
Community Characteristics Associated with HIV Risk among Injection Drug Users in the San Francisco Bay Area: A Multilevel Analysis

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ABSTRACT *Community characteristics have been associated with racial and ethnic health disparities for a wide range of ailments and conditions. Previous research has found that rates of AIDS cases among injection drug users (IDUs) vary by community characteristics. However, few studies have examined whether community characteristics are associated with HIV risk behaviors among IDUs. To address this gap in the literature, we examined the associations between census-tract-level community characteristics and injection-related and sex-related HIV risk behaviors among IDUs in the San Francisco Bay Area. Individual HIV risk behaviors were collected from 4,956 IDUs between 1998 and 2002. Using 2000 US census data, we constructed four census-level community measures: percent African American, percent male unemployment, percent of households that receive public assistance, and median household income. All community variables were measured continuously. Multilevel modeling was used to determine if community characteristics were associated with recent (in the last 6 months) receptive and distributive syringe sharing, multiple sex partners, and unprotected sex risk while controlling for potential individual-level confounders. In bivariate analysis, most of the census-tract-level community characteristics were significantly associated with injection-related HIV risk, while no community characteristics were associated with sex-related risk. However, results from multivariate multilevel models indicate that only percent African American in a census tract was associated with receptive [adjusted odds ratio (AOR)=0.93; 95% confidence interval (CI)=0.89, 0.99] and distributive syringe sharing (AOR=0.94; 95% CI=0.92, 0.99), net of individual-level characteristics. Accounting for individual-level factors in the multivariate model in the sex-related risk models revealed a significant inverse relationship between percent African American and propensity to engage in unprotected sex (AOR=0.95; 95% CI=0.92, 0.99); community-level characteristics remained unassociated with multiple sex partners. In this exploratory analysis, percent African American in a census tract was inversely associated with injection-related risk. The census-tract-level community characteristics we examined seem to exert little*

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influence on individual risk among long-term chronic IDUs. More research is needed examining the influence of other community characteristics that were unmeasured in this paper but might be related to sex and drug risk among IDUs such as shooting galleries, crack houses, drug markets, and availability of preventive HIV services.

KEYWORDS *Census data, Drug use, HIV/AIDS, Neighborhood, Risk factors*

INTRODUCTION

The impact of community characteristics on individual risk behaviors and morbidity and mortality has been well documented and is generally regarded as an important explanation for racial and ethnic disparities in health in the USA. In the area of substance abuse, studies have found that prevalent drug use is associated with demographic and socioeconomic characteristics.¹⁻³ Similarly, substance abuse-related diseases such as HIV/AIDS have been found to vary significantly by neighborhood conditions.⁴ Drug injection contributes significantly to HIV transmission, yet few studies have examined the associations between community characteristics and either HIV infection or HIV risk behaviors among injection drug users (IDUs).

At present, neighborhood community characteristics have appeared to be a more convincing explanation for racial and ethnic differences in HIV prevalence among IDUs than their individual risk behaviors.^{5,6} Studies that have attempted to examine more precise associations between community characteristics and HIV infection among IDUs have found that income inequality at the standard metropolitan statistical area-level is associated with higher HIV prevalence among IDUs.⁷⁻⁹ In a different study, residing in census tracts with high male unemployment was found to be associated with prevalent HIV among IDUs (income equality was not considered in this study).¹⁰

In terms of HIV risk behaviors, a few studies have examined the association between community characteristics and injection-related HIV risk among IDUs.¹¹⁻¹³ These studies found significant differences in HIV risk by community,¹³ by self-reported social disorder,¹² and neighborhood socioeconomic advantage.¹¹ However, none of these studies considered census-tract-level variances in community characteristics or HIV risk behaviors among IDUs.

