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Economic, Legal, and Social Hardships Associated with HIV Risk among Black Men who have Sex with Men in Six US Cities

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ABSTRACT *We assessed whether economic, legal, and social hardships were associated with human immunodeficiency virus (HIV) risk among a sample of Black men who have sex with men (MSM) and whether associations were moderated by city of residence. The study analyzed baseline and follow-up data from HIV Prevention Trials Network 061 (N = 1553). Binary logistic regression assessed associations between hardships and HIV risk indicators. Multivariate regressions were used to test if city of residence had a moderating effect for hardships and HIV risks. Adjusted analyses showed that Black MSM with recent job loss were more likely to engage in condomless insertive anal intercourse (adjusted odds ratios (AOR) = 1.37, 95 % CI 1.01–1.87) and that those with recent financial crisis were more likely to have had two or more male sexual partners in the past 6 months (AOR = 1.65; 95 % CI 1.18–2.29). Black MSM*

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with recent convictions were more likely to have a sexually transmitted infection at 6 months (AOR = 3.97; 95 % CI 1.58–9.94), while those who were unstably housed were more likely to have a sexually transmitted infection at 12 months (AOR = 1.71; 95 %CI 1.02 = 2.86). There were no city of residence and hardship interaction effects on HIV risks. Hardships are important factors that influence HIV risk for Black MSM. Integrating strategies that address structural factors that influence HIV risk may enhance HIV prevention interventions implementation efforts.

KEYWORDS *HIV, STI, Condom use, Black MSM, Social determinants, Incarceration, Unstable housing, Hardships, HIV prevention, African-American, Sexual risk*

INTRODUCTION

Black men are disproportionately impacted by human immunodeficiency virus (HIV) infections in the USA. The HIV rate among Black men overall is the highest of any racial/ethnic category, with 104 infections per 100,000 men.[1, 2] Men who have sex with men (MSM) account for the majority (51 %) of new HIV infections among Blacks in general and among Black men (72 %) in particular.[3] Between 2007 and 2010 Black MSM, aged 13–24, accounted for 45 % of new HIV infections among Black MSM and the majority (55 %) of new HIV infections among MSM overall.[3] The primary mechanism of HIV transmission for MSM is condomless anal intercourse (CAI). Black MSM's disproportionate risk may be partially attributed to the high HIV prevalence in their sexual networks—thereby increasing their likelihood of exposure to HIV infection.[4, 5] HIV disparities for Black MSM are exacerbated by disproportionate delays in diagnosis and treatment for HIV and other sexually transmitted infections (STIs), which increases duration of infectiousness.[3, 6–8] While CAI is necessary for HIV transmission among MSM, the amplifying roles that hardships (e.g., poverty) and sociopolitical processes (e.g., high levels of incarceration) play in affecting HIV risk have been more recently investigated.[6, 9, 10]

Hardships are mechanisms through which social process inequitably impact the health status of people in marginalized communities.[11] Cities are important geographic contexts to study in relation to hardships and HIV risk since the US HIV epidemic is concentrated in urban areas, and cities are sites where many economic, legal, and social policies are implemented and enforced and local health inequities produced.[12, 13] Geographic context is also not limited to physical location but incorporates perspectives on the ways in which structural level inequities, within those geographic contexts, contribute to the production of HIV risk.[14, 15] The purpose of this study was to test the hypothesis that economic, legal, and social hardships were associated with increased odds of HIV risks in a non-probability sample of Black MSM. We further hypothesized that associations between hardships and HIV risks would be impacted by city of residence.

Indicators of various individual-level hardships, including social (unstable housing), economic (joblessness, poverty), and legal (incarceration) have been linked to elevated HIV risks and other poor health outcomes.[16–21] The confluence of various forms of hardships can structure circumstances that involve high risk for HIV and at the same time limit the perceived options available for risk-reduction.[22, 23] For example, consider a case of a Black MSM who is poor, with limited employability due to a felony conviction, at risk of eviction from his home for non-payment of rent, yet is on parole—which requires that he maintain a residential address. The convergence of these hardships could produce a desperate predicament in which the man is left to choose from a limited set of options to resolve it. One

option may be for him to leverage his ability to trade sex in exchange for cash to support his basic living needs, maintain housing, and avoid violating a condition of his parole.[24–26] Despite extant literature supporting these social and structural influences on risk, scientific gaps remain regarding the ways in which hardships may be associated with HIV risk in Black MSM.

