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Impact of Public Housing Relocations: Are changes in neighborhood conditions related to STIs among relocaters?

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Abstract

Background—Cross-sectional and ecologic studies suggest that place characteristics influence sexual behaviors and sexually-transmitted infections (STIs). Using data from a predominately substance-misusing cohort of African-American adults relocating from US public housing complexes, this multilevel longitudinal study tested the hypothesis that participants who experienced greater post-relocation improvements in neighborhood conditions (i.e., socioeconomic disadvantage, social disorder, STI prevalence, male:female sex ratios) would have reduced odds of testing positive for an STI over time.

Methods—Baseline data were collected in 2009 from 172 public housing residents before relocations occurred; three waves of post-relocation data were collected every 9 months thereafter. PCR methods were used to test participants' urine for *C.trachomatis*, *N. Gonorrhoeae*, and *T. vaginalis*. Individual-level characteristics were assessed via survey. Administrative data described the census tracts where participants lived at each wave (e.g., sex ratios, violent crime rates, poverty rates). Hypotheses were tested using multilevel models.

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Results—Participants experienced improvements in all tract-level conditions studied and reductions in STIs over time (baseline: 29% tested STI positive; Wave 4: 16% tested positive). Analyses identified a borderline statistically-significant relationship between moving to tracts with more equitable sex ratios and reduced odds of testing positive for an STI (OR=0.16; 95% CI:0.02, 1.01). Changes in other neighborhood conditions were not associated with this outcome.

Discussion—Consonant with past research, our findings suggest that moving to areas with more equitable sex ratios reduces the risk of STI infection. Future research should study the extent to which this relationship is mediated by changes in sexual network dynamics.

Keywords

African-Americans; Public Housing; Sexually Transmitted Infections; Multilevel Models; Residence Characteristics

Introduction

Several studies suggest that neighborhood characteristics create vulnerability or resilience to sexually-transmitted infections (STIs). Ecologic studies suggest that STI prevalence is elevated in areas that have higher levels of poverty, social disorder, incarceration, or racial/ethnic residential segregation.[e.g.,1,2] Multilevel studies of people nested in places have corroborated these ecologic findings[e.g.,3-6] and have expanded exposures to include male:female sex ratios[7-9] and expanded outcomes to include sexual behaviors.[e.g., 7-9] All but two of these multilevel studies, however, have been cross-sectional.[3,8] Ecologic and cross-sectional studies have limited ability to establish causal relationships between neighborhood-level exposures and STIs.

This longitudinal multilevel study is designed to investigate relationships between changes in exposure to several neighborhood-level conditions (i.e., economic disadvantage, social disorder, male:female sex ratios, STI prevalence) and STI status in a predominately substance-misusing cohort of African-American adults relocating from public housing complexes. These public housing relocations are a part of a paradigm shift in US public housing policy: where once federal and local governments sought to place households that qualified for housing assistance into spatially-concentrated complexes (e.g., high rises, campuses), they now seek to geographically disperse them.[10] Relocations tend to move households to new neighborhoods that are less impoverished, less violent, and have less drug activity than the neighborhoods surrounding the original complexes.[10]

Several studies have examined the implications of these relocations for relocaters' health. While most have found positive effects (e.g., reduced substance misuse[11]), some have found no effect (e.g., depression, anxiety[12]), and a handful have found negative effects (e.g., increased distress and behavioral problems among boys[13]). To date no research has studied relocations' effects on STIs. Rates of STIs appear to be higher in public housing complexes than in the general population, [14,15] and substance misuse is also prevalent.[11,15] Substance misuse creates vulnerability to STIs through several mechanisms, including by making condom use less likely.[16] Further testifying to the significance of studying relocations and STIs is the fact that relocations appear to affect several dimensions of the local environment that have predicted STI status in ecologic and cross-sectional studies (e.g., economic disadvantage, social disorder).

This analysis is guided by the Risk Environment Model, which proposes that vulnerability to HIV and other STIs among substance misusers is generated, in part, by place characteristics and social policies.[17] Social policies and place characteristics may affect STIs through several mechanisms. Areas with imbalanced sex ratios may shift dyadic power dynamics in ways that promote concurrency and dense networks, and discourage condom use.[7,9,18] Residents of impoverished and socially-disordered neighborhoods have higher rates of psychological distress and substance misuse, both of which create vulnerability to engaging in sexual risk behaviors and to having riskier sexual networks.[19,20] Residents of neighborhoods with higher prevalences of STIs may be more likely to select sex partners who have an STI, since individuals often select partners from their neighborhood.[21] We thus hypothesized that people who moved to areas that had more equitable sex ratios, were less economically distressed, less socially disordered, or that had lower STI prevalence would have reduced odds of testing positive for an STI.