In general, studies examining racial and ethnic disparities in health outcomes consider population-level outcomes. Understanding racial disparities in risk and the contribution of community characteristics to those risks are not generally undertaken among high-risk subgroups. Yet, it is likely that much of the disparities in health risk occur due to differences in outcomes among high-risk subpopulations. For instance, in the alcohol epidemiological literature, it is well established that African Americans have higher alcohol abstinence rates, yet among drinkers, African Americans have higher alcohol-related negative consequences.¹⁴ In this case, one possible explanation for this anomalous finding is that African American drinkers consume in higher quantities, different alcohol beverages, or in more risky environments. Understanding how community characteristics might contribute to risk behaviors in high-risk subgroups could be vital to attaining our goal of reducing racial and ethnic disparities in health.

Community characteristics that have been identified as potentially associated with health risk include residential segregation, poverty, income inequality, high unemployment, and various other indices of social and economic disadvantage. Because little work of this kind has yet to be published related to IDUs, we consider

several common census-tract-level measures of demographic and socioeconomic disadvantage in this study. Our goal is to determine whether these community characteristics are associated with individual-level HIV risk behaviors in a large community sample of street-recruited IDUs in the San Francisco Bay Area.

DATA AND METHODOLOGY

Data for this study come from the Urban Health Study (UHS). The UHS collected serial cross-sectional data on HIV risk and infection from street-recruited IDUs semiannually between 1986 and 2005 in the city of San Francisco and between 1992 and 2002 in the East Bay (Oakland and Richmond, CA). These data have been used to examine a wide range of epidemiological, evaluation, and policy questions over the last 15 years.¹⁵⁻²² Recruitment for this study was accomplished using targeted sampling methods, which we have described elsewhere.^{5,23} Eligibility requirements at initial interview included being 18 years of age or older and having physical evidence of drug injection (track marks or stigmata). All respondents were eligible for subsequent interviews at 6-month intervals once enrolled.

Respondents received HIV testing and pre- and posttest counseling and completed a risk behavior assessment in a face-to-face interview with trained study personnel. Data in this analysis consist of 4,956 IDUs recruited during calendar years 1998 to 2002 in the communities throughout the San Francisco Bay Area.

The interview data provided our outcome variables: receptive syringe sharing, distributive syringe sharing, unprotected sex, and multiple sex partners. All outcome measures are based on behaviors in the 6 months prior to interview. Injection-related HIV risk behaviors were measured as yes or no responses to whether respondents had injected with a syringe that had previously been used by another IDU (receptive syringe sharing) or had given a syringe that they had injected with to another IDU who injected with it (distributive syringe sharing). Sex-related HIV risk behaviors were measured as yes or no responses to items on any unprotected vaginal or anal sex and if respondents indicated having more than one sex partner within the last 6 months. For our injection-related risk behavior models, we restricted our sample to those who had participated in intravenous drug use within the last 6 months. Similarly, for our sex-related HIV risk behavior models, we restrict our sample to those who had engaged in sexual activities within the last 6 months. These restrictions reduced our overall sample to 4,589 and 3,742 for the injection-related and sex-related behavior models, respectively.

We examined a wide range of individual level variables identified by previous research as associated with HIV risk among IDUs. These variables included: gender (male or female), age (continuous), education (less than high school, high school, some college, or college graduate), race (white, African American, Hispanic, or other), self-identified sexual orientation (heterosexual or gay/lesbian/bisexual), homeless (yes or no), main income source (paid work, government assistance, or other), currently has a steady sex partner (yes or no), syringe exchange program use in last 6 months (yes or no), HIV positive status (yes or no, based on study testing), and participation in same gender sex in past 6 months (yes or no).*

*To account for potential differences between cities (San Francisco, Richmond, and Oakland), we also ran models with city dummies at level-1. We found no substantive differences in the results and, subsequently, present results from models without city dummies.

To examine the association between individual HIV risk behaviors and community characteristics, we used respondent-provided data on the street and cross-street closest to where they reside to link individuals to their census tract of residence. Respondents who were homeless were asked to provide the intersection nearest to where they slept last night. These data were used to identify the US census tract where the respondent lived.

