Published in final edited form as:
Sex Transm Infect. 2017 December ; 93(8): 583–589. doi:10.1136/sextrans-2016-052889.

Relationships between Neighbourhood Characteristics and Current STI Status among HIV-Infected and HIV-Uninfected Women Living in the Southern United States: A Cross-Sectional Multilevel Analysis

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Contributors: DFH designed the study; acquired, analysed, and interpreted study data, led manuscript development, and agrees to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. MRK, RH, and HLFC contributed to study design, analysis, interpretation of study data, and revised the work critically for important intellectual content. AAA and GMW contributed to study design, data acquisition, interpretation of study data, and revised the work critically for important intellectual content. AR and CL contributed to data acquisition and revised the work critically for important intellectual content. ZR contributed to data analysis and revised the work critically for important intellectual content. DAH, EG, and HB revised the work critically for important intellectual content. All authors provided final approval of the version to be published.

Competing Interests: Authors have no known conflicts to disclose.

Abstract

Objectives—Neighbourhood characteristics (e.g., high poverty rates) are associated with sexually transmitted infections (STIs) among HIV-uninfected women in the United States (US). However, no multilevel analyses investigating the associations between neighbourhood exposures and STIs have explored these relationships among women living with HIV infection. The objectives of this study were to: 1) examine relationships between neighbourhood characteristics and current STI status, and 2) investigate whether the magnitudes and directions of these relationships varied by HIV status in a predominantly HIV-infected cohort of women living in the southern US.

Methods—This cross-sectional multilevel analysis tests relationships between census tract characteristics and current STI status utilizing data from 737 women enrolled at the Women's Interagency HIV Study's southern sites (530 HIV-infected and 207 HIV-uninfected women). Administrative data (e.g., US Census) described the census tract-level social disorder (e.g., violent crime rate) and social disadvantage (e.g., alcohol outlet density) where women lived. Participant-level data were gathered via survey. Testing positive for a current STI was defined as a laboratory-confirmed diagnosis of chlamydia, gonorrhoea, trichomoniasis, or syphilis. Hierarchical generalized linear models were utilized to determine relationships between tract-level characteristics and current STI status, and to test whether these relationships varied by HIV status.

Results—Eleven percent of participants tested positive for at least one current STI. Greater tract-level social disorder (OR=1.34, 95% CI=0.99, 1.87) and social disadvantage (OR=1.34, 95% CI=0.96, 1.86) were associated with having a current STI. There was no evidence of additive or multiplicative interaction between tract-level characteristics and HIV status.

Conclusions—Findings suggest that neighbourhood characteristics may be associated with current STIs among women living in the South, and that relationships do not vary by HIV status. Future research should establish the temporality of these relationships and explore pathways through which neighbourhoods create vulnerability to STIs.

Keywords

HIV; women; sexually transmitted infections; neighbourhood characteristics; multilevel analysis; sexual health

Introduction

Although the HIV epidemic was initially concentrated in the northeastern and western regions of the United States (US), the South now bears a significant burden of the epidemic.[12] Roughly half of new HIV diagnoses in 2010 were located in the South, though just 37% of the US population lives in this region.[2] In addition, nine states in the South (Alabama, Florida, Georgia, Louisiana, Mississippi, North Carolina, South Carolina, Tennessee, and Texas) have higher proportions of individuals diagnosed with HIV who are Black and female than other regions.[2] The South also experiences persistently high prevalences of other sexually transmitted infections (STIs).[1] Co-infection with STIs is common in women living with HIV.[34] STIs contribute to comorbidities (e.g., infertility, pelvic inflammatory disease) and may facilitate the transmission of HIV and other STIs to sexual partners.[3,4] The US National HIV/AIDS Strategy and the Centers for Disease Control and Prevention have identified the improvement of prevention and treatment of HIV and STIs for people living with HIV as priority areas.[5,6]