Materials and Methods

Methods have been described in detail elsewhere,[11] and are summarized below.

Sample, Recruitment, and Retention

We sampled male and female residents of the seven public housing complexes in Atlanta, Georgia, that were scheduled for relocation between 2008-2010; all residents were relocated and complexes were later demolished. People were eligible to take part in the study if they had lived in one of these seven complexes for ≥1 year; self-identified as a non-Hispanic Black/African-American adult (aged ≥18 years); had been sexually active in the past year; and did not live with a current study participant.

Given the broader study's focus on patterns and determinants of pre-/post-relocation changes in substance misuse (including initiation, intensification, and cessation), we used non-probability-based quota sampling methods to create a sample that varied with regard to baseline substance misuse. Specifically, we sought to create a sample in which ¼ of participants met criteria for drug/alcohol dependence, ½ misused substances but were not dependent (i.e., self-reported recent use of illicit drugs, including marijuana, or alcohol misuse, including binge drinking), and ¼ did not misuse substances (i.e., no illicit drug use in the past five years and no recent alcohol misuse).

Several methods were used to recruit the sample: study staff recruited onsite in each complex; community- and faith-based organizations surrounding each complex shared flyers with clients and parishioners; and participants could refer individuals for screening. Intensive retention methods (e.g., monthly calls to participants; contact with hard-to-reach participants' network members) were used to keep attrition low and random.

Data Collection and Measures

Baseline data on individual and census-tract characteristics were gathered in 2009 and captured the pre-relocation period. Because we conducted baseline interviews while relocations were underway in each complex, Wave 1 survey items querying time-varying phenomena captured the time period just before the relocations began in each participant's complex (a time period that ended about 4 months before the interviews, on average); timeline followback methods were used to improve recall. Wave 2 data were gathered nine months after baseline, and Wave 3 and 4 gathered every nine months thereafter; Wave 4 data collection ended in 2012. Participants received $20 for the baseline interview; this amount increased by $5 at each subsequent wave.

Individual-level Data Collection and Measures—The dependent variable was testing positive for at least one of three STIs, as assessed at each wave: *N. gonorrhoeae (GC), C. trachomatis (CT),* or *T. vaginalis (TV)*. Participants were instructed to provide a sample of first stream urine. The presence of GC and CT was determined by using the Becton Dickinson Probe Tec ET Amplified DNA Assay (Sparks, MD). The presence of TV in clinical specimens was determined by using Taq Man PCR. These assays have high sensitivities and specificities.[14] Participants who tested positive were referred to public clinics for treatment, and cases of GC and CT were reported to the Georgia Department of Health surveillance system. Participants were subject to partner treatment protocols depending on their chosen site for treatment; some sites might not have had partner treatment protocols. We did not assess whether participants met state protocol guidelines for CT or GC re-screening three months after treatment.

Individual-level predictors were gathered via audio-computer assisted self-interview methods (ACASI); questions about sensitive topics (i.e., substance use, sex) were asked using audio-assisted personal interviewing (ACAPI) methods to reduce social-desirability bias.[22] The survey assessed several individual-level characteristics that might confound or modify relationships between tract-level exposures and STI status (e.g., gender, household income).

At Waves 2-4 we asked individuals who had tested positive for an STI at the previous interview whether they had received treatment for this STI. Because several participants who tested positive for an STI at Wave 1 reported at Wave 2 that they had not tested positive for that STI at baseline, we refined this question at Wave 3. Specifically, the interviewer reminded the participant at Waves 3 and 4 about the STI for which he/she had tested positive at the prior wave, and asked whether the participant had received treatment for that specific STI in the intervening months. Since we only had accurate data on this variable for Waves 3 and 4 we excluded STI treatment from bivariate and multivariable models.