One complication to our community measures is that all tract identifications were recorded using year 1990 census tract identification conventions. Because we wanted to rely on community characteristics measured as close to the time of the surveys as possible, we converted the 1990 tract numbers to year 2000 tract numbers. However, there is not a one-to-one overlap across decennial tracts. This is due to tracts either merging or splitting across decennial census surveys. The merging of two 1990 census tracts into one 2000 tract does not pose any analytical problems; on the other hand, the splitting of a 1990 tract into two 2000 tracts does. For example, if the same geographic area was identified as tract A in 1990 and, due to splitting, was identified as tract A1 and tract A2 in 2000, it is unclear whether a person residing in tract A should be mapped to tract A1 or tract A2. Because community characteristics are based on 2000 US census data, a method was required to assign persons to several probable 2000 tracts from a 1990 tract that had been split. To do so, we made the simplifying assumption that the probability of a person residing in a particular 1990 split-off was equal to the proportion of the 1990 tract population that resided in the split-off subarea in 2000. To continue with our example: if 20% of the population in tract A were split off into tract A1 and the other 80% was split off to tract A2, a person was assumed to have a 20% probability of residing in tract A1 and an 80% probability of residing in tract A2. As such, a number in the range of 1 to 100 was randomly drawn. If the number fell between 1 and 20, the individual was assigned to tract A1; if the number fell between 21 and 100, the individual was assigned to tract A2. This strategy was applied to every individual who resided in a 1990 tract that was split in 2000. Approximately a third of the individuals in our sample resided in 1990 tracts that split.

Using data from the 2000 US census, we constructed four census-level community measures: percent African American, percent male unemployment, percent of households that receive public assistance, and median household income. All community contextual variables were measured continuously. While reliance on census tract data limits the community effects that we can explore, census data has the advantage of allowing us to examine differences between relatively small geographic and population areas. Other measures such as police arrest, social capital, or even income inequality are either not readily available at the census tract level (police arrest), not available for the areas covered by our study (social capital), or are not designed to measure differences at the census tract level (i.e., income equality). For example, the Gini Index is designed to measure inequality within a community or country and is not suitable for tract-level comparisons. A similar problem occurs for most measures of residential segregation.

Recognizing that the economic deprivation variables are highly correlated with each other, a composite measure was also examined. We used the average of four deprivation indicators: proportion of 16- to 19-year-old high school dropouts, male unemployment rate, households reporting receipt of public assistance, and female-headed households that have been identified as existing in high prevalence in "underclass" areas as a global measure of neighborhood deprivation.²⁴ However, this measure was not significantly associated with any of our outcome variables and is not reported in the tables.

Because our data have a nested structure (persons residing within tracts), we adopt a hierarchical modeling framework to investigate community-level effects on individual HIV risk-behaviors and HIV infection. The clustering of individuals within tracts may lead to underestimated standard errors by conventional regression methodologies if individuals within tracts are nonindependent. The hierarchical modeling framework accounts for the nonindependence of respondents within tracts and adjusts the estimates of the standard errors accordingly. More specifically, we employ a two-level random intercept logistic regression model, in which we conduct separate analyses to estimate the log-odds (logit) for the probability of an individual to participate in each of the four different risky behaviors of interest: (1) receptive syringe sharing, (2) distributive syringe sharing, (3) engaging in unprotected sex, and (4) having multiple sex partners while simultaneously controlling for individual-level and tract-level characteristics. Therefore, while each of our outcomes is measured at the individual level, the risk factors for each outcome will be measured at both the individual and tract levels, allowing us to investigate the way(s) in which community level factors are independently related to HIV risks and infection and the way(s) in which community level factors structure individual-level HIV risk behaviors and infection.

