



Published in final edited form as:

Arch Sex Behav. 2017 May ; 46(4): 925–936. doi:10.1007/s10508-015-0687-x.

Changing places and partners: associations of neighborhood conditions with sexual network turnover among African American adults relocated from public housing

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Abstract

Neighborhood conditions and sexual network turnover have been associated with the acquisition of HIV and other sexually transmitted infections [HIV/STIs]. However, few studies investigate the influence of neighborhood conditions on sexual network turnover. This longitudinal study uses data collected across 7 visits from a predominantly substance-misusing cohort of 172 African American adults relocated from public housing in Atlanta, Georgia, to determine whether post-relocation changes in exposure to neighborhood conditions influence sexual network stability, the number of new partners joining sexual networks, and the number of partners leaving sexual networks over time. At each visit, participant and sexual network characteristics were captured via survey, and administrative data were analyzed to describe the census tracts where participants lived. Multilevel models were used to longitudinally assess the relationships of tract-level characteristics to sexual network dynamics over time. On average, participants relocated to neighborhoods that were less economically deprived and violent, and had lower alcohol-outlet densities. Post-relocation reductions in exposure to alcohol outlet density were associated with fewer new partners joining sexual networks. Reduced perceived community violence was associated with more sexual partners leaving sexual networks. These associations were marginally

significant. No post-relocation changes in place characteristics were associated with overall sexual network stability. Neighborhood social context may influence sexual network turnover. To increase understanding of the social-ecological determinants of HIV/STIs, a new line of research should investigate the combined influence of neighborhood conditions and sexual network dynamics on HIV/STI transmission over time.

Keywords

sexual networks; HIV/STIs; neighborhoods; longitudinal analysis

Introduction

Extensive literature conceptualizes the transmission of HIV and other sexually transmitted infections [HIV/STI] as occurring in a socio-ecological framework.^{1–4} Related research suggests that characteristics of the neighborhoods where people live, including imbalanced male-to-female sex ratios, alcohol outlet density, and incarceration rates, are associated with HIV/STI transmission.^{5–8} Likewise, sexual network characteristics, including partner concurrency and partner risk (e.g., history of substance use, incarceration, STIs) facilitate the acquisition of HIV/STIs.^{9–16}

Sexual networks are not formed in isolation, but instead are often established when people occupy the same spaces and places. Sexual network characteristics may thus be heavily influenced by neighborhood conditions.^{17–25} For example, prior literature demonstrates associations of exposure to drug market activity, alcohol outlets, violence, and incarceration rates with selecting sexual network partners who are infected with HIV/STIs or vulnerable to acquiring HIV/STIs.^{18,20–25}

The vast majority of studies investigating relationships of place to sexual networks, however, treat sexual networks as static. Sexual networks are dynamic. For example, unmarried men and women frequently change sexual partners, often within the period of infectiousness for several STIs.¹² These sexual network dynamics have the potential to increase HIV/STI transmission by increasing the probability of encountering a sexual partner who is susceptible to HIV/STI infection.^{9,13} These network dynamics themselves may be influenced by neighborhood characteristics, a possibility that has rarely been explored in the literature.

The few studies that have explored the links between “place” and transitions in and out of intimate partnerships have been conducted among married couples, adolescents or young adults (17–24 years). These studies have found that place characteristics, such as imbalanced male-to-female sex ratios and economic disadvantage, are associated with the formation and dissolution of romantic partnerships.^{26–28} These same characteristics and other local conditions (e.g., alcohol outlet density, violent crime, incarceration rates) that have been linked to sexual network composition may influence the formation, dissolution, and stability of intimate partnerships, among older *unmarried* adults who are also at risk of acquiring HIV/STIs. The possibility that multiple place characteristics influence partner turnover among older *unmarried* adults has not yet been investigated.

Prior research suggests several pathways through which multiple neighborhood conditions could influence sexual partnership dynamics among unmarried adults. Low male-to-female sex ratios increase perceptions of high partner availability and discourage monogamy among unmarried heterosexual men.²⁹ a circumstance that has been associated with increasing the likelihood of their partners seeking new sexual partnerships.^{30,31} Alcohol outlets and drug markets provide venues where unstable and short-term relationships with risky partners may be formed.^{32,33} Violence and markedly elevated male incarceration rates, which have been associated with alcohol outlet density, drug markets, and low male to female sex ratios among African Americans^{34,35} may influence relationship “churning” by determining partner availability and establishing norms around partner selection. Relationships with incarcerated partners have been shown to dissolve over time,³⁶ and research demonstrates that partners of incarcerated adults establish new sexual partnerships to satisfy the emotional and financial needs that were previously met by their incarcerated partners.^{35,37} Through similar mechanisms men and women living in economically deprived neighborhoods may establish new sexual partnerships to increase access to economic and social support.^{29,31}

