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RESEARCH

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Street drug markets beyond favelas in Belo Horizonte, Brazil

Elenice Oliveira^{1*}, Braulio Figueiredo Alves Silva² and Marcos Oliveira Prates³

Abstract

This study examines whether social disorganization mechanisms that explain clusters of street drug markets in socially disorganized neighborhoods in developed countries can also help explain geographical patterns of drug dealing across neighborhoods in Belo Horizonte, Brazil. Data for this study includes drug arrests from 2007 to 2011 and socio demographic data from the 2010 Census. To examine the influence of exploratory variables on drug market locations, the Negative Binominal regression model was used at two levels of analysis—the Belo Horizonte city center and other neighborhoods including favelas. The findings show that a high hot spot of street drug markets located in the city center is positively associated with housing quality as well as negatively associated with residential tenure. Low hot spots were found in remaining neighborhoods, including impoverished areas of favelas and are related to key social disorganization indicators such as socio-economic status, age at risk, and residential tenure. This study has important implications for crime prevention policies and provides the basis for further comparative research on street drug markets across many different countries.

Background

The explosion of the transnational organized crime of drug trafficking, mainly cocaine, in the 1980s has had a local impact on the emergence of street drug markets in disadvantaged neighborhoods in the large metropolises of developing as well as advanced nations. The rapid spread of illicit drug activity, visible on the streets of these impoverished areas has been associated with many other social problems and criminal activities such as the smuggling of guns, robbery, the trading of illegal goods, prostitution, and violence (Zaluar 1994; Blumstein 1995; Goldstein 1995; Johnson et al. 2000; Ousey and Lee 2002; Misse 2007; Saporì et al. 2012). The local drug trade has also generated fear, inhibiting the ability of community residents in impoverished neighborhoods to restore social order and impacting the quality of life. Although street drug markets are densely clustered in these neighborhoods (Kleiman 1991; Weisburd and Green 1995; Edmunds et al. 1996; Anderson 1999; Harocopos and Hough 2005; Rengert et al. 2005; McCord and Ratcliffe

2007), not all deprived neighborhoods are hot beds for the sale of drugs. Despite varying spatial patterns of drug activity, scholars often continue to limit their inquiry into the causes of these “hot beds” only in impoverished areas.

While criminologists in the US have traditionally used the social disorganization theory to examine the geographical locations and characteristics of drug markets (Saxe et al. 2001; Sun et al. 2004; Freisthler et al. 2005; Martinez et al. 2008; Lipton et al. 2013) this same theory has not yet been tested to examine the same problem in the context of developing nations, especially Brazil. This study tests the classical social disorganization variables to examine variations on the geographical patterns of street drug markets across neighborhoods in a large Brazilian city. Understanding the spatial distribution of these markets sharpens the insights of comparative criminology which has important implications for prevention policies that go beyond repressive enforcement. This study might contribute to a new line of comparative research into street drugs markets, shedding new light on the similarities and differences in social disorganization mechanisms that create hospitable conditions for these markets in different regions, as well as generate new insights into the prevention and control of these markets in deprived

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neighborhoods across developed and less advanced nations.

Brazil, considered as both a destination and transit area for cocaine and marijuana, is also the second largest country outside of the US for cocaine consumption (United States Department of State Bureau for International Narcotics & Law Enforcement Affairs: International Narcotics Control Strategy Report 2013). Although sold in many different ways, street drug markets set up on the streets of *favelas* (slums), known as *bocas de fumo*, is the most visible local drug activity in the country. Since the 1980s, *favelas* have become generators of street drug markets.¹

Although cocaine and marijuana were initially the staple commodities of the *favelas*, crack cocaine has become the drug lords' "bread and butter" since the 1990s. The expansion of drug sales in these communities has triggered many other types of criminal activities (Misse 1997; Beato et al. 2001; Sapori et al. 2012; Silva 2014). As a result, many of these *favelas* have been subjected to government intervention. In some cities, police strategies have been associated with causing the displacement of drug activity from the usual *favelas* to surrounding areas, including the city center (Salgado 2013). These settings are usually known as *cracolândias* or "cracklands" (Rui 2012; Salgado 2013). *Cracolândias* are usually located in open settings such as streets, parks, abandoned buildings, and other well trafficked commercial areas in the central part of cities (Domanico 2006; Grillo 2008; Frugoli and Spaggiari 2010; Salgado 2013).

Nevertheless, not one quantitative study in Brazil has investigated the spatial distribution of street drug markets in relation to the conditions of neighborhoods. This study identifies the geographical patterns of street drug markets in Belo Horizonte, one of Brazil's largest cities, and analyzes how the conditions of social organization in neighborhoods can influence the location of these markets at the city level as well as across neighborhoods. The authors hypothesize that the location of street drug markets is influenced by indicators of social disorganization that are distributed in the urban landscape within and beyond *favelas*.