RESULTS

Table 1 provides a description of individual-level characteristics of our injection-related and sex-related behavior samples. The overall sample (referred to hereafter as the syringe sharing sample) is predominately male (>70%), racial and ethnic minorities (>60%), with low paid employment levels (15%), high homelessness (50%), and moderate HIV infection prevalence (11%). As compared to the sexual risk behavior sample that only includes subjects that reported sexual activity in the last 6 months, few differences were observed. A smaller proportion of the syringe-sharing sample had a steady sex partner (50 vs. 64%) and was African American (47 vs. 51%), while a larger proportion was homeless (50 vs. 47%) and had used a syringe exchange program in the last 6 months (78 vs. 75%). These differences are statistically significant.

Table 2 shows the means, standard deviations, and quartiles of community characteristics by the sample. For the syringe-sharing sample, respondents resided in 294 census tracts in the San Francisco Bay Area. The mean number of respondents in each tract was 15.6 with a standard deviation of 38.75, reflecting the fact that many tracts had few respondents and several with many. The characteristics of the tracts themselves do not reflect significant sociodemographic or socioeconomic disadvantage. As compared to the national averages, the median household income, percent of households receiving public assistance, and percent male unemployment are comparable. However, in the context of the San Francisco Bay Area, these tracts appear worse off. Median household income for the average tract in our sample is 56% of the Bay Area median household income (\$62,024) in 2000. The percent of households receiving public assistance income is triple that of the Bay Area average (9.3 vs. 3.1%), and the male unemployment rate is well over twice as high (11.1 vs. 4.5%). The percent African American is over three times higher in census tracts where respondent reside as opposed to the overall average in the Bay Area (24 vs. 7.5%).

In Tables 3 and 4, we report unadjusted and adjusted odds ratios for receptive and distributive syringe sharing in the 6 months prior to interview. The results of

TABLE 1 Descriptive characteristics of study sample

Characteristic	Syringe sharing sample (N=4,589) Percent	Sexual behavior sample (N=3,742) Percent
Male	71.1	69.5
Mean age (std dev)	43.1 (SD=9.5)	42.6 (SD=9.4)
Race/ethnicity		
White	36.8	32.8
African American	46.9	50.9
Hispanic	8.7	9.0
Other	7.5	7.0
Educational attainment		
High school graduate, general equivalence degree, or more	69.3	69.3
Main source of income		
Paid work	15.4	16.1
Gov't assistance	42.0	41.7
Other	42.7	42.2
Homeless	50.3	46.8
Bisexual/gay or lesbian	13.2	13.0
Had a steady sex partner	50.3	64.4
Used syringe exchange program in last 6 months	77.7	74.7
HIV positive	11.1	10.1
HIV risk behaviors		
Receptive syringe sharing	24.0	25.5
Distributive syringe sharing	25.0	29.9
Engaged in unprotected sex	72.2	71.3
Had multiple sex partners	31.2	41.9
Same-gender sex partner	8.9	11.8

TABLE 2 2000 U.S. Census tract-level community characteristics by syringe sharing sample and sexual behavior sample

Tract characteristics	Mean	25 percentile	50 percentile	75 percentile	SD
Syringe sharing sample					
Number of tracts	294				
Number of persons	15.61	2	4.5	13	38.75
Median HH income (\$1K)	34.83	22.65	29.30	46.75	17.49
% HH receiving public assistance	9.33	5.19	8.71	12.49	6.03
% African American	24.17	6.46	14.84	42.35	23.33
% Male unemployment	11.18	5.64	8.68	17.53	7.54
Sexual behavior sample					
Number of tracts	282				
Number of persons	13.27	1	4	11	31.31
Median HH income (\$1K)	34.66	22.65	28.82	46.54	17.56
% HH receiving public assistance	9.48	5.35	8.76	12.49	6.03
% African American	25.48	6.85	15.17	48.70	23.74
% Male unemployment	11.22	5.65	8.68	17.53	7.46

HH = household

TABLE 3 Unadjusted and adjusted odds ratio of receptive syringe sharing by individual and community factors