Measures of Census-Tract Characteristics—Each participant's home address was geocoded to his/her residential census tract at each wave, and we analyzed existing administrative data to describe characteristics of the census tracts where participants lived at each wave. Baseline tract-level data captured pre-relocation conditions; tract-level data for

Waves 2-3 were contemporaneous with the year of survey-based data collection, or with the most proximate year for which data were available. Data from the US Census Bureau and the Longitudinal Tract Database were used to calculate tract-level male:female sex ratios and tract-level economic indicators (i.e., median income, poverty rates, and educational attainment).[23] We restricted sex ratios to adults aged 18-64 who were non-Hispanic Black/African-American to match our participants' age range and in response to documented patterns of racial/ethnic homophily in sexual relationships.[24]

We analyzed existing annual data from the Georgia Department of Revenue, local police departments, and the Georgia Department of Health to construct tract-level measures of alcohol outlet density (the number of sites per square mile licensed to sell alcohol for off-premises consumption); violent crime rates; and the prevalence of reported STIs (i.e., syphilis, GC, CT).

Because measures of tract characteristics were highly correlated with one another, we used principal components analysis (PCA) with orthogonal rotation (varimax) to generate components. We excluded STI prevalence and sex ratios from the PCA because we believed that their relationships to individual STI status may be distinct from–and specifically may be more direct than–relationships between the other factors and STI status. PCA identified two components: an “economic disadvantage” component (median household income, poverty rate, and educational attainment) and a “social disorder” component (alcohol outlet density and violent crime rates). Scores were standardized, and so a one-point difference in a component represents a difference of one standard deviation from the average component value for the sample.

Analysis

We used descriptive statistics to examine characteristics of participants and census tracts at each wave. Because participants were clustered within seven census tracts at baseline and because interviews were clustered within individuals, we used a three-level multilevel model to test hypotheses. Interview waves (Level 1) were nested within participants (Level 2) and participants were nested in their baseline tract (Level 3). A growth curve model (GCM) was used to characterize change over time in the outcome.[25] Hierarchical generalized linear models (HGLMs) were used to assess bivariate and multivariable relationships; HGLMs are extensions of hierarchical linear models that accommodate non-continuous outcomes, including binary outcomes. Individual-level predictors with $p<0.10$ in bivariate models were included in the final multivariable model.

Measures of tract-level characteristics were centered at their baseline values, creating a baseline measure and a “change since baseline” measure for each tract characteristic.[25] Because participants dispersed post-relocation, tract-level “change over time” variables were treated as time-varying characteristics of individuals (i.e., Level 1); baseline measures were treated as characteristics of the tracts that contained the public housing complexes (i.e., Level 3).

To assess the true magnitude of each tract-level characteristic/STI relationship, variables capturing substance misuse and sexual behaviors were excluded from models when they might mediate these relationships. We concluded that substance misuse might mediate relationships of economic disadvantage and social disorder to STIs,[19,20] and that sexual risk behaviors might mediate relationships of economic disadvantage, social disorder, and sex ratios to STIs.[7-9,19]

Women who reported only having sex with women in the prior wave were excluded from bivariate and multivariable analyses, given the low transmission risk for this group.

Ethics

Emory University's Institutional Review Board approved the study. A Certificate of Confidentiality was obtained to protect participants.

Results

Description of Participants and of the Census Tracts Where They Lived

We enrolled 172 participants in the study; complexes housed a total of approximately 2,300 households pre-relocation. Despite mass relocations, retention rates were high: 95% (163) of the baseline sample took part in Wave 2, and 91% (156) of the baseline sample took part in Wave 4 (Table 1). Fifty-three percent of the sample were women, and the mean age of participants was 42.9 (SD=14.0). Participants were deeply impoverished at baseline: the mean annual household income was $9,849.40 (SD=$8,732.99). Participant's economic status changed little over time, though homelessness increased. By design, a high percentage of participants misused substances at baseline; reported substance misuse dropped steeply between Waves 1 and 2 and these declines were sustained across time. Overall, sexual risk behaviors declined over time.

At baseline, 29% of the sample tested positive for GC, CT, or TV. STI prevalence dropped by a third to 19% at Wave 2, and was 21% at Wave 3 and 16% at Wave 4. Regardless of wave, the vast majority of participants with an STI tested positive for TV; few tested positive for GC or CT. There were substantial gender differences in STI status at baseline: while 42% of women tested positive, just 12% of men tested positive. STI prevalence dropped steeply among men and women between Waves 1 and 2, and this decline persisted. The percentage of people who reported subsequently receiving treatment was high at Waves 3 and 4 (77.3% and 88.9%, respectively).

