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Incarceration and Sexual Risk Behavior and Incident STI/HIV in HPTN 061: Differences by Study City and among Black Sexual Minority Men who have Sex with Men, Black Sexual Minority Men who have Sex with Men and Women, and Black Transgender Women

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Abstract

Background: Black sexual minority men (BSMM) and Black transgender women face disproportionate risk of incarceration and STI/HIV, yet research on the longitudinal association between incarceration and STI/HIV risk in these groups is limited.

Methods: We used data from the HIV Prevention Trials Network (HPTN) 061 study conducted among BSMM and Black transgender women in Atlanta, Boston, Los Angeles, New York City, San Francisco, and Washington D.C., restricting analyses to those who returned for the six-month

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follow-up visit when recent incarceration was measured (N=1169). Using inverse probability of treatment weighting we measured associations between incarceration and next six-month multiple partnerships; selling or buying sex; condomless anal intercourse; and incident chlamydia, gonorrhea, syphilis, and HIV. We explored differences by study city, and among BSMM who had sex with men only, BSMM who had sex with men and women, and Black transgender women.

Results: Approximately 14% reported past six-month incarceration. Incarceration was associated with next six-month selling sex (adjusted risk ratio (ARR): 1.80, 95% confidence interval (CI): 1.12, 2.87) in the overall sample and multiple partnerships among BSMM who had sex with men and women (ARR: 1.34, 95% CI: 1.10, 1.63) and transgender women (ARR: 1.77, 95% CI: 1.22, 2.57). There evidence to suggest incarceration may predict gonorrhea (ARR: 2.35, 95% CI: 0.95, 5.77), with particularly strong associations observed in Los Angeles (ARR: 6.48, 95% CI: 1.48, 28.38).

Conclusions: Incarceration may increase STI/HIV risk among BSMM and Black transgender women. Additional mixed methods research is needed to validate associations and understand pathways.

SUMMARY

Using data from the HIV Prevention Trials Network 061 study, we document the longitudinal relationship between incarceration and sexual risk-taking and infection among Black sexual minority men and Black transgender women.

Keywords

Black sexual minority men; Transgender women; Incarceration; multiple partnerships; Sexually Transmitted Infections (STI); gonorrhea

INTRODUCTION

Black sexual minority men (BSMM) are disproportionately impacted by sexually transmitted infection including HIV (STI/HIV) in the United States.[1] BSMM, who have a 50% chance of acquiring HIV in their lifetime, account for 13% of MSM overall yet 30% of those living with HIV.[2,3] BSMM also experience disproportionate risk of other STI, a key HIV co-factor,[4,5] compared with their white counterparts.[3,6] Multiple socio-structural factors contribute to this disparity in rates of STI/HIV, including stigma and discrimination based on sexual orientation and race[7] and resulting social isolation and low social support. These factors, along with poverty that differentially impact Black people, drive mental/drug disorders, sexual risk behaviors, and in turn STI/HIV.[1,8]

Criminal justice involvement is another prevalent yet understudied structural driver of adverse health that also may contribute to increased STI/HIV risk among BSMM. Members of our research group documented high levels of incarceration among BSMM who participated in the HIV Prevention Trials Network 061 Study (HPTN 061).[8] Sixty percent (60%) had ever been incarcerated and one-quarter were incarcerated in the past 12 months,[1,8] with new incarcerations disproportionately affecting those with lower education and income, higher levels of perceived racism, and a prior incarceration history.[1]

Studies conducted in population-based samples have suggested incarceration—through disrupting social and sexual networks and exacerbating poverty and housing instability—amplifies post-release psychiatric risk, self-medication with substances and sexual risk behavior, and in turn STI/HIV acquisition.[1,6,8] Among BSMM there likewise is evidence to support the potential importance of incarceration as a determinant of STI/HIV risk,[6,9–11] where a history of incarceration is associated with sex trade[6] and condomless sex with multiple and casual partners. Incarceration, including for BSMM, may contribute to STI by disrupting sexual networks, leading to increased levels of condomless sexual partnership exchange and/or increasing links between high- and low-risk individuals, resulting in increasing levels of HIV and STI-discordant partnerships (i.e., between STI positive and negative partners).[11] Further, in BSMM, incarceration is highly associated with substance use,[12] and a strong driver of sex risk and STI. However, research on incarceration in the STI/HIV risk of BSMM is not conclusive; with some studies indicating that incarceration is not associated with multiple partnerships[10,13] or condomless sex among BSMM,[10,14,15] which are key determinants of STI/HIV transmission.[6,10,13]

Extant research on the link between incarceration and STI/HIV risk among BSMM has been limited by reliance on cross-sectional designs and somewhat limited control of confounding factors, which has made estimation of the independent influence of incarceration on STI/HIV risk limited. Further, study samples of individuals categorized as BSMM comprised a heterogeneous group with some identifying as BSMM who have sex with men only, others identifying as BSMM who have sex with men and women, and those assigned male at birth who identify as transgender women. Incarceration may impact these diverse groups differentially and combining groups may mask associations between incarceration and behavioral risk and acquisition.[16] Given the disproportionate burden of incarceration among BSMM and the elevated risk of STI/HIV, there is a need for population-based studies at the national level using a longitudinal data structure and robust control of confounding to estimate of the potential role of incarceration as a structural determinant of STI/HIV in this group.

The purpose of this study was to measure the longitudinal association between recent incarceration and post-release STI/HIV-related risk behaviors and incident STI/HIV acquisition among BSMM in the HPTN 061 cohort recruited from six US cities (Atlanta, Boston, Los Angeles, New York City, San Francisco, and Washington D.C.). Using inverse probability of treatment weighting to account for a robust set of confounding factors, we aimed to measure longitudinal associations between incarceration on post-release sexual risk behaviors, STI, and HIV acquisition. We also aimed to assess whether longitudinal associations between incarceration and post-release STI/HIV risk varied by study city, comparing HPTN cities in the US south, northeast, and west coast. Finally, given evidence of differential relationships between social factors including incarceration STI/HIV risk among BSMM who have sex with men only versus those who have sex with men and women and transgender women,[16] we evaluated whether associations between incarceration and STI/HIV risk differed across these groups.