HIV risk is also impacted by where one lives, although there is little consistency in the geographical contexts studied.[10, 27, 28] In a study comparing 40 US counties with the highest ($n = 20$) and lowest ($n = 20$) proportional increases in acquired immunodeficiency syndrome (AIDS) cases between 1981–1990 and 1995–1999, researchers found that counties with the highest increases in AIDS also had the lowest levels of annual earnings, literacy, and educational attainment.[29] Another study conducted in the southern US found that the influence of socioeconomic deprivation on HIV/AIDS incidence was impacted by whether one lived in a rural or urban zip code.[30] There remains a gap in the scientific literature regarding whether city of residence is a marker of factors—like poverty—that affect HIV risk and experiences of economic, legal, and social hardships among Black MSM.

METHODS

Participants and Procedures

We used baseline, 6-, and 12-month follow-up data collected between July 2009 and October 2010 as part of the HIV Prevention Trials Network (HPTN) 061 study.[31, 32] HPTN 061 was a multi-site study to determine the feasibility and acceptability of a multi-component intervention for Black MSM. The study was conducted in Atlanta, Boston, Los Angeles, New York City, San Francisco, and Washington, DC. In each city, a non-probability sample of Black MSM was recruited directly from the community or by sexual network partners. A variety of recruitment methods were used, including community outreach, engagement of key informants and local community-based groups, online advertising, and other online strategies such as outreach in chat rooms and social networking sites. The institutional review boards at participating institutions in the six cities where the study was conducted approved HPTN 061.

Index participants were defined as community-recruited men who were newly identified with HIV infection, previously diagnosed HIV infection and not receiving HIV care, or HIV-uninfected. Men were eligible to enroll if they self-identified as Black, African American, Caribbean or multiethnic Black; were at least 18 years old; reported ≥ 1 episode of unprotected anal intercourse with a man in the past 6 months; and planned to maintain residence in the metropolitan area during the study period. Data used in this analysis included audio computer-assisted self-interviews (ACASI) and laboratory tests for HIV and other STIs.

Measures

HIV Risk Variables

Condomless Insertive and Receptive Anal Intercourse. Two items for condomless sex were derived from self-reported frequencies of insertive and receptive anal intercourse episodes with male partners and reported frequencies of condom use during those episodes. “Condomless insertive anal intercourse” (CIAI) and “condomless receptive anal intercourse” (CRAI) were categorical items measuring

whether—in the 6 months prior to study enrollment—the participant had any episode of insertive or receptive anal intercourse without using a condom.

Two or More Male Sexual Partners. The variable "two or more male sexual partners" was derived from count data generated by participants' recollections of how many of their sexual partners over the past 6 months were male. All participants had to report sexual intercourse with at least one male partner in the past 6 months to qualify for study participation; therefore, we dichotomized the variable for number of male partners into <2 vs ≥ 2 male sexual partners in order to construct a more distinct marker for elevated HIV risk.[31]

Sexually Transmitted Infections. All study participants were screened for *Chlamydia trachomatis* (CT) and *Neisseria gonorrheae* (GC) at baseline and the 6- and 12-month study visits. STI screening for CT and GC was performed using Hologic Gen-Probe Aptima Combo 2. All participants with STI diagnoses received treatment. We used the variables any STI diagnosis at the 6-month study visit and any STI at the 12-month visit as indicators of recent HIV risk behavior. Further details on these measures are reported elsewhere.[31, 32]

Hardship Variables

Economic Hardships. For the item "unemployed," participants' reported whether they were currently engaged in paid employment at the time of study enrollment (0 = not currently working, 1 = current working). For "recent job loss," participants reported whether they experienced a near-term loss of employment. Participants indicated yes or no to whether in the last 6 months they lost a job (e.g., fired, quit, laid off). The item "financial crisis" was a dichotomous measure (yes/no) of whether in the last 6 months participants had major worsening of their financial status or major chronic financial problems (e.g., home foreclosure).

Legal Hardships. For the item "incarceration history," participants indicated a count of the number of overnight incarcerations they experienced in their lifetimes. To correct for outliers, the 152 participants reporting greater than 10 incarcerations were assigned adjusted values of ten incarcerations. The item "recent arrest" assessed participants' yes or no response to the statement "You or your partner were arrested for a serious crime in the past six months." The "recent conviction" item assessed yes or no responses to the statement that in the past six months, "You or your partner were convicted of a crime and went to jail or prison."

Social Hardships. The item "unstable housing" assessed participants' responses (yes or no) to whether they had changed their residence two or more times in the past 6 months. For the item "no health insurance," participants responded yes or no to whether they had health insurance at enrollment. We included health insurance as a social hardship variable since it indicates a limited capacity to access the broadest range of health services.