Variable	Unadjusted odds ratio (95% confidence interval)	Adjusted odds ratio (95% confidence interval)
Individual effects		
Race/ethnicity		
White	Referent	Referent
African American	0.34 (0.28, 0.42)*	0.47 (0.38, 0.58)*
Hispanic	0.72 (0.56, 0.93)*	0.80 (0.60, 1.05)
Other	0.94 (0.73, 1.21)	1.00 (0.77, 1.29)
Sex		
Male	0.98 (0.86, 1.14)	1.16 (1.00, 1.35)
Age	0.94 (0.94, 0.96)*	0.97 (0.96, 0.97)*
Education level		
Not high school graduate	1.14 (0.97, 1.35)	1.02 (0.85, 1.23)
High school graduate	Referent	Referent
Some college	1.01 (0.83, 1.24)	1.07 (0.86, 1.32)
College graduate	1.02 (0.74, 1.40)	1.05 (0.77, 1.45)
Sexual orientation		
Heterosexual	Referent	Referent
Bisexual/gay or lesbian	1.53 (1.28, 1.83)*	1.22 (0.98, 1.52)
Homelessness		
Yes	1.97 (1.70, 2.30)*	1.69 (1.43, 2.00)*
Main income source		
Paid work	Referent	Referent
Government assistance	0.94 (0.75, 1.18)	1.22 (0.97, 1.54)
Other	1.50 (1.21, 1.86)*	1.45 (1.15, 1.82)*
Steady sex partner		
Yes	1.14 (0.98, 1.33)	1.36 (1.14, 1.63)*
Syringe exchange use, last 6 months		
Yes	0.74 (0.60, 0.92)*	0.67 (0.53, 0.84)*
HIV positive		
Yes	0.77 (0.65, 0.92)*	0.75 (0.61, 0.92)*
Community effects		
Median HH income (\$1K)	1.01 (1.00, 1.02)	1.00 (0.99, 1.00)
% HH receiving public assistance	0.59 (0.49, 0.72)*	0.88 (0.69, 1.13)
% Male unemployment	0.77 (0.64, 0.92)*	1.16 (1.00, 1.34)
% African American	0.83 (0.79, 0.88)*	0.93 (0.89, 0.99)*

All odds ratios for characteristics measured as percentages (e.g., % household receiving public assistance) are for a 10 percentage point change.

HH = household

* $p < 0.05$

the unadjusted models for the receptive and distributive syringe sharing outcomes indicate that both tract-level economic (percent of households receiving public assistance, percent of male unemployed) and racial factors (percent African American) have a statistically significant ($p < 0.05$) and protective relationship against syringe sharing. Only the estimates of median household income were not significant. However, these relationships do not account for the compositional differences across tracts. Once individual-level controls are added and the four community-level characteristics are all included simultaneously, only the effect of

TABLE 4 Unadjusted and adjusted odds ratio of distributive syringe sharing by individual and community factors

Variable	Unadjusted odds ratio (95% confidence interval)	Adjusted odds ratio (95% confidence interval)
Individual effects		
Race/ethnicity		
White	Referent	Referent
African American	0.36 (0.31, 0.43)*	0.49 (0.41, 0.58)*
Hispanic	0.83 (0.65, 1.04)	0.90 (0.72, 1.12)
Other	0.67 (0.51, 0.89)*	0.70 (0.53, 0.92)*
Sex		
Male	0.98 (0.84, 1.14)	1.15 (0.99, 1.33)
Age	0.95 (0.95, 0.96)*	0.97 (0.96, 0.98)*
Education level		
Not high school graduate	1.09 (0.93, 1.28)	1.04 (0.88, 1.22)
High school graduate	Referent	Referent
Some college	0.98 (0.80, 1.19)	1.03 (0.85, 1.27)
College graduate	1.18 (0.87, 1.59)	1.19 (0.87, 1.63)
Sexual orientation		
Heterosexual	Referent	Referent
Bisexual/gay or lesbian	1.30 (1.03, 1.63)*	1.07 (0.84, 1.38)
Homelessness		
Yes	1.91 (1.63, 2.25)*	1.66 (1.40, 1.96)*
Main income source		
Paid work	Referent	Referent
Government assistance	0.74 (0.61, 0.89)*	0.96 (0.80, 1.16)
Other	1.38 (1.14, 1.68)*	1.35 (1.12, 1.64)*
Steady sex partner		
Yes	1.22 (1.08, 1.38)*	1.46 (1.27, 1.68)*
Syringe exchange use, last 6 months		
Yes	0.95 (0.81, 1.13)	0.91 (0.76, 1.08)
HIV positive		
Yes	0.50 (0.39, 0.65)*	0.51 (0.41, 0.65)*
Community effects		
Median HH income (\$1K)	1.01 (1.01, 1.02)*	1.00 (0.99, 1.10)
% HH receiving public assistance	0.67 (0.57, 0.81)*	1.07 (0.82, 1.40)
% Male unemployment	0.78 (0.66, 0.92)*	1.13 (0.94, 1.35)
% African American	0.85 (0.82, 0.89)*	0.94 (0.89, 0.99)*