MATERIALS AND METHODS

The study's enrollment and recruitment methods have been described previously.[17] The HPTN 061 study sought to understand the drivers of HIV risk among BSMM, and to test the feasibility of interventions to prevent the acquisition and transmission of HIV among BSMM. Enrollment took place from 2009–2010 in six US metropolitan cities: Atlanta, Boston, Los Angeles, New York City, San Francisco, and Washington D.C. BSMM were recruited directly from the community or as sexual network partners referred by index participants. Index participants were defined as men or persons born male at birth who were: living with HIV and unaware of their infection; who were living with HIV, not in care, and having condomless sex with partners who were HIV-negative or whose HIV status was unknown; and HIV-uninfected.[8,17] The sample recruited represents a community-based convenience sample. Community recruitment plans were developed at each site and included community outreach, engagement of key informants and local community-based organizations, advertising, and the use of online strategies to include the placement of banner ads, chat room outreach, and social networking sites.[8,17] The enrollment target for each site was 250 community-recruited participants. The goal of the parent study was to understand correlates of incident HIV infection and secondarily to identify individuals who were infected but unaware of their HIV status. The enrollment of community-recruited HIV-uninfected men at each site was capped at 200 participants. The enrollment of community-recruited men who had a prior diagnosis of HIV and were in care and/or who reported only having condomless anal intercourse (UAI) with HIV-positive partners was capped at 10 participants. Once the cap was reached within a study site, recruits with those characteristics were no longer eligible to enroll. The team used limited partner referral to tap into sexual networks in which all new enrollees had the opportunity to refer partners.

A total of 1,553 BSMM were enrolled. Participants completed an audio computer-assisted self-interview (ACASI) that assessed demographic information, psychosocial vulnerability, mental health, substance use, STI/HIV risk behaviors, and partner characteristics. At each study visit, participants also were tested for STI and HIV; methods for testing have been described in detail previously.[19]

The analytic sample for the current analyses focusing on incarceration and STI/HIV risk was composed of the 1169 HPTN 061 participants who returned for the six-month visit and who had non-missing data on recent incarceration at this visit.

Measures

Exposure: Recent Incarceration (6-Month Follow-up).—At the six-month follow-up visit, participants reported the number of times they spent one or more nights incarcerated in the previous six months. We defined recent incarceration as having experienced at least one night incarcerated in the past six months.

Outcomes: HIV/STI-related Sexual Risk Behavior and Sexually Transmitted Infection (12-Month Follow-Up).—Outcomes were measured at the 12-month follow-up visit. We assessed self-report of engagement in STI/HIV-related sexual risk behavior in the past six months including history of multiple partnerships (defined as having two or more

partners); buying sex (defined as giving a partner money, drugs, other goods or a place to stay for sex); and selling sex (defined as receiving from a partner money, drugs, other goods or a place to stay for sex). Urine and rectal swabs were collected for STI testing. The urine samples were tested at local labs and the rectal swabs were tested at the HPTN Laboratory Center for *Chlamydia trachomatis* and *Neisseria gonorrhoeae* (Gen-Probe Aptima Combo 2 Assay, Hologic, San Diego, CA). Incident infection with chlamydia or gonorrhea was defined as testing positive for chlamydia or gonorrhea at the 12-month visit, or an interim visit between the 6- and 12-month visits, among all participants in the analytic sample, all of whom either tested negative for chlamydia and gonorrhea at the 6-month visit or tested positive at the 6 month visit and received appropriate treatment.

A blood specimen was collected for *Treponema pallidum* serology and tested at local laboratories, with positive tests undergoing confirmatory testing. Incident syphilis was defined as having a result at the 12-month visit, or an interim visit between the 6- and 12-month visits, indicating a “reactive” test, as well as a subsequent diagnostic test indicating “new active infection,” all of whom had a “non-reactive” test result at the 6 month visit, or had a reactive test result but a diagnostic test indicating a “treated infection”.

Among those who tested negative for HIV infection at the baseline HIV testing was conducted at local laboratories, assessed via rapid testing and confirmed by Western blot testing. Quality assurance testing was performed retrospectively at the HPTN Laboratory Center to confirm HIV status. Incident infection with HIV is defined as testing positive for HIV at the 12-month visit, or an interim visit between the baseline and 12-month visits, among all participants who tested negative for HIV at the baseline visit.

We also examined dichotomous indicators of infection with chlamydia, gonorrhea, syphilis, or HIV separately, and an indicator of infection with any STI (chlamydia, gonorrhea, or syphilis).

Covariates.—The following covariates were all measured at the baseline study visit and were identified as potential confounders based on our conceptual models of incarceration and STI/HIV risk and were included in models to predict the inverse probability of treatment weights: socio-demographic and identity indicators included study city, age, gender identity (defined as identification as a male versus as a female to measure transgender woman); status of whether has sex with men and women versus with men only; current cohabitation status; education status (defined by greater than a high school education versus less); insufficient income (defined as not having enough money in the household for rent, food, or utilities in the past six months); report of current unstable housing when asked to describe household; healthcare coverage; and lifetime incarceration history. Psychosocial vulnerability and mental health factors included perceived homophobia and perceived racism measured using an adapted version of the Racism and Life Experience Scales- Daily Life Experiences (RaLES-DLE) scale which captures the extent to which daily racism microaggressions cause distress due to experiences of racism; internalized homophobia measured by a modified version of the Herek and Glunt scale (1995); experience of violence if they had been threatened at gun or knife point, been hit or had an object thrown at them, or lifetime history of being threatened with physical violence because of either their race or

sexuality; social support measured by a modified version of the social support scale from the Rand Medical Outcomes Study;[20] and depressive symptoms measured by the CES-D.[21] We measured self-reported alcohol use using the AUDIT[22,23] in which individuals with a score of 8–40 were considered to have unhealthy alcohol use in the past six months;[23,24] weekly marijuana use in the past six months; and hard drug use in the past six months defined as use of heroin, crack, cocaine, methamphetamine, or unprescribed prescription drugs (Vicodin, Oxycontin, and Xanax), or miscellaneous drugs (e.g., Ketamine, hallucinogens). Baseline STI/HIV-related indicators included dichotomous indicators for past six-month report of multiple (two or more) partnerships; concurrent partnerships in past six-months (defined as having anal sex with other men during the same period as having a primary partner); buying sex; selling sex; biologically-confirmed infection with chlamydia, gonorrhea, or syphilis; lifetime testing history; HIV positive status.

STI/HIV Prevention Services Received During Incarceration.—Among those with a history of recent incarceration (N=686), participants were asked whether they had received STI/HIV prevention services including HIV testing, information on how to prevent HIV, condoms, or treatment for HIV.

Statistical Analysis

We performed analyses in R version 3.6.2 (Vienna, Austria[23]). We calculated frequencies and/or means of demographic, socioeconomic, and behavioral variables measured at baseline and stratified by study city.

We estimated unadjusted and adjusted risk ratios (ARR) and 95% confidence intervals (CIs) for the associations between recent incarceration and STI/HIV-related risk behaviors and biologically-confirmed STI and HIV. We controlled for potential confounders using inverse probability of treatment weighting (IPTW). Participants' predicted probabilities (i.e., propensity score) of recent incarceration at six months (main exposure) were estimated by regressing incarceration on covariates using logistic regression.[25] Scale items were included as continuous variables in the propensity score models. Propensity scores were converted into inverse probability weights, which were stabilized in regard to the probability of the observed exposure,[26] creating a weighted sample that balanced the distribution of the covariates independent of exposure status[27,28]. After weighting we evaluated the difference in the standardized mean (for continuous variables) or probability (for binary variables) of each covariate between those with and without six-month incarceration;[28] differences were less than ±0.20 standard deviations, suggesting weighting resulted in adequate balance on each covariate (all differences were less than 0.20 and for binary confounders, the maximum difference was 0.1051 for lifetime incarceration) (see Supplemental File: Technical Appendix for additional detail on propensity score methods).