Relocations took participants from the seven tracts that contained the public housing complexes to 77 tracts at Wave 2; subsequently, some participants moved again, and thus participants lived in 84 tracts at Wave 3 and in 83 tracts at Wave 4. The median distance that participants moved between Waves 1 and 2 was 5.17 miles (25^{th} percentile=2.97, 75^{th} percentile=7.97); almost all remained within the state of Georgia (e.g., just three lived outside the state at Wave 2). Relocations took participants to new census tracts that were qualitatively different from the tracts where they lived at baseline. For example, the mean poverty rate in the tracts where participants lived at baseline was 46.1% (SD=9.6); on average, at Wave 2 the mean poverty rate was 30.2% (SD=11.8), 16 percentage points lower than that of their baseline tract. Tract-level poverty rates were stable thereafter. Changes in measures of other tract-level economic conditions, and of social disorder and STI prevalence, followed a similar pattern: high disadvantage/disorder/STI prevalence at baseline, followed by substantial improvements between baseline and Wave 2 that were sustained across time.

At baseline, on average across tracts there were 89 Black/African-American men for every 100 Black/African-American women. While this average remained unchanged across time, wave-specific means conceal considerable variation in intra-individual exposures to local sex ratios: while the mean intra-individual change in sex ratios between Waves 1 and 2 was just 0.01, the standard deviation around this mean was 0.36.

Growth Curve Model Results: Trends in the Odds of Testing Positive for an STI

In the optimal GCM, time was operationalized as the number of months since baseline and temporal trajectories in STIs varied across participants (Table 2). The odds ratio for time (OR=0.96; 95% Confidence Interval [CI]=[0.94, 0.98]) indicates that the odds of testing positive for an STI declined by 4% with each passing month; the magnitude of this decline did not vary by gender.

Bivariate Results

Bivariate analyses indicate that the odds of testing positive at baseline were lower among men than women (OR=0.05; CI=[0.01, 0.22]), and that increasing age and income were protective (OR=0.95, CI=[0.91, 0.99]; OR=0.75, CI=[0.58, 0.95], respectively). There was a borderline statistically-significant relationship indicating that each new casual partner increased the odds of testing positive for an STI by 23% (OR=1.23, CI=[0.96, 1.56]).

Bivariate models identified several relationships between tract-level conditions and the odds of testing positive. Specifically, the odds of testing positive for an STI at baseline were higher among participants living in more economically disadvantaged tracts (OR=3.14; CI=[1.07,9.21]), and there was a borderline statistically-significant finding that participants who experienced greater reductions in tract-level economic disadvantage over time had a lower odds of testing positive (OR=1.37; CI=[0.87, 2.17]). The odds of testing positive for an STI at baseline were higher among participants living in tracts with fewer men relative to women (OR=0.06, CI=[0.01, 0.54]), though there was no relationship between changes in sex ratios and STI at the bivariate level (OR=0.29; CI=[0.06, 1.52]). Additionally, while there was no relationship between baseline tract-level STI prevalence and the outcome, there was a borderline statistically-significant finding that people who experienced greater reductions in STI prevalence had a lower odds of testing positive for an STI over time (OR=1.22; CI=[0.98, 1.52]). Social disorder was unrelated to the outcome, and participant gender did not moderate any of these multilevel relationships (data not shown).

Multivariable Models

While tract-level economic conditions, sex ratios, and STI prevalence were all nominally related to STIs in bivariate analyses, we could not include all three tract-level predictors in the same model because they were correlated with one another. We therefore ran three separate multivariable models that explored the relationship of each of these tract-level predictors to the outcome (Table 3, Models A-C). The relationship between changes in sex ratios and the outcome attained borderline statistical significance (Model A). Specifically, analyses suggest that the odds of testing positive for an STI were lower among participants who moved to tracts with more equitable sex ratios (OR=0.16; CI=[0.02, 1.01]). A standardization of ratios and examination of the data tells us that a one SD improvement in sex ratios results in an average difference in STI rates of 20% vs. 11%, or a 9% decrease. Removing the substance-misuse variable from Models A and C did not appreciably alter the results. Adding sexual behavior variables (i.e. condom use at last sex, primary partnerships, casual partnerships) reduced the magnitude of the association between moving to a tract with more equitable sex ratios and STIs (from OR=0.16 to OR=0.26), a finding that suggests that these sexual behaviors may mediate this relationship.