Growing evidence suggests that features of the social and built environment may shape women's vulnerability to STIs. Geographic areas with high levels of poverty and violent crime tend to have high prevalences of STIs, including HIV.[7,8] Multilevel studies exploring associations between neighbourhood characteristics and sexual health in individuals have found that living in neighbourhoods with high densities of alcohol outlets, prevalent neighbourhood poverty, and prevalent STIs is associated with more sexual partner risk (e.g., non-monogamy, dense sexual networks), sexual network turnover, and STIs in *HIV-uninfected* populations.[9-16] An understanding of whether neighbourhood factors influence current STI status could inform HIV/STI prevention and treatment efforts. However, the vast majority of multilevel research exploring relationships between neighbourhoods and STIs study these relationships in youth or young adults;[10-12,16] it is possible that relationships between neighbourhood characteristics and sexual health vary across the life course.[17] In addition, to our knowledge, no multilevel studies investigating the associations between neighbourhood exposures and STIs have explored these relationships in a predominantly *HIV-infected* cohort. It is unclear how neighbourhood characteristics create vulnerability to STI acquisition for people living with HIV. It is possible that the magnitude or direction of relationships between neighbourhood characteristics and STIs are different for HIV-infected versus HIV-uninfected women. For example, neighbourhood characteristics may be less influential for HIV-infected women because they have stronger incentives to protect their health or that of their partner (e.g., condom use).[18]

This multilevel cross-sectional study describes associations between neighbourhood characteristics and current STI status among a predominantly HIV-infected cohort of women living in the southern US, and tests whether the associations between neighbourhood characteristics and having a current STI vary by HIV status. This analysis is guided by the Socioecologic Framework (SEF),[19] which acknowledges that features of the physical and social environment may shape access to resources (e.g., employment opportunities) needed to engage in healthful behaviours as well as exposure to hazards associated with negative health outcomes. For example, living in neighbourhoods with high densities of businesses selling alcohol for off-premise consumption may increase a woman's probability of having a current STI by promoting greater community-level alcohol consumption, more sexual risk behaviour, and by connecting women to risky sexual networks.[20,21] We hypothesized that greater neighbourhood social disorder (e.g., more violent crime) and greater social disadvantage (e.g., more alcohol outlets) would be associated with having a current STI,[7,8,10-12] and that the magnitude of this relationship would be stronger for HIV-uninfected participants.[18]

Methods

Sample and Recruitment

The Women's Interagency HIV Study (WIHS) is a multisite, prospective cohort study designed to characterize the impact and progression of HIV among US women.[22] In 2013, WIHS expanded to clinical research sites in the Southern US (i.e., Alabama, Florida, Georgia, Mississippi, and North Carolina). These sites enrolled HIV-infected women and HIV-uninfected women at high risk of HIV acquisition between October 2013 and September 2015. WIHS eligibility criteria included being a woman between 25-60 years old. In addition, HIV-infected women were antiretroviral therapy (ART) naïve or started highly active antiretroviral therapy (HAART) after December 31, 2004; had never been on non-HAART ART, and had documented pre-HAART CD4 counts and HIV viral load. HIV-uninfected women reported either personal or partner characteristics associated with increased risk of HIV acquisition in the last five years: clinical STI diagnosis (e.g., using injection drugs).

Participants were recruited by WIHS using several strategies, including clinic and community-based organization referrals. Institutional Review Board (IRB) approval was obtained at each of the collaborating institutions and written informed consent was obtained prior to initiation of study procedures. Methods are described in detail elsewhere.[22] This secondary analysis, approved by the Emory University IRB, is restricted to WIHS participants who provided written informed consent to collect and geocode their residential address. For more detailed description of WIHS methods and the secondary analysis described herein, please see the Web Only Appendix.

Data Collection and Measures

Outcome: Current Sexually Transmitted Infection—The outcome, testing positive for a current STI (binary), was defined as a laboratory-confirmed diagnosis for at least one of the following at baseline: chlamydia, gonorrhoea, trichomoniasis, or early syphilis (titre and confirmatory test results consistent with primary, secondary, or early latent [<1 year duration] infection). Assessment for each STI was conducted according to WIHS protocol-requirements. Participants with a current STI were referred to medical providers for treatment. Participants who did not have laboratory test results for all four of the STIs available and also did not have at least one positive test among available results were excluded from the analyses (n=63, 8.55%). Study sites other than Georgia had higher rates of missing STI data, as did HIV-infected participants ($p<0.05$). We used maximum likelihood estimation and included covariates (i.e., HIV status, enrolment site) associated with missing outcome data in all multivariable models, thus controlling for potential bias introduced.[23]

Census Tract-Level Characteristics—Baseline participant residential addresses were geocoded to census tracts. Measures describing the social and physical environments of the census tracts where women lived were constructed using existing data sources (e.g., US Census) (Table 1).

