THE MICRO-SPATIAL LINK BETWEEN OPEN-AIR DRUG MARKETS AND

CRIME

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A thesis submitted to the

Graduate School-Camden

Rutgers, The State University of New Jersey

In partial fulfillment of the requirements

For the degree of Master of Arts

Graduate Program in Criminal Justice

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May 2016

THESIS ABSTRACT

The Micro-Spatial Link between Open-Air Drug Markets and Crime

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In the 1980s, the United States experienced a significant increase in drug offenses and associated fear of crime among residents. Substantial research has been devoted to the proposition of drug addiction and crime to examine whether drug consumption makes addicts commit a crime, or crime-prone individuals are more likely to become drug addicts. However, the research about the relationship between the area where drugs are sold, namely open-air drug markets, and crime rates is sparse. The ecological criminology and opportunity theories that investigate the relationship between the crime and place, as well as informal social control mechanisms inspired many criminologists to investigate the distribution of crime at micro-spatial areas. Advances in the geographic information systems and technology in the late 1980s have allowed scholars to demonstrate crime distribution at micro places, which are very small geographic areas, such as addresses or street segments. Empirical research on micro crime places indicates that less than five percent of these micro settings account around for 50 percent of the offence incidents for an extended period. Additionally, crime significantly clusters at micro places, where illegal drug markets exist, as compared to non-drug hot spots. The current study examines the spatial correlation between open-air drug markets and violent and property crimes at the block level. Considering that using block group or census tract level data fail to capture block by block variation of crime, the variables were constructed from parcel-tax data. Using

GeoDa's local spatial autocorrelation (LISA) analysis and regression functionality to identify violent and property crime clusters, results revealed a substantial effect of alcohol-related establishments on the elevated levels of crime that residents experience. The overwhelming impact of alcohol-related establishments on the occurrence of crime incidents hindered to examine the true extent of the role of open-air drug markets associated with the elevated levels of crime. However, the results, in conjunction with the significant body of empirical research on micro crime places, demonstrate that only less than five percent of the city blocks account for the high-high clusters of the offense incidents.

Keywords: open-air drug markets, violent crimes, property crimes, micro spatial analysis

Introduction

In the 1980s, the United States experienced a significant increase in drug offenses and associated fear of crime among residents (Weisburd & Mazerolle, 2000). More specifically, the dramatic increases in drug issues in the United States occurred during three distinct periods of time (Wilson, 1990) starting in the 1960s. From 1965 until 1975, the primary drug problem was heroin (Johnson, 2003; Wilson, 1990). As a result of shifts on the demand side of illicit drug preferences, crack cocaine became the main problem for the following ten years (i.e., 1975-1985; Levitt & Venkatesh, 2000; Johnson, 2003; Wilson, 1990). Although heroin and crack cocaine users still existed, marijuana consumption has been prevalent, especially among low-income individuals, since 1985 (Johnson, 2003; Wilson, 1990). The dramatic rise in drug problems has inspired scholars to explore effects of drug use on crime rates (Baumer, 1994; Grogger & Willis, 2000). Additionally, substantial research has been devoted to the proposition of drug addiction and crime to examine whether drug consumption makes addicts commit a crime, or crime-prone individuals are more likely to become drug addicts (Fagan, 1993; Friedman, Glassman, & Terras, 2001). However, the research about the relationship between the area where drugs are sold, namely open-air drug markets, and crime rates is sparse.

Participants of illicit markets access each other through friends and acquaintances, or the vendors and buyers use suitable locations to find each other and exchange money and illegal goods (Eck, 1995). Drug markets may take several forms depending on the location of the market and the circumstances of the dealing between the vendors and buyers (Harocopos & Hough, 2005). A closed market is defined as drug markets where the participants know each other through social networks (e.g., friends). Conversely, in the open market, the participants are unacquainted with each

other (Harocopos & Hough, 2005). Emerging illicit drug markets are mobile markets where the vendors and buyers of illegal drugs arrange the details of the transaction over the phone. Open-air drug markets, on the other hand, are described as the retail marketplaces that operate in spatially well defined open-air locations (Harocopos & Hough, 2005).

The ecological criminology and opportunity theories that investigate the relationship between the crime and place, such as routine activity theory (Cohen & Felson, 1979), the rational choice perspective (Cornish & Clarke, 1987; Clarke & Felson, 1993), crime pattern theory (Brantingham & Brantingham, 1993), and situational prevention theory (Clarke, 1983), as well as informal social control mechanisms, such as broken windows theory (Wilson & Kelling, 1982) and collective efficacy (Sampson, Raudenbush, & Earls, 1997) inspired many criminologists to investigate the distribution of crime at micro-spatial areas. Advances in the geographic information systems and technology in the late 1980s have allowed scholars to demonstrate crime distribution at micro places (Weisburd, Hinkle, Famega, & Ready, 2011), which are very small geographic areas, such as addresses or street segments.

Empirical research on micro crime places indicates that less than five percent of these micro settings account around for 50 percent of the offence incidents for an extended period (e.g., that about 4.5 percent of the street segments accounted approximately for 50 percent of the crime in Tel Aviv; see Weisburd and Amram, 2014). Additionally, crime significantly clusters at micro places, where illegal drug markets exist (i.e., drug hot spots), as compared to non-drug hot spots (Weisburd & Mazerolle, 2000; Taniguchi, Ratcliffe, & Taylor, 2011). Accordingly, identifying open-air drug markets will allow police agencies to apply hot spots policing

techniques. Hot spots policing refers to concentrating police efforts on tiny geographical locations; that handle the disproportionate amount of crimes (Braga & Weisburd, 2010; Sherman, 2013). From this perspective, criminal justice stakeholders, upon identifying open-air drug hot spots, will be able to devote their scarce resources to these crime-prone micro places, and reduce overall crime rates associated with open-air drug markets.