Discussion

In this predominately substance-misusing sample of African-American adults relocating from distressed/obsolete public housing complexes, we found that the odds of testing positive for an STI declined markedly post-relocation, and that these declines were sustained across time. Consonant with past studies of relocaters and of substance misusers, baseline prevalences of STIs were high.[14,26] The prevalence of STIs decreased substantially post-relocation and at subsequent visits: 29% of participants tested positive for an STI at baseline, whereas 16% tested positive at Wave 4. Additionally, and also consistent with past studies,[10-14] participants also experienced substantial and persistent post-relocation improvements in several dimensions of their socioeconomic environments, including in background STI prevalence, economic conditions, and social disorder.

In this sample, there was a borderline statistically-significant relationship between moving to tracts with more equitable sex ratios and reduced odds of testing positive for an STI. To our knowledge, this is the first longitudinal multilevel study to evaluate this association. Several mechanisms may drive this possible relationship. Imbalanced sex ratios may shift dyadic power dynamics in ways that promote concurrency and dense networks, both of which facilitate the spread of STIs.[7,18] Moving to areas with more equitable sex ratios might thus protect against STI infection. Future research with this cohort will examine the possibility that changes in participants' condom use, partnership characteristics, and sexual networks mediate this relationship.

In contrast with past studies, we found no relationship between STI status and tract-level economic conditions, STI prevalence, or social disorder. Several factors may explain these differences. First, much (though not all)[8] of the past research on place characteristics and sexual behaviors/STIs tested relationships in the general population;[3-7,9] these relationships may not be generalizable to substance-misusing populations. Regardless of local economic conditions, STI prevalence, or social disorder, substance misusers may be more likely than nonusers to have unprotected sex with STI-positive partners.

Second, the *nature* of the changes participants experienced in their local environments and our ability to measure them might have affected our findings. Our tract-level measure of STI prevalence captured reported cases of CT, GC, and syphilis. Regardless of wave, however, the vast majority of our participants tested positive for TV, not CT or GC. Heterogeneity exists in the distributions of STIs across space,[27] and so census tracts with high CT, GC, or syphilis prevalences may not have a high TV prevalence.

The lack of association between changes in local economic conditions and STIs might be explained by the fact that, while participants experienced substantial improvements in local economic conditions, they still lived in impoverished tracts after relocating: the mean Wave 2 tract-level poverty rate of 30.2% exceeds the federal definition of a “poverty area” (20%). Perhaps participants needed to move out of poverty areas altogether to experience the benefits of improving economic conditions on STIs.

Limitations

We could not randomly select residents from the complexes because no sampling frame of substance-misusing residents of the complexes existed. Additionally, because relocations were underway when recruitment began, we could not use targeted sampling or respondent-driven sampling methods: both rely on network-based recruiting and the relocations disrupted residents' networks. As discussed in detail elsewhere,[11] however, our sample's sociodemographic composition was similar to those of the underlying populations of residents in each of the seven complexes, as documented by HUD. The fact that relocations were underway during recruitment may have facilitated recruitment of active substance misusers, who tend to have a harder time finding housing during relocations.[28]

We could not randomize residents to post-relocation census tracts, and so it is possible that participants who were more at-risk for an STI at baseline were more likely to move to tracts with lower sex ratios. Countering this threat to validity, however, is that fact that our post-hoc analyses indicate that participants who had an STI at baseline tended to experience *greater* improvements in sex ratios between Waves 1 and 2 than participants who did not test positive for an STI.

We could not create a control group of non-relocaters for this study: no severely distressed/obsolete complexes remain in Atlanta. Possibly, the reductions in STIs observed here were driven by participant aging or by broader historical changes in Atlanta. Notably, there is no evidence in surveillance data of declines in GC or CT in Fulton County (Atlanta) over the study period.[29] Additionally, changes in STIs in our sample were systematically associated with specific changes in sex ratios in ways supported by past research,[7-9] suggesting that they are not merely artifacts of these threats to validity.

Our STI measure likely underestimated the burden of STIs in our sample. We only tested participants for urethral STIs, and also only tested participants for three STIs. Additionally, while our baseline exposure measures captured the pre-relocation period, our measure of baseline STI status was contemporaneous with the time of the interview. It is possible that some participants may have become infected during the lag between the pre-relocation period and the baseline STI test.