To address missingness on outcomes and covariates, we utilized multiple imputation by chained equations for missing data[29] in questionnaire responses yielding 55 imputed datasets using predictive mean matching. Out of the 1,169 subjects present at the 12-month visit, 633 (54.15%) were missing information on a covariate. The quality of the imputations was assessed via visual inspection of density plots of the imputed variables. Values of the

imputed variables were checked to make sure that only plausible values were imputed (see Supplemental File: Technical Appendix for additional detail on imputation methods).

To obtain risk ratios, unweighted and weighted modified Poisson regressions which uses robust variance estimates, were conducted for each outcome in each imputed dataset. This modification of Poisson regression allows for estimation of risk ratios for binary outcomes. Parameter estimates and variances were extracted from each model and were pooled to obtain unweighted and weighted risk ratios and standard errors for the association between exposure and outcome following Rubin's rules.[30] Logistic regression with the Ridge penalty was conducted for each of the imputed datasets, to create fifty-five sets of propensity scores, which were used to create fifty-five sets of inverse probability weights.[31] These weights were then used in the fully adjusted analysis to assess the relationship between six-month incarceration status and specific HIV/STI-related sexual risk behavior and STI/HIV (see Supplemental File: Technical Appendix for additional detail on regression methods).

Given that exposure to urethral versus rectal infection may differ between BSMM who have sex with men only, BSMM who have sex with men and women, and transgender women we examined the association between incarceration and urethral versus rectal infection stratified by gender and sexual identity. To contextualize findings on differences in associations between incarceration and infection, we also report on numbers of sexual partners in each of these groups.

To better understand differences in the relationship between incarceration and STI/HIV across study cities, we calculated city-specific frequencies of receipt of jail and prison-based STI/HIV prevention services.

RESULTS

Study Population Characteristics

The analytic cohort was defined as participants with known exposure status at the 6-month follow-up visit. Specifically, the analytic sample included 1169 participants who attended the 6-month follow-up visit and had a non-missing value on past 6-month incarceration. Of the 384 for whom we lacked exposure data, 364 participants did not present for the 6-month follow-up visit and of those who presented, 20 had missing data on recent incarceration history. All 1169 participants were included in the analysis given we imputed missing 12-month outcome data, whether it was missing because the participant did not return for the 12-month follow-up visit (n=118/1169 were lost to follow-up and did not present for the 12 month visit=10.1%) or because the participant attended the 12-month follow-up visit yet had missing outcome data.

Baseline Participant Factors: The largest percentage of the analytic sample participants resided in New York City (22%), followed by Atlanta (18%) and Los Angeles (18%), Washington DC (15%) and Boston (15%), and San Francisco (13%). At baseline, the analytic sample members had a median age of 39 years (range: 18 to 70 years old) with 34% aged 18–30 years, and 54% had male partners only in the past six months, 42% had both men and women for partners, and 4% (n=42) were transgender women (Table 1) in the past

six months. At baseline, 56% had insufficient income, 49% had greater than a high school education, 10% reported unstable housing, and 61% had health insurance coverage. Baseline participant sociodemographic characteristics differed across cities with the most differences observed in Washington DC, compared with other cities. In Washington DC, the sample members were younger, with over 60% of participants 18–30 years old versus 22–36% in other cities ($p<0.001$). The Washington DC sample also had higher percentages of men who have sex with men only (80%) versus 38–60% elsewhere ($p<0.001$), greater than a high school education (68%) versus 36–56% elsewhere ($p<0.001$), and lower percentages reporting income concerns (33%) versus 52–73% elsewhere ($p<0.001$) or housing instability (4%) versus 8–13% elsewhere ($p<0.001$). Healthcare coverage was highest in Boston (94%); 72–75% in New York, Washington DC, and San Francisco; and lowest in Atlanta (25%) and Los Angeles (34%) ($p<0.001$).

Approximately 42% of participants had symptoms indicative of major depression, 32% were categorized as having unhealthy alcohol use, 31% reported past six month marijuana use, and 40% past six month hard drug use, defined as use of heroin, crack, cocaine, methamphetamine, or unprescribed prescription drugs (Vicodin, Oxycontin, and Xanax), or miscellaneous drugs (e.g., Ketamine, hallucinogens). Depression and substance use tended to be more common in Boston (depression: 51%, unhealthy alcohol use: 44%, hard drug use: 54%) and San Francisco (depression: 45%, unhealthy alcohol use: 38%, hard drug use: 62%); Atlanta had elevated levels of unhealthy alcohol use (40%) while rates of depression and hard drug use were comparable to the overall sample.

At baseline, 42% of participants endorsed multiple partnerships, 88% had never been tested for HIV, 12% had a current STI and 18.6% were HIV positive. Washington DC had the lowest levels of multiple partnerships and highest levels of HIV testing, and the highest levels of current STI at baseline.

When comparing those were retained in this final sample (N=1169), versus those who were not present for the six-month follow-up visit and/or who failed to report on incarceration (N=384), we observed no differences in social support, psychosocial vulnerability factors (experienced and internalized homophobia and experienced racism), buying or selling sex, multiple partnerships, condom use, and STIs including gonorrhea and syphilis ($p>.05$ for all measures). However, some differences in those lost to follow-up were observed; we observed those who were not retained versus those who were retained were more likely to be infected with chlamydia (10.8 versus 4.9%; $p=0.02$) and to use opioids (10.4 versus 6.5%; $p=0.04$) yet less likely to be newly infected with HIV (0.4% versus 2.9%; $p= 0.02$).

Distribution of Incarceration Exposures and STI/HIV Risk Outcomes.—At the six-month follow-up, 14% of the analytic sample of 1169 (n=165/1169) reported having been incarcerated since the baseline enrollment visit. At twelve-month follow-up, approximately 39% reported multiple partnerships in the past six months; 6% reported buying sex; 8% reported selling sex; and 12% reported CAI with a partner perceived to be infected with HIV or whose status was unknown. Approximately 10% were newly infected with an STI in the past six months; six-month incidence levels of chlamydia, gonorrhea, and syphilis were 4%, 2%, and 2%, respectively. In Washington DC, the sample had the

lowest levels of multiple partnerships and sex trade and the highest level of STI (six-month incidence of 17%). Atlanta had the second highest level of incident STI (10%) driven in large part by high levels of syphilis. In Boston, buying sex (27%), selling sex (22%), and multiple partnerships (15%) were among the highest, yet STI the lowest (2%). Among participants testing HIV negative at the baseline study visit, 27 people (3%) tested positive by the 12-month study visit. The majority of incident HIV cases were observed in Los Angeles (n=10 cases, 5% six month incidence) and Atlanta (n=7 cases, 3% six month incidence).