Because several tract-level predictors were correlated, we were unable to group tract-level predictors a priori. Instead, we used principal components analysis with orthogonal rotation (varimax) to condense tract-level variables into components and to avoid multicollinearity in multivariable models. We extracted two continuous standardized principal component scores for factors with eigenvalues >1.0: (1) “social disorder” (vacant housing units, violent crime rate, STI prevalence, percent poverty, percent unemployed); and (2) “social disadvantage” (percent renter-occupied housing units, alcohol outlet density). For each factor, a one standard deviation increase indicates greater than average social disorder or social disadvantage for the sample.

Participant-Level Characteristics—WIHS collected all demographic and behavioural data using interviewer-administered questionnaires. Participant-level characteristics that might confound or modify relationships between tract-level characteristics and current STI status were determined a priori via a literature review.[3418]

The effect modifier of interest was being HIV-infected, defined by WIHS as a reactive serologic enzyme-linked immunosorbent assay test and a confirmed positive western blot or detectable plasma HIV-1 ribonucleic acid.

Control variables captured demographic characteristics and behaviours in the past six months and were binary unless otherwise noted: age in years (continuous mean-centred); married or cohabitating; non-Hispanic African-American; annual income ≤$18,000; self-rated quality of life (QOL) (continuous mean-centred, measured using an abbreviated Medical Outcomes Study Scale ranging from 0-100, with higher scores indicative of greater QOL[24]); alcohol and substance use (>7 drinks in the past week or any injection or non-injection use of crack, cocaine, heroin, marijuana, hallucinogens, club drugs, methamphetamines, or recreational prescription drug use in the last 6 months); exchange of sex for drugs, money or housing; homeless (currently living in a rooming or halfway house, shelter, welfare hotel, or on the street); lifetime history of chlamydia, gonorrhoea, trichomoniasis, or syphilis; condomless vaginal or anal sex; and study site (5-level categorical).

Analysis

We used descriptive statistics to describe distributions of participant- and census tract-level variables at baseline. We modelled bivariate and multivariable relationships with hierarchical generalized linear models (HGLMs) using a logit link with random effects for the intercept in order to model participant-level clustering within census tracts.[25] All HGLMs had two levels: participants (Level 1) were nested in census tracts (Level 2). Because an aim of this study was to determine whether the magnitudes and directions of relationships between tract characteristics and having a current STI might vary by HIV status, we tested statistically for multiplicative and additive interactions between neighbourhood characteristics and testing positive for an STI by HIV status. We tested for interaction between tract characteristics and HIV status on the multiplicative scale by entering cross-level interaction terms for HIV status and tract-level variables (i.e., HIV status*social disorder, HIV status*social disadvantage), retaining interaction terms with $p<0.05$ in the Full Multivariable Model. We tested for interaction between neighbourhood characteristics and HIV status on the additive scale by fitting separate models using a binomial distribution and identity link, controlling for participant-level confounders.[26] We entered cross-level interaction terms for HIV status and tract-level variables (i.e., HIV status*social disorder, HIV status*social disadvantage) stepwise. Interaction terms with p<0.05 were considered statistically significant on the additive scale.

Participant-level covariates traditionally included in models evaluating STI outcomes (e.g., alcohol and substance use) may lie in the causal pathways between tract characteristics and current STI status.[15] Including these variables in the full model would attenuate relationships between tract characteristics and outcomes if they did indeed lie on the causal pathway. We therefore re-ran the Full Multivariable Model excluding variables that might lie on the causal pathway between neighbourhood characteristics and STIs (i.e., income, QOL, alcohol and substance use, homelessness, STI history, unprotected sex). We compared odds ratio (OR) estimates for all tract-level variables in the Full vs. Reduced Models; differences in magnitude >10% suggested that excluded variables may attenuate relationships between neighbourhood characteristics and STIs.

HGLMs were fit using PROC GLIMMIX using Newton Raphson optimization and Gauss-Hermite quadrature approximation in SAS 9.4.