¹ *Favelas* are informal urban settlements built by poor workers and their families who migrated from rural areas to large cities searching for a better quality of life in the nineteenth century. They are not homogeneous in terms of social and economic conditions. They are often located in areas of ecological risk subjected to geographical erosion and natural disasters, where inhabitants built their shacks without any official control, and exhibit signs of poverty and social disorganization. These areas tend to be interspersed within other urban settings with a visibly better standard of living (De Souza 2010). Drug lords discovered the most favorable conditions in *favelas*, including volatile communities marked by decades of government neglect, a lack of resources and basic infrastructure, police inefficiency and corruption, as well as a high rate of unemployment and other social problems (Misse 1997; Zaluar and Alvito 1998; Leeds 1998; Beato et al. 2001; Zaluar 2004; Soares et al. 2005; Vargas 2006; Misse 2007; Misse and Vargas 2010).

Research field

Belo Horizonte, founded in 1897 and located in the southern region of Brazil, on the border of Sao Paulo and Rio de Janeiro, is the capital of the State of Minas Gerais, which is the fourth largest state in Brazil. The city occupies an area of 335 square kilometers with an estimated population of 2,375,444 people. The economy is dominated by the service sector (Instituto Brasileiro de Geografia e Estatística—IBGE 2010 Census). According to the 2010 Census, out of 628,447 households in Belo Horizonte, 66.58 % are owner-housing units; 7.23 % are in the process of being purchased; and 18.06 % are rented housing units. With regards to the racial composition, the city is divided into 46.37 % white, 42.1 % mixed or brown (*pardos*), 10.27 % black, 1.08 % Asian, 0.17 % indigenous, and 0.01 % non-declared. The majority of blacks are concentrated in *favelas* (Ferrari 2013). In addition, 95.6 % of the population lives just above the poverty line while 3 % are in between indigence and the poverty line and finally 1.4 % below the poverty line. Approximately 200,000 people live below the poverty line. According to official data, there are 487 individual neighborhoods in Belo Horizonte including 215 *favelas*, *vilas* (up-dated improved *favelas*), and other public housing spread throughout the city. Nearly half a million people live in the more than 130,000 households located in these areas.

The rapid and disorganized growth of the city during the 1950s along with the intense process of urban migration and housing deficit contributed to the further development of more *favelas* (Oliveira 2012). Government improvement programs since the 1980s have allowed *favelas* to become more integrated into the rest of the city. *Favelas* have evolved in a disorderly fashion creating a variegated mixture of urban progress including updated electricity, plumbing, sanitation, and finally, a thriving commercial area with extreme social marginalization and poverty. This has created a safe zone and a danger zone for life in the *favela* (Alvito 1998; Zaluar 2004; De Souza 2010). This makes Belo Horizonte a conundrum in the fertile landscape of Brazil and allows us to examine the various conditions of neighborhoods and how they might shape the distribution of street drug markets in specific neighborhoods and not in others.

Theoretical framework

In the US, the social disorganization theory, which was originally used to understand the social ecology of crime and delinquency (Shaw and McKay 1942) has been applied in empirical research to explain the influence of social disorganization variables (e.g., racial heterogeneity, income inequality, single-parenthood, poverty, and residential mobility) on street drug markets' geographical pattern (Rengert et al. 2005; Roh and Choo 2008; Martinez

et al. 2008). Overall their findings have shown a strong association between street drug markets and correlates of structural disadvantage at the neighborhood level.

Since the 1980s, a new wave of research on drug markets has provided a new body of knowledge that has helped to disentangle the relationship between socially disorganized neighborhoods and street drug markets. According to Rengert et al. (2005), drug markets in impoverished neighborhoods can be explained by three factors. First, the least amount of resistance is demonstrated by local residents who are basically disorganized, do not know or care to confront drug dealers directly, or simply feel helpless to do so. Secondly, impoverished neighborhoods have the largest proportion of population most vulnerable to the attraction of drug activity. This at-risk group includes the unemployed, the undereducated, and young men under the age of 30. Thirdly, in these neighborhoods there is a concentration of environmental advantages that make the areas attractive to drug dealers. These advantages could include a high proportion of rental dwellings, proximity to homeless shelters, bars, liquor stores, unattended parks, as well as major thoroughfares, and transportation hubs (Rengert et al. 2005).

