited to going to the grocery store, going on walks, or filling vehicles with gas (State of Michigan, 2020a). Prohibited activities included attending any public gathering, going to malls or restaurants, or visiting someone in a care facility (i.e., hospital, nursing home).

The state-mandated order also required businesses to fully adopt work-from-home practices, restrict the number of workers that could be present at a work location, and implement strict social-distancing standards for employees and customers. Critical infrastructure workers, such as those in health care, law enforcement, and grocery stores were permitted to report to work in person in order to “sustain or protect life” State of Michigan (2020a). McCann (2020) ranked all 50 U.S. states from the weakest COVID-19 restrictions (1st) to the strictest (50th) based on 17 metrics relating to state-level policies, such as the presence or absence of public mask requirements, restrictions on large gatherings, and health checks at restaurants. Michigan ranked 30th, indicating the state’s COVID-19 restrictions were stricter than the majority of states but were somewhat moderate compared to others.

Since the implementation of several state-wide lockdown orders, a great deal of research has begun to explore what impacts these may have for broader society. Several studies in the field of criminology and criminal justice have done so by examining how crime trends may have shifted due to changes in the routine activity of human behavior following these lockdown orders. These studies have relied on Cohen...
and Felson’s (1979) routine activity theory to explain why state-mandated lockdown orders were associated with changes in various forms of crime such as domestic violence, homicide, and assault (e.g., Ashby, 2020; Piquero et al., 2020; Rosenfeld & Lopez, 2020).

Despite the recent emergence of research on this front, policy discussions have thus far been informed by preliminary evidence. Research that has evaluated how stay-at-home orders impacted crime trends have thus far primarily relied on data from single cities within one state or several cities from multiple states (e.g., Ashby, 2020; Mohler et al., 2020; Nix & Richards, 2021; Piquero et al., 2020). As noted by others, the evidence on this research front remains incomplete due to limitations in data and methodological scope (Nix & Richards, 2021; Piquero, Jennings, Jemison, Kaukinen, & Knaul, 2021). Indeed, more robust empirical research that is considerate of each state’s situational circumstances is needed to effectively inform data-driven policies for managing similar public health crises.

Our analysis is largely informed by the recommendations of Stickle and Felson (2020) to conduct crime-specific, temporally considerate, place-based analyses when assessing state lockdown orders as exogenous sources of variation that influence crime trends. Accordingly, we examine data from multiple cities that fall under restrictions of a single stay-at-home order, utilize a geographically sensitive coding scheme to accurately discern residential and commercial burglaries, and analyze data over a three-year period through a series of interrupted time-series analyses. Specifically, the current study seeks to empirically examine the extent to which the Michigan mandatory stay-at-home order is significantly associated with changes in weekly counts of commercial and residential burglary across four Michigan cities.

1. COVID-19, state lockdown orders, and crime

In response to the emergence of the global pandemic, a wealth of timely research has collectively contributed to real-time initiatives that evaluate the impact of the COVID-19 pandemic on public health issues. For example, several studies have shed light on some of the consequences of the global pandemic and stay-at-home orders for people’s mental health. As noted by Marroquín, Vine, and Morgan (2020) and others, peoples’ depression, generalized anxiety, and stress have been found to increase in varying degrees during the pandemic and immediately following lockdown orders (Pieh, Budimir, & Probst, 2020; Tull et al., 2020).

Criminologists have begun to grapple with the consequences of this public health crisis as it relates to crime. Using a theoretical framework founded on routine activities (Cohen & Felson, 1979), many have suggested that changes in the routine structure of human mobility due to the pandemic, social distancing, and lockdown orders may fundamentally alter the presence of suitable targets and lack of capable guardians. This change in routine activity is, in turn, expected to influence the frequency and magnitude of opportunities for victimization Stickle and Felson (2020), Mohler et al. (2020).

Accordingly, researchers have focused on evaluating how the global pandemic and lockdown orders may have altered the opportunity structure for certain crimes. For example, Rosenfeld and Lopez (2020) assessed how trends in violent and property offenses have changed over the course of the pandemic. Their findings suggest violent crimes such as homicide and aggravated assaults rose quite dramatically during May and June of 2020. In contrast, larceny, drug offenses, and motor vehicle thefts dropped significantly during the same time periods (Rosenfeld & Lopez, 2020). Campedelli, Aziani, and Favaron (2020) found similar declines in offenses such as robbery and theft after the state-mandated lockdown in Los Angeles, California. However, Ashby (2020) and Campedelli et al. (2020) both find that violent offenses did not significantly drop following stay-at-home orders.

A burgeoning area of research on this front has focused more specifically on several crime-specific trends and their relation to the state-mandated stay-at-home orders as well. Several studies have found that domestic violence calls increased shortly after stay-at-home orders across several cities in different states (Bullinger, Carr, & Packham, 2020; Mohler et al., 2020; Nix & Richards, 2021; Piquero et al., 2020). However, as Nix and Richards (2021) and others have noted, these trends may be temporary (Piquero et al., 2020). Others have noted a similar temporary effect of the stay-at-home order on crime for violent and property offenses as well (Campedelli et al., 2020).