This longitudinal study sought to determine whether changes in exposure to multiple neighborhood conditions were associated with the overall stability of sexual partnerships, formation of new sexual partnerships, and the dissolution of sexual partnerships in a predominantly substance-misusing and unmarried sample of adults relocated from public housing in Atlanta, Georgia. These adults were relocated as part of a federally-funded housing policy, which sought to decentralize poverty by demolishing distressed public housing complexes and providing residents of these complexes with “Housing Choice” vouchers to secure housing in the private market. The current study expands analyses about “place” and sexual network turnover by focusing on a sample of predominantly unmarried older adults (median age of 45 years), and expanding the neighborhood conditions of interest to include neighborhood features that have been underexplored in prior research on sexual partner turnover. Because sexual partner turnover has been associated with HIV/STI transmission, quantifying the relationships of place characteristics to transitions in and out of intimate relationships among African American adults, who are disproportionately burdened by high rates of HIV and other STIs, can generate hypotheses about the mechanisms linking place characteristics to HIV/STI transmission, and can inform the development of interventions targeting social networks and specific neighborhood conditions.

Methods

Study sample, recruitment, and retention

Participants were recruited from seven severely distressed public housing complexes in Atlanta, Georgia that were demolished between 2008 and 2010 during the last round of federally-funded housing demolitions and relocations in the city. Severely distressed public housing is defined as housing in extreme physical disrepair, and/or located in neighborhoods with high rates of poverty or violent crime.³⁸ The relocations have been described in detail previously.⁵ Diverse recruitment strategies were employed, including collaborating with community- and faith- based organizations, recruiting onsite at the housing complexes, and asking participants to refer other adults.

Men and women recruited from the complexes were eligible for the study if they were 18 years old, identified as non-Hispanic Black/African American, reported having sex in the past year, resided in one of the seven public housing complexes, and did not reside with a current study participant. Because one of the primary objectives of this study was to determine whether changes in exposure to neighborhood conditions influenced substance use, non-probability based quota sampling was utilized to establish a study population with diverse substance use histories: ¼ met criteria for drug/alcohol dependence; ½ reported misusing substances but were not dependent; and ¼ did not report illicit drug use in the past five years and no recent alcohol misuse. The Texas Christian University (TCU) Drug Screen II was used to determine substance use dependence. TCU Drug Screen II scores range from 0 to 9, with scores 3 found to correspond with a DSM diagnosis of drug dependence.³⁹

Once enrolled, participants attended a baseline visit (visit 1). Follow-up visits (visits 2 to 7) were scheduled 9 months thereafter. Participants received \$20 USD for participating at baseline, and this incentive increased by an increment of \$5 at each subsequent visit. Intensive retention strategies retained 89.5% of the sample between visits 1 and 7.

Data collection and measures

At each visit, information on participants was captured by audio computer-assisted self-interview (ACASI). Social network information was captured using a social network inventory administered by trained interviews at visits 1 and 2 and ACASI from visits 3 to 7. A variable was constructed to account for this change in data collection. The social network inventory asked participants to name a maximum of 15 social network members and describe network members' demographic and behavioral characteristics. Sexual networks were defined as network members with whom participants reported having sex in the last six months.

Outcome variables: sexual network dynamics—Outcomes were three sexual network characteristics: stability of sexual networks, number of new partners joining sexual networks, and number of partners leaving sexual networks. Creating each outcome required linking sexual network members across visits. To determine visit-to-visit changes in sexual network membership, study staff compared the names and sociodemographic information of social network members across visits. When network members could not be linked using this process (due to misspellings, etc.), study staff contacted participants to retroactively confirm possible linkages. Sexual network stability was calculated using the following equation:⁴⁰

$$\text{Sexual network stability} = \frac{C}{A+B - C}$$

A= number of sexual network members at visit $t-1$

B= number of sexual network members at visit t

C= number of sexual network members common between $t-1$ and visit t

Stability values ranged from 0 to 1, with higher values corresponding with higher stability. Because a large percentage of participants reported stability equal to 1, stability was dichotomized, with stability=1 denoting fully-stable sexual networks and stability <1 denoting partly-stable sexual networks. Because stability cannot be used to discern whether sexual network members are leaving or entering networks; separate measures of the number of sexual partners joining and leaving sexual networks were constructed. The number of sexual partners joining sexual networks was operationalized as the number of new network members that entered sexual networks between visit $t-1$ and visit t . The number of sexual partners leaving sexual networks was operationalized as the number of network members that left sexual networks between visit $t-1$ and visit t . Because each outcome was measured across two visits, baseline measures of each outcome were not available.