The City of Camden, New Jersey is an important jurisdiction within which to investigate the relationship between open-air drug markets and violent crime. For the remainder of this article ''Camden'' refers to the City of Camden. Based on 2010 US Census, Camden is 8.92 square miles in area with a population of 77,344, of which 48.6 percent are male with an average resident age of twenty-eight. The population is made up of 48.1 percent African-American, 47 percent Hispanic or Latino, and 4.9 percent non-Hispanic white residents. The total number of housing units within Camden in 2010 was 28,358, of which 60.8 percent were renter-occupied, and 39.2 percent were owner-occupied properties. The number of female-headed households within Camden in 2010 was 9,276, of which 61 percent were living with their children under 18 years. Camden is also densely populated; the number of persons that lived in Camden in 2010 was approximately 8,670 per square mile (U.S. Census Bureau, 2010c). Additionally, based on 2009-2013 American Community Survey five-year estimates, 39.8 percent of Camden's residents live below poverty level (U.S. Census Bureau, 2010a).

The peculiarities that make the city unique regarding crime and open-air drug market association are its high crime rate and being a part of the Philadelphia/Camden High-Intensity Drug Trafficking Area (HIDTA; Office of National Drug Control Policy, 2010). Based on the FBI data on Part I index crimes Camden was ranked as

the most dangerous city in the United States in 2004, 2008, 2009, 2011, 2012 and 2014 (CQ Press, 2015). Additionally, Camden has consistently been one of the top ten most dangerous cities in the United States each year between 1997 and 2012 (CQ Press, 2015). For instance, according to FBI, while the United States average was 387 violent crimes per 100,000 people, Camden City experienced 1,993 violent crimes (FBI, 2012), which is 5.1 times higher than the national average, in 2012.

The micro place-based analysis works well in Camden as it is not a large geographic area and has high population density. In response to these suggestions, it is important to investigate the spatial link between open-air drug markets and crime clusters at micro places. Given the current state of literature regarding the relationship of drug markets, especially open-air drug markets, to higher crime rates, the primary goal of this study is to investigate the fundamental question of whether open-air drug markets are associated with elevated levels of crime. It is hypothesized that open-air drug markets will serve as crime attractors and thus have higher rates of violent and property crime than non-drug hot spots.

Literature Review

In the United States, theories explaining crime clusters at micro-geographic units have their roots in the 1920s and 1940s. In 1925, Park, Burgess, and McKenzie wrote the book on city youth gangs settled on street corners. The book called *The City* is the first example that shows how to study the city associated with crime events (Park et al., 1984). Shaw and McKay (1942) investigated juvenile delinquency in urban areas and revealed that the distribution of crime is not homogeneous within neighborhoods; these incidents cluster at specific micro-geographic areas (Shaw & McKay, 1942). The importance of the place where crime incidents occur has received an increase of scholarly attention and experienced resurgence since the 1970s, upon the development of theories that investigate the relationship between the crime and place. Environmental criminological theories, such as routine activity theory (Cohen & Felson, 1979), the rational choice perspective (Cornish & Clarke, 1987; Clarke & Felson, 1993) and crime pattern theory (Brantingham & Brantingham, 1993) have become the major guides for criminologists exploring the relation between crime and place.

Routine activity theory suggests that the convergence of motivated offenders and suitable targets in time and space, where the capable guardians do not exist, increases the likelihood of crime occurring (Cohen & Felson, 1979). Capable guardians, such as, bystanders, intimate handlers (e.g., parent, teacher), and place managers (e.g., resident managers; Eck, 1995) diminish the likelihood of crime incidents occuring and provide informal social control as they might intervene (Felson, 1987; Eck, 1995). The rational choice perspective posits that offenders decide to commit specific crimes after evaluating potential costs and benefits of involving those crime opportunities (Cornish & Clarke, 1987). Brantingham and

Brantingham (1993), in light of these two theories (i.e., routine activity and the rational choice perspective), presented the theory of crime pattern theory. The key proposition of crime pattern theory is that places known by motivated offenders and the routes between those areas offer opportunities for these criminally motivated individuals to get into contact with suitable targets or potential victims in the course of their daily routines (Brantingham & Brantingham, 1993). Additionally, Brantingham and Brantingham (1995) introduced the concepts of crime generators (i.e., crime facilitators) and crime attractors associated with crime pattern theory. The notion of crime generators was described as non-residential places, such as concert halls, stadiums, and malls that attract large numbers of people regardless of their criminogenic tendencies (Brantingham & Brantingham, 1995). On the other hand, certain types of non-residential places (e.g., bars, alcohol outlets) were described as crime attractors, because they either facilitate the occurrence of crime incidents or perceived as so due to activities or reputation associated with them; eventually, they attract motivated offenders (Brantingham & Brantingham, 1995). In addition to these theories, situational prevention theory, developed by Clarke (1983), is another opportunity theory that has been instrumental for scholars in investigating crime and place connection. Situational prevention theory emphasizes the importance of ecological measures (e.g., target hardening) in reducing the opportunities for crime by increasing its perceived risks (Clarke, 1983).

Informal social control mechanisms are additional critical factors in understanding the variability of crime at micro-geographic units (Groff, 2015; Weisburd, Groff, & Yang, 2014b). Improving informal social control within a neighborhood may help reduce occurrence of conventional crime (Groff, Ratcliffe, Haberman, Sorg, Joyce, & Taylor, 2015) because it diminishes opportunities for

offense incidents (Weisburd et al., 2014a). Broken windows theory, developed by

Wilson and Kelling (1982), is one of the most influential theories that emphasize the

importance of informal social control. The central theoretical proposition of the

broken windows theory is that the communities where there is a lack of informal

social control among neighbors experience more serious crime (Wilson & Kelling,

1982). Additionally, disorder and fear of crime are the two primary reasons of

diminished informal social control (Wilson & Kelling, 1982). According to Wilson

and Kelling, unchecked social disorder conditions, such as panhandler and physical

disorder conditions, such as abandoned property, and damaged street lighting within a

neighborhood stimulate fear of crime among residents (Wilson & Kelling, 1982).

Additionally, while social disorders last for a short period, on the other hand, physical

disorders remain stable over time and exhibit visible neighborhood decay (Skogan,

2015). These areas can attract outside offenders by conveying the message that the

area is out of control, and their probability of arrest is minute as they perceive nobody

will intervene or at least call the police (Wilson & Kelling, 1982). This sequential

development process starts with social and physical disorders that cause fear of crime

and diminishes informal social control, eventually, leads to increases in serious crime

(Wilson & Kelling, 1982; Taylor and Gottfredson, 1986; Weisburd, Wooditch,

Hinkle, & Braga, 2015). Another informal social control mechanism, collective

efficacy, is defined as "social cohesion among neighbors combined with their

willingness to intervene on behalf of the common good" (Sampson et al., 1997, p.