Associations: Incarceration and STI/HIV Risk Overall and by Study City

Incarceration and Sexual Risk Behavior—In the overall sample, those with a recent history of incarceration were more likely to report multiple partnerships in the past six months versus those with no incarceration history (risk ratio (RR): 1.32, 95% confidence interval (CI): 1.13, 1.56) (Table 2a). After adjustment, the ARR was 1.15 (0.94–1.42). Recent incarceration was associated with nearly twice the risk of buying sex in the past six months (RR: 1.97, 95% CI: 1.18–3.30). After adjustment, the ARR was 1.64 (95% CI: 0.93–2.90). The association between incarceration and buying sex varied across cities with evidence of a particularly strong association in Boston (ARR: 3.46, 95% CI: 1.52–7.85). In both unadjusted and adjusted analyses, incarceration was associated with selling sex (ARR: 1.80, 95% CI: 1.12, 2.87). There was no evidence of an association between incarceration and CAI with a partner who was HIV-positive or of unknown HIV status among those who were HIV-negative at baseline (ARR: 1.12, 95% CI: 0.72–1.58).

Incarceration and STI/HIV—In the overall sample, there was a trend suggesting that incarceration was associated with six-month incident gonorrhea (ARR: 2.35, 95% CI: 0.95–5.77) but not incident chlamydia (ARR: 0.72, 95% CI: 0.27–1.94) or syphilis (ARR: 1.22, 95% CI: 0.42–3.51). While city-specific associations should be interpreted with caution given the low cell counts, the association between incarceration and gonorrhea was particularly strong in Los Angeles (ARR: 6.48, 95% CI: 1.48–28.38).

Incident HIV was observed in 5 participants with a recent history of incarceration (3.6%) and 22 among participants with no recent history (2.8%) (Table 2c). There were no significant associations between incarceration and HIV infection.

Associations: Incarceration and STI/HIV Risk among BSMM who Have Sex with Men Only, BSMM who have Sex with Men and Women, and Black Transgender Women

Incarceration and Sexual Risk behavior—We observed heterogeneity in estimated associations between incarceration and outcomes across sub-groups; incarceration appeared to predict increased risk of multiple partnerships among BSMM who had sex with men and women (ARR: 1.34, 95% CI: 1.10, 1.63) and transgender women (ARR: 1.77, 95% CI: 1.22, 2.57), yet not among BSMM who had sex with men only (ARR: 0.68, 95% CI: 0.41, 1.12) (Table 3a). Among BSMM who had sex with men and women there was a suggestion that incarceration was associated with buying sex (ARR: 2.08, 95% CI: 0.97, 4.44) but not with selling sex (ARR: 1.45, 95% CI: 0.79, 2.69). Among transgender women, the point estimates for associations between incarceration and both buying and selling sex

were strong yet analyses were underpowered and extremely imprecise (buying sex: ARR: 3.45, 95% CI: 0.54–22.04; selling sex: 2.01, 95% CI: 0.57, 7.06) due to the small sample size of this sub-group (N=49). Incarceration was not associated with past six-month CAI across sub-groups.

Incarceration and STI/HIV—There is evidence that BSMM who had sex with men only who had been incarcerated and released in the past six months had over twice the risk of acquiring an STI in the next six months (RR: 2.04, 95% CI = 1.05, 4.00) versus those with no incarceration history. After adjustment the ARR was 1.87 (95% CI = 0.88, 3.95).

Prevalence of STI/HIV Prevention Services During Incarceration—Among those with a history of incarceration at baseline, a minority reported correctional-facility based HIV testing (24%), STI/HIV prevention education (25%), and provision of condoms during incarceration (10%). STI/HIV prevention during incarceration varied markedly by study city. For example, 21% of Los Angeles participants had received condoms during incarceration compared with 4% of participants from Boston or Atlanta.

DISCUSSION

To our knowledge, this is the first longitudinal study on incarceration and release and sexual risk behavior and biologically-confirmed STI/HIV among BSMM. In this population-based cohort recruited from six US urban cities, nearly one in seven had been incarcerated in the past six months. In longitudinal analyses adjusting for a robust set of socio-demographic, identity, economic, psychosocial vulnerability and mental health confounding factors and baseline history of incarceration, there was evidence that recent incarceration was independently associated with subsequent increased risk of STI/HIV risk behaviors and in some cities with incident gonorrheal infection. A study limitation was the small cell counts particularly for infection outcomes given the sixth month follow-up period, when incident infection was measured. Nonetheless, these findings provide empirical support[6,9,10] for the potential role of incarceration in increased STI/HIV risk among BSMM. If indeed found to be validated in other study samples, these collective findings would point to the possibility that implementing criminal justice reforms that reduce exposure to policing and incarceration among BSMM—an action which is critically needed across US cities for a host of social justice, economic justice, wellbeing, and health reasons—may potentially have the consequence of also decreasing STI/HIV risk in this group. The influence of implementing such policy changes on health including STI/HIV risk would need to be evaluated to understand if and how decarceration plays a role in HIV transmission.

The current study corroborated prior cross-sectional studies that documented associations between incarceration STI/HIV risk[6,9,10] including prior studies in the HPTN 061 cohort which had indicated incarceration and related factors (e.g., recent conviction of either participants or their partners) were associated with sex trade and STI with increasing burden of incarceration linked to increased STI/HIV risk in a dose response manner[6,9] as well as a recent study in the 061 cohort that indicated any lifetime history of incarceration was associated with incident rectal chlamydial and gonococcal infection.[19] The current study using longitudinal data indicated that recent incarceration is independently associated

with subsequent increases in sex trade and STI during community re-entry. Further, the study highlights the STI/HIV risk associated with recent and short-term incarceration given the incarceration and release events we captured occurred between the baseline and six-month study visit and hence were less than six months. The importance of short-term, repeat incarceration in STI risk has been observed previously in BSMM and the general population.[10,32]

We observed city-specific differences in associations between incarceration and STI/HIV risk outcomes. For example, incarceration predicted higher risk of sex trade in Boston and Washington DC than in other cities, it was particularly strongly associated with incident gonorrhea in Los Angeles yet not associated with infection in other cities. It is hard to know what may drive city-specific differences in associations between incarceration and outcomes. The differences could be a function of behavioral or network differences across HPTN 061 cities. For example, the Washington DC HPTN 061 sample was more likely than samples recruited in other cities to include BSMM who have sex with men only and to be educated, employed, stably housed, and have low risk of sex trade (~3%). The sample recruited from Boston appeared to have an opposite profile from Washington; it was much more likely than other cities to be BSMM who have sex with both men and women, to experience joblessness, housing instability, and to have high levels of sex trade (>10%). One may hypothesize that incarceration may exert greater impact in populations with either lower levels of baseline adversity because incarceration is not competing with other adverse conditions to drive risk, and in populations with higher levels of risk because it works synergistically with other adverse factors to drive risk. Additional quantitative and qualitative studies are needed to better describe regional and city specific differences that could assess the influence of incarceration on STI/HIV behavioral risk and infection as well as differences in the correctional settings and re-entry programming to best learn how to mitigate incarceration-related risk.