In addition to those factors, there are two other reasons that explain why drug dealers tend to be concentrated in specific areas. Firstly, a crowd of dealers in proximity to one another tends to provide better protection from the police (Kleiman 1991). Secondly, due to “agglomeration economies,” street drug markets operate much like legitimate retail businesses (Rengert 1996; Rengert et al. 2000). Once a specific area becomes well known as a source for drugs, it establishes a steady clientele of both resident and outside buyers. Additionally, Kleiman (1991) argued that these are locations that offer a low risk of apprehension for both sellers and buyers.

Despite the contributions of these empirical studies in explaining the locations of street drug markets, social disorganization processes continue to frame contemporary explanations of street drug markets and other crimes (Bursik 1988; Martinez et al. 2008; Lipton et al. 2013). The urban landscape of large cities has changed since the pioneering work of the founders of the ecological studies on crime, but illicit drug activity as well as other social problems continues to be clustered in run-down neighborhoods. Based on the relevance of this scientific debate and the need to expand this debate into the international context, particularly in developing countries, this study tests the social disorganization theory, which has been commonly used in the US, to investigate the association between indicators of social disorganization within and beyond *favelas* and the spatial distribution of street drug markets in the city of Belo Horizonte.

Methodology

In this study, neighborhoods are operationally defined by census tracts. Belo Horizonte is divided into 3937 census tracts (36 out of the total are concentrated in the city center) with an average of 600 residents per tract (2010 Census). According to the Brazilian Institute of Geography and Statistics (IBGE), the census tracts are divided into two categories: “normal,” which commonly refers to tracts in neighborhoods and represents 88 % of the total; and “subnormal,” representing the other 12 % and located in *favelas*. Less than 1 % of census tracts were dropped from this study because they represent areas not relevant to the analysis, such as hospitals, schools, and facilities where there is missing data.

Some scholars have criticized the use of census tracts or other administrative boundaries as an inappropriate proxy for neighborhoods (Rengert et al. 2005; Rengert and Lockwood 2009). Census tracts are, however, the most used proxy for neighborhoods in most social disorganization research (Hart and Waller 2013). The main advantages of using census tracts are that they are small units and relatively homogeneous in terms of socioeconomic and demographic characteristics. In this present research, the use of census tracts allows for the comparison of the influence of indicators of social disorganization on street drug markets in different areas throughout the city.

In this study, street drug markets refer to geographically fixed locations where illicit drugs are bought and sold (Johnson et al. 2000). In order to measure the existence and proliferation of these markets across neighborhoods, this study uses geo-referenced drug arrest data related to drug sales including cocaine, crack-cocaine, and marijuana occurring from 2007 to 2011 for the entire city of Belo Horizonte. This was provided by the Integrated Information Center for Social Defense of the Military Police of the state of Minas Gerais. The study does not provide information on the types of drugs that were sold.

One of the problems of solely using drug arrests as a measure of drug markets instead of in combination with other possible sources such as intelligence records, community meetings, calls for service, and public surveys among others (Jacobson 1999), is its failure to fully capture the precise picture of much of the drug activity which goes unreported. Additionally, the use of drug arrests has been criticized as it only reflects law enforcement agencies' responsiveness in pursuing offenders (Ousey and Lee 2002). Arrest data may also be biased by police corruption and impunity. Traditionally impoverished areas in Brazil are characterized by poor police presence and corruption which has contributed to turning *favelas* into a no-man's-land and an ideal location for criminal activity. Although these factors could influence

the validity of drug arrests as a measure of street drug markets, drug sale arrests continues to be commonly used as a relevant measure of street drug markets in empirical research (Lipton et al. 2013).

Additionally, this study uses the 2010 Census data provide by IBGE to measure indicators of social disorganization, which includes household density, residential tenure, racial heterogeneity, socio-economic status, age risk (between 15 and 24), and housing quality.