918), and stresses the importance of attachment to the neighborhood, and informal

rather than formal control (Weisburd et al., 2015). For instance, Weisburd, Groff, and

Yang (2014) used the percentage of active voters (i.e., individuals who have voting

patterns over two years) as an indicator of collective efficacy to examine its role on

crime patterns at street segments (Weisburd et al., 2014b). Voting consistently over time is one of the behaviors that show residents' willingness to participate in public affairs (Weisburd et al., 2014a; Weisburd et al., 2014b).

In late 1980s, these emerging perspectives inspired many criminologists to focus on the distribution of crime at micro places, such as addresses (Sherman, Gartin, & Buerger, 1989) or street segments (i.e., the two block faces on a street between two intersections; Weisburd et al., 2014b) rather than focusing on larger social environments (e.g., cities, neighborhoods). This body of work that emphasizes the importance of micro places in clustering crime incidents was described by the term ''criminology of place'', coined by Sherman and his colleagues in 1989 (Sherman et al., 1989). The significant body of empirical research on micro crime places indicates that less than five percent of these micro settings account around for 50 percent of the offense incidents (Sherman et al., 1989; Weisburd, Bushway, Lum, & Yang, 2004; Weisburd & Amram, 2014). Moreover, micro crime places, where crime clusters at, remain stable over an extended period as to its level of crime concentration (Weisburd et al., 2004). For instance, Weisburd et al. (2004) examined street segments in the city of Seattle over a 14-year period and revealed that only 4.5 percent of the street segments, consistently, accounted for 50 percent of the crime incidents (Weisburd et al., 2004). Furthermore, crime clusters at micro places, where illegal drug markets exist (i.e., drug hot spots), are even more significant compared with non-drug micro places (Weisburd & Mazerolle, 2000; Taniguchi, Ratcliffe, & Taylor, 2011).

There is a strong association between drug markets, especially open-air drug markets, and violence due to several reasons (Blumstein & Wallman, 2006). To begin, the illegal nature of the market makes drug dealing extraordinarily risky (Levitt & Verkatesh, 2000). For instance, Levitt and Verkatesh (2000) stated that death rates in

their sample were seven percent for each year, by which they studied a drug selling gang's finances (Levitt & Verkatesh, 2000). Additionally, conflicts among competing sellers, who are probably illegal gun owners, or disputes between vendors and buyers more likely to result in violent crime (e.g., homicide) as participants are less likely to call upon law enforcement agencies to resolve disagreements (Levitt & Venkatesh, 2000; Blumstein & Wallman, 2006). Moreover, it is not uncommon for drug dealers to rob their vulnerable clients through intimidation or actual damages (Chaiken and Chaiken, 1990; Eck, 1995; Harocopos & Hough, 2005). Furthermore, from a similar perspective, having drugs and money makes drug dealers attractive targets for robbing (Simon & Burns, 1998).

Using social networks is a solution both for the vendors and buyers to avoid the dangerous situations stated above and reduce the risk of being apprehended by the police. However, limiting the transaction opportunities based on friends and acquaintances is not satisfactory for the participants of drug markets. Vendors need to find more customers to increase their profit, and buyers want to access drugs easily when they need it. These necessities of participants yield the suppliers and buyers to explore suitable places for the transaction by using their daily routine activities (Eck, 1995). Drug markets that settled based on the notion of routine activities are more likely located in the vicinity of places where legitimate routine activities of individuals concentrate, such as recreation areas, malls, and along main roads (Eck, 1995). Additionally, drug markets that operate through a routine activities approach are more likely to be situated in economically depressed neighborhoods' physically deteriorated locations, such as small apartment complexes without resident managers or vacant buildings where control over drug dealing lacks by innocent parties (Eck, 1995). Moreover, the locations of open-air drug markets show sustainability as the

vendors are strongly attached their points of sale: the vendors believe that any displacement would result in loss of their clientele as the buyers want to access the vendors where they think the dealers supposed to be (Eck, 1995).

The attributes of drug marketplaces stated above indicate the importance of routine activities and micro-geographic units in investigating the relationship between the open-air drug markets and violent crimes as these illicit drug markets clusters at particular micro-spatial locations rather than being randomly spread out. Further, the routine activities of the clientele help explain why individuals from upper-middle-class neighborhoods/cities surrounding the City of Camden come to and get arrested during the illicit transaction. Additionally, informal social control mechanisms, which are explained through broken windows theory and collective efficacy, are additional significant factors help understand the underlying factors that converge open-air drug markets and violent crime and make Camden attractive to both users and suppliers.

Data and Methods

This study examines the spatial correlation between open-air drug markets and violent and property crimes, namely Part I (i.e., Index Crimes) crimes. Given that violent crimes have relatively small clearance rates (e.g., that only 12.7 percent of burglary offenses were cleared in 2012; Federal Bureau of Investigation [FBI], 2015); arrest data were utilized to capture the true extent of violent and property crimes. According to the FBI's Uniform Crime Reports (UCR), which relies on the number of offenses reported to and officially recorded by the police agencies (Matthews, Nolan III, & Haas, 2013), reported incidents are indexed in two categories as violent and property crimes. Arson, burglary, larceny-theft, and motor vehicle theft are classified as property crimes (FBI, 2010a), while aggravated assault, forcible rape, murder, and robbery are classified as violent crimes (FBI, 2010b). However, forcible rape was excluded as it is under-reported and occurs for different reasons than other violent crime. Rape incidents, unlike aggravated assault, murder, and robbery, mainly occur as a result of sexual inducements of offenders. Similarly, although a property crime, arson occurs for reasons different from burglary, theft, and motor vehicle theft; while offenders instantly obtain economic gains through burglary, theft, and motor vehicle theft, this is not true for arson. Accordingly, arson was excluded, as well.