Demographics Eight demographic variables were also included in this analysis. City of residence reflects the metropolitan area where the study participants were enrolled into the study. Participants attested to living in the area at time of

enrollment as well as their plans to remain in the metropolitan area for the duration of the study. Participants' self-reported age at the time that they enrolled in the study was assessed in years. Income was measured as categorical annual earnings brackets ranging from 1 = less than $5000, 2 = $5000–$9999 then measured at $10,000 increments up to 10 = ≥$80,000. To assess education, participants were asked to indicate their highest level of educational attainment from a list of six categories ranging from "less than eighth grade" to "master's degree or other advanced degree." Baseline HIV infection status was assessed using a serum HIV antibody test. We used this demographic item to describe the HIV serostatus of the sample. Additional details about this measure are reported elsewhere.[31, 32] We also included baseline prevalence of CT and GC in the sample. Recruitment type was a categorical measure of whether a study participant was either directly recruited in the community by research staff or referred to the study from an enrolled participant.

Statistical Analysis

Statistical analyses were performed using SAS 9.3. Our overall approach to this analysis was to first describe the distribution of hardship indicators and HIV risks in the samples of MSM across the six cities. Chi-square analysis was then used to compare whether there were cross-city differences in the proportions of HIV risks among MSM within each specific hardship indicator. Post hoc analysis using the Marascuilo procedure was performed to test the differences of all pairs of proportions for the HIV risks that had significantly different proportions across cities.[33] Binary logistic regression models were then constructed to examine how the economic, legal, and social hardship indicators were associated with HIV risk. We excluded HIV-infected participants ($n = 344$) from regression analyses on CRAI and CIAI outcomes in order to minimize misinterpretation of unprotected sex outcome data that could be introduced if HIV-infected MSM were employing sero-sorting strategies as harm reduction. We adjusted the regressions for age, city of residence, and recruitment type and reported adjusted odds ratios (AOR) with 95 % confidence intervals for each hardship. Finally, we investigated interactions between hardships and city of residence to determine whether hardships had a different effect on HIV risks in different cities. To reduce the number of regression models, we recoded the indicators in each hardship category into single dichotomous (yes or no) variables. The newly constructed variables were any economic hardship (AEH), any legal hardship (ALH), and any social hardship (ASH). In order to test for interactions between hardships and "city of residence," we created five class variables for city of residence, with New York City designated as the reference variable. We used chi-square to test for significant interaction between the newly constructed hardship variables and the city of residence.

RESULTS

A cross-city summary of demographics, hardship indicators, and HIV risks is presented in Table 1. The mean age was 37.7 years (SD = 11.5). Thirty-six percent earned less than $10,000 annually. Overall, 16.7 % of the sample had less than a high school education. The prevalence of HIV at baseline was 21.7 %. Most participants were unemployed (57 %), with one third (32 %) experiencing the loss of a job within the past 6 months. A high percentage of the sample (39 %) experienced a major financial crisis within the past 6 months. The prevalence of unstable housing was 22 %. Thirty-eight percent did not have health insurance

TABLE 1 Summary of demographics and hardship variables by city

Characteristic (%)	Atlanta ($n=288$)	Boston ($n=235$)	Los Angeles ($n=279$)	New York City ($n=306$)	San Francisco ($n=195$)	Washington DC ($n=219$)
Demographics						
Age[a]	38.8(11.7)	39.1(11.9)	37.5(11.8)	37.7(10.9)	41.5(11.3)	31.6(10.9)
Annual income <$10,000	43.2	41.9	54.4	33.8	28.4	19.8
<High school education	16.4	17.3	17.7	25.5	12.2	11.9
HIV infection	21.2	18.1	32.3	23.3	12.3	22.7
Chlamydia infection	4.3	1.3	2.9	1.8	2.4	10.4
Gonorrhea infection	7.5	2.1	9.0	v3.9	3.0	14.4
Community recruited	82.9	95.8	78.1	86.8	99.0	98.2
Economic hardship indicators						
Unemployed	70.9	71.3	76.3	74.8	73.0	43.6
Recent job loss	36	25	30	33	39	31
Financial crisis	41.1	45.5	38.2	34.2	41.8	33.8
Legal hardship indicators						
Incarceration history[a]	3.3 (4)	3.1 (3)	3.6 (4)	2.9 (4)	3.3 (4)	1.1 (2)
Recent arrest	10.0	16.6	9.6	5.7	12.2	5.1
Recent conviction	12.8	17.4	9.4	9.4	13.9	9.4
Social hardship indicators						
Unstable housing	24.8	31.4	22.4	21.2	19.1	11.2
No health insurance	76.0	8.0	63.3	24.2	26.0	30.0
HIV risk indicators						
CIAI	75.5	69.4	71.0	79.5	76.7	72.9
CRAI	46.3	44.2	55.7	49.5	48.8	61.1
≥2 male sex partners	81.5	79.7	82.3	86.5	78.9	80.3
Any STI 6 months	5.6	2.0	7.7	6.8	3.8	14.8
Any STI 12 months	12.3	8.3	17.0	8.0	6.9	26.2