One lingering question that has received comparatively less attention is how the state-mandated lockdown orders have influenced specific property offenses such as burglary. According to Stickle and Felson (2020), burglary offenses may apply especially well within the context of the routine activity framework and state-mandated orders because of their direct associations with residential and commercial areas. In alignment with the original tenets outlined by Cohen and Felson (1979), one should expect that state-mandated lockdown orders will reduce opportunities for residential burglary by increasing the presence of capable guardians in homes. In contrast, these orders are expected to increase opportunities for commercial burglary due to nonessential businesses suspending on-site operations, leaving business locations without employees, and thus absent of capable guardians. This systemic change in the presence of capable guardians would, according to routine activity theory, increase the number of suitable commercial targets (i.e., absent commercial business establishments) and decrease the number of suitable residential targets (i.e., occupied residential domains). Changes in burglary trends would, therefore, be predominantly influenced by this shift in opportunity structures for residential and commercial targets given that motivated offenders are theorized to be omnipresent in society (Cohen & Felson, 1979). According to these postulations, supporting evidence would indicate higher rates of burglary at business locations and lower rates of burglary at residential locations following the implementation of lockdown orders.

The consistency with which conclusions are derived for violent offenses and their relation to state-mandated lockdown orders do not, however, parallel findings for burglary. Campedelli et al. (2020) find no support to suggest that burglaries declined following the California state-mandated order in their examination of official crime report data in Los Angeles. However, Mohler et al. (2020) find that burglaries decreased significantly following the order in Los Angeles, California using calls for service data. Discrepant findings may be due in part to differences in data and statistical analyses employed; however, Campedelli et al. (2020) additionally emphasize that neither study separated burglary as occurring at residential and non-residential locations. This distinction may also lead to differences in findings with important theoretical and empirical implications as noted above.

We suggest disparate findings in the current research exist for two reasons, though others may exist as well. First, few have separated burglaries into their respective locations of occurrence. For example, burglaries can occur at residential or non-residential locations. Piquero et al. (2021), find that residential burglaries do not significantly drop following the lockdown order in Queensland, Australia; however, their results also indicated that non-residential burglaries increased significantly after the order was implemented. Others, such as Abrams (2021), also find similar declines in residential burglary and increases in non-residential burglary following lockdown orders across several US cities. This distinction not only emphasizes the important empirical implications for discerning the geographical context of burglary but also sheds light on potential theoretical implications as well.

Additionally, we emphasize that for theoretical testing and application, non-residential burglary can be further specified as occurring at commercial or non-commercial sites. For example, a burglary that occurs at an abandoned building or school might be considered a non-residential burglary. These locations are not, however, commercial

1 For a timely review of the latest research on domestic violence during the COVID-19 pandemic, see Piquero et al. (2021).
given that they possess different routine structures and fundamental roles when compared to commercial locations like hotels, shopping malls, and retail stores that distribute marketable goods and services. Inconsistent findings may exist in the literature due to underlying differences in where burglaries occur, which in turn, reflect different theoretical processes outlined in our application of the routine activity framework.

Those who have disaggregated burglary by residential and commercial locations generally find differences in trends that align with the theoretical expectations outlined above as well. For example, Ashby (2020) found that residential burglary dropped significantly following state-mandated orders across 16 major US cities. Rosenfeld and Lopez (2020) similarly found that residential burglaries dropped during the same time periods across several major US cities whereas commercial burglaries increased significantly over the course of 2020. Descriptive news reports from cities such as Los Angeles, San Francisco, San Diego, Oakland, and Seattle indicate increases in commercial burglary rates as well (Loftstrom & Martin, 2020; Miller, 2020), whereas cities such as New York City, Sioux City, and Tulsa reported decreases in residential burglaries (Berg, 2020; Jacobs & Barrett, 2020; Lenzini, 2020). Alternatively, in Vancouver, Canada, Hodgkinson and Andreesen (2020) reported a significant initial increase in commercial burglaries during COVID-19 followed by a notable decrease, with residential burglaries demonstrating no significant changes.

Despite these findings, we emphasize that classifying burglary as a residential or commercial incident warrants methodological considerations that have additional implications for empirical analyses. A recent study conducted by Felson et al. (2020), which is one of the few studies that provide insight on classifying burglary by location of occurrence, advance research on this front by assessing residential and commercial burglary rates in Detroit, Michigan during the month of March 2020. The authors discern residential burglaries from commercial burglaries through census block data, with blocks comprised of over 90% residential properties being considered residential, and those under 90% classified as commercial blocks. Felson et al. (2020) preliminary descriptive assessment revealed burglaries in the residential block groups decreased by 43% from the beginning to the end of March 2020. Further, burglaries in the blocks classified as commercial increased by 8% during this same time period.

Although this study produces a model approach for future research to follow, the method employed for classifying residential and commercial burglary highlights another avenue for further methodological improvement. As noted by Felson et al. (2020), the main analysis problem in their study was the nature of the data reports, which inhibited their ability to accurately classify where a burglary took place. Hypothetically, under Felson et al.’s (2020) coding scheme, any burglary that occurred in a street block that is 89% residential would have been classified as a “commercial burglary.” We echo Felson et al. (2020) by emphasizing that those who disaggregate burglaries by location of occurrence must be cognizant of the underlying theoretical and empirical implications that a coding scheme may have for the advancement of research on the associations between the stay-at-home orders and burglary trends.

Another prominent issue that might contribute to inconsistent findings in this area of research is that few have examined the effect of a single state-mandated lockdown order on burglary across several major cities within their respective state (e.g., Ashby, 2020; Mohler et al., 2020; Rosenfeld & Lopez, 2020). Importantly, the U.S. government did not enact a nationwide stay-at-home order given that there is no constitutional mechanism to do so; thus, the decision to implement or not implement these orders was dictated by the state governments (Lieb, 2020). As a result, discrepant findings in the few studies that have examined crime trends across multiple cities may be partly attributed to the varying clauses and restrictions outlined in their respective state-mandated orders. This pattern is not isolated to burglary, rather it is prevalent across all examinations of crime and their relation to the pandemic thus far.