Census-tract measures—Participant home addresses were geocoded to census tracts where they resided at each visit; 2010 census tract boundaries were used for all visits. Data from the US Census Bureau and the Longitudinal Tract Database were used to construct tract-level poverty rates, median household income, educational attainment, residential instability (e.g., the proportion of households that moved in the last year), proportion non-Hispanic Black residents, proportion renter-occupied housing, and male-to-female sex ratios. Male-to-female sex ratios were calculated for non-Hispanic Black/African American adults aged 18–64 years to reflect the demographic profile of the study population and the high frequency of racial/ethnic assortativity observed among non-Hispanic Black/African American adults.^{10,11} Incarcerated adults were excluded from male-to-female sex ratios of tracts where corrections facilities were located to account for the potential unavailability of incarcerated partners to serve as sexual partners. Annual data from the Georgia Department of Revenue, local police departments, and Georgia Department of Corrections were respectively used to construct tract-level measures of alcohol outlet density, violent crime rates, and incarceration rates at each visit.

Because economic conditions, violent crime, and alcohol outlet density may be correlated, principle components analysis (PCA) with orthogonal rotation was conducted to determine the dimensionality of these items. PCA identified two components: an economic disadvantage component (i.e. poverty rates, median household income, and educational attainment) and a social disorder component (i.e. alcohol outlet density and violent crime). Other characteristics were not included in the PCA because they were conceptualized as independent constructs.

Individual-level characteristics—Several individual-level factors were considered in analysis, and dichotomized unless otherwise noted. Gender was fixed at the first visit, and the following time-varying characteristics referred to a six-month reporting period unless otherwise noted: marital status, age (continuous), any employment, household income (ordinal), number of residential moves (continuous), moving to a different census tract since the last visit, substance use (e.g. use of illicit drugs or alcohol in excess), depressive symptoms (CESD-20 scale), and perceived community violence. Perceived community violence was measured using a 5-item scale that captured how frequently participants perceived the following events in their neighborhood: fights with weapons; violent

arguments among neighbors; gang fights; sexual assault; and robbery.⁴¹ Responses were averaged across items to establish a mean score.

(Name of institution deleted to maintain confidentiality) approved the study and a Certificate of Confidentiality was obtained to protect participants.

Data analysis

The distributions of individual-, tract-, and network-level characteristics were described across visits, and correlations between census tract characteristics were assessed. The distribution of each outcome over time was graphed to determine how time (in months) should be defined for each outcome. Time was defined as months since visit 2 in analyses of sexual network stability. For analyses of the number of new sexual partners joining sexual networks, time was defined using two variables- months since visit 2 and months since visit 3. Time was defined as months since visit 2 in analyses of the number of sexual partners leaving sexual networks. In subsequent sections, “time” refers to these outcome-specific definitions.

Histograms of each outcome were evaluated at each visit to determine how each outcome should be operationalized. Sexual network stability had a Bernoulli distribution. The number of new sexual partners joining sexual networks had a Poisson distribution. The number of sexual partners leaving sexual networks had a binomial distribution (as a function of the size of the sexual network at t-1).

All place characteristics (i.e., perceived community violence and census tract characteristics) were centered at their baseline values, which established two variables. The first represented the baseline value and the other represented the change in value since baseline. Change since baseline measures were time-varying individual-level characteristics. Because two time points were included in each outcome, time-varying individual and place characteristics were lagged.

Three models were used to evaluate the relationships of time, individual and census tract characteristics to each outcome. All models for each outcome included random intercepts for participants and random slopes for time, and models assessing the number of sexual partners joining sexual networks controlled (and included random slopes) for sexual network size at t-1. Because variance in outcomes across baseline census tracts was negligible, random intercepts were not included for baseline census tracts. The first model assessed the relationships of time to each outcome, and whether gender or baseline substance misuse interacted with time to influence each outcome. Interactions associated with each outcome at $p < 0.10$ were included in subsequent models. The second model assessed the relationships of each individual- and tract-level characteristic to each outcome, while controlling for time or the time-gender/substance use interaction if significant in Model 1. The third model assessed the relationship of change since baseline measures of place characteristics associated with each outcome in Model 2 at a p -value < 0.10 , controlling for the baseline measure of the selected place characteristics, time (or time interactions when significant at p -value < 0.10 in prior models), age, gender, ACASI survey administration variable, and other participant characteristics associated with each outcome at $p = 0.05$ in Model 2.

Results

Description of participants and the census tracts where they lived

A total of 172 participants were enrolled. At baseline, 57% of the sample were women and the mean age of participants was 43 years ($SD=14.0$ years, Table 1). Participants were impoverished (mean income=\$9,849.40, $SD=\$8,733$) and most were not working full-time (89.5%). The majority of participants were neither married nor cohabitating (90.6%).

As a result of the public housing relocations, participants moved from the 7 census tracts where their former housing complexes were located to 94 census tracts by visit 7. On average, these relocations brought participants to neighborhoods that had lower economic disadvantage and social disorder. At baseline, participants resided in census tracts where approximately half of households were below poverty and violent crime rates averaged 35.6 per 1000 residents. By visit 2, participants resided in census tracts where approximately one third of households lived below poverty and violent crime rates averaged 21.0 per 1000 residents. These changes were sustained in subsequent visits.