All odds ratios for characteristics measured as percentages (e.g., % household receiving public assistance) are for a 10 percentage point change.

HH = household

* $p < 0.05$

percent African American in a census tract remained statistically significant. For a 10-percentage-point increase of African Americans in a tract, the odds of receptive syringe sharing decreases by a factor of 0.93 (it decreases by a factor of 0.94 for distributive syringe sharing).

For the unprotected sex model (Table 5), we found that none of the community characteristics were associated with this outcome in bivariate analysis. However, in multivariate analysis, percent African American was significantly associated with lower odds of unprotected sex (adjusted odds ratio=0.95; 95% confidence

TABLE 5 Unadjusted and adjusted odds ratio of unprotected sex by individual and community factors

Variable	Unadjusted odds ratio (95% confidence interval)	Adjusted odds ratio (95% confidence interval)
Individual effects		
Race/ethnicity		
White	Referent	Referent
African American	0.80 (0.70, 0.92)*	0.78 (0.67, 0.92)*
Hispanic	1.07 (0.77, 1.48)	1.00 (0.72, 1.40)
Other	0.98 (0.71, 1.34)	1.05 (0.73, 1.51)
Sex		
Male	0.86 (0.73, 1.02)	1.15 (0.96, 1.39)
Age	0.98 (0.98, 0.99)*	0.98 (0.98, 0.99)*
Education level		
Not high school graduate	1.07 (0.92, 1.25)	1.07 (0.91, 1.27)
High school graduate	Referent	Referent
Some college	0.93 (0.75, 1.14)	0.93 (0.74, 1.16)
College graduate	0.81 (0.50, 1.31)	0.83 (0.51, 1.34)
Sexual orientation		
Heterosexual	Referent	Referent
Bisexual/gay or lesbian	0.75 (0.62, 0.90)*	0.85 (0.59, 1.21)
Homelessness		
Yes	1.10 (0.94, 1.28)	1.22 (1.03, 1.43)*
Main income source		
Paid work	Referent	Referent
Government assistance	0.68 (0.53, 0.87)	0.86 (0.64, 1.16)
Other	0.83 (0.65, 1.05)	0.86 (0.66, 1.11)
Steady sex partner		
Yes	2.56 (2.18, 3.00)*	3.03 (2.48, 3.71)*
Same gender sex partner		
Yes	0.75 (0.60, 0.95)*	0.98 (0.68, 1.41)
Syringe exchange use, last 6 months		
Yes	0.70 (0.58, 0.86)*	0.64 (0.52, 0.79)*
HIV positive		
Yes	0.27 (0.21, 0.36)*	0.28 (0.21, 0.38)*
Community effects		
Median HH income (\$1K)	1.00 (1.00, 1.01)	1.00 (0.99, 1.01)
% HH receiving public assistance	0.96 (0.85, 1.07)	1.18 (1.00, 1.41)
% Male unemployment	0.94 (0.86, 1.02)	0.96 (0.85, 1.09)
% African American	0.97 (0.95, 1.00)	0.95 (0.92, 0.99)*

All odds ratios for characteristics measured as percentages (e.g., % household receiving public assistance) are for a 10 percentage point change.