There is a great deal of research discussing the importance of determining units of analysis in studying crime clusters at micro-geographic locations (Roncek & Maier, 1991; Smith, Frazee, & Davison, 2000; Weisburd, Bruinsma, & Bernasco, 2009). Using city blocks while linking the theory of routine activity to the role of crime attractors (e.g., bars, taverns, open-air drug markets) for elevated crime clusters in their vicinity helps avoid potentially fallacious conclusions that can stem from using larger units of analysis, such as block groups, or smaller units of analysis, such

as addresses (Roncek & Maier, 1991). For instance, it is not uncommon for crimes to be committed, to a certain geographic extent, away from the facilities as crime attractors' actual addresses (Ratcliffe, 2012; Groff & Lockwood, 2014). Therefore, city blocks were considered as the proper units of analysis of this study. However, investigating crime clusters at micro-geographic units, such as city blocks for an extended period may be problematic due to year-to-year variation in crime (Roncek & Maier, 1991). Accordingly, because census changes over time, this study examines the relationship between open-air drug markets and violent and property crimes committed in Camden only over a one-year period by utilizing 2014 crime data.

Independent Variables

Routine activities theory emphasizes the importance of micro-geographic studies for investigating the relationship between crime and place (Weisburd et al., 2009). Additionally, units of analysis of a study depend on the nature of the problems examined (Weisburd et al., 2009). Given that the social phenomenon of the drug market occurs at the block level (McCord & Ratcliffe, 2007), a micro-analysis of Camden at the block level was performed to examine the spatial link between open-air drug markets and violent and property crimes. However, although the US Census collects data at the block level, data provided by the US Census is only available as aggregates at the block group or census tract level due to security concerns about individuals. Considering that using block group or census tract level data fail to capture block by block variation of crime, the variables were constructed from parcel-tax data to investigate the relationship between open-air drug markets and violent and property crimes at the block level. According to the US Census, the population of block groups ranges from 600 to 3,000 residents, and a population of census tract ranges between 1,200 and 8,000 people, with an optimum size of 4,000 persons. For

instance, New Jersey has 2,010 census tracts, 6,320 block groups, and 169,588 census blocks (U.S. Census Bureau, 2010b) indicating that a block group in New Jersey consist of approximately 27 blocks.

Stability of neighborhoods increases the likelihood that residents will perform as capable guardians (Cohen & Felson, 1979). The low socioeconomic status (SES) and residential instability of neighborhoods have been considered as potential indicators of violence (Sampson et al., 1997). Therefore, residential stability is one of the independent variables that should be controlled for in investigating effects of open-air drug markets on violent crimes. Additionally, vacant buildings (i.e., abandoned properties) as potential crime sites have shown to be related to residential instability (Johnson, Taylor, Groff, 2015; Martinez, Rosenfeld, & Mares, 2008). Residential stability was captured by the ratio of owner-occupied housing units over non-owner occupied housing units provided by tax data. The socio-economic composition of city blocks was captured with the property values of housing units within each block. Alcohol-related establishments, such as alcohol outlets, liquor stores, and bars are common facilities that account for crime clusters (Groff & Lockwood, 2014). Accordingly, alcohol-related establishments are another independent variable of this study. Given that public institutions a neighborhood have, such as churches and schools may (or may not) have role in controlling crime through eliminating social disorganization (Gainey & Triplett, 2011), public institutions within Camden are considered as another independent variable. The effects of the independent variable of interest, which is open-air drug markets, of violent and property crime dispersion within city blocks, were investigated controlling for these ecological factors.

Spatial data analysis statistics, such as the Moran's I spatial statistic were conducted through GeoDa, a free software program that provides users variety of functions, such as spatial regression, and visualization of global and local spatial autocorrelation. The values of Moran's I lies between -1 and +1: negative spatial autocorrelation results in negative values and positive spatial autocorrelation results in positive values. The close values of Moran's I to +1 indicate that similar values are next to each other. On the other hand, when similar values are dispersed across the city (i.e., such as bus stops), the Moran's I gets closer to -1. A value of 0 for Moran's I indicates a random spatial pattern (i.e., no autocorrelation). Geary's C, which is also known as Geary's contiguity ratio, is another measure of spatial autocorrelation that could be utilized to examine correlations between variables. Values of Geary's C range from 0 to 2. Values closer to 0 indicate stronger positive spatial autocorrelation while the values closer to 2 illustrate stronger negative spatial autocorrelation. A value of 1 for Geary's C demonstrates a random spatial pattern (Raty & Kangas, 2006). Although Geary's C is more sensitive to local spatial autocorrelation and used with smaller units of analysis, I chose to use Moran's I as it is a more conservative measure, and traditionally used in crime analysis.

GeoDa's regression functionality introduces three models, which are OLS with spatial dependence diagnostics (i.e., classic model), spatial lag model, and spatial error model using maximum likelihood estimation (Anselin, 2004). Classic model and spatial error model both assume that the dependent variable is not influenced by neighboring dependent or independent variables, and test the effects of independent variables on dependent variable within a given neighborhood. These two models differ in that the former does not introduce spatial weights, whereas the latter does. Spatial weights are derived from either criterion of contiguity (i.e., the neighbor is

defined as having a common point on their boundaries) or k-nearest neighbor criterion
(Anselin, 2004). Spatial lag model, on the other hand, speculates that the dependent
variable is affected by its neighbors, and demonstrates a given neighborhood's
impacts on its neighbors. The diagnostics for spatial dependence, obtained through the
classic model, indicate whether spatial dependence exists, and, if so, which model is
more appropriate to run (i.e., spatial lag or spatial error model).

GeoDa's local spatial autocorrelation (LISA) analysis was used to identify
violent and property crime clusters. LISA cluster maps provide information about four
types of spatial autocorrelation: high-value areas on a particular variable surrounded
by high-value are shown in dark red; low-value areas on a particular variable
surrounded by low-value are shown in dark blue; high-value areas on a given variable
surrounded by low-value are shown in light red; and low-value areas on a particular
variable surrounded by high-value are shown in light blue (Anselin, 2004).