General patterns of drug activity in Belo Horizonte

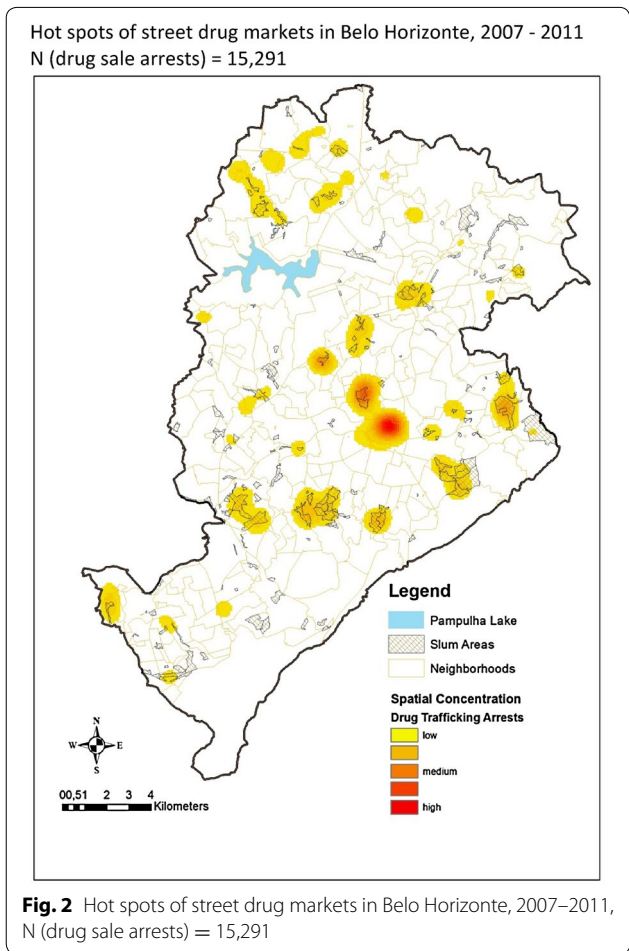
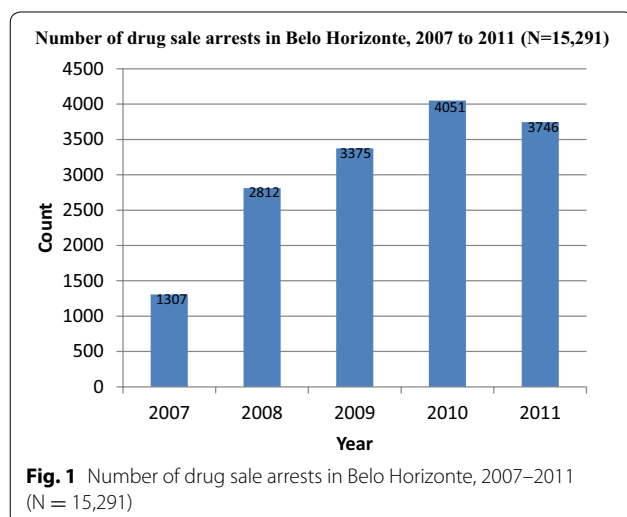
Police data related to drug sales shows an increase in the total number of arrests per year during this period of analysis. The total number of arrests rose from 1307 in 2007–3746 in 2011. This represents an increase of 53.59 % over the entire period (see Fig. 1).

Although it is not clear whether this increase in arrests signifies an escalation of sales or is simply the result of more intensive policing, the data indicates its recurrence in the city. This is demonstrated by the Kernel density function map (see Fig. 2).

Based on aggregated arrest data for all the years in analysis, the map above, which shows the neighborhoods (polygons), clearly demonstrates the evolution of street drug markets. Low-and-medium density hot spots are highly concentrated in specific slums as indicated on the map. High-density hot spots are also evident and basically concentrated in the city center as well as nearby slums. This finding is also supported by the Pearson correlation coefficient, which shows that the location of these drug markets is constant over the years in the study.

Exploratory variables and measurements

To clarify, the aforementioned variables and their measurements are specified as follows:



Household density

In this study, household density is used as an indicator of population density. It is calculated by the average number of people per household for households at the census-tract level of analysis. Household density is an adequate indicator of crowding which in turn is associated to poverty and the likelihood of criminal activity (Harries 2006). This study investigates whether the weakening of guardianship associated with “crowding” in impoverished areas also has an effect on the street drug market density. “Crowding” might contribute to increasing youths’ propensity for involvement in delinquency and criminal behavior, which in turn may increase their likelihood of drug use and recruitment by dealers.

Residential tenure

A large number of rental units as opposed to owner units has a negative impact, leading to a higher crime rate and increased drug activity (Rengert et al. 2005). This variable is measured by the proportion of rental units in the census tracts.