HH = household

* $p < 0.05$

interval=0.92, 0.99). A 10-percentage-point increase of African Americans in a tract decreases the odds of engaging in unprotected sex by a factor of 0.94. In our model of multiple sex partners (Table 6), we found that none of the community effects were significantly associated with odds of reporting multiple sex partners in either bivariate or multivariate analyses. (Running these analyses including subjects who did not report sexual activity did not change the estimate in any meaningful way.)

TABLE 6 Unadjusted and adjusted odds ratio of multiple sex partners by individual and community factors

Variable	Unadjusted odds ratio (95% confidence interval)	Adjusted odds ratio (95% confidence interval)
Individual effects		
Race/ethnicity		
White	Referent	Referent
African American	0.69 (0.59, 0.80)	1.13 (0.93, 1.37)
Hispanic	0.78 (0.61, 1.01)	1.03 (0.75, 1.42)
Other	1.04 (0.82, 1.31)	1.09 (0.83, 1.44)
Sex		
Male	1.04 (0.88, 1.23)	0.94 (0.80, 1.12)
Age	0.96 (0.96, 0.97)*	0.97 (0.96, 0.98)*
Education level		
Not high school graduate	1.09 (0.94, 1.27)	0.97 (0.81, 1.16)
High school graduate	Referent	Referent
Some college	1.15 (0.98, 1.36)	1.18 (0.96, 1.43)
College graduate	1.45 (1.06, 1.99)*	1.37 (0.94, 2.01)
Sexual orientation		
Heterosexual	Referent	Referent
Bisexual/gay or lesbian	2.67 (2.22, 3.21)*	2.20 (1.79, 2.72)*
Homelessness		
Yes	1.86 (1.58, 2.18)*	1.33 (1.13, 1.57)*
Main income source		
Paid work	Referent	Referent
Government assistance	0.84 (0.67, 1.06)	0.86 (0.68, 1.09)
Other	1.40 (1.15, 1.69)*	1.22 (0.99, 1.51)
Steady sex partner		
Yes	0.26 (0.22, 0.30)*	0.26 (0.23, 0.31)*
Same gender sex partner		
Yes	4.10 (3.23, 5.20)*	3.88 (2.63, 5.73)*
Syringe exchange use, last 6 months		
Yes	0.82 (0.70, 0.95)*	0.83 (0.70, 0.98)*
HIV positive		
Yes	1.14 (0.90, 1.44)	0.92 (0.71, 1.20)
Community effects		
Median HH income (\$1K)	1.00 (1.00, 1.01)	1.00 (0.99, 1.00)
% HH receiving public assistance	0.89 (0.77, 1.01)	1.08 (0.90, 1.31)
% Male unemployment	0.94 (0.82, 1.09)	0.97 (0.85, 1.10)
% African American	0.93 (0.89, 0.96)	0.97 (0.94, 1.01)

All odds ratios for characteristics measured as percentages (e.g., % household receiving public assistance) are for a 10 percentage point change.

HH = household

* $p < 0.05$

Various functional forms (e.g., log [median household income]) and combinations of variables were explored but did not yield significantly different results. Recognizing that the community economic deprivation variables are highly correlated with each other, a composite measure was also examined but was not significantly associated with any of the outcomes.

DISCUSSION

In this sample of highly disadvantaged, urban long-term IDUs, few community-level variables were associated with either sex- or injection-related HIV risk. Our most consistent finding was that the African American percentage in a census tract was associated with a decreased probability of syringe sharing and engaging in unprotected sex, net of neighborhood-level economic characteristics, and individual-level controls. No community level characteristics that we examined were associated with multiple sex partners.