Longitudinal analysis

Sexual network stability—Across visits, sex network stability increased (Table 1), but to a greater extent among men (Table 2- Model 1). In Model 2, being married or cohabiting was associated with more sexual network stability (Table 2- Model 2). No changes in exposure to place characteristics were associated with sexual network stability.

Number of new partners joining sexual networks—The number of new partners joining sexual networks increased between visits 2 and 3, and declined thereafter (Table 3- Model 1). The decrease in the number of new partners joining sexual networks after visit 3 was steeper among participants who were not using substances at baseline compared to those who used substances at baseline. In Model 2, reduced exposure to social disorder was marginally associated with fewer new partners joining sexual networks (Table 3-Model 2: $b=0.17$; $p\text{-value}=0.07$). Reduced exposure to alcohol outlet density demonstrated a similar relationship with fewer new partners joining sexual networks, when it was disaggregated from the social disorder component and analyzed separately (Table 3-Model 2: $b=0.03$; $p\text{-value}=0.03$). Participant age was associated with fewer new partners joining sexual networks, while employment and moving to a different census tract since the last visit were associated with more new partners joining sexual networks.

In Model 3, the relationship of post-relocation reductions in exposure to social disorder to the number of new partners joining sexual networks decreased in magnitude and significance (Table 3-Model 3a: 0.13, $p\text{-value}=0.15$). Because alcohol outlet density was included as an item in the social disorder measure, the association of exposure to alcohol outlet density with the number of new partners joining sexual networks was assessed in a separate model. Similarly, the strength of the association of post-relocation reductions in exposure to alcohol outlet density with fewer new partners joining sexual networks decreased, but remained marginally significant (Table 3-Model 3b: 0.03, $p\text{-value}=0.06$).

Number of partners leaving sexual networks—The number of partners leaving sexual networks decreased across visits and this decrease was steeper among men compared to women (Table 4- Model 1). In Model 2, post-relocation reductions in perceived community violence were associated with more partners leaving sexual networks, though this association was marginally significant (Table 4- Model 2: $b=-0.01$, $p\text{-value}=0.09$). The relationship of reductions in perceived community violence to more partners leaving sexual networks increased in magnitude and remained marginally significant in Model 3 (Table 4- Model 3: $b=-0.11$, $p\text{-value}=0.07$).

Discussion

In this predominantly substance-misusing sample of African American adults relocated from severely-distressed public housing complexes, post-relocation changes in exposure to neighborhood social conditions were marginally associated with sexual network dynamics. Specifically, post-relocation reductions in exposure to alcohol outlet density were associated with fewer new sexual partnerships, and reduced community violence was associated with more partners leaving participants' sexual networks. This study supports prior research which suggests that patterns of sexual partnerships are influenced by local conditions.^{26–28} This study contributes new information about the relationships of local conditions to sexual partnering in a predominantly unmarried sample of adults.

The relationship of reduced exposure to alcohol outlet density to fewer new partners joining sexual networks is supported by prior research suggesting alcohol outlets influence STI transmission by establishing settings where new partnerships are established, a mechanism identified in prior STI outbreak investigations.²² Reductions in exposure to alcohol outlet density may also limit the formation of new sexual partnerships by serving as a proxy for increased social cohesion. Social cohesion may confer greater collective efficacy and social control and uphold social norms that discourage serial relationships. Research conducted in Los Angeles by Theall and colleagues supports this hypothesis by suggesting that increases in tract-level social capital mediate the association of reductions in alcohol outlet density with reductions in gonorrhea rates.⁸ In sub-analysis, social cohesion did not appear to mediate the association between alcohol outlet density and the number of new partners joining sexual networks among this sample, but future research should test this hypothesis.

Our finding that reduced perceived community violence was associated with more sexual partners leaving sexual networks corresponds to prior research suggesting that post-relocation reductions in community violence lead to less indirect concurrency and fewer “risky” sexual partners over time.¹⁹ The observed findings may capture participants' efforts to disconnect from these and other risky sexual partnerships over time as they relocated to neighborhoods that they perceived to have less social disorder, and where norms discouraging “risky” sexual partnerships may have been upheld. Prior research suggests that residents relocated from public housing sever ties with neighbors who are emotionally and financially draining.⁴²

Limitations

The following limitations should be considered when interpreting this study's findings. Participants could not be randomly selected because a sampling frame of substance-using residents was not available for the seven housing complexes. In addition, a control group of nonrelocators could not be established because all severely-distressed housing complexes in Atlanta were demolished. The residents of other complexes could not serve as a suitable comparison group because they are predominantly elderly and disabled.

Additionally, the findings from this study may not be generalizable to all residents relocated from public housing because substance-using adults were oversampled at baseline. The demographic profile of this study's sample, however, corresponds with the overall composition of residents living in the seven complexes reported by the US Department of Housing and Urban Development.