Racial heterogeneity

Traditionally Brazil is considered a racial democracy.² However, the idea that there is no racial discrimination in the country has been de-mystified by empirical research showing that both blacks and people of mixed race, have been subjected to socio-economic disadvantages in comparison with whites (Ribeiro et al. 2009; Lamarca and Vettore 2012). Although, there is no evidence of geographical segregation of blacks in Brazil in the same manner that existed in the US, blacks and racially mixed individuals tend to be spatially concentrated in the country's Northeast and North regions as well as in the impoverished areas in large Brazilian metropolises (Ribeiro et al. 2009). In regards to treatment under the justice system, studies in early 1980s show that blacks are more likely to be labeled "criminals" than whites and represent the majority of victims of homicides by firearm³ (Waiselfisz 2012). Although the Brazilian Census categorizes race according to the categories of white (*Branca*), black (*Preta*), mixed (*Parda*), yellow (*Amarela*), and indigenous (*Indigena*) (Waiselfisz 2012), researchers who use census data to study race in Brazil have used a dichotomous category—white and non-white—to examine racial inequality in the country (Ribeiro et al. 2009; Lamarca and Vettore 2012). This study follows this tradition and measures race in terms of white and non-white. An index of racial inequality (IRI) is used to measure racial heterogeneity. This index varies from -1 to 1 . If the value of the IRI is equal to 1 , all households in the census tract were formed by whites. If the value of IRI is equal to -1 , all households in the census tract were formed by non-whites. Finally, if the value of IRI is zero (0) the proportion of whites and non-white in all households in the census tracts is equal.

Socio-economic status

Low socio-economic status leads to social disorganization "which in turn increases crime and delinquency rates" (Shaw and McKay 1942; Sampson and Groves 1989). This has a negative impact on residents' ability to

solve common community problems. Socio-economic status is based on the minimum salary.⁴ An index of household socio-economic status (IHSES) was created. The index values range from -1 to 1 . If the value of the IHSES is equal to 1 , all households in the census tract had incomes above two minimum salaries per month. By contrast, if the value of IHSES is equal to -1 , all the households in the census tract had incomes lower than two minimum salaries. Finally, if the value of the IHSES is equal to zero, the proportion of households with incomes above and lower than two minimum salaries is equal.

Housing quality

This variable refers to an indicator of neighborhood conditions including access to infrastructure and public services that can have an effect on the quality of life. Research has shown that poor housing condition has contributed to residents' fear of crime and affect collective efficacy (Roman and Knight 2010). In this study a factorial analysis using Varimax rotation was performed to create the housing quality factor (HQF). This factor includes the following components: (a) percentage of households with no access to water supply, (b) percentage of households with no bathroom facility, (c) percentage of households with no electricity, and (d) percentage of households with no sanitation service. This factor varies from -0.50 to 5.51 . If the HQF is higher, the access of individuals and their families to basic infra-structure and services is worse.

Age

In this study, the proportion of youths from 15 to 24 at census-tract level is an indicator of individuals' risk of being targeted by dealers, which in turn influences the spatial distribution of street drug markets. Studies have shown that adolescents are more likely to explore possibilities leading to a life of possible crime and delinquency (Hunter 1985). Felson and Boba (2010) makes the point that criminal activity peaks in a person's 20s and tends to decrease with age. Research has given evidence that youths, because of their vulnerability and impressionability, are easy targets for drug involvement as users and sellers (Johnson et al. 2000). Dealers tend to target areas where youths congregate such as shopping malls, sporting arenas, and public parks (Curtis and Wendel 2000; Freisthler et al. 2005). In addition, in impoverished areas, low informal control mechanisms, family-structure breakdowns, peer pressure and a history of cultural violence are all factors contributing to the age-risk that

² Brazilians trace their heritage to the history of cultural miscegenation among the Portuguese colonizers, African slaves, and native Indians. For decades, race was synonymous with skin color and physical features, with the spectrum of colors varying from pale-white to blue-black. The large proportion of people who identify their skin color falling into the intermediate palate of various shades of brown classify themselves as mixed (*pardos* or *morenos*). According to the 2010 Census, blacks and people of mixed race represent 50.7 % of the total population while white represent 47.7 % (Lamarca and Vettore 2012).

³ In 2012, 28,946 blacks were victims of violence in comparison with 10,632 whites, corresponding to 28.5 murders per 100,000 blacks as opposed to 11.8 per 100,000 whites (Waiselfisz 2012).

⁴ Minimum salary refers to the government-established minimum wage per hour for someone working a full-time position in Brazil. Currently, the minimum salary is established at R\$779.79 (<http://www.salariominimo2015.com.br/>).

Table 1 Descriptive statistics_ main socio-disorganization variables

Socio-disorganization variables	N	Minimum	Maximum	Mean	Std. deviation
Household density	3830	1.19	4.75	3.13	0.39
Socio-economic status	3830	-1.00	1.00	-0.33	0.57
Racial heterogeneity	3837	-1.00	1.00	-0.047	0.42
Risk age (15–24)	3837	0.00	51.28	16.86	3.54
Residential tenure	3830	0.00	89.47	19.94	10.03
Housing quality	3830	-0.50	5.51	-0.40	0.42

makes youths, usually young men, more likely to engage in delinquency (Shaw and McKay 1942). Although these findings are relevant in the US, they can also be applied to the same conditions in Brazil, where research has shown that a high proportion of impoverished youths in *favelas* often provide an ever-growing mass of inexpensive recruits available for the use of drug lords (Zaluar 1985; Dowdney 2003; Zaluar 2004; Nascimento 2005).