In the overall sample, we observed a weak relationship between incarceration and next six month multiple partnerships. This finding is consistent with prior cross-sectional studies examining incarceration and multiple partnerships in BSMM[6,9] yet largely inconsistent with findings from research conducted in numerous study populations of men including heterosexual Black men that demonstrate incarceration is linked to a 50% or greater increased risk of multiple parntersships.[33–36] One reason for the disparate findings in samples of BSMM and other male populations may be because incarceration influences different outcomes for different populations of BSMM. When examining associations within BSMM who have sex with men and women, we observed, as we have in largely heterosexual samples, incarceration was strongly associated with buying sex and, additionally, predicted increases in multiple partnerships.[33] While among BSMM who have sex with men only, incarceration did not increase risk of multiple partnerships, it was strongly associated with selling sex, and behavioral risk appeared to translate to incarceration-related infection in this group. Finally, although we had a small sample of transgender women, there was a trend suggesting that incarceration may exert influence across multiple sex risk indicators and highlighted the need to evaluate the role of criminal justice involvement in the STI/HIV risk in larger samples of transgender women.

As noted, the current findings suggest reducing incarceration may improve health though the findings highlight the need for additional research in this group." Further, the findings suggest that if an incarceration occurs, there is a strong need for evidenced-based interventions (e.g., STI testing and treatment) within criminal justice settings and following release to community settings to prevent incarceration-related STI/HIV risk. Such programming must be implemented in tandem with programs that address the structural factors including poverty and racism that drive STI/HIV-related drug use, sex risk, infection, and distrust in the healthcare system.

Although this analysis contributes to our understanding of the influence of recent incarceration and subsequent STI risk behaviors and outcomes, there are several study limitations to consider. As noted, we were limited by small cell counts in some analyses especially for low prevalence outcomes (six-month STI incidence). We wished to examine an indicator of recent incarceration, which was not measured at baseline but initially at the six-month visit, hence leaving only a six-month follow-up period to accrue cases. Second, in such observational analyses, one cannot rule out residual confounding. To best mitigate risk of residual confounding, our team developed a strong strategy for causal identification. We developed conceptual models based on the extant literature to describe how incarceration may influence STI/HIV risk by working through incarceration's effect on reductions in social support and access to care and increases in psychiatric factors and substance use factors, each of which are STI/HIV risk factors. Building from these model, we developed robust direct acyclic graphs to aid in careful identification of numerous covariates (25 variables) which are known to predict incarceration and to play a role in STI/HIV risk outcomes, to address confounding bias in an attempt to isolate the relationship between incarceration and post-release STI/HIV risk. However, while we assume all important confounders are measured, and all backdoor paths are blocked, this may not be the case. Third, study findings cannot be generalized to BSMM as a whole given the parent study's convenience sampling strategy and eligibility criteria (i.e., must have reported at least one episode of condomless anal intercourse with another man in the past six months); the sample represents those at elevated risk of STI/HIV. However, given sexually active BSMM are a priority population for HIV/STI prevention efforts given current STI/HIV disparities however, our study's focus on this group is warranted. Fourth, while there is evidence incarceration may have different relationships with outcomes depending on recruitment city, we are underpowered to formally test city-specific differences in associations and further, we lack city-specific data on the nature of detainment and the post-release environment to help us interpret why there may be differences by geography. There is a need for such a contextual analysis to understand how the conditions of detainment and services provided during incarceration and after release may be differentially linked to protection against STI/HIV risk in this population. In addition, self-reported incarceration during study follow-up as well as information about risky behaviors may be underreported as a result of social desirability bias given the stigma and discrimination associated with these behaviors and experiences. Underreporting of outcome indicators may affect all participants, regardless of incarceration status, or may be correlated with incarceration. Given we cannot know how underreporting is distributed across the sample we cannot predict the direction of potential bias. Finally, the fact that the sample is a convenience sample recruited through

a range of heterogeneous methods, and hence it was not intended to be representative of a particular sample of BSMM/BTGW, may limit our ability to generalize study findings. Utilizing the strategy of partner referral is often used to reach hard-to-reach populations, hence a countervailing study strength is the large sample of BSMM/TGW to support study implementation including stratified analyses.

Despite these limitations, this analysis represents one of the largest population-based samples of BSMM in the US. The findings highlight a need to further explore the potential role of incarceration in the STI/HIV risk of BSMM. First, findings highlight the critical need for a robust study on incarceration and STI/HIV risk in Black transgender women. The small numbers of transgender persons included in STI/HIV prevention cohorts limits research on this highly vulnerable group, which represents a critical gap that must be remediated. Second, ongoing cohorts of sexual minority men that include racial/ethnic minority participants should systematically collect information on incarceration history to best characterize the role of incarceration in STI/HIV related risk-taking and HIV progression. The Veterans Aging Cohort Study has begun such data collection, and other cohorts should follow suit. Longitudinal data to enable repeated measures analyses will help boost statistical power to enable accurate characterization of incarceration's role in STI/HIV risk. Third, we need qualitative research among BSMM and Black transgender women who have experienced incarceration to better characterize paths to risk and for different sub-groups. Finally, as noted, understanding geographic differences in how incarceration may influence STI/HIV risk are needed. Implementation science methods should be applied to understand the context of the detainment environment, differences in services provided during incarceration and re-entry differ across place in the US, and how these factors bear on risk-taking after release.

Despite the need for these additional fields of study we provide the following recommendations for researchers, practitioners, and policy makers: collaborative relationships should be established and maintained with criminal justice systems and re-entry programs to expand the provision of STI/HIV services (e.g., STI testing and treatment) while social justice efforts and criminal justice reform focused on the needs of Black people are critical to advancing health equity and population health overall; these also may play a role in reduced STI/HIV risk in this population.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Table 1.