At the same time, studies that assess the potential impact of a state-mandated lockdown order in only one city suffer from other external threats to validity. Findings from these individual study locations may be conditionally dependent on the single city examined; thus, the generalizability of their findings is limited (e.g., Campedelli et al., 2020; Felson et al., 2020). At the time of writing this manuscript, no research has been directed at examining differences in crime trends across multiple cities that fall under the same state-mandated order in the US. The generality and consistency of conclusions about burglary may therefore be inhibited due to the limited understanding of how these orders impact burglary across multiple cities under the same restrictions.

2. Current study

The current study proposes that the Michigan stay-at-home order has altered the routine activity of peoples’ daily lives across four major cities. One notable component of these orders was the mandate requiring people to shelter in place (i.e., stay in their homes) and work from home, which in turn, left business establishments largely unattended. Following Felson et al. (2020) and others, we suspect that the situational structure of victimization opportunities shifted due to these changes in available targets (i.e., homes versus business establishments) and capable guardians (i.e., residential inhabitants, shoppers, business owners, pedestrians) (Payne, Morgan, & Piquero, 2021). Residential and commercial trends across several major cities in Michigan should consequently reflect these changes in routine activity. Despite recent research on this issue, few studies have disentangled burglary by its type of location, which may provide different and critically valuable theoretical implications.

Additionally, no studies at this time specifically assessed how several cities in the same state have been affected by their respective state-mandated order. Doing so will provide further evidence to support the consistency and generality of an effect that a single state’s lockdown order has on burglary across several cities. This study addresses these shortcomings by assessing whether weekly counts of residential and commercial burglaries have changed following the implementation of a state-wide stay-at-home order across four major Michigan cities. In accordance with the routine activity theory, we hypothesize weekly counts of commercial burglary will increase following the state-mandated order whereas residential burglaries will decline following these orders.

2.1. Data

This study examines residential and commercial burglary data, which were provided by four Michigan law-enforcement/public safety agencies from each of the following cities: Detroit, Grand Rapids, Kalamazoo, and Lansing. The study period from which the data come spans the duration of 2018 through the end of 2020 for a total of 23,995 residential and commercial burglaries (See Table 1). The data analyzed were classified as burglary with- and without-forced entry based on Michigan Incident Crime Reporting (MICR) state offense and arrest charge codes. Table 1 presents the annual frequency and rate of residential and commercial burglary for each city in our study sample.

2.1.1. Cities

Demographically, Kalamazoo is the smallest city in this study sample with an estimated population of 76,201 in 2019, followed by Lansing...
with 116,677, Grand Rapids with 201,004, and Detroit with 670,052 (U. S. Census Bureau, 2019a). Detroit has, however, experienced the largest population decline among all four cities, which dates to as early as the 1950s after the auto industry began to consolidate (Thompson, 1999). Most recently, Detroit’s population dropped by 6% since 2010. All other cities have experienced relative growth in population size ranging from as large as 7% in Grand Rapids to as small as 2.5% in Kalamazoo during the same time period. In terms of racial composition, Lansing, Grand Rapids, and Kalamazoo are primarily White (>60%), with Black residents representing about 23%, 19%, and 25% of these cities’ overall populations, respectfully. In contrast, Black residents make up nearly 80% of the population in Detroit, due in part to a departing White middle-class following the continued decline in population and availability of jobs during the 1980s (Thompson, 1999). Additionally, there is a notable difference in household income and poverty status between the four cities. Grand Rapids has the highest median household income at $51,817, followed by Lansing at $41,066, Kalamazoo at $39,494, and Detroit at $33,965 (U.S. Census Bureau, 2019b). The proportion of persons in poverty follow a similar pattern with Detroit having 35% of persons in poverty compared to Grand Rapids with 20% of persons in poverty.

### 2.2 Measures

#### 2.2.1 Dependent variables

**Residential and commercial burglary.** Burglary incident-level data were acquired through Freedom of Information Act (FOIA) requests. Each agency’s data administrator provided burglary incidents that were filtered according to the location of occurrence using a location identifier. Given that these identifiers did not explicitly classify incidents as occurring at commercial locations, we rely on past coding schemes used for classifying properties as “commercial” to determine if an incident was a commercial burglary. For example, properties such as hotels, restaurants, full-service banks, and gas stations were all deemed as commercial properties according to a study conducted by Browning et al. (2010). We, therefore, use the list of commercial properties provided by Browning et al. (2010) to determine whether an incident should be classified as a commercial burglary based on whether the victimized property would be considered as commercial. This process was preferred in comparison to treating all non-residential burglaries as

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4 The Michigan Penal Code defines burglary as “Any person who breaks and enters or enters without breaking, any dwelling, house, tent, hotel, office, store, shop, warehouse, barn, granary, factory or other building, boat, ship, railroad car or structure used or kept for public or private use, or any private apartment therein, or any cottage, clubhouse, boat house, hunting or fishing lodge, garage or the out-buildings belonging thereto, any ice shanty with a value of $100.00 or more, or any other structure, whether occupied or unoccupied, without first obtaining permission to enter from the owner or occupant, agent, or person having immediate control thereof, is guilty of a misdemeanor” (Michigan Legislature, 2021: Section 750.115).
occurring at commercial locations (e.g., Felson et al., 2020) as doing so will prevent confounding our empirical findings with a particular coding scheme. Accordingly, incidents that transpired at locations such as hotels, stores, supermarkets, business lots, and auto dealerships were coded as “commercial” burglaries. Incidents that occurred at residential locations (i.e., homes, apartments, and condominiums) were coded as “residential” burglaries. These two types of burglary incidents were then aggregated to weekly counts from January 1st, 2018 to December 27th, 2020 to obtain 156 weeks of weekly burglary count data for each city. Table 2 provides summary statistics for all study variables used in the analyses.