Results

Bivariate Analysis

Table 1 presents the values for bivariate Moran's I and bivariate local Moran's I, showing the strength and direction of the correlation between independent variables and outcome crime types (i.e., violent and property crime incidents). The results of bivariate tests indicate that all independent variables except ''percent of high-value housing'' and ''percent of non-housing units'' positively correlated with the dependent variables. However, none of the independent variables moderately or strongly correlated with the dependent variables; all values for Moran's I are close to 0. Using city blocks as the units of analysis rather than larger units, such as block groups and investigating crimes committed in the study site only over a one-year period may have resulted in these small values of Moran's I. If the rates of crime were used as opposed to counts, the values for Moran's I would have been larger but this would also falsely inflate the data. Additionally, utilizing Geary's C would have indicated stronger correlations but Moran's I was utilized for reasons discussed above.

Considering the empirical relationship between the low socioeconomic status (SES) and the likelihood of increased violent crime levels (Sampson et al., 1997), the violent crime incidents in low SES blocks were visualized. Figure 1 illustrates the spatial autocorrelation of the high-high and the low-low clusters of a percent of low-value housing and violent crime. The high violent crime rate in blocks of low SES surrounded by other poor blocks with high violent crime rate are shown in dark red. Similarly, the low violent crime rate in blocks of low SES surrounded by other poor blocks with low violent crime rate are shown in dark blue. According to LISA analysis, there are only 85 blocks, which corresponds to 5 percent of the city blocks in Camden, accounting for the high-high clusters of violent crimes.

Given that the risk of experiencing property crime victimization is more likely for people with high socioeconomic standards than persons with low SES (Tseloni, Osborn, Trickett, & Pease, 2002), the property crime incidents in medium and high SES blocks were visualized, as well. Figure 2 demonstrates the spatial autocorrelation of the high-high and the low-low clusters of a percent of middle and high-value housing combined and property crime. High property crime rate in blocks of medium and high SES surrounded by other similar blocks with high property crime rate are shown in dark red. Likewise, low property crime rate in blocks of medium and high SES surrounded by other similar blocks with low property crime rate are shown in dark blue. LISA analysis indicates that only 4 percent of the city blocks (i.e., 68 blocks) in Camden are responsible for the high-high clusters of property crimes.

Table 1

The Values for Bivariate Moran's I for Violent Crime (VC) and Property Crime (PC)

Independent Variables	Moran's I for VC	Moran's I for PC
# of drug offenses	0.027	0.027
Owner occupied over non-owner occupied housing	0.014	0.019
Percent of low-value housing	0.021	0.005
Percent of medium-value housing	0.000	0.003
Percent of high-value housing	-0.018	-0.018
Alcohol-related establishments	0.003	0.001
# of churches	0.005	0.007
# of schools	0.002	0.000
# of non-housing buildings	-0.003	-0.006