Total Sample and City-Specific Distributions of Study Variables (N=1169)

Variable	N (%) in the Total Sample	Atlanta (N=207)	New York City (N=256)	Washington DC (N=177)	Boston (N=173)	Los Angeles (N=207)	San Francisco (N=149)	X^2 Test Statistic (P value)
Socio-demographic Factors (Measured at Baseline)								
Age								
18 – 30 Yrs Old	396 (33.9%)	57 (27.5%)	80 (31.2%)	109 (61.6%)	42 (24.3%)	75 (36.2%)	33 (22.1%)	X^2 = 112.65 P value <0.001
31 – 50 Yrs Old	611 (52.3%)	109 (52.7%)	152 (59.4%)	61 (34.5%)	104 (60.1%)	109 (52.7%)	76 (51.0%)	
51 – 70 Yrs Old	161 (13.8%)	41 (19.8%)	24 (9.4%)	6 (3.4%)	27 (15.6%)	23 (11.1%)	40 (26.8%)	
Men Who Have Sex with Men Only (Past 6 Months)								
MSMO	631 (54.0%)	101 (48.8%)	131 (51.2%)	141 (79.7%)	66 (38.2%)	124 (59.9%)	68 (45.6%)	X^2 = 85.17 P value <0.001
MSMW/Trans women	487 (41.7%)	98 (47.3%)	117 (45.7%)	28 (15.8%)	101 (58.4%)	72 (34.8%)	71 (47.7%)	
Trans	49 (4.2%)	8 (3.9%)	7 (2.7%)	7 (4.0%)	6 (3.5%)	11 (5.3%)	10 (6.7%)	
Current Live-in Partnership	177 (15.1%)	32 (15.5%)	40 (15.6%)	30 (16.9%)	34 (19.7%)	17 (8.2%)	24 (16.1%)	X^2 = 11.46 P value = 0.040
>High School Diploma	568 (48.6%)	104 (50.2%)	114 (44.5%)	120 (67.8%)	62 (35.8%)	84 (40.6%)	84 (56.4%)	X^2 = 48.25 P value <0.001
Insufficient Income for Rent, Utilities (Past 6 Months)								
No	513 (43.9%)	74 (35.7%)	119 (46.5%)	118 (66.7%)	46 (26.6%)	99 (47.8%)	57 (38.3%)	X^2 = 68.83
Yes	655 (56.0%)	133 (64.3%)	137 (53.5%)	58 (32.8%)	127 (73.4%)	108 (52.2%)	92 (61.7%)	P value <0.001
Current Unstable Housing	113 (9.7%)	27 (13.0%)	26 (10.2%)	7 (4.0%)	23 (13.3%)	18 (8.7%)	12 (8.1%)	X^2 = 12.56 P value = 0.027
Has Health Coverage	712 (60.9%)	52 (25.1%)	192 (75.0%)	127 (71.8%)	162 (93.6%)	70 (33.8%)	109 (73.2%)	X^2 = 293.23 P value <0.001
Psychosocial Vulnerability Factors (Measured at Baseline)								
Racism Scale (mean (SD))	49.5 (24.0)	45.0 (24.4)	48.5 (25.6)	50.1 (23.3)	51.6 (21.6)	49.3 (24.1)	54.5 (23.1)	P value = *0.18*
Sex stigma Scale (mean (SD))	53.2 (31.5)	48.5 (31.7)	52.2 (34.0)	50.8 (29.0)	55.3 (30.5)	55.3 (30.5)	59.8 (29.5)	P value = *0.009*
Internalized Homophobia (mean (SD))	15.6 (7.01)	17.3 (7.31)	15.1 (6.78)	14.8 (6.94)	16.8 (6.96)	15.0 (6.78)	15.0 (7.00)	P value = 0.03
Lifetime History Violence *	866 (74.1%)	154 (74.4%)	188 (73.4%)	108 (61.0%)	130 (75.1%)	166 (80.2%)	120 (80.5%)	X^2 = 23.76 P value < 0.001

Variable	N (%) in the Total Sample	Atlanta (N=207)	New York City (N=256)	Washington DC (N=177)	Boston (N=173)	Los Angeles (N=207)	San Francisco (N=149)	X^2 Test Statistic (P value)
Social Support (mean (SD))	19.7 (7.27)	20.3 (7.29)	19.3 (7.30)	22.3 (6.03)	17.7 (7.49)	19.4 (7.33)	19.2 (7.34)	P value *<0.001*
Depression (CES-D≥16)	487 (41.7%)	85 (41.1%)	95 (37.1%)	66 (37.3%)	88 (50.9%)	86 (41.5%)	67 (45.0%)	*X2 = 85.05* *P value <0.001*
Unhealthy alcohol use (AUDIT≥8)	379 (32.4%)	82 (39.6%)	63 (24.6%)	58 (32.8%)	76 (43.9%)	44 (21.3%)	56 (37.6%)	*X2 = 85.05* *P value <0.001*
Weekly Marijuana Use (Past 6 Months)	362 (31.0%)	57 (27.5%)	89 (34.8%)	34 (19.2%)	65 (37.6%)	64 (30.9%)	53 (35.6%)	X^2 = 19.32 P value = 0.002
Hard Drug Use[†] (Past 6 Months)	471 (40.3%)	85 (41.1%)	97 (37.9%)	34 (19.2%)	93 (53.8%)	71 (34.3%)	91 (61.1%)	X^2 = 78.61 P value <0.001
Multiple partnership	494 (42.3%)	92 (44.4%)	131 (51.2%)	49 (27.7%)	80 (46.2%)	73 (35.3%)	69 (46.3%)	X^2 = 30.339 P value <0.001
Ever Tested for HIV	1028 (87.9%)	187 (90.3%)	218 (85.2%)	163 (92.1%)	158 (91.3%)	179 (86.5%)	123 (82.6%)	X^2 = 13.06 P value = 0.021
Any STI [‡]	138 (11.8%)	28 (13.5%)	23 (9.0%)	54 (30.5%)	3 (1.7%)	22 (10.6%)	8 (5.4%)	X^2 *= 85.05* P value *<0.001*
Incarceration (Measured at 6 Month Follow-up)								
Recent incarceration	165 (14.1%)	35 (16.9%)	45 (17.6%)	16 (9.0%)	30 (17.3%)	22 (10.6%)	17 (11.4%)	X^2= 12.09 P value = 0.04
STI/HIV-related Behaviors and Infection Outcomes (Measured at 12 Month Follow-up)								
Multiple Partnership	456 (39.0%)	85 (41.1%)	112 (43.8%)	59 (33.3%)	69 (39.9%)	73 (35.3%)	58 (38.9%)	X^2 = 7.41 P value = 0.18
Buying Sex	67 (5.7%)	13 (6.3%)	11 (4.3%)	6 (3.4%)	18 (10.4%)	13 (6.3%)	6 (4.0%)	X^2 = 14.64 P value = 0.01
Selling Sex	93 (8.0%)	18 (8.7%)	18 (7.0%)	6 (3.4%)	20 (11.6%)	13 (6.3%)	18 (12.1%)	X^2 = 15.97 P value = 0.01
Condomless Anal Intercourse with an HIV Unknown or Positive Partner (Among those who were HIV negative at baseline)	112 (12.0%)	16 (9.6%)	22 (11.3%)	22 (15.7%)	14 (9.6%)	19 (12.2%)	19 (14.3%)	X^2 = 7.72 P value = 0.1774
Any STI**	89 (7.6%)	21 (10.1%)	14 (5.5%)	30 (16.9%)	3 (1.7%)	18 (8.7%)	3 (2.0%)	P value <0.001
Gonorrhea	26 (2.2%)	8 (3.9%)	2 (0.8%)	8 (4.5%)	0 (0%)	7 (3.4%)	1 (0.7%)	P value = 0.003
Chlamydia	51 (4.4%)	5 (2.4%)	8 (3.1%)	21 (11.9%)	2 (1.2%)	13 (6.3%)	2 (1.3%)	P value = 0.004

