



HHS Public Access

Author manuscript

Ann Assoc Am Geogr. Author manuscript; available in PMC 2013 April 26.

Published in final edited form as:

Ann Assoc Am Geogr. 2012 September 1; 102(5): 1058–1066. doi:10.1080/00045608.2012.674902.

An examination of spatial concentrations of sex exchange and sex exchange norms among drug users in Baltimore, Maryland

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Abstract

Baltimore, Maryland consistently ranks highest nationally in rates of sexually transmitted diseases and HIV infection. Prior studies have identified geographic areas where STI and HIV infection in the city is most prevalent. It is well established that sex exchange behavior is associated with HIV and STIs, yet it is not well understood how sex exchangers are spatially distributed within the high-risk areas. We sought to examine the spatial distribution of individuals who report sex exchange compared to those who do not exchange. Additionally we examined the spatial context of perceived norms about sex exchange. Data for the study came from a baseline sample of predominately injection drug users (n=842). Of these, 21% reported sex exchange in the prior 90 days. All valid baseline residential addresses of participants living within Baltimore city boundaries were geocoded. The Multi-Distance Spatial Cluster Analysis (Ripley's K-function) was used to separately calculate the K-functions for the addresses of participants reporting sex exchange or non-sex exchange, relative to the recruited population. Evidence of spatial clustering of sex exchangers was observed and norms aligned with these clusters. Of particular interest was the high density of sex exchangers in one specific housing complex of East Baltimore, which happens to be the oldest in Baltimore. These findings can inform targeted efforts for screening and testing for HIV and STIs and placement of both individual and structural level interventions that focus on increasing access to risk reduction materials and changing norms about risk behaviors.

Keywords

Sex exchange; spatial clustering; norms

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The authors have no conflicts of interest to declare.

Background

It is well established that exchanging sex for money or drugs is associated with increased risk of HIV and STI (Astemborski et al. 1994, 382–387; Rietmeijer et al. 1998, 353–360; Doherty et al. 2000, 717–726). Recent attention to sex risk environments (e.g. bathhouses, sex resorts, commercial sex areas) has gained attention in public health research (Rhodes 2002, 85–94; Wylie, Shah, and Jolly 2007, 617–628). These environments facilitate social interactions between individuals and have been shown to be associated with infectious disease transmission (Wohl et al. 2010) which underscore the value and importance of including geographic dimensions into study and analysis of HIV risk behavior.

Baltimore consistently ranks among the most burdened cities in rates of HIV and sexually transmitted infections (STIs) in the United States (Centers for Disease Control and Prevention 2009; Centers for Disease Control and Prevention 2010; Center for Sexually Transmitted Infection Prevention, DHMH, Baltimore City Health Department, and Maryland Office of Planning). Prior geographic studies conducted in Baltimore have identified core areas of gonorrhea transmission (Zenilman et al. 1999, 75–81; Jennings et al. 2005, 73–80); Chlamydia (Hardick et al. 2003, 64–70) and HIV infection (Towe et al. 2010, 522–528). These studies have demonstrated that STIs are not evenly distributed throughout the city but are found in areas that correspond with poor social cohesion (Ellen et al. 2004, 117–122), poverty, crimes and drug use. Less is known about the spatial distribution of individuals who exchange sex relative to this area characterized by high-sex risk. Identifying locations where sex exchangers cluster can refine prevention and treatment efforts.

One mechanism through which neighborhood or residential location has been hypothesized to influence health is through facilitating social interactions and formation and perpetuation of social norms. It has been argued that culture and social norms are rooted in place (Mills et al. 2001, 980–983; Gesler and Kearns 2002). Descriptive norms are perceptions of an individual about their peers engaging in a specific behavior. Injunctive norms are perceptions about other approval of a behavior (Cialdini, Reno, and Kallgren 1990, 1015–1026). Studies with a wide range of populations and ethnic groups have reported positive associations between both types of norms and HIV-risk behaviors such as condom use (Albarracin et al. 2001, 142–161; Hart, Peterson, and Community Intervention Trial for Youth Study Team 2004, 1122–1124), use of shooting galleries (Tobin, Davey-Rothwell, and Latkin 2010), sharing injection equipment (Andia et al. 2008, 249–257), and sex exchange (Davey-Rothwell and Latkin 2008, 47–50). Little attention has been paid to the spatial context of social norms and their association with behavior. Understanding the geographies of norms could inform placement of interventions designed to change norms.