CIAI condomless insertive anal intercourse, *CRAI* condomless receptive anal intercourse, *STI* sexually transmitted infection

[a]Mean (SD). $N=1553$

coverage. Recent legal hardships were the least prevalent in comparison to economic and social hardships.[20] Overall, 13 % of the sample had recent convictions, with slightly less (8.4 %) having been recently arrested. The men spent an average of three nights incarcerated in their lifetime. Three fourths of the sample reported CIAI (74.2 %), while one half reported CRAI (50.9 %). Most participants (81.5 %) reported ≥2 male sex partners in the past 6 months. The percentage of the overall sample with any STI at 6 months was 6.8 %, which is equivalent to the prevalence of CT (6.5 %) and GC (6.7 %) at baseline. The percentage with any STI increased nearly twofold to 13.12 % at 12 months.

Comparisons of HIV Risks by Hardship and City of Residence

Table 2 shows the proportion of men within a specific hardship category, who had the indicated HIV risk. For example, the first row and first column of the table shows that 75.3 % of unemployed men in the Atlanta reported CIAI, while 59.7 % of unemployed men in Boston reported CIAI. Chi-square results indicated that the proportions of some reported HIV risks were not equal across the six cities for MSM with certain economic (i.e., recent job loss, financial crisis), legal (i.e., incarceration, recent conviction), and social (i.e., unstable housing) hardships. For MSM with recent job loss, there were cross-city differences in the proportions of any STI at 6 months ($\chi^2 = 12.75$, $n = 317$, $p < .05$) and any STI at 12 months ($\chi^2 = 18.3$, $n = 288$, $p < .02$). For MSM with a financial crisis, the proportions of CRAI ($\chi^2 = 11.62$, $n = 581$, $p < .05$), any STI at 6 months ($\chi^2 = 12.8$, $n = 380$, $p < .05$) and any STI at 12 months ($\chi^2 = 19.5$, $n = 354$, $p < .01$) also differed across cities. For those with incarceration histories, cross-city differences were found for proportions of CRAI ($\chi^2 = 12.01$, $n = 902$, $p < .04$) and any STI at 12 months ($\chi^2 = 15.8$, $n = 522$, $p < .01$). Among those with recent conviction, proportions differed across cities for ≥2 male sexual partners ($\chi^2 = 11.35$, $n = 167$, $p < .05$) and any STI diagnosis at 12 months ($\chi^2 = 15.7$, $n = 90$, $p < .01$). In the social hardship category, MSM with unstable housing differed across cities on the proportion of CIAI ($\chi^2 = 13.28$, $n = 322$, $p < .03$) and any STI at 6 ($\chi^2 = 12.49$, $n = 201$, $p < .03$) and 12 ($\chi^2 = 13.68$, $n = 186$, $p < .02$) months. Although the null hypothesis of equality of proportions across cities was rejected for specific HIV risks among MSM with the abovementioned economic, legal, and social hardships, results of the post hoc analysis using the Marascuilo pairwise procedure only showed significant cross-city differences in HIV risk for MSM with recent job loss and financial crisis (Table 2). There is not sufficient data to conclude that there are particular cross-city differences in HIV risks among the other hardship indicators that had statistically significant chi-squares.

Multivariate and Logistic Regressions

Results of the adjusted binary logistic regressions of hardships on HIV risks are displayed in Table 3. Recent job loss was associated with increased odds of CIAI. Incarceration history was associated with decreased odds of CRAI. Those with a recent financial crisis had increased odds of ≥2 male sex partners, while those with recent conviction and those without health insurance had decreased odds of sex ≥2 male sex partners. Recent conviction was also associated with having an STI diagnosis at the 6-month study visit. Those with unstable housing had increased odds of being diagnosed with an STI at the 12-month study visit.