Table 1
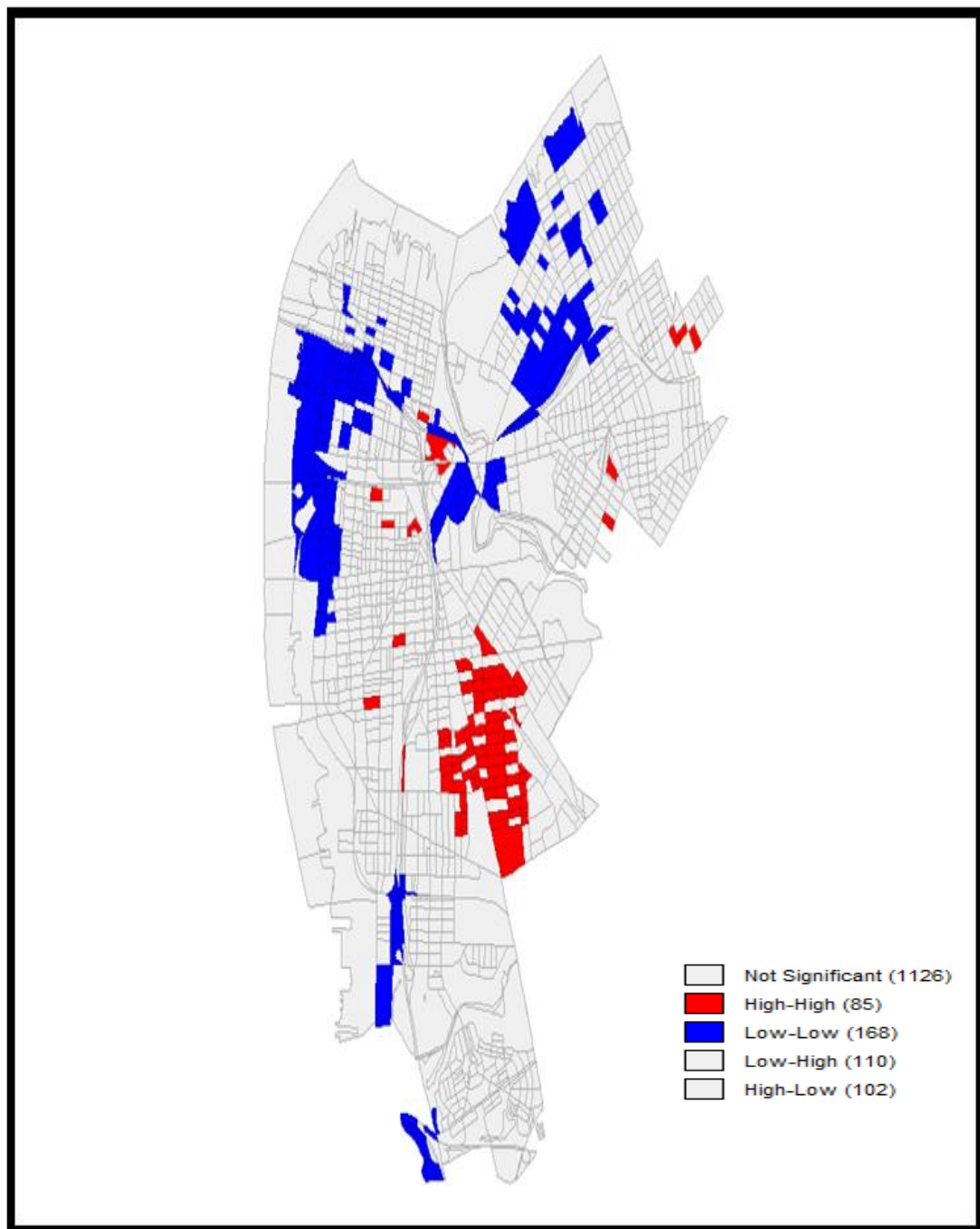
Figure 1. Bivariate LISA cluster map: percent of low-value housing vs. violent crime. This figure illustrates the high-high and the low-low clusters of a percent of low-value housing and violent crime. The low-high and the high-low clusters are not shown to emphasize the similar values clustered together.
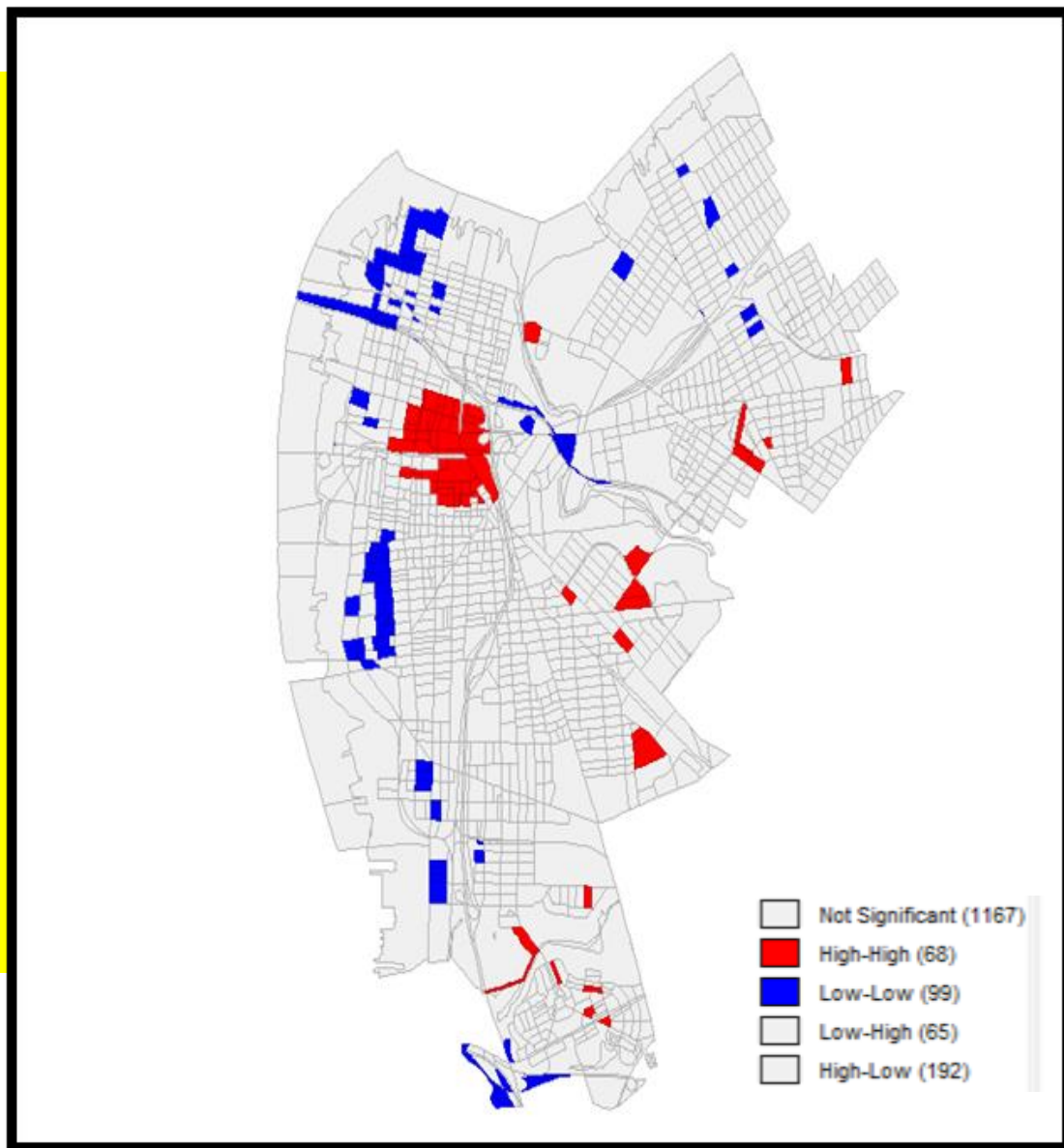
Figure 2. Bivariate LISA cluster map: percent of medium and high-value housing (combined) vs. property crime. This figure illustrates the high-high and the low-low clusters of a percent of medium and high-value housing (combined) and property crime. The low-high and the high-low clusters are not shown to emphasize the similar values clustered together.

Multivariate Analysis

The traditional linear models for both violent and property crime at the block level ended up being insignificant due to the spatial error in the model as identified by the Moran's error measurement. Accordingly, the natural log of the dependent variables was taken to address the issue of skewness in violent and property crime. The diagnostics for spatial dependence, obtained through the simple OLS regression (i.e., classic model), indicate that spatial dependence exists. The values of Moran's I (error) both for violent crime (0.032) and property crime (7.279) analysis show that it is necessary to consider space in the model. This actually justifies using spatial analysis since the subjects are not randomized as opposed to traditional statistical analysis assumes.

The diagnostic output of the classic model provides five Lagrange Multiplier (LM) test statistics which are LM-Lag, Robust LM-Lag, LM-Error, Robust LM-Error, and LM-SARMA (Anselin, 2004). The Robust versions of the statistics were considered as the standard versions of the statistics (i.e., LM-Lag and LM-Error) are both significant for violent crime analysis. The Robust LM-Error statistic is significant (with $p = 0.012$), while the Robust LM-Lag statistic is not (with $p = 0.953$). Accordingly, a spatial error model was performed (Anselin, 2004).

Table 2 presents the unstandardized coefficients, standard errors of these raw coefficients, and significances associated with the spatial error model for violent crime analysis. Consistent with the propositions of crime pattern theory, the spatial error model reveals the importance of certain types of non-residential places, such as alcohol outlets and open-air drug markets in facilitating the occurrence of crime incidents and attracting motivated offenders. The indicator of open-air drug markets (i.e., the number of drug offenses; $p < .001$) and alcohol-related establishments ($p < $

.001) are statistically significant risk factors for the occurrence of violent crimes.