Results

Characteristics of census tracts and participants

A total of 845 women were enrolled at WIHS's southern sites. One hundred eight women were excluded from these analyses because they did not have geocoded address data; the majority of these women did not consent for geocoding (n=65, 60.2%). Participants excluded from these analyses because they were missing geocoded address data were more likely to report annual household incomes ≤$18,000 (83.2% vs. 69.0%, p=0.003); alcohol and substance use (48.1% vs. 37.9%, p=0.04); and sex exchange (17.6% vs. 5.7%, p<0.0001).

In the final analytic sample (N=737), participants were on average 44 years old (SD=9.3), 71.9% were HIV-infected, and 83.3% identified as non-Hispanic African American (Table 2). For a more detailed description of results, please see the Web Only Appendix.

Eleven percent of participants tested positive for at least one STI at baseline. The proportion testing positive for any STI was comparable by HIV status. Participants on average lived in census tracts with 29.1% of residents living in poverty (SD=13.6), and with 19.1 newly reported STI cases per 1,000 residents (SD=13.3) and 13.7 violent crimes per 1,000 residents annually (SD= 13.4) (Table 2). On average, tracts contained roughly five alcohol outlets per square mile (SD=7.8).

Associations between neighbourhood characteristics and current STI status

In bivariate analyses (Table 3), neither tract-level social disorder (OR=1.18, 95% Confidence Interval [CI]=0.91-1.52) nor social disadvantage (OR=1.21, 95% CI=0.94-1.54) were associated with current STI status.

In the Reduced Model, tract-level social disorder (OR=1.30, 95% CI=0.99-1.72, p=0.06) was associated with having a current STI when excluding participant-level covariates that may lie on the causal pathway. Tract-level social disadvantage (OR=1.34, 95% CI=0.96-1.87, p=0.08) was associated with having a current STI (Reduced Model). Specifically, a one standard deviation higher social disorder component was associated with a 30% greater odds of having a current STI and a one standard deviation higher social disadvantage component was associated with a 34% greater odds of having a current STI.

There was no evidence of effect modification of the relationships between social disorder, social disadvantage, and having a current STI by HIV status on either a multiplicative or additive scale (p>0.05). Odds ratios for tract-level characteristics in the Full Model, as compared to the Reduced Model excluding participant-level variables that might lie on the causal pathway were within 4% for all comparisons, suggesting that excluded variables did not lie on the causal pathway.

Discussion

In this multilevel analysis controlling for participant-level characteristics, we found that greater tract-level neighbourhood social disorder (i.e., greater violent crime, vacant housing, poverty, STI prevalence) and social disadvantage (i.e., more alcohol outlets, renter-occupied housing) were associated with having a current STI among women living in the South and that these relationships did not vary by HIV status. To our knowledge, this study is among the first to test relationships between neighbourhood characteristics and STIs in adult women[101316] and the first to analyse whether these relationships varied by HIV status.

Our findings are consistent with past studies exploring relationships between neighbourhood conditions and STIs in young adults.[10-1216] These studies have found that neighbourhood poverty and neighbourhood STI prevalence (elements of the social disorder component) are associated with testing positive for a current STI.[10-12] Similarly, *changes* in neighbourhood social disorder and social disadvantage are associated with *changes* in network characteristics and STIs: reductions in neighbourhood poverty, violence (elements of the social disorder component), and alcohol outlets (an element of the social disadvantage component) are associated with less partner risk, fewer sexual partners in close proximity (i.e., less spatial assortivity), fewer sex partners entering networks, and with lower neighbourhood STI prevalence over time.[13-152127] Neighbourhood social disorder and social disadvantage may create vulnerability to STIs by promoting norms supporting higher risk sexual behaviours and substance use, connecting women to higher risk sexual networks, and ultimately increasing the probability of having a sexual partner with an STI.[10112021]

Interestingly, in this predominantly HIV-infected cohort, none of the participant-level characteristics included in our bivariate or multivariable models were associated with current STI status. Similarly, the effect estimates for social disorder and social disadvantage in the Full Model versus the Reduced Model found that all estimates were well within the a priori 10% threshold, further supporting that these participant-level factors (e.g., alcohol and illicit substance use, condomless sex) did not lie on the causal pathway connecting neighbourhood characteristics and STIs. It is likely that sexual network characteristics, and not individual attributes, are key mediators of the relationships between neighbourhood characteristics and current STI status.[913-1621] It is also possible that additional mechanisms, which we did not assess but merit further exploration, lie on the causal pathway between neighbourhood characteristics and current STI status among HIV-infected women specifically. For example, being on ART has been linked to decreased STI risk among HIV-infected women in studies exploring individual-level determinants of STIs.[3] An emerging line of multilevel research suggests that neighbourhood factors shape HIV care and treatment among HIV-infected populations: neighbourhood disadvantage is associated with lower CD4 counts and less ART initiation.[28,29]