The aims of this study were to 1) examine the spatial distribution of individuals who report sex exchange compared to those who do not exchange, 2) examine the spatial distribution of descriptive and injunctive norms on sex exchange and, 3) to examine associations between spatial variables and sex exchange. Attention to spatial concentrations of poor health behaviors is important because it can inform resource allocation, public health screening and interventions.

Methods

Study Population and Recruitment

Data for this study came from the baseline of the STEP into Action study. Recruitment and assessment methods have been described in detail elsewhere (Tobin et al. 2010). In brief, recruited study participants, herein referred to as Index participants, were individuals aged 18 years and older who self-reported injection drug use in the prior 6 months or were drug users or sex partners who were recruited into the study by the Index. Index participants were recruited by trained field staff, through participant word-of-mouth and advertisements. All eligible participants provided written informed consent and completed an assessment on sex risk behavior using audio computer assisted self-interview software (ACASI). Trained research assistants then administered a survey to collect socio-demographics, drug use history, perceived norms and residential address data. All participants were remunerated for the study visit. This study was approved by the Johns Hopkins Bloomberg School of Public Health Institutional Review Board.

Measures

Sex exchange was operationalized as having sex in exchange for drugs, money, food or shelter in the prior 90 days.

To assess descriptive norms, participants were asked “How many of your friends have sex or turn tricks in exchange for money or drugs?” A dichotomous variable was created where 0=none and 1=a few to all. Injunctive norms were determined using the question, “How many of your friends would disapprove if you has sex for money or drugs (0=none and 1=a few to all).”

Census data came from 2000 US Census File 1 and File 3 (US Census Bureau). Variables included were: median household income per census block group, percent of the census block group population that is minority race (Black, Asian, Hawaiian/Pac. Islander, Native American, other), percent of households (both vacant and occupied) that are available for rent and percent in labor force.

Violent crime data came from the Baltimore city Police Department 911 calls which was classified using the United States Department of Justice Bureau of Justice Statistics (BJS) and was cleaned/geocoded by the JHU Eisenhower Library.

Spatial Methods

All valid, baseline residential addresses of STEP participants living within Baltimore city boundaries were geocoded using ESRI’s Streetmap USA extension (Environmental Systems Research Institute 2009). The geocoding match was 99% with an average score of 97. Using the residential addresses of STEP participants, the kernel density of sex exchange behavior, descriptive norms and injunctive norms were calculated and displayed using ArcMap 9.3 (Environmental Systems Research Institute 2009). The spatial locations of high-density regions or “hot spots” of sex exchange and injunctive and descriptive norms were identified

and were compared to choropleth maps of the selected demographic, socioeconomic and structural census variables.

The Multi-Distance Spatial Cluster Analysis (Ripley's K-function) tool in ArcGIS 9.3 was used to separately calculate the K-functions for the residential addresses of participants reporting sex exchange or non-sex exchange, relative to the recruited population. The k-function identifies a probability density function, that defines the probability of observing a participant reporting certain norms or sex exchange behaviors at a location. In this case, the K-function indicates whether norms and behaviors are more spatially clustered than expected and at what average distance between residences that these clusters occur. Clustering was visually evaluated by seeing whether a graph of the L-function, which is derived from a transformation of the K-function so that the function is linear, exceeds the maximum confidence band. The confidence bands for this analysis were calculated using 999 Monte Carlo simulations in the Baltimore city land boundaries and by using a simulated outer boundaries edge correction. This analysis was conducted using ArcGIS 9.3.

To evaluate whether sex exchangers cluster more than non-sex exchangers, the ratio of the log intensity function was calculated in the *splanx* package of R Open Source software to estimate the spatial odds of sex exchange (R Development Core Team 2008; Rowlingson et al. 2010). The maximum likelihood estimate was used for the bandwidth. A surface plot of the spatial odds was created to visually identify high risk areas.

Bivariate associations between sex exchange and census variables were examined using t-tests.

Results

The final sample were n=720 participants who reported a valid address during their baseline survey. Of these, n=151 (20%) reported sex exchange. Table 1 presents comparisons of baseline characteristics and norms comparing sex exchangers to non-sex exchangers. A greater proportion of sex exchangers were younger, female, bisexual, homeless, smoked crack and injected drugs in the past 6 months. A greater proportion of sex exchangers perceived that a few to all of their friends exchange sex ($p<0.0001$) compared to non-exchangers. A smaller proportion of sex exchangers perceived that a few to all of their friends would disapprove sex exchange (injunctive norms)($p<0.0001$). No census variables were statistically associated with sex exchange behavior in bivariate analysis (Table 2).