The social network measures were egocentric and participants might not have nominated an exhaustive list of social network members. Thus for some participants we might not have captured sexual partners who were not nominated in the social network name generator. We did not utilize marginal structural models to account for the time-varying nature of some confounders (e.g., employment), which further limits our ability to make causal interpretations. We also did not define the correlation structure of repeated measures of each outcome because time was treated as continuous, and the timing of interviews varied across individuals. Lastly, we did not measure the duration and gaps between different sexual partnerships, or whether sexual partnerships with the same individuals recurred. Both of these characteristics can influence HIV/STI transmission.¹²

Conclusion

Despite these limitations, this analysis adds knowledge about the possible links between improvements in neighborhood social conditions and changes in sexual network dynamics. Future research should evaluate whether relationships between place characteristics and HIV/STI incidence are mediated by network dynamics. Advancing scientific understanding of the pathways linking place and social network characteristics to HIV/STI transmission can inform future multi-level HIV/STI prevention strategies.

Acknowledgments

This study was funded by two grants from the National Institute on Drug Abuse at the National Institutes of Health (R21DA027072 & R01DA029513), and a grant from the Emory University Center for AIDS research (P30 AI050409). RR was supported by The Georgia State Center of Excellence on Health Disparities (P20MD004806). DFH was partly funded by the Robert W. Woodruff pre-doctoral fellowship of the Emory University Laney Graduate School and a grant from the National Institute of Mental Health at the National Institutes of Health (F31MH105238). Support for EFD was provided by 2T32-MH078788. The authors also thank the study participants for sharing their time and insight.

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Table 1

Distributions of participant, network, and census tract characteristics among 172 African American adults relocated from seven public housing complexes in Atlanta, GA, across 7 visits of follow-up

Characteristics ^h	Visit 1 N(%) or Mean (SD)	Visit 2 N(%) or Mean (SD)	Visit 3 N(%) or Mean (SD)	Visit 4 N(%) or Mean (SD)	Visit 5 N(%) or Mean (SD)	Visit 6 N(%) or Mean (SD)	Visit 7 N(%) or Mean (SD)
<i>Participant</i>	N=171 ⁱ	N=163	N=160	N=156	N=158	N=154	N=154
Age	42.9 (14.0)	43.1 (13.9)	43.2 (14.0)	43.5 (13.8)	46.4 (13.7)	46.8 (13.7)	47.2 (13.8)
Women ^j	98 (57.0)	96 (58.9)	93 (58.1)	90 (57.7)	91 (57.6)	89 (57.8)	90 (58.44)
Married or cohabiting	16 (9.4)	16 (9.5)	15 (9.4)	15 (9.7)	17 (10.8)	15 (9.7)	14 (9.1)
Employed	18 (10.5)	20 (12.3)	30 (18.8)	24 (15.6)	30 (19.35)	23 (14.9)	30 (19.5)
Household income	\$9,849.4 (\$8,733.0)	\$10,473.9 (\$9,655.9)	\$11,217.1 (\$9,533.8)	\$9,966.2 (\$9,137.4)	\$11,013.5 (\$10,325.6)	\$11,672.4 (9279.9)	\$13,918.9 (12399.8)
Homelessness	--	7 (4.3)	8 (5.0)	10 (6.5)	11 (7.0)	8 (5.2)	15 (9.7)
Times moved	--	1.08 (0.3)	0.42 (1.72)	0.22 (1.06)	0.45 (1.62)	0.57 (2.02)	0.48 (1.76)
Moved since last visit	--	156 (95.7)	45 (27.6)	42 (26.1)	37 (23.0)	28 (17.6)	33 (21.43)
Incarcerated in jail/prison/detention	--	--	6 (3.75)	3 (1.92)	3 (1.91)	4 (2.60)	4 (2.6)
Mild depressive symptoms (CESD-20 score=15-22)	45 (26.3)	42 (25.9)	47 (29.4)	31 (20.4)	35 (22.3)	36 (23.7)	32 (20.9)
Major depressive symptoms (CESD-20 score >22)	48 (28.1)	27 (16.7)	19 (11.9)	23 (15.1)	32 (20.4)	23 (15.1)	25 (16.3)
Substance use	122 (81.9)	101 (63.5)	92 (58.6)	90 (58.1)	85 (54.5)	94 (62.3)	98 (64.1)
Perceived community violence	2.8 (2.2)	0.62 (1.1)	0.70 (1.2)	0.61 (1.0)	0.79 (1.3)	0.9 (1.4)	0.8 (1.5)
<i>Network</i>							
Total sex network size	1.21 (1.02)	0.76 (0.88)	0.94 (0.99)	0.84 (0.89)	0.85 (0.80)	0.68 (0.70)	0.80 (0.84)
Proportion of sex network members living in same neighborhood	0.51 (0.48)	0.27 (0.44)	0.28 (0.45)	0.34 (0.47)	0.40 (0.47)	0.45 (0.48)	0.45 (0.49)
Fully-stable sexual network	--	41 (31.8)	36 (29.3)	50 (41.7)	62 (53.5)	62 (57.9)	70 (68.0)
Number of new partners joining sexual networks	--	0.3 (0.7)	0.6 (1.0)	0.4 (0.8)	0.3 (0.6)	0.1 (0.4)	0.2 (0.7)
Number of partners leaving sexual networks	--	0.8 (1.0)	0.5 (0.8)	0.5 (0.9)	0.3 (0.7)	0.3 (0.6)	0.1 (0.4)
<i>Census tract</i>							
Proportion of residents living in poverty	0.5 (0.1)	0.3 (0.1)	0.3 (0.1)	0.3 (0.1)	0.3 (0.1)	0.3 (0.1)	0.3 (0.1)