TABLE 2 Distribution of HIV risks by hardships and city of residence

HIV risks by hardship indicator[a]	City of residence						
	Atlanta [1] ($n=288$)	Boston [2] ($n=235$)	Los Angeles [3] ($n=279$)	New York [4] ($n=306$)	San Francisco [5] ($n=195$)	Washington [6] ($n=212$)	Post hoc
Unemployed (%)							
CIAI	75.3	59.7	77.6	76.9	76.4	74.4	
CRAI	51.2	43.3	53.7	53.9	56.6	60.0	
≥2 male sex partners	87.1	70.1	80.6	80.8	78.2	80.2	
Any STI 6 months	5.17	2.17	6.4	14.3	7.9	15.1	
Any STI 12 months	7.1	14.6	14.6	6.5	10.0	21.2	
Recent job loss (%)							
CIAI	77.4	69.9	69.6	82.6	79.0	82.0	
CRAI	46.5	46.2	53.3	45.7	38.6	62.3	
≥2 male sex partners	79.6	80.0	87.0	86.9	84.5	86.9	
Any STI 6 months*	6.6	2.5	4.8	4.4	4.8	19.1	NS
Any STI 12 months*	10.7	8.8	18.3	4.6	13.5	33.3	6>4
Financial crisis (%)							
CIAI	77.6	73.1	76.4	83.5	76.8	67.6	
CRAI*	44.4	44.1	52.8	50.5	45.7	66.2	6>1; 6>2
≥2 male sex partners	82.8	83.8	86.0	88.4	85.4	82.4	
Any STI 6 months*	5.5	1.5	7.0	7.4	5.1	18.6	6>2
Any STI 12 months**	10.3	7.0	18.6	3.1	10.7	28.9	3>4; 6>4
Incarceration history (%)							
CIAI	79.3	70.8	72.2	78.6	75.4	71.9	
CRAI*	44.4	37.5	54.9	50.3	48.1	51.6	NS
≥2 male sex partners	82.0	79.4	83.8	86.8	76.2	82.8	
Any STI 6 months	3.6	2.2	8.5	4.6	3.5	14.8	
Any STI 12 months**	13.3	7.2	18.1	9.0	5.9	28.0	NS
Recent arrest (%)							
CIAI	71.4	65.8	63.0	82.4	69.6	72.7	
CRAI	44.4	47.2	55.6	64.7	63.6	44.5	

CRAI	44.4	47.2	55.6	64.7	63.6	44.5	
≥2 male sex partners	78.6	73.7	85.2	88.2	79.2	81.2	
Any STI 6 months	6.3	4.4	6.3	7.7	13.3	14.3	
Any STI 12 months	16.7	5.6	27.8	0	15.4	40.0	
Recent conviction (%)							
CIAI	68.6	70.0	69.3	85.2	63.0	70.0	
CRAI	50.0	46.2	65.4	55.6	59.3	50.0	
≥2 male sex partners*	72.2	62.5	92.3	89.3	70.4	80.0	NS
Any STI 6 months	12.5	3.9	14.3	9.5	12.5	33.3	
Any STI 12 months**	14.3	5.6	28.6	5.0	15.4	75.0	NS
Unstable housing (%)							
CIAI*	73.5	60.6	73.4	85.5	77.8	58.3	
CRAI	50.8	42.0	60.1	53.2	44.4	66.7	
≥2 male sex partners	76.8	76.1	85.3	90.5	81.1	87.5	
Any STI 6 months*	5.0	2.3	2.7	4.8	0.0	23.1	NS
Any STI 12 months*	21.6	9.8	19.4	9.5	8.7	57.1	NS
No health insurance (%)							
CIAI	74.2	57.9	74.6	81.3	77.4	76.6	
CRAI	45.0	47.4	54.2	45.3	48.1	64.1	
≥2 male sex partners	82.9	94.7	86.0	90.7	71.7	83.1	
Any STI 6 months	5.7	0.0	7.5	5.9	3.0	15.0	
Any STI 12 months	11.3	12.5	15.1	12.8	3.5	27.8	

Figures represent percentages of "yes" responses. The numbers in square brackets in column heads refer to the numbers used for illustrating significant difference in the last column "Post hoc"

NS=not significant. CIAI=condomless insertive anal intercourse; CRAI=condomless receptive anal intercourse; STI=sexually transmitted infection

*$p<.05$; **$p<.01$

[a]HIV risks dichotomized

TABLE 3 Summary of adjusted binary logistic regression analysis predicting HIV risk indicators

	CIAI ($n=1219$)	CRAI ($n=1219$)	≥2 male sex partners ($N=1553$)	Any STI 6 months ($N=1553$)	Any STI 12 months ($N=1553$)
Hardship indicators	AOR (95 % CI)	AOR (95 % CI)	AOR (95 % CI)	AOR (95 % CI)	AOR (95 % CI)
Economic					
Unemployed	0.94 (.71, 1.23)	1.07 (.85, 1.37)	0.79 (.58, 1.07)	1.51 (.82, 2.75)	0.82 (.51, 1.33)
Recent job loss	1.37 (1.01, 1.87)**	0.79 (.61, 1.03)	1.14 (.80, 1.62)	0.80 (.41, 1.57)	1.21 (.72, 2.02)
Financial crisis	1.30 (.98, 1.73)	0.96 (.75, 1.22)	1.65 (1.18, 2.29)**	1.16 (.62, 2.17)	0.85 (.52, 1.37)
Legal					
Incarceration history	1.15 (.89, 1.50)	0.73 (.58, .91)*	1.02 (.76, 1.38)	0.61 (.32, 1.15)	0.98 (.61, 1.58)
Recent arrest	0.91 (.55, 1.52)	1.22 (.77, 1.94)	1.08 (.60, 1.93)	0.94 (.31, 2.84)	1.11 (.48, 2.57)
Recent conviction	0.82 (.51, 1.32)	1.18 (.77, 1.81)	0.56 (.33, .93)**	3.97 (1.58, 9.94)*	1.39 (.63, 3.06)
Social					
Unstable housing	0.87 (.64, 1.19)	1.15 (.87, 1.51)	0.93 (.65, 1.34)	0.60 (.27, 1.34)	1.71 (1.02, 2.86)**
No health insurance	0.92 (.69, 1.23)	1.07 (.83, 1.38)	0.66 (.47, .93)**	0.87 (.46, 1.66)	1.08 (.65, 1.79)