Figure 1. displays the kernel density of participants who reported sex exchange. Those reporting sex exchange behaviors were most concentrated in an area that corresponds to a subsidized housing development in East Baltimore. The two other high-density areas included another public housing development in West Baltimore and a residential section in East Baltimore. Figure 2 displays the kernel density of non-sex exchange participants. Residences of non-sex exchangers were more spatially distributed across Baltimore and were not as densely located in subsidized housing areas. The K-function suggests that the observed sex exchange and non-sex exchange behaviors both cluster significantly more than expected. However, when the ratio of spatial intensity is used to compare the spatial risk of

sex exchange versus non-sex exchange, participants reporting sex exchange behaviors cluster more.

The regions with a high kernel density of sex exchange spatially aligned with regions that had a high kernel density of participants reporting that a few to all friends engage in sex exchange (descriptive norms) and no friends would disapprove of sex exchange (injunctive norms) (maps not shown). Further, this density was highly concentrated in the housing development in East Baltimore.

Discussion

The present study found evidence of spatial clustering of individuals who report sex exchange behaviors as compared to individuals who did not report sex exchange after adjusting for the distribution of the sample. Specifically, clustering was observed in two low-income housing complexes and one low-income residential neighborhood. Of particular interest was the high density of sex exchangers in one specific housing complex of East Baltimore, which happens to be the oldest in Baltimore. According to US Census data the demographic profile of this housing complex is over one-third single female households with children under the age of 18 as compared to another housing complex in East Baltimore that did not have clustering of sex exchangers where the proportion was 19% (U.S. Census Bureau 2000). These findings can inform targeted efforts for screening and testing for HIV and STIs and placement of both individual and structural level interventions that focus on the broader needs of low-income women who are raising children.

Much has been written about the role of low-income housing complexes and ghettos in spatially concentrating poverty stigma and increasing social isolation and marginalization (Williams and Ekundayo 2001, 387–393; Keene and Padilla 2010, 1216–1223; Takahashi 1997, 903–914). Concentrated areas of crime, drug use and poor housing are associated with poor physical and mental health outcomes for the residents living in these areas (Matheson et al. 2006, 2604–2616; Aneshensel et al. 2007, S52–9). This was a sample of low-income, minority drug users who are themselves spatially concentrated in the city due to factors such as housing availability and residential segregation. Accounting for this, the present study found spatial concentrations of individuals who report sex exchange behavior that is not explained by census-level variables. Identifying localized concentrations of individuals who engage in high-risk sexual behavior may be a reflection of socio-geographic and cultural processes specific to this location. Further investigation is warranted to explore possible reasons for migration of sex exchangers to these locations and not others. Findings also raise the issue of additive concentration of risk and its impact on the health of individuals and other residents in these areas.

To what extent these complexes are socially isolated is unknown. It has been argued that isolation and therefore limited access to resources is important to consider. Alternatively, Kwan et al.'s (2008, 437–446) conceptualization of socio-geographic context includes a focus on the dynamic nature of individual movement outside of neighborhood of residence. Future studies are needed to focus on the spatial aspects of social networks of sex exchangers within and external to the neighborhood of residence.

Our lack of associations between census-level variables and sex exchange may reflect an issue of scale. That is, census-level or zip code based variables did not adequately or precisely explain socio-spatial processes that occur in places such as housing complexes. Employing ethnographic or other field-based methods would enable a more in-depth exploration of the lived experiences of individuals who live in these places and the pertinent geographic factors that are in play regarding sex exchange.

As expected, we found that norms were aligned with reports of behavior. Norms are a social process that have been found to predict behavior and may be one pathway through which place impacts health behavior. Norms about these behaviors may be more public in housing project and hence has a greater influence on both norms and behaviors. Concentrations of norms on sex exchange may challenge efforts to intervene on the risk behavior.

Limitations of this analysis should be noted. First, the spatial distribution was based on the self-reported residential address only and we lacked data on the locations of the sex exchange behaviors. Also, the analysis was subject to the “small numbers problem” which leads to high random variability (McLafferty 2008, 1–16).

These limitations notwithstanding, this study offers a unique perspective on the geographic context of sex exchange and expands behavioral health research by adding a contextual dimension to individuals who engage in sex-risk behavior.