Because our outcome was relatively common (approximately 20% prevalence across waves), ORs may slightly overestimate the magnitude of the relationship between changes in sex ratios and STIs. At present, it is not possible to calculate Prevalence Ratios (which better estimate Relative Risks when outcomes are more common) in multilevel models with dichotomous outcomes. We conducted a post-hoc analysis in which the outcome was the odds of testing positive for GC or CT–a relatively uncommon outcome in our sample–and re-ran our analysis of the relationship between sex ratios and this revised STI measure. The magnitude and direction of the relationship suggests that participants who moved to tracts with more equitable sex ratios had a markedly reduced odds of testing positive for GC or CT, though this relationship did not attain statistical significance, perhaps because of the rare nature of the outcome (OR=0.05; CI=0.0007, 3.83; p=0.18).

Conclusion

African-American adults relocating from distressed housing complexes in Atlanta, Georgia experienced substantial improvements in multiple tract-level conditions and significant post-relocation declines in STIs. Multilevel longitudinal analyses found a borderline statistically-significant relationship between moving to tracts with more equitable sex ratios and reduced odds of testing positive for an STI in this high-risk cohort. Future research should explore whether post-relocation changes in sexual-network dynamics mediate this relationship.

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Table 1

Distributions of individual- and census-tract level characteristics at baseline and over time in a sample of 172 African-American adults relocating from public housing complexes in Atlanta, Georgia.

Characteristic of participants and census tracts	Wave 1 N (%) or Mean (SD) N(171[1])	Wave 2 N (%) or Mean (SD) (N=163)	Wave 3 N (%) or Mean (SD) (N=160)	Wave 4 N (%) or Mean (SD) (N=156)
Participant Characteristics				
Gender				
Woman[2]	97 (53.4%)	95 (58.3%)	92 (57.5%)	89 (57.1%)
Man	75 (43.6%)	68 (41.7%)	68 (42.5%)	67 (43.0%)
Age (years)	42.9 (14.0)	43.1 (13.9)	43.2 (14.0)	43.5 (13.8)
Married or living as married	16 (9.4%)	16 (9.5%)	15 (9.4%)	15 (9.7%)
Employed	18 (10.5%)	15 (9.3%)	15 (9.4%)	15 (9.7%)
Annual Household Income	$9,849.40 ($8,732.99)	$10,473.86 ($9,655.89)	$11,217.11 ($9,533.78)	$9,966.22 ($9,137.36)
Homeless	0 (0%)	7 (4%)	8 (5%)	10 (6%)
HIV positive (self report)	15 (8.8%)	16 (9.9%)	14 (8.8%)	16 (10.3%)
Self-rated health	1.85 (1.01)	1.87 (1.03)	1.73 (1.09)	1.97 (1.04)
Binge drinking twice or more (30 day reporting period)	63 (38%)	41 (26%)	44 (28%)	29 (19%)
Use of illicit drugs weekly or more (6 month reporting period)	50 (30%)	40 (25%)	30 (19%)	29 (19%)
Met screening criteria for dependence on alcohol or other drugs (6-month reporting period)	36 (21%)	18 (11%)	14 (9%)	14 (9%)
Length of time living at current address	76.6 (84.1)	8.3 (3.4)	20.9 (12.1)	46.4 (135.5)
Casual partners				
Any	63 (37.3%)	55 (34.4%)	50 (31.2%)	44 (28.4%)
Mean Number of casual partners	0.95 (1.92)	0.63 (1.64)	0.71 (1.82)	0.63 (1.90)
Primary partners				
Any	143 (84.6%)	120 (74.1%)	113 (70.6%)	116 (74.8%)
Mean Number of primary partners	1.11 (1.12)	0.92 (0.84)	0.87 (1.09)	1.37 (6.48)
Only reported same-sex behavior in six-month reporting period				
Men	5 (6.8%)	5 (7.5%)	5 (7.5%)	6 (9.1%)
Women	5 (5.3%)	4 (4.3%)	1 (1.1%)	3 (3.5%)
Condom use at last sex	70 (40.9%)	54 (38.8%)	48 (37.5%)	42 (32.8%)