Table 1 below illustrates a descriptive analysis of the independent variables.

Using negative binomial regression model to assess the influence of risk on street drug sale arrests

In Criminology research, crime is an event which can be observed through incident counts. Crime incidents are distributed as “rare events counts” whether by individuals or larger aggregations (Piza 2012). In both cases, the Poisson and the negative binomial (NB) regression models are relevant to the analysis of count data. The main difference between these models is related to the assumptions regarding the conditional mean and variance of the dependent variable. The Poisson regression model assumes that the conditional mean and variance of the distribution is equal, while the NB regression model does not assume an equal mean and variance, and thus the Poisson model is particularly appropriate for correcting overdispersion in the data (Paternoster and Brame 1997; Osgood 2000). Since many have noted that criminological data rarely exhibit equal means and variances, the NB regression model has become increasingly popular for use in contemporary studies of crime (MacDonald and Lattimore 2009; Silva 2014).

In this study, we use NB regression to examine the relationship between street drug market locations and indicators of social disorganization. To assess the necessity of the NB regression model, a goodness of fit Chi-square test (GoF) and the Akaike Information Criterion (AIC)⁵ were calculated to compare against the fit of the Poisson regression. The *p* value for the GoF (AIC) was 0.287 (16,988) and 0.000 (39,754) for the NB and Poisson

regressions respectively. This is a clear indication that the NB fit is much more appropriate than the Poisson model, which is as expected in virtue of the overdispersion present in this study’s data.

Statistical modeling

The results of the exploratory analysis observed through the kernel density function previously discussed suggest that the city center of Belo Horizonte, compared to the rest of the city, has different characteristics that may explain its high concentration of drug sale. In fact, the city center of Belo Horizonte is very unique in comparison to the rest of the city because of its complex urban landscape formed by residential and office building complexes, intense commerce and shopping-malls, major transportation hubs, convention centers, hotels, prostitution zones, *cracolandas*, bars, discos, public parks, and higher transient population in comparison with the rest of the city. The convergence of all these factors in the city center contributes to an increase in opportunities for illicit markets, while increased anonymity due to the population in transit reduces natural surveillance. Overall, the city center suggests a crime generator scenario that creates many opportunities for illicit drug activity. Furthermore, as suggested by the literature, areas of prostitution and illicit markets for goods contribute to the creation of crime attractor spots attracting buyers and drug dealers (Felson and Boba 2010). It is possible that all these environmental characteristics inflate the results and contribute to make the city center an area of relative risk for drug markets. This means that the city center should be treated separately in the statistical modeling. This was also verified using the NB regression model for the entire city, including an indicator variable tracking whether the census tract belongs (1) or does not belong (0) to the city center of Belo Horizonte (see Table 2 below).

Clearly, the center indicator variable shows that there is a difference of about 15 times the number of drug arrests in the downtown census tracts, or in other words, the risk of drug arrests in the downtown area is almost 1400 % that of the rest of the city. Due to the significance of this

⁵ The smaller AIC the better the model fit.

Table 2 Descriptive statistics_ main socio-disorganization variables

Socio-disorganization variables	N	Minimum	Maximum	Mean	Std. deviation
Household density	3830	1.19	4.75	3.13	0.39
Socio-economic status	3830	-1.00	1.00	-0.33	0.57
Racial heterogeneity	3837	-1.00	1.00	-0.047	0.42
Risk age (15-24)	3837	0.00	51.28	16.86	3.54
Residential tenure	3830	0.00	89.47	19.94	10.03
Housing quality	3830	-0.50	5.51	-0.40	0.42

result, showing the relevant patterns of center of the city to be distinct, the main goal of this study is to understand the relation between variations in the social conditions of neighborhoods and spatial patterns of street drug markets in the city center in comparison with other parts of the city. For these reasons, we have separated the data into two groups for better analysis: (1) downtown census tracts and (2) others census tracts. The analysis of independent variables will be presented in the following table for each level of analysis.

Results and discussion

The results of the overall regression model NB pointed to the need to work with two levels of analysis: the city center alone and the remaining outside neighborhoods (including *favelas*). The city center remained separate from other neighborhoods due to its unique characteristics. The concentration of commercial areas, combined with modern residential apartment buildings, major transportation hubs, parks, and the intense flux of vehicle and pedestrian traffic is in sharp contrast with visible pockets of blight in the city. This would include areas of prostitution, homelessness, *cracolandias*, vacant lots and buildings, low-income shopping malls, as well as the sale of counterfeit merchandise via street vendors. All the tests were conducted using the drug arrest data at the census-tract level. Table 3 below illustrates the findings for the city center.