Acknowledgments

This research was funded through a grant from the National Institutes of Drug Abuse grant R01 DA016555

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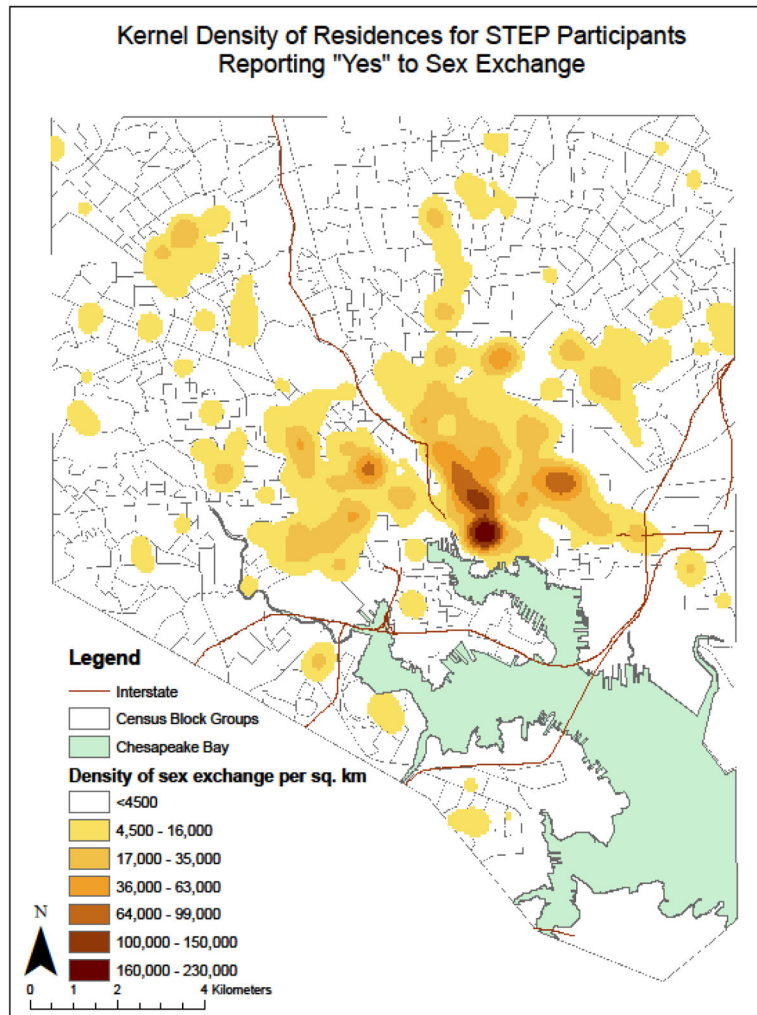


Figure 1. Spatial distribution of participants who report sex exchange, The STEP Into Action study, Baltimore, Maryland.