Characteristic of participants and census tracts	**Wave 1 N (%) or Mean (SD) N(171[1])**	**Wave 2 N (%) or Mean (SD) (N=163)**	**Wave 3 N (%) or Mean (SD) (N=160)**	**Wave 4 N (%) or Mean (SD) (N=156)**
Diagnosed with an STI prior to baseline	69 (40%)	---	---	---
Treated for an STI since last wave, among people who tested STI positive at last wave[3]	---	---	17 (77.3%)	24 (88.9%)
Tested positive for gonorrhea, Chlamydia, or trichomonas				
Overall	47 (29%)	25 (19%)	29 (21%)	22 (16%)
Women	39 (42%)	22 (29%)	24 (30%)	18 (23%)
Men	9 (12%)	3 (6%)	4 (7%)	5% (3)
Tested positive for gonorrhea				
Overall	3 (2%)	0 (0%)	1 (1%)	0 (0%)
Women	3 (3%)	0 (0%)	1 (1%)	0 (0%)
Men	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Tested positive for Chlamydia				
Overall	10 (6%)	5 (4%)	3 (2%)	1 (1%)
Women	6 (7%)	3 (4%)	1 (1%)	1 (1%)
Men	4 (6%)	2 (4%)	2 (3%)	0 (0%)
Tested positive for trichomonas				
Overall	41 (26%)	21 (13%)	26 (16%)	21 (13%)
Women	36 (39%)	20 (22%)	23 (25%)	17 (19%)
Men	5 (7%)	1 (1%)	2 (3%)	3 (4%)
Census tract characteristics				
Number of participants per census tract	24.4 (7.4)	2.1 (1.7)	1.9 (1.4)	1.9 (1.4)
Male:Female Sex Ratio among Black/African-American 18-64 year olds	0.89 (0.32)	0.90 (0.21)	0.89 (0.24)	0.89 (0.23)
Prevalence of sexually transmitted infections per 1000	47.8 (16.9)	29.4 (14.4)	32.2 (16.5)	32.0 (15.9)
Median household income	$15,809.9 ($4482.6)	$33,476.0 ($15,788.3)	$33,784.5 ($16,020.0)	$33,804.8 ($16,245.0)
Poverty rate	46.1% (9.6)	30.2% (11.8)	30.1% (12.0)	30.0% (12.6)
Percent of adults (≥25 years) whose highest degree is a high school diploma or less	67.1% (13.4)	49.1% (17.6)	48.8% (17.9)	48.6% (18.1)
Violent crime rate (per 1000)	35.6 (15.8)	20.7 (14.7)	20.7 (14.4)	21.5 (15.7)
Density of alcohol outlets per square mile	9.3 (8.0)	6.4 (5.0)	6.4 (5.1)	6.7 (5.8)

Characteristic of participants and census tracts	**Wave 1 N (%) or Mean (SD) N(171[1])**	**Wave 2 N (%) or Mean (SD) (N=163)**	**Wave 3 N (%) or Mean (SD) (N=160)**	**Wave 4 N (%) or Mean (SD) (N=156)**
Economic Disadvantage Component	0.82 (0.54)	-0.29 (0.94)	-0.31 (0.96)	-0.32 (0.99)
Social Disorder Component	0.35 (1.32)	-0.16 (0.79)	-0.16 (0.77)	-0.08 (0.88)

[1] Baseline survey data were lost for one participant, so the baseline N=171, though 172 individuals were in the cohort.

[2] Women included three individuals who were transgendered (male to female).

[3] We did not query prior STI treatment at baseline and several Wave 2 participants misreported their baseline STI status.

Table 2

Bivariate relationships between each individual- and tract-level predictor and the odds of testing positive for a sexually transmitted infection in a sample of 172 African-American adults relocating from seven public housing complexes. Relationships were modeled using hierarchical generalized linear models.[45]