2.2.2. Intervention

Michigan stay-at-home-order. The state-mandated lockdown order is defined as the intervention/interruption; thus, all weeks that occurred before the order was implemented (January 1st, 2018 to March 23rd, 2020) and after it was implemented (June 1st, 2020 to December 27th, 2020) are dummy coded 0. All weeks are dummy coded 1 to indicate when the lockdown order was in effect (after March 23rd through June 1st). The intervention specification used in this study resembles others, where the policy intervention is specified as an abrupt, temporary change (e.g., Mohler et al., 2020). This intervention specification most closely reflects the true policy period. Further, this specification operates under the assumption that any changes in the expected average weekly count of burglary following the lockdown order will last only for the duration that the policy was instated. Accordingly, we examine approximately 116 weeks of pre-intervention data, 10 weeks of intervention-period data, and 30 weeks of post-intervention data.

2.3. Analytic strategy

We conducted an interrupted time series analysis (ITSA), separately for each city, to determine whether the average weekly count of residential and commercial burglaries was associated with a significant change for the duration of the Michigan stay-at-home order. Poisson regression models were used to analyze the 156-weeks of burglary count data from January 1st, 2018 through December 27th, 2020. Accordingly, each city has two regression equations based on the two types of burglary data analyzed; thus, we discuss findings from 8 total models.

Before conducting the ITSA, seasonality, trend, and systematic patterns in the residuals for each burglary time series were considered (Bernal, Soumerai, & Gasparetti, 2018; Jandoc, Burden, Mamdani, Levesque, & Cadarette, 2015). We accounted for seasonality by incorporating a vector comprised of monthly dummy variables (11-fixed effects month indicators) in the regression equations to model cyclical variations in the burglary data over a three-year period (e.g., Corsaro & Engel, 2015; Lu et al., 2019). Trend was accounted for by including a vector of yearly indicators (2-fixed effects annual indicators) in the regression equations to model annual variations in burglary counts over the study period. Including these variables in the regression models was shown to improve model fit in preliminary analyses and will assist in conservatively estimating the association between weekly burglary counts and the state lockdown order.

Systematic patterns across the outcome measure error terms were examined using correlogram plots and the refined Portmanteau (Q) test (Box & Pierce, 1970; Liung & Box, 1979). Results indicated that serial correlation was present in several burglary time series; thus, we employed linear Poisson autoregressive or Poisson AR models when applicable (Brandt & Williams, 2001). Using the Stata user-written package, arpio, we utilize a series of linear Poisson autoregressive models to account for serial correlation while also adjusting for over-dispersion (Katsouyanni et al., 1996; Schwartz et al., 1996).

In a supplemental analysis to the ITSA described above, we assessed the removal of the lockdown order to determine whether its removal led to significant changes in residential and commercial burglary. This will provide additional insight into the overall effect that the lockdown order had on residential and commercial burglary during the pandemic. For this analysis, we analyzed weekly burglary data for the weeks during the lockdown order (weeks 117–126) and the weeks following its removal (weeks 127–156). This 39-week sample corresponds to a separate intervention analysis in which all weeks during the intervention period were coded (I = 0) and all weeks following the intervention period were coded (I = 1). The dummy variable (I) indicating when the order was lifted captures any changes in the expected mean weekly count of burglary following the removal of the lockdown order in Michigan.

3. Results

Figs. 1 and 2 provide a graphical display of the time series for residential and commercial burglary in each city from 2018 to 2020. We begin by describing annual trends in residential and commercial burglaries across all four cities from 2018 to 2020 (See Table 1). When
Residential Burglary (2018-2020)

Fig. 1. Time series of residential burglaries per week. Dashed vertical black lines indicate beginning and end of the lockdown order. Colors from www.ColorBrewer.org by Cynthia A. Brewer, Geography, Pennsylvania State University.

pooling the city data together, results indicate residential burglaries declined by about 5% between 2018 and 2019. Results from pooled data indicate trends in commercial burglaries follow a steeper decline across all cities from 2018 to 2019 by almost 22%. When comparing the pooled city data from 2019 to 2020, residential burglaries decline by 33% whereas commercial burglaries increase by 8%. One unique trend in these 2020 findings pertains to Detroit, whereby commercial burglaries dropped by 18% from 2019 to 2020. These preliminary annual findings shed light on the uniqueness of 2020 in general and the potential contributions that the lockdown may have had for Michigan city burglary trends.

Table 3 presents results from the main ITSA in which we employ a series of Poisson regression models that account for serial correlation to analyze weekly counts of residential and commercial burglary. We report unstandardized coefficients, the estimated percent change in weekly counts of burglary ($\exp(b) - 1 \times 100$), and the lower and upper bounds from 95% confidence intervals. Fig. 3 provides a graphical depiction of the main intervention effect in terms of the estimated percent change in average weekly counts of burglary for the duration of the lockdown order with 95% confidence bands for each city and type of burglary.