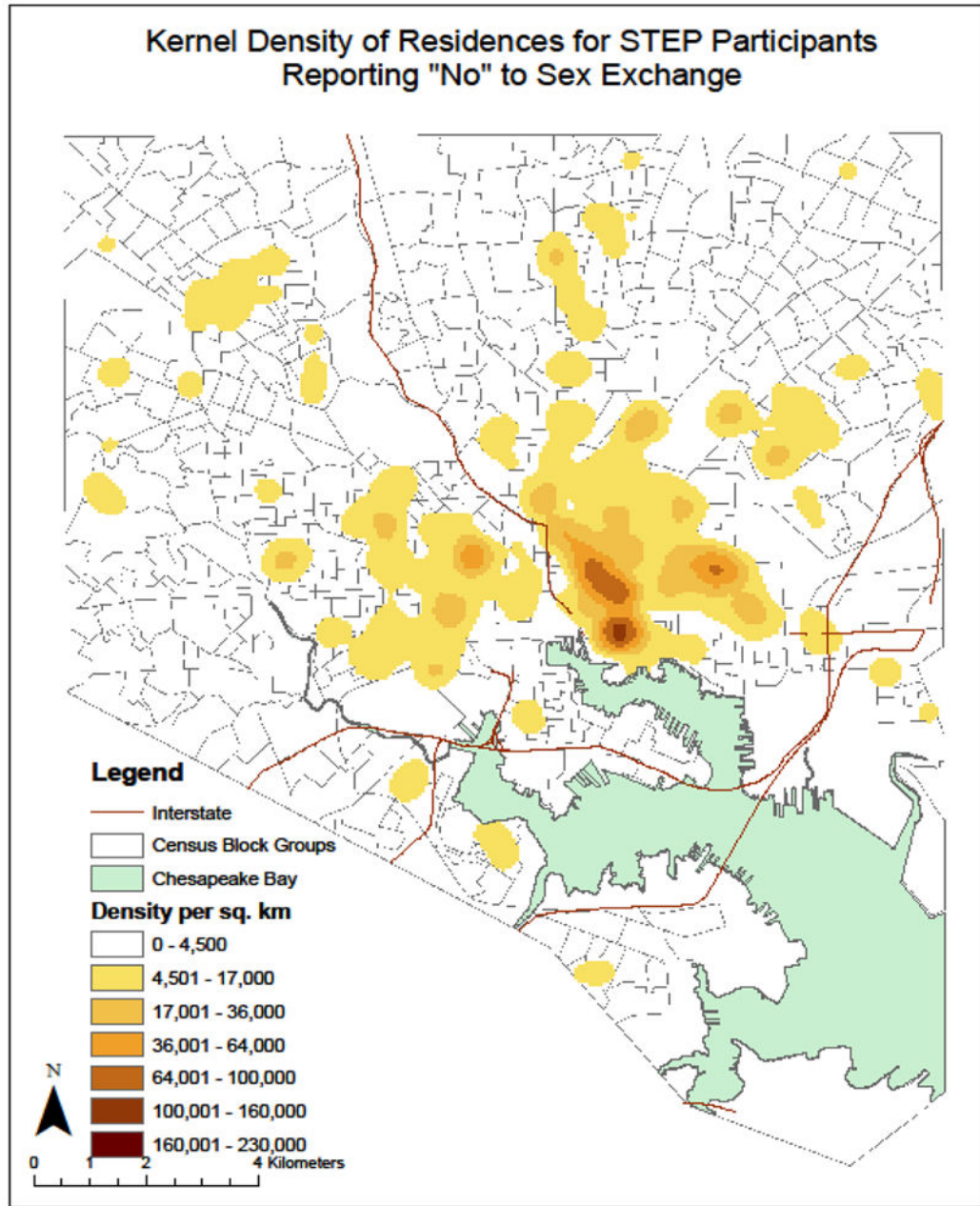


Figure 2. Spatial distribution of participants who did not report sex exchange, The STEP Into Action study, Baltimore, Maryland.

Table 1

Sample characteristics of n=751 geo-coded study participants

Variable	No Sex Exchange N=569	Sex Exchange N=151	p-value
Age (mean years, SD)	43.9 (7.53)	40.2 (7.70)	<0.001
Gender			
Male	375 (66)	47 (31)	
Female	194 (34)	104 (69)	<0.001
Sexual identity			
Gay	14 (2)	6 (4)	
Straight	542 (95)	116 (77)	
Bisexual	13 (2)	29 (19)	<0.001
Unemployed past 6 months			
No	58 (10)	8 (5)	
Yes	511 (90)	143 (95)	0.08
Homeless past 6 months			
No	408 (72)	75 (50)	
Yes	161 (28)	76 (50)	<0.001
Incarcerated past 6 months			
No	409 (72)	106 (70)	
Yes	160 (28)	45 (30)	0.69
Injected drugs past 6 months			
No	102 (18)	10 (7)	
Yes	467 (82)	141 (93)	<0.001
Smoked crack past 6 months			
No	196 (34)	32 (21)	
Yes	373 (66)	119 (79)	<0.01
How many of your friends have sex for money or drugs			
None	197 (35)	10 (7)	
Some-All	372 (65)	141 (93)	<0.001
How many of your friends would disapprove if you were to have sex for money or drugs			
None	134 (24)	58 (38)	
Some-All	435 (76)	93 (62)	<0.001

Table 2

Bivariate associations of census variables and sex exchange

Variable	No Sex Exchange N=569	Sex Exchange N=151	p-value
Median household income	22,324	21,396	0.34
Percent minority	0.85 (0.23)	0.87 (0.19)	0.42
Percent rental	0.55 (0.24)	0.58 (0.23)	0.19
Percent in labor force	0.50 (0.11)	0.50 (0.11)	0.97
Violent crimes (log transform)	3.94 (0.73)	3.91 (0.78)	0.67

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