The racial heterogeneity index is negatively associated with street drug markets, showing that changing the racial composition of the census tract from non-white to white is associated with a significant reduction in the risk of the occurrence of drug arrests. In addition, residential tenure is negatively related to drug markets. For every 1-unit increase in the proportion of rented housing at the census tract level, the number of drug arrests is reduced by 8 %. The housing quality index (HQI) is strongly related and positively associated with street drug markets. For every 1-unit increase on a scale ranging from -0.50 to 5.51 (see Table 1) in the index of housing quality at the census tract level, the logarithm of the expected number of drug arrests increases by 12 units,

Table 3 Negative binomial regression results for belo horizonte city center (census tracts_N = 36)

	Estimate	Std. error	z value	Pr (> z)	RR
(Intercept)	12.674	2.277	5.565	0.000	319,336.2813
Household density	0.542	0.672	0.807	0.420	1.7201
Residential tenure	-0.081	0.029	-2.777	0.005	0.9222
Risk age (15-24)	0.012	0.058	0.207	0.836	1.0120
Socio-economic status	-1.069	2.259	-0.474	0.636	0.3434
Racial heterogeneity	-6.484	1.963	-3.302	0.001	0.0015
Housing quality	12.470	5.506	2.265	0.024	260,406.7212
a	1.894				

a = overdispersion parameter

indicating an extreme relative risk of about 260,000 %. However, this observation must be evaluated with care, since a small variation in the logarithmic scale can represent a very large variation in the original scale. Thus, a 95 % confidence interval in the logarithmic scale varies (1.68, 23.26) while in the original scale it varies (5.36, 1.2×10^{10}). Therefore, in the most conservative scenario the HQI increases the risk of drug arrests by about 400 %.

Table 4 above shows the age variable is statistically significant and has a positive correlation with the presence of street drug markets. For every 1-unit increase in the proportion of the population at the risk age, drug arrests increase by 3.8 percent. Furthermore, the association between housing quality and street drug markets is positive. A similar association was found for the entire city of Belo Horizonte as well as for the city-center level. For every 1-unit increase in housing quality, there is an increase of 20 % in the risk of drug arrests. On the other hand, the increase of 1 unit in the proportion of household income at the census-tract level reduces the number

Table 4 Negative binomial regression results for remaining neighborhoods in belo horizonte (census tracts_N = 3901)

	Estimate	Std. error	z value	Pr (> z)	RR
(Intercept)	-0.422	0.324	-1.304	0.192	0.655
Household density	0.166	0.095	1.741	0.082	1.180
Residential tenure	0.012	0.003	4.010	0.000	1.012
Risk age (15–24)	0.037	0.009	4.290	0.000	1.038
Socio-economic status	-0.701	0.131	-5.350	0.000	0.496
Racial heterogeneity	-0.187	0.170	-1.096	0.273	0.830
Housing quality	0.185	0.060	3.088	0.002	1.204
a	2.279				

a = overdispersion parameter

of drug arrests by 50.4 percent. Additionally, the association between residential tenure and street drug markets is positive, but the effect is very small. For every 1-unit increase in the proportion of rented housing at the census-tract level, drug arrests are increased by 1.2 %. Finally, the change in the racial composition of the census tract from non-white to white is associated with a 17 % reduction in drug arrests.

Overall this study demonstrates that social disorganization variables are correlated with the geography of street drug markets. This geographical pattern is also comparable to the US.

The negative association between racial heterogeneity and street drug markets is supported by research showing that street drug markets are more likely to be established in non-white neighborhoods (Rengert et al. 2005). However, in this study, the relation between race and street drug market density needs more investigation since the findings might be biased by the differential drug enforcement policies directed towards blacks and racial inequality in the country.

The increase in socio-economic status which is measured by the index of household socio-economic status is associated with a reduction in street drug markets. This result supports Saxe et al. (2001), which show that drug sales are more likely to be reported in the most disadvantaged neighborhoods than in the least disadvantaged, as expected on the basis of the social disorganization theory.

Another finding is the positive association between the housing quality and street drug market venues. Although the measures used for housing quality in this current study differ from those used in research in the US, there is still a correlation that exist between housing quality and street drug markets in both countries. The current

research findings are again comparable to the US. A lack of urban infrastructure and public services is associated with government neglect, which leads to a high rate of drug and criminal activity—a recurrent pattern in *favelas* (Alvito 1998; Beato et al. 2001; Zaluar 2004; Nascimento 2005; De Souza 2010; Beato and Zilli 2012) as well as in socially disorganized neighborhoods in the US (Hess 1998; Curtis and Wendel 2012).