Turning now towards the results for commercial burglary in Table 4, our findings indicate that the lockdown order was associated with a statistically significant increase in the mean weekly count of commercial burglary for the duration of the lockdown order in Detroit ($b = 0.38, 95\% CI [0.07, 0.69]$). As seen in Fig. 3, an increase in the mean weekly count of commercial burglaries following the lockdown order in Detroit is estimated to be 46.22%. Commercial burglaries were expected to increase for the duration of the lockdown order in Kalamazoo as well, but the effect size of the intervention coefficient was not significant. Interestingly, the average weekly count of commercial burglary was expected to drop in Grand Rapids and Lansing during the lockdown order, though these estimates are not significant either. Results from

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15 We thank one of the anonymous reviewers for suggesting this.
tests of the equality of regression coefficients indicate that the lockdown order effects on commercial burglary were not significantly different across cities as well.

The annual parameter estimates indicate that commercial burglaries were expected to be greater in 2018 and 2020 relative to 2019 across most cities. For example, the mean weekly count of commercial burglaries was expected to be significantly greater in 2018 relative to 2019 by 36.34% in Detroit ($b = 0.31, 95\% CI [0.18, 0.44]$) and by 29.69% in Lansing ($b = 0.26, 95\% CI [0.03, 0.49]$). Commercial burglaries were also expected to be greater in 2020 relative to 2019 by 75.07% in Grand Rapids ($b = 0.56, 95\% CI [0.27, 0.85]$) and by 95.42% in Kalamazoo ($b = 0.67, 95\% CI [0.40, 0.95]$) as well. Unlike all other cities, the mean weekly count of commercial burglary in Detroit was expected to be significantly lower in 2020 relative to 2019 by 24.42% ($b = -0.28, 95\% CI [-0.44, -0.12]$).

Table 5 presents results from the supplemental analysis, whereby changes in residential and commercial burglary following the removal of the Michigan lockdown order were analyzed. Results indicate that residential burglary trends remained low even after the lockdown order was lifted after accounting for a linear trend term and any residual autocorrelation in the burglary trends. In contrast, results for commercial burglary trends in Table 5 indicate that the mean weekly count of commercial burglary was expected to decrease in Detroit by 49.84% in the weeks following the removal of the lockdown order ($b = -0.69, 95\% CI [-1.29, -0.09]$). These results suggest that although most burglary trends remain consistent in the weeks following the lockdown order for several of the cities analyzed, commercial burglaries in Detroit tapered off following a period of increased activity during the lockdown order.

3.1. Sensitivity analysis

The George Floyd protests, which took place in hundreds of cities worldwide following the killing of George Floyd in Minneapolis on May 25th, 2020, may present a historical threat to our analysis given that such protests may have occurred during the intervention period (March 23rd – June 1st) (Smith, Wu, & Murphy, 2020). Rosenfeld and Lopez (2020) found that in the last week of May of 2020 (week 22 in our analysis), commercial burglaries increased in numerous cities across the U.S. by nearly 200%. However, the spike in burglaries was limited to this single week, as the rate of commercial burglaries abruptly returned to normal levels by the first week of June (Rosenfeld & Lopez, 2020). Protests occurred in all four cities examined in the current study, and media reports suggest property damages and theft at commercial locations may have occurred during these protests, particularly in Grand Rapids, Kalamazoo, and Lansing (Associated Press, 2020a, 2020b; Censky, 2020; Smith et al., 2020).

We re-estimated the regression models by including a dummy-coded indicator for when George Floyd was killed, whereby the week in which he died (week 122) was provided a dummy code ($I = 1$) to depict the intervention specification described by Rosenfeld and Lopez (2020). Despite this tragic event occurring on the last day of the 121st week of our study period, we coded the event as occurring on the 122nd week to reflect the time-oriented nature of the event.

Our findings indicate that including George Floyd’s death as an additional interruption in the Poisson regression models does not change...
### Table 3

**ITSA of Residential Burglary Using Poisson Regression**

| Variables | Detroit | Grand Rapids | Kalamazoo | Lansing |
|-----------|---------|--------------|-----------|---------|
| **Intervention** | | | | |
| MI Lockdown | $-0.23^{**}$ (0.07) | $-0.47^{**}$ (0.21) | $-0.12$ (0.14) | $-0.07$ (0.15) |
| **Year** | | | | |
| 2018 | 0.06* (0.03) | 0.07 (0.08) | 0.03 (0.06) | 0.16* (0.06) |
| 2020 | $-0.42^{***}$ (0.03) | $-0.02$ (0.09) | $-0.29^{***}$ (0.07) | $-0.22^{**}$ (0.07) |
| **Month** | | | | |
| January | $-0.01$ (0.06) | $-0.09$ (0.17) | $-0.16$ (0.12) | $-0.11$ (0.14) |
| February | $-0.07$ (0.06) | $-0.02$ (0.17) | $-0.23$ (0.13) | $-0.03$ (0.14) |
| March | $-0.14^{*}$ (0.06) | $-0.35$ (0.19) | 0.02 (0.12) | $-0.17$ (0.15) |
| April | $-0.03$ (0.06) | $-0.07$ (0.19) | 0.05 (0.13) | 0.04 (0.14) |
| May | $-0.04$ (0.06) | 0.01 (0.17) | 0.15 (0.12) | 0.06 (0.14) |
| June | $-0.08$ (0.06) | 0.31 (0.16) | 0.06 (0.12) | 0.05 (0.14) |
| July | $-0.07$ (0.05) | 0.22 (0.16) | 0.27* (0.11) | 0.25* (0.13) |
| August | $-0.03$ (0.05) | 0.30 (0.16) | 0.12 (0.12) | 0.41** (0.12) |
| September | $-0.11$ (0.06) | 0.20 (0.16) | 0.20 (0.12) | 0.19 (0.13) |
| October | 0.06 (0.05) | 0.11 (0.16) | $-0.02$ (0.12) | 0.13 (0.13) |
| November | $-0.01$ (0.06) | 0.00 (0.17) | $-0.04$ (0.13) | 0.04 (0.14) |
| **Autoregressive terms** | | | | |
| AR (1) | 0.26** (0.08) | 0.11 (0.09) | 0.18* (0.09) | 
| AR (2) | 0.04 (0.09) | 
| AR (3) | 0.17 (0.09) | 
| AR (4) | 0.26** (0.08) | 
| Constant | 4.74*** (0.04) | 2.16*** (0.13) | 2.55*** (0.09) | 2.26*** (0.11) |
| F-statistic | 24.08*** | 2.85*** | 4.85*** | 5.10*** |
| $R^2$ adjusted | 0.73 | 0.15 | 0.26 | 0.29 |
| Q-statistic | 44.72 | 47.00 | 26.03 | 38.94 |
| N | 152 | 155 | 156 | 155 |