CIAI condomless insertive anal intercourse, *CRAI* condomless receptive anal intercourse, *STI* sexually transmitted infection
*$p<.05$; **$p<.01$

Tables 4, 5 and 6 display the results of the multivariate regressions and interactions for city of residence and any economic hardship (AEH; Table 4), any legal hardship (ALH; Table 5), and any social hardship (ASH; Table 6). There were no significant interactions between any of the hardships (AEH, ALH, and ASH) and city of residence on HIV risks. Controlling for the other predictors in the model, having any economic hardship was not associated with any HIV risks. Black MSM residing in Boston were less likely to report CRAI compared to those in New York City, while Black MSM in San Francisco were less likely than those in New York City to be diagnosed with STI at the 12-month study visit. Compared to New York City, Black MSM residing in Washington DC were more likely to have had STI diagnoses at the 6- and 12-month study visits. Controlling for all other predictors, having ALH was associated with decreased CRAI. There were no associations between ALH and other HIV risks. Black MSM in Boston were more likely to be diagnosed with an STI at the 6-month study visit, compared to Black MSM residing in New York City. Black MSM residing in Washington DC were more likely to report CRAI and more likely to have had STI diagnoses at 6- and 12-month study visits than those residing in New York City. Controlling for the other predictors in the model, ASH was not associated with any HIV risks. Men in Boston were less likely to report CIAI and CRAI and were less likely to be diagnosed with an STI at the 6-month study visit compared to Black MSM residing in New York City. Black MSM residing in San Francisco were less likely to be diagnosed with an STI at the 12-month study visit. As in the previous two models, Black MSM residing in Washington DC were more likely to report CRAI and more likely to have had STI diagnoses at 6- and 12-month study visits.

DISCUSSION

In this study, the hypothesis that economic, legal, and social hardships were associated with increased odds of HIV risks was tested in a non-probability sample of Black MSM from six US cities. We further tested an additional hypothesis that the association between hardships and HIV risk were moderated by city of residence. The findings from this study partially support our hypothesis that hardships were associated with HIV risk. Although the prevalence of hardships was high in the overall sample, only four hardships were associated with increased HIV risk. Recent job loss was associated with increased odds of CIAI. Financial crisis was associated with increased odds of having ≥2 male sex partners. Recent conviction was associated with increased odds of STI diagnosis at 6 months. Those with unstable housing had increased odds of any STI at 12 months. It is documented in the literature that incarceration among unstably housed men is associated with increased odds of trading sex for money.[34] It is also plausible that economic deprivation, that often characterizes post-incarceration reintegration, limits men's housing options and thus leads them to live in areas of high STI prevalence—increasing their likelihood of sexual exposure to networks embedded within those areas.[35, 36] There is also evidence that incarceration disrupts stability in men's sexual partnerships.[37–39] One potential consequence of this disruption is an increase in casual sexual partnerships and concomitant increases in the likelihood of exposure to STIs. This contention is consistent with data indicating that recent incarceration among men is associated with multiple partnerships (adjusted prevalence ratio: 1.66, 95 % CI 1.43–1.93) and unprotected sex (APR 1.99, 95 % CI 1.45–2.72).[40] Financial crisis was associated with increased odds of ≥2 male sex

TABLE 4 Interaction effects coefficients from binary regression of city of residence and any economic hardship on HIV risks