Variable	N (%) in the Total Sample	Atlanta (N=207)	New York City (N=256)	Washington DC (N=177)	Boston (N=173)	Los Angeles (N=207)	San Francisco (N=149)	X^2 Test Statistic (P value)
Syphilis	25 (2.1%)	11 (5.3%)	4 (1.6%)	8 (4.5%)	1 (0.6%)	0 (0%)	1 (0.7%)	P value = 0.001
HIV (Among those who were HIV negative at 6 month study visit)	27 (2.9%)	7 (4.2%)	2 (1.0%)	3 (2.1%)	1 (0.7%)	10 (6.4%)	4 (3.0%)	P value = 0.030

*Experience of violence was coded as a lifetime history of having been threatened at gun or knife point, been hit or had an object thrown at them, or been threatened with physical violence because of either their race or sexuality.

†Hard drug use defined as use of heroin, crack, cocaine, methamphetamine, or unprescribed prescription drugs (Vicodin, Oxycontin, and Xanax), or miscellaneous drugs (e.g., Ketamine, hallucinogens) in the past six months

‡Includes new infection with gonorrhea, chlamydia, or syphilis between the 6 and 12th month visit.

Sex Transm Dis. Author manuscript; available in PMC 2023 April 01.

Table 2a.

Unadjusted and Adjusted (Weighted) Risk Ratios (RRs) and 95% Confidence Intervals (CIs) for the Associations for Incarceration and STI/HIV-related Sexual Risk Behaviors, by Study City

	Multiple Partnership			Buying Sex			Selling Sex			Condomless Sex with HIV+/HIV unknown (among HIV- at baseline)		
	n (%)	**Unadjusted RR (95% CI)**	**Weighted RR (95% CI)**	**n (%)**	**Unadjusted RR (95% CI)**	**Weighted RR (95% CI)**	**n (%)**	**Unadjusted RR (95% CI)**	**Weighted RR (95% CI)**	**n (%)**	**Unadjusted RR (95% CI)**	**Weighted RR (95% CI)**
Overall												
No Incarceration (n=1004)	374 (37.3%)	Referent	Referent	50 (5.0%)	Referent	Referent	68 (6.8%)	Referent	Referent	97 (12.2%)	Referent	Referent
Incarceration (n=165)	82 (49.7%)	1.32 (1.13, 1.56)	1.15 (0.94, 1.42)	17 (10.3%)	1.97 (1.18, 3.30)	1.64 (0.93, 2.90)	25 (15.2%)	2.12 (1.39, 3.22)	1.80 (1.12, 2.87)	15 (10.9%)	1.05 (0.70, 1.57)	1.13 (0.72, 1.76)
Atlanta												
No Incarceration (n=172)	67 (39.0%)	Referent	Referent	10 (5.8%)	Referent	Referent	13 (7.6%)	Referent	Referent	13 (9.4%)	Referent	Referent
Incarceration (n=35)	18 (51.4%)	1.23 (0.86, 1.75)	0.99 (0.61, 1.62)	3 (8.6%)	1.48 (0.43, 5.12)	0.82 (0.20, 3.27)	5 (14.3%)	1.82 (0.70, 4.77)	1.10 (0.36, 3.32)	3 (11.1%)	1.50 (0.59, 3.79)	1.29 (0.45, 3.73)
New York City												
No Incarceration (n=211)	87 (41.2%)	Referent	Referent	10 (4.7%)	Referent	Referent	15 (7.1%)	Referent	Referent	19 (12.4%)	Referent	Referent
Incarceration (n=45)	25 (55.6%)	1.36 (1.01, 1.83)	1.29 (0.91, 1.82)	1 (2.2%)	0.45 (0.06, 3.45)	0.33 (0.04, 2.53)	3 (6.7%)	0.92 (0.28, 3.04)	0.56 (0.16, 1.97)	3 (7.3%)	0.76 (0.30, 1.94)	0.73 (0.25, 2.08)
Washington DC												
No Incarceration (n=161)	55 (34.2%)	Referent	Referent	4 (2.5%)	Referent	Referent	3 (1.9%)	Referent	Referent	20 (15.4%)	Referent	Referent
Incarceration (n=16)	4 (25.0%)	0.97 (0.45, 2.10)	0.90 (0.37, 2.21)	2 (12.5%)	5.04 (1.00, 25.44)	4.93 (0.88, 27.70)	3 (18.8%)	9.99 (2.20, 45.46)	8.74 (1.74, 43.80)	2 (20.0%)	1.30 (0.50, 3.40)	1.17 (0.38, 3.57)
Boston												
No Incarceration (n=143)	54 (37.8%)	Referent	Referent	10 (7.0%)	Referent	Referent	11 (7.7%)	Referent	Referent	13 (10.7%)	Referent	Referent
Incarceration (n=30)	15 (50.0%)	1.31 (0.91, 1.89)	1.33 (0.92, 1.93)	8 (26.7%)	3.20 (1.42, 7.22)	3.46 (1.52, 7.85)	9 (30.0%)	3.26 (1.52, 7.00)	3.41 (1.57, 7.39)	1 (4.0%)	0.84 (0.23, 3.00)	1.06 (0.32, 3.55)

	Multiple Partnership			Buying Sex			Selling Sex			Condomless Sex with HIV+/HIV unknown (among HIV- at baseline)		
	n (%)	Unadjusted RR (95% CI)	Weighted RR (95% CI)	n (%)	Unadjusted RR (95% CI)	Weighted RR (95% CI)	n (%)	Unadjusted RR (95% CI)	Weighted RR (95% CI)	n (%)	Unadjusted RR (95% CI)	Weighted RR (95% CI)
Los Angeles												
No Incarceration (n=185)	63 (34.1%)	Referent	Referent	12 (6.5%)	Referent	Referent	11 (5.9%)	Referent	Referent	16 (11.6%)	Referent	Referent
Incarceration (n=22)	10 (45.5%)	1.21 (0.74, 1.89)	0.88 (0.47, 1.65)	1 (4.5%)	0.64 (0.09, 4.71)	0.25 (0.03, 1.97)	2 (9.1%)	1.37 (0.33, 5.75)	0.58 (0.13, 2.62)	3 (16.7%)	1.69 (0.63, 4.53)	1.15 (0.31, 4.25)
San Francisco												
No Incarceration (n=132)	48 (36.4%)	Referent	Referent	4 (3.0%)	Referent	Referent	15 (11.4%)	Referent	Referent	16 (13.7%)	Referent	Referent
Incarceration (n=17)	10 (58.8%)	1.57 (1.02, 2.43)	1.44 (0.86, 2.42)	2 (11.8%)	3.40 (0.67, 17.34)	2.51 (0.45, 13.96)	3 (17.6%)	1.48 (0.48, 4.53)	1.86 (0.61, 5.67)	3 (18.8%)	0.99 (0.34, 2.85)	1.49 (0.55, 4.02)

Table 2b.