1. Reference year is 2019.
2. Reference month is December.
3. $p < .05$
4. **$p < .01$**
5. ***$p < .001$***

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**Effect Size Dot Plot With 95% Confidence Intervals**

Fig. 3. Michigan Lockdown Order Effect Size Dot Plot. Note: Effect sizes plotted as expected percent change in burglary for the duration of the lockdown order. Colors from [www.ColorBrewer.org](http://www.ColorBrewer.org) by Cynthia A. Brewer, Geography, Pennsylvania State University.
### Table 4

**ITSA of Commercial Burglary Using Poisson Regression**

| Variables                  | Detroit | Grand Rapids | Kalamazoo | Lansing |
|----------------------------|---------|--------------|-----------|---------|
|                            | b       | SE           | b         | SE      |
| **Intervention**           |         |              |           |         |
| MI Lockdown                | 0.38**  | (0.16)       | −0.08     | (0.31)  |
| Year**                     | 2018    | 0.31***      | 0.02      | (0.16)  |
|                            | 2020    | −0.28***     | 0.56**    | (0.15)  |
| **Month**                  |         |              |           |         |
| January                    | 0.07    | (0.14)       | −1.09***  | (0.34)  |
| February                   | 0.01    | (0.14)       | −1.05***  | (0.34)  |
| March                      | −0.16   | (0.15)       | −0.83*    | (0.32)  |
| April                      | −0.07   | (0.15)       | −0.56     | (0.32)  |
| May                        | −0.13   | (0.15)       | −0.39     | (0.29)  |
| June                       | −0.01   | (0.14)       | −0.40     | (0.28)  |
| July                       | 0.17    | (0.14)       | −0.22     | (0.25)  |
| August                     | 0.07    | (0.14)       | 0.18      | (0.23)  |
| September                  | 0.03    | (0.14)       | 0.10      | (0.23)  |
| October                    | 0.15    | (0.14)       | −0.30     | (0.26)  |
| November                   | 0.12    | (0.14)       | −0.39     | (0.27)  |
| **Autoregressive terms**   |         |              |           |         |
| AR (1)                     | 0.34*** | (0.08)       | 0.06      | (0.09)  |
| AR (2)                     | 0.04    |              |           |         |
| AR (3)                     | 0.05    |              |           |         |
| AR (4)                     | −0.11   |              |           |         |
| AR (5)                     | 0.09    |              |           |         |
| Constant                   | 2.54*** | (0.11)       | 1.20***   | (0.20)  |
| F-statistic                | 6.04*** |              | 3.41***   |         |
| R²-adjusted                | 0.33    |              | 0.23      |         |
| Q-statistic                | 50.11   |              | 32.97     |         |
| N                          | 155     |              | 151       |         |

|                        |         |              |           |         |
| **Residential Burglary** |         |              |           |         |
| **Intervention**        |         |              |           |         |
| MI Lockdown             | 0.00    | (0.10)       | 0.34      | (0.20)  |
| Trend                    | 0.00    | (0.00)       | 0.01      | (0.01)  |
| **Autoregressive terms**|         |              |           |         |
| AR (1)                   | 3.95*** | (0.43)       | −0.11     | 0.16    |
| Constant                 | 0.20    | (12.55**     | 0.00      | 0.81    |
| F-statistic              | −0.04   | (0.37)       | −0.02     | 0.04    |
| R²-adjusted              | 23.79   | (14.17)      | 24.19     | 13.22   |
| N                        | 40      | (39)         | 40        | 40      |

|                        |         |              |           |         |
| **Commercial Burglary** |         |              |           |         |
| **Intervention**       |         |              |           |         |
| MI Lockdown            | −0.69*  | (0.30)       | 0.56      | (0.41)  |
| Trend                   | 0.02    | (0.01)       | 0.00      | (0.01)  |
| Constant                | 0.02    | (1.36)       | 1.24      | 1.71    |
| F-statistic             | 2.71    | (1.62)       | 0.09      | 5.28**  |
| R²-adjusted             | 0.08    | (0.03)       | −0.05     | 0.18    |
| Q-statistic             | 23.23   | (17.07)      | 15.06     | 7.78    |
| N                       | 40      | (40)         | 40        | 40      |

* Reference year is 2019.
** Reference month is December.
* p < .05
** p < .01
*** p < .001