Finally, the negative association between rented units and street drug sale arrests in the city center is in contradiction with the social disorganization theory. This finding agrees with the results of previous research on street drug markets (Rengert et al. 2005), but the finding might be influenced by other mediated situational variables. Belo Horizonte, like any other large metropolis in Brazil, has experienced a growth of large apartment complexes, an urbanization process common in large metropolises across the globe. This has resulted in an increase of the number of rental units. The large proportion of residential apartment buildings along with the security that entails (e.g., security devices, CCTV cameras, and doormen) could be one of the reasons for the reduction of street drug sales within these areas. Rengert et al. (2005), also suggests that, renters might consider their units to be permanent, as suburban homeowners do. This would possibly explain an increase in renters' community involvement, increasing informal control and in turn lead to a reduction in the likelihood of street drug markets.

Conclusions

This study has important implications for the framework of comparative criminology and practical prevention polices. Firstly, it demonstrates the similar conditions of neighborhoods internationally, emphasizing the importance of geographical factors as related to street drug markets in Belo Horizonte and the US. While corroborating the social disorganization theory, the study supports the applicability in explaining the relationship between the conditions of neighborhoods and the existence of street drug markets in an urban context outside the US.

Secondly, using census tract as a small-scale measure of neighborhoods, the study allows us to make comparisons illuminating differences between street drug market density across the city center and its environs. This also helps to de-mystify the idea of impoverished neighborhoods as being the main problem. Social disorganization mechanisms are not an exclusive attribute of these areas, but can occur to varying degrees on a small scale throughout the urban landscape. The study also shows that street drug markets overlap with a very specific type of census tract, indicating a difference in the influence of social disorganization factors across census tracts within and beyond *favelas*.

Thirdly, the current study touches on major policy implications. Studies in the US have shown a positive correlation between poor housing design and residents' fears of helplessness or apathy with regards to crime near their homes (Jacobson 1999). This same principle should be applied in Belo Horizonte in those small areas where poor housing quality correlates with drug arrests. Based on this insight, improvement in housing quality within these sensitive areas would enhance a sense of community involvement which would deter potential drug activity.

In addition, practical polices should be focused in areas where there is a higher proportion of at-risk youths. Mentoring programs such as Big Brothers Big Sisters (BBBS) and Community-Based Mentoring Program in the US have proven effective in reducing drug and alcohol use and antisocial behavior among mentored youths as demonstrated by the Institute National of Justice' CrimeSolutions.gov. Similar programs should be implemented in Belo Horizonte, where a higher concentration of youths at risk of involvement in drug activity as users or buyers overlaps with a high density of drug markets.

To sum up, the suggestion has been made that future research should focus on smaller units of analysis than census tracts, such as street segments or blocks, which have been traditionally used to research crime in the US. This would help form a more precise examination of variations in the locations of street drug markets within census tracts themselves. The Criminology of Place highlights that social disorganization varies in space in the same way that crime does. This model suggests that social disorganization indicators should be integrated with immediate environmental features and opportunities to explain patterns on a small scale of analysis (Weisburd et al. 2012). Based on this premise, new lines of research on drug markets in Brazil should examine the relationship between risk-features at the level of place that influence street drug market density. Differences between these patterns would help guide policy-makers and police agencies to more efficiently "design out" risk factors that attract buyers and sellers at specific places and time. Future research should also examine how interventions at locations where drug activity takes place can influence the displacement of street drug markets. This is a relevant issue in Belo Horizonte, where *favelas* have undergone an urbanization process improving the residents' quality of life.

Our findings are consistent with previous research that claim geographical patterns of drug markets overlap with social disorganization features of neighborhoods; thus the study provides basic elements relevant to the comparative debate on patterns of street drug markets in the US and Brazil. However, the findings should be taken with caution. This study does not differentiate between

types of drugs and demand, which might have an influence on drug sale sites. Therefore, it would help to identify and compare differences and similarities between the dynamics of these markets, examining how and why they crop up only in certain settings. Additionally, the causal order between drug activity and social disorganization cannot be established in this study. Finally, any generalization should be taken with caution due to validity problems related to the use of drug arrests as the sole measure of street drug markets.

Authors' contributions

EDS conceived and coordinated the study, acquired the data, participated in its methodological design, interpretation of results, and wrote the manuscript. BFAS: participated in the research design, carried out the spatial and statistical analysis, and helped in the interpretation of the results. MOP carried out the statistical analysis and participated in the interpretation of the results. All authors read and approved the final manuscript.

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Competing interests

The authors declare that they have no competing interests.

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