Findings are subject to limitations. Although the WIHS provides a high quality sample of women who are living with and at increased risk of HIV infection in the southern US, study participants agree to long-term follow-up and may not be representative of the general population. Participants excluded from this analysis due to a lack of geocoded address data may have lived in qualitatively different neighbourhoods. However, participants with and without geocoded address data were not statistically different with respect to current STI status. Residential census tracts may fail to capture the activity spaces in which sexual risk behaviours most frequently occur, although individuals living with and at increased risk of HIV tend to select sexual partners in closer proximity than lower risk populations.[13] Relationships between neighbourhood factors and having a current STI may vary across different STI types. We did not have sufficient prevalence in this sample to assess relationships between neighbourhood factors and each STI type (e.g., social disorder and chlamydia). However, past research supports that the geographic distributions of STIs share common spatial cores.[30] Due to the cross-sectional nature of our study, we are unable to draw conclusions regarding the causality of relationships between tract characteristics and STIs.

Collectively, our findings underscore the importance of neighbourhood characteristics in shaping women's risk for STIs and suggest that relationships between neighbourhood characteristics and current STI status do not vary by HIV status in our sample. Additional research is needed to establish the causal direction of these relationships and to elucidate the pathways through which neighbourhood conditions create vulnerability to STIs among HIV-infected and high-risk HIV-uninfected women living in the Southern US. If future research supports our findings, interventions designed to reduce women's STI risk should seek to improve neighbourhood conditions or mediators of relationships between neighbourhoods and STIs.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

The authors thank the Women's Interagency HIV Study participants for sharing their time and experiences. The authors also acknowledge the efforts and dedication of WIHS study staff, with special thanks to Ighovwerha Ofotokun, Neela Goswami, Sarah Sanford, Deja Er, Rachael Farah-Abraham, Erin Balvanz, Catalina Ramirez, Andrew Edmonds, Carrigan Parrish, Zenoria Causey, Venetra McKinney, and Lisa Rohn. In addition, the authors express sincere thanks to the state health departments and law enforcement agencies that provided data needed to construct census tract predictors.

Funding: This work was supported by the National Institute of Mental Health of the National Institutes of Health under Award Number F31MH105238, the Surgeon General C. Everett Koop HIV/AIDS Research Grant, the George W. Woodruff Fellowship of the Laney Graduate School, the Emory Center for AIDS Research (P30 AI050409), the Eunice Kennedy Shriver National Institute of Child Health & Human Development of the National Institutes of Health under Award Number K01HD074726, and the Centers for Disease Control and Prevention under Cooperative Agreement U01PS003315 as part of the Minority HIV/AIDS Research Initiative. Participant data in this manuscript were collected by the Women's Interagency HIV Study (WIHS): UAB-MS WIHS (PIs: Michael Saag, Mirjam-Colette Kempf, and Deborah Konkle-Parker), U01-AI-103401; Atlanta WIHS (PIs: Ighovwerha Ofotokun and Gina Wingood), U01-AI-103408; Miami WIHS (PIs: Margaret Fischl and Lisa Metsch), U01-AI-103397; UNC WIHS (PI: Adaora Adimora) U01-AI-103390; WIHS Data Management and Analysis Center (PIs: Stephen Gange and Elizabeth Golub) U01-AI-042590. The WIHS is funded primarily by the National Institute of Allergy and Infectious Diseases (NIAID), with additional co-funding from the Eunice Kennedy Shriver National Institute of Child Health and Human Development (NICHD), the National Cancer Institute (NCI), the National Institute on Drug Abuse (NIDA), and the National Institute on Mental Health (NIMH). Targeted supplemental funding for specific projects is also provided by the National Institute of Dental and Craniofacial Research (NIDCR), the National Institute on Alcohol Abuse and Alcoholism (NIAAA), the National Institute on Deafness and other Communication Disorders (NIDCD), and the NIH Office of Research on Women's Health. WIHS data collection is also supported by UL1-TR000004 (UCSF CTSA) and UL1-TR000454 (Atlanta CTSA).