	HIV risks									
	CIAI		CRAI		≥2 male sex partners		Any STI 6 months		Any STI 12 months	
Variables	*B*	SE	*B*	SE	*B*	SE	*B*	SE	*B*	SE
Constant	1.03*	0.06	0.05	0.06	1.48*	0.07	−2.83*	0.18	−1.93*	0.12
Any economic hardship (AEH)	0.09	0.06	−0.05	0.06	0.07	0.07	0.01	0.18	−0.23	0.12
City of residence										
Atlanta	0.08	0.14	−0.20	0.12	−0.04	0.15	−0.04	0.38	0.09	0.23
Boston	0.15	0.14	−0.30**	0.13	−0.08	0.16	−1.01	0.54	−0.42	0.30
Los Angeles	−0.18	0.13	0.21	0.12	0.03	0.15	0.48	0.31	0.41	0.22
San Francisco	0.10	0.15	−0.02	0.14	−0.21	0.16	−0.55	0.50	−0.80**	0.36
Washington DC	−0.17	0.16	0.37	0.15	−0.11	0.18	1.18*	0.29	1.14*	0.24
Interactions										
AEH × Atlanta	−0.06	0.14	0.06	0.12	0.08	0.15	0.23	0.05	−0.19	0.23
AEH × Boston	−0.25	0.14	0.10	0.13	−0.14	0.16	−0.11	0.54	0.08	0.30
AEH × Los Angeles	0.14	0.13	−0.06	0.12	0.18	0.15	−0.53	0.31	0.04	0.22
AEH × San Francisco	0.12	0.15	−0.19	0.14	0.10	0.16	0.28	0.50	0.48	0.36
AEH × Washington DC	0.14	0.16	0.12	0.15	−0.02	0.18	−0.18	0.29	−0.16	0.24

CIAI condomless insertive anal intercourse, *CRAI* condomless receptive anal intercourse, *STI* sexually transmitted infection, *B* unstandardized coefficient beta, *SE* standard error
*$p<.05$; **$p<.01$

TABLE 5 Interaction effects coefficients from binary regression of city of residence and any legal hardship on HIV risk indicators

	HIV risks									
	CIAI		CRAI		≥2 male sex partners		Any STI 6 months		Any STI 12 months	
Variables	*B*	SE	*B*	SE	*B*	SE	*B*	SE	*B*	SE
Constant	1.04**	0.06	0.06	0.06	1.51*	0.07	−2.78*	0.17	−1.99*	0.12
Any legal hardship (ALH)	0.05	0.06	−0.14**	0.06	−0.01	0.07	−0.08	0.17	0.00	0.12
City of residence										
Atlanta	0.01	0.13	−0.16	0.12	−0.03	0.15	0.06	0.33	−0.01	0.26
Boston	−0.27	0.14	−0.16	0.13	−0.07	0.17	1.08**	0.53	−0.34	0.29
Los Angeles	−0.20	0.13	0.18	0.12	−0.03	0.15	0.10	0.37	0.32	0.24
San Francisco	0.10	0.15	−0.06	0.14	−0.14	0.17	−0.40	0.42	−0.55	0.31
Washington DC	−0.17	0.16	0.30**	0.13	0.07	0.17	1.16*	0.28	1.06*	0.22
Interactions										
ALH × Atlanta	0.17	0.13	0.01	0.12	0.00	0.15	−0.31	0.33	0.95	0.25
ALH × Boston	0.07	0.14	−0.20	0.13	−0.15	0.17	0.04	0.53	−0.30	0.29
ALH × Los Angeles	0.10	0.13	0.11	0.12	0.15	0.15	0.24	0.46	0.17	0.24
ALH × San Francisco	−0.12	0.16	−0.12	0.14	−0.13	0.17	−0.12	0.42	−0.27	0.31
ALH × Washington DC	−0.08	0.15	−0.11	0.13	0.10	0.17	0.32	0.28	0.19	0.22

CIAI condomless insertive anal intercourse, *CRAI* condomless receptive anal intercourse, *STI* sexually transmitted infection, *B* unstandardized coefficient beta, *SE* standard error
*$p<.05$; **$p<.01$

TABLE 6 Interaction effects coefficients from binary regression of city of residence and any social hardship on HIV risk indicators