Characteristics ^h	Visit 1 N(%) or Mean (SD)	Visit 2 N(%) or Mean (SD)	Visit 3 N(%) or Mean (SD)	Visit 4 N(%) or Mean (SD)	Visit 5 N(%) or Mean (SD)	Visit 6 N(%) or Mean (SD)	Visit 7 N(%) or Mean (SD)
Median household income (USD)	\$15809.9 (\$4482.6)	\$33476.0 (\$15788.3)	\$33735.6 (\$15928.7)	\$33530.8 (\$17094.3)	\$34408.4 (\$16516.8)	\$33396.7 (\$15422.4)	\$32693.5 (\$15046.2)
Proportion of residents whose highest level of educational attainment is a high school diploma/GED	0.7 (0.1)	0.5 (0.2)	0.5 (0.2)	0.5 (0.2)	0.5 (0.2)	0.5 (0.2)	0.5 (0.2)
Alcohol outlet density	9.3 (8.0)	6.4 (5.1)	6.3 (5.1)	6.7 (5.8)	6.7 (5.8)	6.6 (5.7)	6.2 (5.3)
Violent crime rate per 1000 residents	35.6 (15.8)	20.7 (14.7)	20.9 (14.4)	20.7 (14.8)	21.3 (15.1)	21.6 (14.6)	21.1 (14.2)
Incarceration rate per 1000 residents	13.6 (12.2)	11.8 (8.2)	11.3 (8.9)	10.5 (7.5)	10.7 (7.7)	11.6 (8.5)	11.4 (7.5)
Male to female sex ratios	0.9 (0.3)	0.9 (0.2)	0.9 (0.2)	0.9 (0.2)	0.9 (0.3)	0.9 (0.3)	0.9 (0.3)
Residential instability ^k	0.3 (0.1)	0.2 (0.1)	0.2 (0.1)	0.3 (0.1)	0.2 (0.1)	0.2 (0.1)	0.3 (0.1)
Proportion renter-occupied housing	0.8 (0.2)	0.6 (0.2)	0.6 (0.2)	0.6 (0.2)	0.6 (0.2)	0.6 (0.2)	0.6 (0.2)
Proportion non- Hispanic Black residents	0.8 (0.2)	0.7 (0.3)	0.7 (0.2)	0.7 (0.3)	0.7 (0.3)	0.7 (0.3)	0.8 (0.3)

^h Participant characteristics were measured for a six month reporting period unless otherwise stated

ⁱ Baseline survey data was lost for one participant

^j Women included 3 transgender women (i.e. male to female)

^k The proportion of residents who moved in the last year

Table 2

Relationships of individual- and tract-level characteristics to sexual network stability among a sample of 172 African-American adults relocated from seven public housing complexes.

Characteristics	Coefficient (p-value)		
	Model 1 ^a	Models 2 ^b	Model 3 ^c
Intercept	-0.95 (<0.01)	--	-1.13 (0.02)
<i>Time</i>			
Time since visit 2	0.04 (<0.01)	0.04 (<0.01)	0.06 (<0.01)
<i>Participant</i>			
ACASI survey administration		0.15 (0.69)	-1.26 (0.02)
Age		0.01 (0.25)	0.01 (0.18)
Baseline gender (ref=female)	-0.91 (0.03)	--	-1.14 (0.01)
Baseline gender * time since visit 2	0.03 (0.09)	--	0.03 (0.08)
Married or cohabiting		0.83 (0.05)	0.84 (0.04)
Employed		-0.08 (0.79)	--
Household income		0.07 (0.24)	--
Number of times moved in the last six months		0.02 (0.76)	--
Moved census tract since last visit		-0.32 (0.21)	--
Depressive symptoms (ref= CESD-20 score <15)			
Mild (CESD-20 score= 15–22)		-0.10 (0.72)	--
Major (CESD-20 score >22)		0.08 (0.80)	--
Substance use in the last six months		-0.13 (0.62)	--
Perceived community violence			
Baseline		-0.06 (0.49)	--
Change since baseline		0.09 (0.22)	--
<i>Census tract</i>			
Economic disadvantage			
Baseline		0.15 (0.57)	--
Change since baseline		0.18 (0.21)	--
Social disorder			
Baseline		0.14 (0.30)	--
Change since baseline		0.13 (0.35)	--
Violent crime (per 1000 residents)			
Baseline		11.71 (0.26)	--
Change since baseline		11.50 (0.17)	--
Alcohol outlet density			
Baseline		0.02 (0.36)	--
Change since baseline		0.02 (0.44)	--
Incarceration (per 1000 residents)			
Baseline		-0.001 (0.94)	--
Change since baseline		-0.001 (0.94)	--
Male to female sex ratio			