The contents of this publication are solely the responsibility of the authors and do not represent the official views of the National Institutes of Health (NIH). The NC Department of Health and Human Services does not take responsibility for the scientific validity or accuracy of methodology, results, statistical analyses, or conclusions presented.

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Key Messages

- Neighbourhood characteristics shape US women's vulnerability to STI infection.
- Relationships between neighbourhood characteristics and having a current STI do not vary by HIV status.
- Improving neighbourhood conditions may enhance women's sexual health.

Table 1
Census tract measures, definition, data source, and year

Measure	Definition	Data Source	Year
Social disorder component			
Percent vacant housing units	Percent vacant residential housing units	United States (US) Department of Housing and Urban Development and US Postal Service	2013
Violent crime rate	Total murder, non-negligent manslaughter, forcible rape, robbery, and aggravated assaults per 1,000 tract residents[1]	Law Enforcement Agencies (i.e., police department, Sheriff's Office)	2013
Sexually transmitted infection (STI) prevalence	Prevalence of newly reported STIs (i.e., chlamydia, gonorrhoea, and primary and secondary syphilis) per 1,000 tract residents aged 15-64[2]	State Department of Health	2013
Percent poverty	Percent residents with annual income below poverty level	American Community Survey (ACS)	2009-2013
Percent unemployment	Percent unemployed residents ≥ 16 years old	ACS	2009-2013
Social disadvantage component			
Percent renter-occupied housing units	Percent renter occupied housing units	ACS	2009-2013
Alcohol outlet density	The number of businesses with a license to sell beverages containing alcohol (e.g., liquor, beer, wine) for off-premise consumption per tract square mile[1,3]	State Licensing Agencies (e.g., Department of Revenue, Alcoholic Beverage Control Commission)	2014

[1]Addresses were obtained from state agencies and geocoded to tracts; addresses within a 100-foot buffer of the tract boundary were included in the tract's calculation.

[2]In Alabama, the number of newly identified STIs was available by ZIP code, but not census tract. ZIP-level STI counts were allocated to tracts based on the proportion of residential population using the 2015 boundaries USPS-HUD ZIP to tract crosswalk file. Twelve ZIP code-census tract combinations were not included in the crosswalk file. For these 15 participants (17% of participants with available census tract data at site), ZIP code STI prevalence was assigned to the participant census tract. We conducted sensitivity analyses, removing these participants from the analytic data set, to explore potential bias introduced by this substitution. The rounded Full Model odds ratio estimate with and without these 15 participants was the same.

[3]In Mississippi, off-premise liquor licensing data were available (liquor can only be purchased at package/liquor stores), but licensing data for sale of beer and wine off-premise were not publically available. As a proxy, we used non-restaurant businesses with permits to sell eggs or milk (e.g., convenience stores, pharmacies) under the oversight of the Mississippi Department of Agriculture and Commerce because these types of businesses would have refrigerated display cases and likely have the capacity to sell beer and wine.

Table 2

Distributions of census tract and participant characteristics among 737 women enrolled in the Women's Interagency HIV Study Southern Sites

Characteristics of participants and census tracts	n (%) or Mean (SD)
Outcomes	
Laboratory confirmed STI	
HIV-infected	58 (10.9)[1]
HIV-uninfected	21 (10.1)
Overall	79 (10.7)
Missing	63 (8.5)
Chlamydia	
HIV-infected	5 (0.9)
HIV-uninfected	4 (1.9)
Overall	9 (1.2)
Missing	32 (4.3)
Gonorrhoea	
HIV-infected	5 (0.9)
HIV-uninfected	1 (0.5)
Overall	6 (0.8)
Missing	37 (5.0)
Trichomoniasis	
HIV-infected	34 (6.4)
HIV-uninfected	12 (5.8)
Overall	46 (6.2)
Missing	15 (2.0)
Syphilis	
HIV-infected	17 (3.2)
HIV-uninfected	4 (1.9)
Overall	21 (2.8)
Missing	19 (2.6)
Census tract-level characteristics	
Social disorder component	
Percent vacant housing units	7.8 (6.3)
Violent crime rate per 1,000 residents	13.5 (13.4)
Missing	44 (6.0)
Percent poverty	29.1 (13.6)