While the finding that higher proportion of African Americans in a census tract was inversely related to HIV risk might seem counterintuitive, the disproportionate impact of HIV/AIDS on African Americans historically may help explain our result. By 1998, HIV/AIDS was understood to be an imminent health threat to African Americans, perhaps increasing motivations to reduce HIV risk in this population. Both national and local studies have found evidence that compared to whites, African Americans are more likely to be tested for HIV^{25–28} and are more likely to use condoms in steady sex partnerships.²⁹ In addition, the higher HIV prevalence among African American IDUs and in African American neighborhoods documented in earlier studies in these communities^{10,30–32} likely contributed to the lower risk behaviors observed here, as IDUs who discover they are HIV infected typically reduce HIV risk behaviors. The combinations of these factors likely contributed to safer drug use and sex norms among populations of IDUs in our samples.

Another possible explanation for lower HIV risk behaviors in census tracts with more African Americans could be that such communities have greater access to HIV prevention services. Over the 25 years of the HIV epidemic, prevention resources have steadily become more focused on the areas and groups with higher HIV prevalence.³³ This general trend may have resulted in greater availability of HIV prevention and drug treatment services in areas where African Americans are more likely to reside.

Lastly, differences in drug preference and attendant sexual risk behaviors might also contribute to this community-level impact. White IDUs in this sample were more likely to use stimulant drugs, specifically methamphetamine. Methamphetamine use has been associated with greater sex-related HIV risk among drug users and heterosexuals.^{34–37}

These results should be considered in relation to a number of limitations of this study. First, because there was some ambiguity in assigning persons residing in 1990 tracts that had been split, random measurement error in tract-level characteristics may have biased the tract level effects towards zero. Second, relying on 2000 measures of tract characteristics for individuals sampled before and after 2000 also increased our tract-level measurement error as tract characteristics may have changed during our study period. Third, our analyses used cross-sectional data. As such, we are relying on a single-point-in-time snapshot of a person's individual and tract level characteristics to explain present-day behavior. However, the social and economic environments experienced in the past may influence present-day behaviors. Cross-sectional data is unable to capture this potential dynamic, and longitudinal data are required to investigate the temporal relationships. Fourth, all individual data on risk are self-reported and may be subject to recall and social desirability biases. However, items used in this study have been shown to have adequate reliability and validity.^{38–40} Fifth, we only considered a limited type of community contextual variables: those available from the US census. Other research has identified a variety of potentially key contextual variables that are

not captured on census forms, including type of drug market and drug scene,^{41,42} perceptual and objective measures of social disorder,^{12,43} social capital, and law enforcement practices, among others.^{44–47} Obtaining such data is difficult. For instance, police arrest data, while routinely available at the county level, would be of little use in a census tract-level analysis. Linking local police and county sheriff data to census tracts across the three counties and numerous cities where study respondents resided would be extremely costly. Sixth, census tracts as a unit of analysis may not adequately capture key ecological factors associated with risk in this population, as has been pointed out elsewhere.⁴⁸ Research that provides more detailed neighborhood analyses and comparisons may be more appropriate for identifying community effects.^{5,10} Lastly, the high proportion of homeless individuals in the sample may impact study findings because the areas where they spend most of their time are likely to change or because community context is less likely to influence their behavior. Analyses of the sample using only housed respondents did not alter the results substantively.

The increasing interest in how social, economic, and physical structure shapes HIV risk among IDUs is vital to preventing the spread of HIV in the USA and elsewhere.⁴⁹ These data contribute to this knowledge base and indicate that simple measures of community context may shed little light on the specific macro and micro features of a neighborhood that contribute to risk among IDUs. That is, more proximal measures of risky drug use and sexual practices such as the presence of prostitutes, shooting galleries, crack houses, and drug markets may be more meaningful in understanding HIV risk behaviors, prevalence, and incidence among drug users in the USA. Similarly, the community-level impacts of various prevention programs should also be explored more thoroughly. More research that considers both risk and protective factors at the community level is warranted.

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