Characteristics	Coefficient (p-value)		
	Model 1 ^a	Models 2 ^b	Model 3 ^c
Baseline		0.28 (0.62)	--
Change since baseline		-0.09 (0.87)	--
Proportion Non-Hispanic Black residents			
Baseline		-0.09 (0.91)	--
Change since baseline		0.22 (0.68)	--
Proportion renter-occupied housing			
Baseline		1.42 (0.15)	--
Change since baseline		0.63 (0.40)	--
Residential instability			
Baseline		1.39 (0.50)	--
Change since baseline		0.96 (0.51)	--

Note: Sexual network stability had a Bernoulli distribution. All variables were time-varying and lagged one visit unless otherwise noted.

^aModel 1 assessed the relationships of time to sexual network stability, and whether gender or baseline substance misuse interacted with time to influence sexual network stability. Non-significant (p-value 0.10) interactions are not shown.

^bModel 2 assessed the relationships of each participant and place characteristic to sexual network stability, controlling for the time-gender interaction.

^cModel 3 assessed multivariable relationships of the time-gender interaction, age, ACASI survey administration variable and other participant characteristics significant at p-value 0.05 in Model 2 to sexual network stability.

Table 3

Relationships of individual-, network-, and tract-level characteristics to the number of new partners joining sexual networks among a sample of 172 African-American adults relocated from seven public housing complexes.

Characteristics	Coefficient (p-value)			
	Model 1 ^a	Model 2 ^b	Model 3a ^c	Model 3b ^d
Intercept	-0.85 (<0.05)	--	-0.41 (0.41)	-0.42 (0.38)
<i>Time</i>				
Time since visit 2	0.03 (0.04)	--	0.04 (0.02)	0.04 (0.02)
Time since visit 3	-0.13 (<0.01)	--	-0.13 (<0.01)	-0.13 (<0.01)
<i>Participant</i>				
ACASI survey administration		-0.15 (0.57)	-0.23 (0.38)	-0.20 (0.44)
Age		-0.02 (0.01)	-0.01 (0.12)	-0.01 (0.08)
Baseline gender (ref=female)		0.10 (0.64)	0.19 (0.36)	0.19 (0.36)
Married or cohabiting		0.12 (0.70)	--	--
Employed		0.51 (0.01)	0.46 (0.03)	0.47 (0.03)
Household income		-0.04 (0.41)	--	--
Number of times moved in the last six months		0.01 (0.91)	--	--
Moved census tract since last visit		0.34 (0.06)	--	--
Depressive symptoms (ref= CESD-20 score <15)				
Mild (CESD-20 score= 15–22)		0.05 (0.79)	--	--
Major (CESD-20 score >22)		0.16 (0.47)	--	--
Baseline substance use	-0.07 (0.79)	--	-0.13 (0.64)	-0.12 (0.68)
Baseline substance use* time since visit 3	0.06 (0.02)	--	0.05 (0.03)	0.05 (0.03)
Substance use in the last six months		0.03 (0.87)	--	--
Perceived community violence			--	--
Baseline		0.12 (0.03)	--	--
Change since baseline		0.06 (0.26)	--	--
<i>Network</i>				
Number of sexual network members	-0.46 (<0.01)	--	-0.50 (<0.01)	-0.50 (<0.01)
<i>Census tract</i>				
Economic disadvantage				
Baseline		0.01 (0.96)	--	--
Change since baseline		0.11 (0.27)	--	--
Social disorder				
Baseline		0.01 (0.95)	0.01 (0.96)	--
Change since baseline		0.17 (0.07)	0.13 (0.15)	--
Violent crime rate (per 1000)				
Baseline		-3.62 (0.62)	--	--
Change since baseline		8.83 (0.10)	--	--

Characteristics	Coefficient (p-value)			
	Model 1 ^a	Model 2 ^b	Model 3a ^c	Model 3b ^d
Alcohol outlet density				
Baseline		0.01 (0.59)	--	0.01 (0.66)
Change since baseline		0.03 (0.03)	--	0.03 (0.06)
Incarceration (per 1000 residents)				
Baseline		-0.01 (0.64)	--	--
Change since baseline		-0.004 (0.69)	--	--
Male to female sex ratio				
Baseline		0.29 (0.46)	--	--
Change since baseline		0.31 (0.35)	--	--
Proportion Non-Hispanic Black residents				
Baseline		0.15 (0.79)	--	--
Change since baseline		0.24 (0.49)	--	--
Proportion renter-occupied housing				
Baseline		-0.72 (0.27)	--	--
Change since baseline		0.69 (0.17)	--	--
Residential instability				
Baseline		0.65 (0.66)	--	--
Change since baseline		1.38 (0.11)	--	--

Note: The number of new partners joining sexual networks had a Poisson distribution. All variables were time-varying and lagged one visit unless otherwise noted.