Characteristics of participants and census tracts	**n (%) or Mean (SD)**
Percent unemployed	16.1 (8.0)
STI prevalence per 1,000 residents	19.1 (13.3)
Missing	1 (0.1)
Social disadvantage component	
Percent renter-occupied housing units	51.9 (21.7)
Alcohol outlet density	4.8 (7.6)
Missing	1 (0.1)
Participant-level characteristics	
HIV-infected	530 (71.9)
Age in years	43.7 (9.3)
Marital status	
Married or living as married	244 (34.1)
Missing	3 (0.4)
Ethnicity/Race	
Non-Hispanic African American	614 (83.3)
Annual household income	
$18,000 or less	492 (66.8)
Missing	24 (3.3)
Quality of life index	67.1 (20.5)
Missing	3 (0.4)
Alcohol or illicit substance use	279 (37.9)
Missing	1 (0.2)
Sex exchange	42 (5.7)
Missing	1 (0.1)
Homeless	47 (6.4)
Missing	12 (1.6)
Lifetime STI diagnosis	472 (64.0)
Condomless vaginal or anal sex	274 (42.3)
Missing	4 (0.5)

[1]Participants could test positive for more than one STI. As a result, the total count of STIs by type exceeds the total count of participants with a diagnosed STI.

Table 3

Bivariate and multivariable relationships between census tract characteristics and the odds of having a current STI among women enrolled in the Women's Interagency HIV Study Southern Sites

Characteristics of census tracts and participants	Bivariate OR (95%)	Reduced Model aOR (95%)[1]	Full Model aOR (95%)[1]
Census tract-level characteristics			
Social disorder component[2]	1.18 (0.91, 1.52)	**1.30 (0.99, 1.72)**	1.25 (0.94, 1.66)
Social disadvantage component[3]	1.21 (0.94, 1.54)	**1.34 (0.96, 1.87)**	**1.34 (0.96, 1.86)**
Participant-level characteristics			
HIV-infected	1.22 (0.68, 2.17)	1.34 (0.71, 2.51)	1.51 (0.76, 3.00)
Age in years	1.03 (1.00, 1.06)	1.02 (0.99, 1.05)	1.02 (0.99, 1.05)
Married or living as married	0.76 (0.44, 1.33)	0.99 (0.55, 1.79)	0.95 (0.52, 1.74)
Non-Hispanic African-American	1.51 (0.69, 3.31)	0.88 (0.38, 2.02)	0.87 (0.38, 1.99)
Annual household income of $18,000 or less	1.24 (0.70, 2.19)	--	0.86 (0.46, 1.58)
Quality of Life Index	1.00 (0.99, 1.01)	--	1.00 (0.99, 1.02)
Alcohol or illicit substance use	1.56 (0.93, 2.63)	--	1.46 (0.82, 2.60)
Sex exchange	1.05 (0.36, 3.08)	--	1.12 (0.33, 3.79)
Homeless	1.10 (0.40, 2.94)	--	1.24 (0.43, 3.46)
Lifetime STI diagnosis	1.12 (0.65, 1.92)	--	1.13 (0.61, 2.10)
Condomless vaginal or anal sex	0.92 (0.54, 1.56)	--	1.19 (0.65, 2.20)
Study site (ref=Georgia)			
Alabama	0.28 (0.10, 0.77)	0.17 (0.05, 0.61)	0.17 (0.05, 0.60)
Florida	0.54 (0.24, 1.21)	0.30 (0.10, 0.91)	0.32 (0.10, 0.99)
Mississippi	0.55 (0.27, 1.16)	0.60 (0.27, 1.33)	0.64 (0.29, 1.44)
North Carolina	0.22 (0.10, 0.50)	0.24 (0.10, 0.59)	0.24 (0.10, 0.59)
Model fit			
Random intercept variance (p-value)	--	0.39 (0.24)	0.32 (0.29)
-2LL	--	403.41	400.28
AIC		427.41	438.28
BIC		475.27	514.07

[1] Multivariable modelling was restricted to participants with no missing data for predictor or outcome variables (n=589).

[2]Component generated from principal component analysis (PCA) including tract-level vacant housing units, violent crime rate, STI prevalence, poverty, and unemployment.

[3]Component generated from PCA including tract-level renter-occupied housing and alcohol outlet density.