	HIV Risks									
	CIAI		CRAI		≥2 male sex partners		Any STI 6 months		Any STI 12 months	
Variables	*B*	SE	*B*	SE	*B*	SE	*B*	SE	*B*	SE
Constant	1.07*	0.07	0.05	0.06	1.48*	0.07	−2.82*	0.18	−1.94*	0.12
Any social hardship (ASH)	−0.02	0.70	−0.03	0.60	0.10	0.07	−0.16	0.18	0.07	0.12
City of residence										
Atlanta	0.15	0.16	−0.11	0.14	−0.09	0.17	0.06	0.38	0.13	0.26
Boston	−0.32**	0.14	−0.29**	0.13	−0.12	0.16	−1.06**	0.54	−0.40	0.28
Los Angeles	−0.21	0.13	0.17	0.12	−0.02	0.15	0.42	0.32	0.43	0.28
San Francisco	0.12	0.15	0.13	0.13	−0.18	0.16	−0.60	0.50	−0.67**	0.32
Washington DC	−0.08	0.14	0.44*	0.13	−0.04	0.16	1.13*	0.27	0.99*	0.21
Interactions										
ASH × Atlanta	−0.12	0.16	−0.11	0.14	0.04	0.17	0.04	0.38	−0.32	0.26
ASH × Boston	−0.23	0.14	0.01	0.13	−0.13	0.16	0.15	0.54	0.18	0.28
ASH × Los Angeles	0.13	0.13	0.06	0.12	0.13	0.15	−0.02	0.32	−0.23	0.23
ASH × San Francisco	0.02	0.15	−0.10	0.13	−0.20	0.16	−0.28	0.50	−0.09	0.32
ASH × Washington DC	0.02	0.14	0.17	0.13	0.03	0.16	0.39	0.27	0.23	0.21

CIAI condomless insertive anal intercourse, *CRAI* condomless receptive anal intercourse, *B* unstandardized coefficient beta, *SE* standard error
*$p<.05$; **$p<.01$

partners. These results were expected and are consistent with a recent large study of Black and Latino MSM in which researchers found that financial hardship was associated with condomless anal intercourse with sero-discordant or sero-unknown partners.[41]

Several hardships were associated with HIV risk but in the direction that was not anticipated. Incarceration history was associated with decreased likelihood of CRAI, and recent conviction was associated with decreased likelihood of having ≥2 male sex partners. These findings could be a reflection of increased access to HIV prevention programs that were designed to address the high prevalence of HIV in correctional settings. Some MSM may make informed decisions about managing their risk when they are in situations where they have high probability of exposure to HIV. For example, while sero-positioning (e.g., assuming the role of the insertive versus receptive sexual partner) is not an evidence-based risk reduction strategy, it can be a harm reduction option that Black MSM employ in some situations.

The results did not support our second hypothesis that the city of residence moderated the associations between hardships and HIV risks. There were no significant interactions between the cities of residence and any hardship categories. Because the samples of Black MSM in each city were not probability-based and were recruited through site-specific approaches, some of the cross-city variance might have been obfuscated. All of the cities in the study had large populations (all the metro areas were greater than 2 million residents); thus, it is possible that the more localized effects of living in neighborhoods (e.g., Harlem versus Chelsea) were missed. The chi-square analyses indicated some significant cross-city differences in proportions of HIV risks for MSM with certain hardship indicators; however, those results do not support rejecting the null hypothesis that city has no effect on associations between hardships and HIV risk. Nonetheless, there are a number of recent studies that provide supporting evidence that geographic patterns of risk may be indicative of underlying social policies and political processes that differentially impact the health of communities, including HIV risk.[6, 7, 42, 43]

We note a number of limitations in our present study. The analyses were limited to variables in the existing HPTN 061 dataset, and not the full range of relevant variables. We used individual level variables as indicators for hardships, when group or area level variables might have been more informative. Future studies should include measures that combine individual and area level (e.g., census tract, zip code, neighborhood, city) measures since multi-level models have been shown to be better predictors of associations between hardships and health.[44] We used dichotomized predictor and outcome variables in our analysis, which likely reduced sensitivity in our ability to detect associations between hardships and HIV risks. The failure to detect associations between most of the hardships and HIV risks may reflect the need for additional research focused on improving concept measurement. It is also possible that this sample may not have included cities with enough differences to see the hypothesized effects. The six cities included in this analysis were not selected based on any economic, legal, or social characteristics of the city themselves, but were selected for the parent study because they were cities where clinical research sites were located that had sufficient capacity to implement the HPTN 061 research protocol. A different sample of cities might have yielded more city-specific findings. The data were collected via self-report and thus are vulnerable to social desirability. Our use of ACASI to collect these data was an attempt to reduce social desirability. We were unable to eliminate sampling bias as a threat to the validity of our finding that there were cross-city differences observed in HIV risks. The findings should be

considered with these limitations in mind. Despite the limitations, the findings contribute to an emerging evidence base on the scientific understandings of hardships as determinants of HIV risk for Black MSM.

Economic, legal, and social hardships are recognized as root causes of health inequities.[12, 45–47] Further research is needed to better understand how hardship conditions affect HIV risk for Black MSM, including exploring intersections between measures of various types and levels of hardships. Future research can build on these results by exploring whether individual-level hardships interact with area-level hardships to predict HIV risk in Black MSM and what is the impact of geo-political location on these associations. Hardships are social issues that impact HIV and require public health scientists to broaden their current focus on surveillance and behavior modification to include policy interventions aimed at reducing social inequities that contribute to the production of HIV risk.[48–50]

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