Additionally, the residential stability of a block as reflected by owner-occupied

housing units over non-owner occupied housing units (p < .001) is another

statistically significant risk factor in regard to the occurrence of violent crime

incidents. However, the only measure that is highly significant and has relatively high

coefficient is alcohol-related establishments. All other variables, including the

indicator of open-air drug markets, have minuscule coefficients, suggesting that the

most important risk factor in generating violent crime incidents is the alcohol-related

establishments. The spatial error model also reveals that low SES as reflected by the

percent of low-value housing is negatively correlated with violent crime rate,

suggesting that poverty is not necessarily related to violent crime and reinforcing the

importance of alcohol-related establishments in predicting violent crime clusters.

The public institutions a block have as reflected by the number of churches,

the number of schools and number of non-housing buildings appear to have, if any, a

minor role associated with the occurrence of violent crime. None of these public

institutions meets the conventional levels of statistical significance. However,

churches, unlike schools and other non-housing buildings, negatively correlated with

violent crime incidents, suggesting that they may have a role in controlling crime

through eliminating social disorganization. The positive correlation between schools

and violent crime, as well as other non-housing buildings and violent crime incidents,

provides evidence for the notion of routine activity theory, suggesting that these non-

residential places facilitate the convergence of motivated offenders and suitable

targets, and increase the likelihood of occurring violent crime incidents. Overall, the

model for violent crime analysis explains 13 percent of the variation in the occurrence

of violent crime incidents ($R^2 = .13$). The reason that makes the value of R-squared

relatively small is the size of units of analysis and limited period the study examined.

Table 2

Spatial Error Model-Maximum Likelihood Estimation (Violent Crime)

Variable	B	SE B	Significance
Constant	0.129	0.025	0.000***
# of drug offenses	0.011	0.001	0.000***
Owner occupied over non-owner occupied housing	0.000	0.000	0.006**
Percent of low-value housing	-0.001	0.000	0.245
Alcohol-related establishments	0.294	0.088	0.000***
# of churches	-0.027	0.031	0.376
# of schools	0.052	0.073	0.477
# of non-housing buildings	0.018	0.123	0.885
LAMBDA	0.389	0.087	0.000***

*Note*s. $R^2 = .13$
n=1591
*p < .05, **p < .01, ***p < .001

Table 2 Regression Table

The diagnostic output of the classic model for property crime analysis provides

similar LM test statistics. Since the standard versions of the statistics are both

significant, the robust versions of the statistics were considered. The Robust LM-

Error statistic is significant (with p = 0.000), while the Robust LM-Lag statistic is not

(with p = 0.756). Accordingly, similar to violent crime analysis, a spatial error model

was performed.

Table 3 presents the unstandardized coefficients, standard errors of these raw

coefficients, and significances associated with the spatial error model for property

crime analysis. As in the violent crime analysis, the open-air drug markets (p < .001)

and alcohol-related establishments (p < .05) remain as significant risk factors for the occurrence of property crimes, reinforcing the suggestions of crime pattern theory. Similarly, the residential stability of blocks maintains its significance (p < .01) as to being a risk factor associated with the occurrence of property crime incidents. Socio-economic status of residents within a block as reflected by percent of medium-value housing (p < .001) and percent of high-value housing units (p < .001) is an additional statistically significant risk factor in regard to the occurrence of property crime incidents. The percent of low-value housing units was excluded from the multivariate model as it is an insignificant predictor for property crimes within a block.

The measures of public institutions that were included to capture their contributions to property crime incidents do not follow the outcomes predicted by routine activities theory. Indeed, the presence of churches and non-housing buildings within a block appear to prevent the occurrence of property crime incidents. Similar to violent crime analysis, the correlation between schools and property crime is positive, providing additional evidence that schools, forsooth, pave the way for the convergence of motivated offenders and suitable targets, and enhance the likelihood of occurring property crime incidents. However, as in the violent crime analysis, these public institutions failed to approach the conventional levels of statistical significance. Additionally, similar to violent crime analysis, the only measure that is significant and has relatively high coefficient in the model is alcohol-related establishments. All other variables, including the independent variable of interest, which is open-air drug markets, have minuscule coefficients, reinforcing that the most important risk factor in generating property crime incidents is the alcohol-related establishments.

Table 3

Spatial Error Model-Maximum Likelihood Estimation (Property Crime)

Variable	*B*	*SE B*	Significance
Constant	0.021	0.034	0.536
# of drug offenses	0.015	0.001	0.000[***]
Owner occupied over non-owner occupied housing	0.000	0.000	0.001[***]
Percent of medium-value housing	0.003	0.001	0.000[***]
Percent of high-value housing	0.003	0.001	0.000[***]
Alcohol-related establishments	0.240	0.095	0.012[*]
# of churches	-0.058	0.033	0.083
# of schools	0.025	0.080	0.753
# of non-housing buildings	-0.093	0.134	0.489
LAMBDA	0.465	0.080	0.000[***]

*Note*s. R^2 = .19
n=1591
[*]p < .05, [**]p < .01, [***]p < .001

Table 3 Regression Table

The model for property crime analysis appears to be stronger than the one for violent crime analysis as it explains 19 percent of the variation in property crime incidents (R^2 = .19). However, this R-squared value is still relatively a small one due to previously explained issues stemming from the units of analysis and limited period the study investigated.

Discussion and Conclusions

The current study sought to illustrate the micro-spatial link between open-air drug markets and crime. However, this study, consistent with the literature, revealed a substantial effect of alcohol-related establishments on the elevated levels of crime that residents experience. Nevertheless, results from open-air drug markets and other factors associated with crime incidents are worth noting.