Characteristics of participants & census tracts	Odds Ratio (95% Confidence Interval)
Time-Varying Subject Covariates	
Number of months since baseline	0.96 (0.94, 0.98)
Age	0.95 (0.91, 0.99)
Annual household income	0.75 (0.58, 0.95)
Homeless	1.26 (0.19, 8.21)
Self-rated health	1.27 (0.82, 1.96)
HIV positive	1.14 (0.15, 8.71)
Dependent on alcohol or other drugs (past 6 months)	1.06 (0.37, 3.08)
Binge drinking (past month)	0.91 (0.40, 2.04)
Illegal drug use weekly or more (past six months)	6.15 (2.11, 17.91)
Length of time living at current address	1.00 (0.99, 1.00)
Condom use at last sex	1.05 (0.45, 2.43)
Primary partnerships (past 6 months)	
Any	1.10 (0.37, 3.24)
Number of primary partners	1.06 (0.69, 1.63)
Casual partnerships (past 6 months)	
Any	1.34 (0.54, 3.21)
Number of casual partners	1.23 (0.96, 1.56)
Perceived community violence (past 6 months)	
Baseline	1.27 (0.93, 1.74)
Change since baseline	1.18 (0.94, 1.47)
Non-Time Varying Subject Covariates	
Gender	0.05 (0.01, 0.22)
Gender*time	1.00 (0.95, 1.06)
STI ever	2.60 (0.80, 8.43)
Married	0.30 (0.03, 2.59)
Employed	0.32 (0.04, 2.56)
Census-Tract Level Predictors	
Economic Conditions component	
Baseline	3.14 (1.07, 9.21)
Change since baseline	1.37 (0.87, 2.17)
Social disorder component	
Baseline	0.97 (0.54, 1.75)
Change since baseline	1.06 (0.70, 1.60)
Violent crime rate (per 1000 residents)	
Baseline	1.02 (0.98, 1.07)

Characteristics of participants & census tracts	Odds Ratio (95% Confidence Interval)
Change since baseline	1.01 (0.99, 1.03)
Density of off-premises alcohol outlets	
Baseline	0.99 (0.89, 1.09)
Change since baseline	1.01 (0.94, 1.08)
Male:Female sex ratio (Black adults)	
Baseline	0.06 (0.01, 0.54)
Change since baseline	0.29 (0.06, 1.52)
Prevalence of STIs (per 100)	
Baseline	1.13 (0.74, 1.72)
Change since baseline	1.22 (0.98, 1.52)

[4]All covariates tested with time (slope) in models; baseline and change since baseline in tract-level predictors tested simultaneously.

[5]Because of the small number of men who reported only engaging in same-sex sexual behavior in the past 6 months, the relationship between same-sex behavior and STIs among men could not be explored in bivariate or multivariable analyses.

Table 3

Multivariate relationships between tract- and individual-level predictors and the odds of testing positive for a sexually transmitted infection in a sample of 172 African-American adults relocating from seven public housing complexes. Relationships were modeled using hierarchical generalized linear models.[6]

Characteristics of participants & census tracts	**Odds Ratio (p-value)**		
	Model A	**Model B**	**Model C**
Intercept	3.06 (0.29, 32.60)	1.45 (0.14, 14.91)	1.20 (0.08, 19.07)
Time-Varying Subject Covariates			
Number of months since baseline	0.97 (0.94, 0.99)	0.96 (0.94, 0.99)	0.96 (0.93, 0.99)
Age	0.98 (0.93, 1.03)	0.97 (0.93, 1.01)	0.97 (0.93, 1.02)
Annual household income	0.77 (0.60, 0.98)	0.79 (0.62, 1.00)	0.80 (0.62, 1.04)
Illegal drug use weekly or more (past six months)	7.85 (2.45, 25.10)	--	5.09 (1.62, 15.99)
Condom use at last sex	--	--	1.04 (0.41, 2.59)
Primary partnerships (past 6 months)			
Any	--	--	0.66 (0.16, 2.71)
Number of primary partners	--	--	1.08 (0.60, 1.94)
Casual partnerships (past 6 months)			
Any	--	--	1.02 (0.37, 2.86)
Number of casual partners	--	--	1.26 (0.95, 1.69)
Non-Time Varying Subject Covariates			
Gender	0.05 (0.01, 0.22)	0.08 (0.02, 0.30)	0.03 (0.01, 0.16)
Census-Tract Level Predictors (Time Varying)			
Male:Female sex ratio (Black adults)			
Baseline	0.24 (0.02, 3.05)	--	--
Change since baseline	0.16 (0.02, 1.01)	--	--
Economic Conditions component			
Baseline	--	1.48 (0.51, 4.27)	--
Change since baseline	--	1.13 (0.70, 1.81)	--
Prevalence of STIs (per 100)			
Baseline	--	--	1.08 (0.73, 1.59)
Change since baseline	--	--	1.04 (0.80, 1.35)
Variance components			
Community at baseline	0.00 (----)	0.00 (----)	0.00 (----)
Initial status	2.74 (1.94, 3.87)	2.55 (1.83, 3.55)	2.57 (1.78, 3.71)

[6]All covariates tested with time (slope) in models; baseline and change since baseline in tract-level predictors tested simultaneously.