### Table 5

**ITSA of Residential and Commercial Burglary Following Lockdown Removal Using Poisson Regression**

| Variables                  | Detroit | Grand Rapids | Kalamazoo | Lansing |
|----------------------------|---------|--------------|-----------|---------|
|                            | b       | SE           | b         | SE      |
| **Residential Burglary**   |         |              |           |         |
| **Intervention**           |         |              |           |         |
| MI Lockdown                | 0.00    | (0.10)       | 0.34      | (0.20)  |
| Trend                      | 0.00    | (0.00)       | 0.01      | (0.01)  |
| **Autoregressive terms**   |         |              |           |         |
| AR (1)                     | 3.95*** | (0.43)       | −0.11     | 0.16    |
| Constant                   | 0.20    | (12.55**     | 0.00      | 0.81    |
| F-statistic                | −0.04   | (0.37)       | −0.02     | 0.04    |
| R²-adjusted                | 23.79   | (14.17)      | 24.19     | 13.22   |
| Q-statistic                | 40      | (39)         | 40        | 40      |

|                        |         |              |           |         |
| **Commercial Burglary**  |         |              |           |         |
| **Intervention**        |         |              |           |         |
| MI Lockdown             | −0.69*  | (0.30)       | 0.56      | (0.41)  |
| Trend                   | 0.02    | (0.01)       | 0.00      | (0.01)  |
| Constant                | 0.02    | (1.36)       | 1.24      | 1.71    |
| F-statistic             | 2.71    | (1.62)       | 0.09      | 5.28**  |
| R²-adjusted             | 0.08    | (0.03)       | −0.05     | 0.18    |
| Q-statistic             | 23.23   | (17.07)      | 15.06     | 7.78    |
| N                       | 40      | (40)         | 40        | 40      |

* p < .05
** p < .01
*** p < .001
the preexisting associations found between the lockdown order and changes in residential and commercial burglary. Indeed, the activity following the murder of George Floyd was not associated with changes in the average weekly count of residential and commercial burglary when controlling for the state lockdown order as well as annual and seasonal fluctuations in burglary. Taken together, we do not have sufficient evidence to suggest that Floyd’s unfortunate death confounded the association between the state lockdown order and residential and commercial burglaries.

4. Discussion

Our study contributes to the emerging body of ongoing research assessing the impact of the COVID-19 pandemic on crime in the U.S. Specifically, we assess the effects of a state-mandated lockdown order on residential and commercial burglary, a set of crimes that have received some empirical attention, but findings remain largely inconsistent and limited. Building on this line of inquiry, we extend prior literature by (1) analyzing burglary data from multiple cities within a single state, and thus, a single lockdown order, and (2) employing a more transparent coding scheme for discerning residential and commercial burglaries. As a whole, we present a methodologically rigorous examination of how the implementation of the Michigan stay-at-home order impacted residential and commercial burglary rates in four Michigan cities.

In general, the empirical results lend marginal support for our hypotheses. Two of the four cities in our sample exhibited a decline in residential burglaries that were significantly associated with the implementation of the stay-at-home order. Only one of the four cities exhibited a significant increase in commercial burglaries during the lockdown order. The presented evidence lends limited support to suggest that the decrease in residential burglary may be attributed to residents spending more time in their homes, thus acting as capable guardians to their property (Cohen & Felson, 1979). On a similar note, only scant evidence exists to propose that the increase in commercial burglary could be attributed to an absence of capable guardians at commercial locations as a result of the lockdown order mandating non-essential businesses suspend on-site operations (Cohen & Felson, 1979).

Our analyses reveal that differences in the lockdown order’s effect did not vary significantly from city to city for both types of burglary as well. No clear evidence exists to suggest that differences in the lockdown order’s effect would be attributable to potential underlying confounds. As for the cities that experienced significant changes in their burglary trends during the lockdown, our evidence indicates these changes may be temporary. We interpret our supplemental analysis findings cautiously, however, due to the limited number of observations analyzed.

Although this study accounts for several shortcomings in past research that has assessed the effects of state-mandated orders on burglary within the context of COVID-19, several limitations in this study present opportunities for future research. For example, while evaluating several cities within the same state alleviates one potential threat to internal validity, this research study remains situated within one state. Findings are, therefore, lacking strong external validity in that they are potentially dependent on the state and its respective state-mandated order. Indeed, 20 states employed stricter state-wide lockdown orders and still many others that employed weaker restrictions (if any at all) (McCann, 2020). We encourage researchers to consider evaluating how lockdown restrictions impact burglary in several cities within the same state as well as across multiple states rather than just one.

We recommend other researchers consider the potential limitations in which routine activity theory applies to the relationship between lockdown orders and crime once accounting for differences in city population and demographic composition. No empirical evidence here indicates that the lockdown order’s effect varied significantly across four Michigan cities that differ in population size and sociodemographic characteristics. At a minimum, however, we strongly encourage those who pursue this avenue of research to develop a classification scheme for city size, as doing so will contribute to systematically rigorous and more consistent research on this topic in the future.

On a similar note, future studies should consider incorporating other theoretically relevant factors within the routine activity framework. Though our findings cannot speak to precisely why not all cities experienced changes in burglary, nor were these changes significantly different between cities, city-specific unemployment rates during the pandemic could partly contribute to these differences. Detroit experienced the largest increase in unemployment rates at the onset of the pandemic among all four cities in our sample, spiking from 5% in March 2020 to 25% in April, and concluding the year at 10% (Bureau of Labor Statistics, 2020). Grand Rapids experienced the second largest increase in unemployment rate immediately following the pandemic and was the only other city to demonstrate a significant decrease in residential burglaries as well. These increases may have resulted in more people, who were unable to work, remaining in their homes for longer periods of time. Consequently, local businesses that previously employed these individuals may have had fewer capable guardians present to protect their establishments from being victimized during the lockdown.