The results of both bivariate and multivariate tests indicate that all independent variables but alcohol-related establishments have a minor impact on the occurrence of violent and property crimes. The presence of alcohol-related establishments within blocks is a good predictor of both violent and property crimes and provides noteworthy information about the measures to be taken in dealing with crime incidents. These outcomes, therefore, reinforce a substantial number of studies suggesting that the higher density of alcohol outlets increase the concentrations of crime incidents (Roncek & Maier, 1991; Parker, McCaffree, & Skiles, 2011). The results, in conjunction with the significant body of empirical research on micro crime places, also demonstrate that only less than five percent of the city blocks in Camden account for the high-high clusters of the offense incidents (Sherman et al., 1989; Weisburd, Bushway, Lum, & Yang, 2004; Weisburd & Amram, 2014). Accordingly, criminal justice stakeholders should devote their scarce resources to these crime-prone blocks that are responsible for the disproportionate amount of crimes to reduce overall crime rates in Camden. These findings also indicate the importance of collaboration in dealing with crime incidents through controlling places that serve as crime attractors, including open-air drug markets. Any program or policy to be effective in overcoming open-air drug market problem should involve cooperation with law enforcement agencies, other public and private social service agencies, and community

organizations. The responsible stakeholders should hold monthly meetings in which they share information with one another about ongoing problems of the jurisdiction; document necessary steps should be taken by the relevant agency, listen to community members' expectations, and evaluate the monthly outcomes of their meetings. The effectiveness of following similar steps in dealing with open-air drug market problem has been proven in MacArthur Park through a program called *Alvarado Corridor Initiative* by the city leaders in Los Angeles (Sousa & Kelling, 2010). Additionally, given the results that open-air drug markets are clustered at certain blocks rather than being evenly distributed across neighborhoods, the underlying strategies of program or policies should focus on blocks, not neighborhoods.

Residential stability

The presence of non-owner occupied housing units within blocks increases residential instability and the likelihood of existing open-air drug markets. A policy that stipulates the presence of block associations and holds responsible these organizations for maintaining the well-being of vacant housing units within blocks may help control crime incidents. Another problem contributing crime problem in Camden as revealed by the parcel-tax data is that a considerable proportion of owners of housing units live outside the city as they possessed these properties for investment purposes. Accordingly, a policy that gives the city more authority to buy the properties, which are being used for drug dealing by tenants, would be effective in struggling with open-air drug market problem. The governmental purchasing of these housing units would encourage landlords to maintain their properties in drug-free conditions.

Socio-economic status

The positive correlation of percentage of low-value housing and number of drug-related arrests, as opposed to negative correlations of the percentage of medium value or high-value housing and a number of drug-related arrests, demonstrate the significance of low SES of residents in predicting locations of open-air drug markets. These outcomes suggest that open-air drug markets are more likely to be located within blocks where low-income individuals reside. Additionally, considering the higher crime prevalence in Camden than the national average (FBI, 2012), it is more likely to have criminal histories for people reside in Camden than other residents. Accordingly, one of the reasons for the positive correlation between the percentage of low-value housing and number of drug-related arrests could be the fact that individuals who cannot find regular job opportunities due to their criminal backgrounds might have tended to deal drugs. According to the Society of Human Resources Management, more than 90 percent of companies in the United States perform criminal background checks on job applicants (Society of Human Resources Management, 2011). Therefore, program or policies those provide employment opportunities to unemployed people with criminal backgrounds through prohibiting employers from investigating about potential employees' criminal histories may be effective in minimizing or eliminating open-air drug markets.

Additionally, similar to Medicaid, adopting a social help program (e.g., Rentaid) for low-income individuals to pay for housing would discourage them to involve in drug dealing as the program stipulates any drug offense, upon being accepted for the program, would result in losing their eligibility. Such a program, which compensates certain percent (e.g., 10 percent) of the monthly lease, would eliminate the concentration of economically disadvantaged residents within certain

blocks where monthly rental payments are low. Similarly, tenant management organizations would be encouraged to apply discounts, similar to military discounts or senior citizen discounts, for low-income individuals through governmental rewards.

Alcohol-related establishments

Overall, these findings suggest that if the number of alcohol-related establishments in the City of Camden were reduced, the occurrence of violent and property crime incidents in the surrounding areas would decline, as well. This crime reduction could be succeeded through a policy that stipulates mandatory requirements for alcohol-related establishments, such as the installation of CCTV (i.e., closed-circuit television) systems to maintain their ability to do business. Stringent regulations on the renewal of liquor store licenses would help decrease the number of crime incidents by the closure of alcohol outlets that consistently violate the legal provisions of the regulations (Parker, McCaffree, & Skiles, 2011). Additionally, these outcomes strengthen the idea that ensuring public safety and dealing with crime requires not only law enforcement agencies but also cooperation among all responsible parties as it is not the police agencies' responsibility to control whether alcohol-related establishments follow what the regulations dictate.

Public institutions

The only public institution type that indicated a positive impact on preventing occurrence of crime incidents in both models was churches. On the other hand, schools appeared to be a public institution type that accounts for the increase in crime incidents in their vicinity, suggesting that additional measures to be taken associated with crime reduction should consider schools in the first place. Given the promising role of churches in eliminating social disorganization, it is critical to specify its unique characteristics that may help controlling crime. Churches as voluntariness-based

community organizations are present in all neighborhoods regardless of their socio-economic status and attract people from a broad range of socio-economical backgrounds (Rose, 2000). Individuals of high SES from outside the community may provide external sources as churches have a high opinion of helping neighborhoods in addressing problems (Rose, 2000). These exterior supports obtained through churches may help explain their relatively increased level of crime control capability and contribution to disadvantaged communities in preventing social disorganization. Additionally, considering that the presence of churches and non-housing buildings appear to prevent the occurrence of property crime incidents as opposed to routine activities theory predicts, another reasonable explanation for these outcomes is that there may be more target hardening measures, such as more street lighting and security cameras (i.e., CCTV systems) in areas where churches and non-housing buildings are located. These ecological measures reduce the opportunities for crime by increasing its perceived risks.

A variety of limitations should be considered when evaluating findings of the current study. The unique structure of Camden regarding its high crime rate, as it has consistently been one of the most dangerous ten cities in the United States for each year between 1997 and 2012 (CQ Press, 2015), might raise concerns about generalizability. Additionally, although arrest data were utilized rather than clearance rates of crime incidents, the limitations of police recorded data are still potent. In both models, the overwhelming impact of alcohol-related establishments on the occurrence of crime incidents hindered to examine the true extent of the role of open-air drug markets associated with the elevated levels of crime. Future research should consider these issues in investigating crime and open-air drug market association to reveal the actual impact of open-air drug markets on crime clusters at micro-spatial areas.

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