^aModel 1 assessed the relationships of time to the number of new partners joining sexual networks, and whether gender or baseline substance misuse interacted with time to influence the number of new partners joining sexual networks, while controlling for the number of sexual network members at the prior visit. Non-significant (p-value 0.10) interactions are not shown.

^bModel 2 assessed the relationships of each participant and place characteristic to the number of new partners joining sexual networks, controlling for the time-baseline substance use interaction and number of sexual network members at the prior visit.

^cModel 3a and 3b assessed the relationships of change since baseline measures of place characteristics significant at p-value <0.10 in Model 2 to the number of partners joining sexual networks, controlling for the baseline measures of the selected place characteristics, time-baseline substance use interaction, age, gender, ACASI survey administration variable, number of sexual network members at the prior visit, and other participant characteristics significant at p-value 0.05 in Model 2.

^dBecause alcohol outlet density was included as an item in the social disorder measure, the multivariable associations of changes in exposure to social disorder and alcohol outlet density with the number of new partners joining sexual networks were assessed in separate models.

Table 4

Relationships of individual- and tract-level characteristics to the number of partners leaving sexual networks among a sample of 172 African-American adults relocated from seven public housing complexes.

Characteristics	Coefficient (p-value)		
	Model 1 ^a	Model 2 ^b	Model 3 ^c
Intercept	0.56 (<0.01)	--	-0.83 (0.10)
Time			
Time since visit 2	-0.04 (<0.01)	--	-0.05 (<0.01)
<i>Participant</i>			
ACASI survey administration		0.21 (0.55)	0.23 (0.51)
Age		-0.01 (0.22)	-0.01 (0.35)
Baseline gender (ref=female)	0.69 (0.03)	--	0.74 (0.02)
Baseline gender * time since visit 2	-0.03 (0.04)	--	-0.02 (0.06)
Married or cohabiting		-0.62 (0.08)	--
Employed		0.19 (0.47)	--
Household income		-0.02 (0.70)	--
Number of times moved in the last six months		-0.11 (0.18)	--
Moved census tract since last visit		0.09 (0.70)	--
Depressive symptoms (ref= CESD-20 score <15)			
Mild (CESD-20 score= 15–22)		0.05 (0.83)	--
Major (CESD-20 score >22)		0.11 (0.68)	--
Substance use in the last six months		0.01 (0.96)	--
Perceived community violence			--
Baseline		0.02 (0.78)	-0.01 (0.93)
Change since baseline		-0.01 (0.09)	-0.11 (0.07)
<i>Census tract</i>			
Economic disadvantage			
Baseline		-0.17 (0.42)	--
Change since baseline		-0.07 (0.57)	--
Social disorder			
Baseline		-0.11 (0.33)	--
Change since baseline		-0.04 (0.70)	--
Violent crime rate (per 1000 residents)			
Baseline		-9.41 (0.26)	--
Change since baseline		-3.50 (0.60)	--
Alcohol outlet density			
Baseline		-0.02 (0.44)	--
Change since baseline		-0.01 (0.64)	--
Incarceration (per 1000 residents)			
Baseline		-0.001 (0.96)	--
Change since baseline		-0.01 (0.63)	--

Characteristics	Coefficient (p-value)		
	Model 1 ^a	Model 2 ^b	Model 3 ^c
Male to female sex ratio			
Baseline		-0.03 (0.94)	--
Change since baseline		0.27 (0.59)	--
Proportion Non-Hispanic Black residents			
Baseline		-0.44(0.51)	--
Change since baseline		0.20 (0.66)	--
Proportion renter-occupied housing			
Baseline		-1.02 (0.18)	--
Change since baseline		-0.02 (0.98)	--
Residential instability			
Baseline		-1.78 (0.28)	--
Change since baseline		-0.44 (0.72)	--

Note: The number of partners leaving sexual networks had a Binomial distribution. All variables were time-varying and lagged one visit unless otherwise noted.

^aModel 1 assessed the relationships of time to the number of partners leaving sexual networks, and whether gender or baseline substance misuse interacted with time to influence the number of partners leaving sexual networks. Non-significant (p-value 0.10) interactions are not shown.

^bModel 2 assessed the relationships of each participant and place characteristic to the number of partners leaving sexual networks, controlling for the time-gender interaction.

^cModel 3 assessed the relationship of change since baseline measures of place characteristics significant at $p < 0.10$ in Model 2 to the number of partners leaving sexual networks, controlling for the baseline measures of the selected place characteristics, time-gender interaction, age, ACASI survey administration variable, and other participant characteristics that were significant at p-value 0.05 in Model 2.