Lastly, we recommend researchers consider measuring city enforcement of and citizen adherence to state lockdown orders. These dynamics may partly attribute to significant differences in the magnitude of effects across other cities in future research. Analyzing mobility data through Google or SafeGraph may provide convincing empirical evidence regarding the extent that citizens in any given city adhered to stay-at-home orders (e.g., Chang et al., 2021; Mohler et al., 2020; Piquero et al., 2020). Those who pursue these data should strongly consider the implications of what level of analysis the data are collected at. For example, Google mobility data are collected at the county level (Google, 2021). Conclusions drawn from these data about county-wide mobility patterns may not necessarily reflect city-wide trends.

In summary, our findings shed light on the following conclusions. First, our study demonstrates the utility of the routine activity framework for explaining changes in crime trends during the COVID-19 pandemic, particularly when lockdown orders legally restrict the daily activities of citizens. Our results indicate that not all cities experienced significant reductions in residential burglary and increases in commercial burglary during the same state-mandated lockdown order. These findings highlight an important factor that has yet to receive much attention in the current literature. The potential intra-state variation in burglary trends that emerged during the Michigan state lockdown order highlights the importance of considering how burglary trends manifest within states rather than merely across them. We further encourage others to expand on our analyses by using longer study periods and different states to evaluate how the emergence of Floyd protests serves as another pivotal point in which burglary trends may have changed following state-mandated lockdown orders as well. Such analyses will shed light on the idiosyncratic nature of long-term burglary trends in the wake of state-mandated lockdown orders as well as Floyd’s passing.

Our study informs policy in several ways. First, our findings revealed that city-wide changes in burglary trends during lockdown orders were not evenly dispersed across commercial and residential premises. Areas

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16 See Appendix B for two abbreviated tables of the results from this sensitivity analysis.
17 In a separate sensitivity analysis, we estimated the regression models using non-residential burglaries as the outcome. This measures all burglaries that did not occur at a residential location, including incidents at commercial and non-commercial locations. This variable is less sensitive to the socio-spatial nuances that characterize commercial locations; thus, it is less theoretically refined and has limited construct validity. Despite theoretical reason to differentiate between non-residential and commercial burglary, our results were nearly identical when compared to the results that emerged for burglaries that occurred in commercial areas.
with a high commercial business presence might be at an increased risk of burglary during the state-mandated lockdown orders due to an absence of capable guardians. Accordingly, police departments may use these findings to inform their patrol strategies by targeting areas that are at greater risk of being burglarized during similar mobility-restricting state mandates. Prior research has demonstrated the utility of using targeted, proactive policing strategies to reduce crime in high-risk areas (Weisburd & Magmudar, 2017), and other research has suggested effective policing of micro-time, or short-term, hot spots may be useful in preventing burglary as well (Santos & Santos, 2021). Indeed, during public health emergencies where patterns of social behavior are changed suddenly and temporarily, police departments should be proactive when considering where hot spots may evolve based on the presence of effective guardians at certain locations. Institutionalizing these plans preemptively may help to prevent or reduce sudden increases in crime while providing a strong foundation for evidence-based decisions when timely data are available.

Second, our findings underscore the importance for business owners to take necessary precautionary actions to make their spaces more defensible, whether that be double-checking their existing security infrastructure or installing new systems, to ensure their locations are protected in the absence of employees. Researchers have found that security devices such as window locks and deadbolts may be effective in preventing burglaries (Tseleni, Thompson, Grove, Tilley, & Farrell, 2017). Other scholars have found that burglar alarm systems are also effective preventative devices (Coupe & Kaur, 2005), but are particularly useful when combined with other security devices (Tseleni et al., 2017). One major critique with alarm systems is the increased burden they place on police workloads, as the alarm may be set off in a false activation, resulting in police responding to a scene where no crime has been committed (Blackstone, Hakim, & Meehan, 2020; Coupe & Kaur, 2005). To address this concern, some agencies have instituted Public-Private-Partnership policies that contract private agencies to help respond to burglar alarm systems, with police responding only when a crime has been verified to occur. Policies such as these have been found to reduce burglary rates and preserve police time and resources (Blackstone et al., 2020). Coupled with encouraging local businesses to evaluate and improve their security systems, police departments should explore policies that may help manage the increased workload caused by more alarm systems being installed.

Finally, our findings emphasize the need for timely crime data and proactive monitoring of that data in police departments. Changes in crime trends during the lockdown order are not entirely synonymous across cities and contexts. Though some patterns are discernable and may be generalized to other jurisdictions, it is prudent that police departments effectively document and manage their respective crime data. Some cities may experience similar changes in burglaries whereas others may report counterintuitive trends. Particularly in times of rapid social change such as the COVID-19 pandemic, timely data are essential for providing law enforcement officials with the information needed to make evidence-based policies to address changes in crime rates.

Taken together, our study highlights the importance of the Michigan stay-at-home order for explaining increases in residential burglary and declines in commercial burglary. The findings suggest that failing to classify burglary based on where it occurs (i.e., residential vs commercial/non-residential) can severely mislead a general understanding of the effect that state lockdown orders have on burglary. Further, our findings indicate the importance of evaluating multiple city locations that fall under the same state-mandated lockdown order, as there is some variation and, at times, inconsistencies that warrant further exploration. We hope that the findings presented here will inspire more research that expands on our assessments, through incorporating other theoretical frameworks, additional data, and other robust empirical analyses to understand how stay-at-home orders have impacted crime and the daily lives of Americans in the global pandemic.

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Appendix A. Supplementary materials

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jcrimjus.2021.101834.

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