Unadjusted and Adjusted (Weighted) Risk Ratios (RRs) and 95% Confidence Intervals (CIs) for the Associations for Incarceration and Next Six Month Incident STI, by Study City

	Any STI			Chlamydia			Gonorrhea			Syphilis		
	n (%)	**Unadjusted RR (95% CI)**	**Weighted RR (95% CI)**	**n (%)**	**Unadjusted RR (95% CI)**	**Weighted RR (95% CI)**	**n (%)**	**Unadjusted RR (95% CI)**	**Weighted RR (95% CI)**	**n (%)**	**Unadjusted RR (95% CI)**	**Weighted RR (95% CI)**
Overall												
No Incarceration (n=1004)	75 (7.5%)	Referent	Referent	46 (4.6%)	Referent	Referent	19 (1.9%)	Referent	Referent	21 (2.1%)	Referent	Referent
Incarceration (n=165)	16 (9.7%)	1.26 (0.76, 2.11)	1.37 (0.79,2.35)	5 (3.0%)	0.69 (0.28, 1.70)	0.72 (0.27, 1.94)	7 (4.2%)	2.12 (0.91, 4.99)	2.35 (0.95, 5.77)	4 (2.4%)	1.14 (0.40, 3.28)	1.22 (0.42, 3.51)
Atlanta												
No Incarceration (n=172)	15 (8.7%)	Referent	Referent	5 (2.9%)	Referent	Referent	6 (3.5%)	Referent	Referent	7 (4.1%)	Referent	Referent
Incarceration (n=35)	6 (17.1%)	1.85 (0.77, 4.46)	1.78 (0.70, 4.54)	0 (0%)	N/A	N/A	2 (5.7%)	1.56 (0.33, 7.43)	1.02 (0.20, 5.28)	4 (11.4%)	2.66 (0.82, 8.63)	2.92 (0.88, 9.64)
New York City												
No Incarceration (n=211)	11 (5.2%)	Referent	Referent	5 (2.4%)	Referent	Referent	2 (0.9%)	Referent	Referent	4 (1.9%)	Referent	Referent
Incarceration (n=45)	3 (6.7%)	1.19 (0.35, 4.09)	0.86 (0.24, 3.10)	3 (6.7%)	2.50 (0.62, 10.01)	1.82 (0.43, 7.66)	0 (0%)	0.00 (0.00, 0.00)	0.00 (0.00, 0.00)	0 (0%)	0.00 (0.00, 0.00)	0.00 (0.00, 0.00)
Washington, DC												
No Incarceration (n=161)	28 (17.4%)	Referent	Referent	19 (11.8%)	Referent	Referent	6 (3.7%)	Referent	Referent	8 (5.0%)	Referent	Referent
Incarceration (n=16)	4 (25.0%)	1.47 (0.59, 3.71)	1.64 (0.63, 4.29)	2 (12.5%)	1.09 (0.28, 4.29)	1.38 (0.36, 5.30)	2 (12.5%)	3.27 (0.72, 14.90)	3.22 (0.63, 16.40)	0 (0%)	0.00 (0.00, 0.00)	0.00 (0.00, 0.00)
Boston												
No Incarceration (n=143)	3 (2.1%)	Referent	Referent	2 (1.4%)	Referent	Referent	0 (0%)	Referent	Referent	1 (0.7%)	Referent	Referent
Incarceration (n=30)	0 (0%)	0.00 (0.00, 0.00)	0.00 (0.00, 0.00)	0 (0%)	0.00 (0.00, 0.00)	0.00 (0.00, 0.00)	0 (0%)	0.00 (0.00, 0.00)	0.00 (0.00, 0.00)	0 (0%)	0.00 (0.00, 0.00)	0.00 (0.00, 0.00)
Los Angeles												

	Any STI			Chlamydia			Gonorrhea			Syphilis		
	n (%)	**Unadjusted RR (95% CI)**	**Weighted RR (95% CI)**	**n (%)**	**Unadjusted RR (95% CI)**	**Weighted RR (95% CI)**	**n (%)**	**Unadjusted RR (95% CI)**	**Weighted RR (95% CI)**	**n (%)**	**Unadjusted RR (95% CI)**	**Weighted RR (95% CI)**
No Incarceration (n=185)	15 (8.1%)	Referent	Referent	13 (7.0%)	Referent	Referent	4 (2.2%)	Referent	Referent	0 (0%)	Referent	Referent
Incarceration (n=22)	3 (13.6%)	1.54 (0.48, 4.89)	1.63 (0.48, 5.51)	0 (0%)	0.00 (0.00, 0.00)	0 (0.00, 0.00)	3 (13.6%)	5.86 (1.41, 24.35)	6.48 (1.48, 28.38)	0 (0%)	0.00 (0.00, 0.00)	0.00 (0.00, 0.00)
San Francisco												
No Incarceration (n=132)	3 (2.3%)	Referent	Referent	2 (1.5%)	Referent	Referent	1 (0.8%)	Referent	Referent	1 (0.9%)	Referent	Referent
Incarceration (n=17)	0 (0%)	0.0 (0.00, 0.00)	0.0 (0.00, 0.00)	0 (0%)	0.00 (0.00, 0.00)	0.0 (0.00, 0.00)	0.00 (0%)	0.00 (0.00, 0.00)	0.00 (0.00, 0.00)	0 (0%)	0.00 (0.00, 0.00)	0.00 (0.00, 0.00)

Table 2c.

Unadjusted and Adjusted (Weighted) Risk Ratios (RRs) and 95% Confidence Intervals (CIs) for the Associations for Incarceration and Next Six Month Incident HIV, by Study City

	Incident HIV		
	n (%)	**Unadjusted RR (95% CI)**	**Weighted RR (95% CI)**
Overall			
No Incarceration (n=798)	22 (2.8%)	Referent	Referent
Incarceration (n=137)	5 (3.6%)	1.29 (0.50, 3.34)	1.34 (0.49, 3.63)
Atlanta			
No Incarceration (n=139)	6 (4.3%)	Referent	Referent
Incarceration (n=27)	1 (3.7%)	0.86 (0.11, 6.85)	1.07 (0.13, 8.56)
New York City			
No Incarceration (n=153)	1 (0.7%)	Referent	Referent
Incarceration (n=41)	1 (2.4%)	2.35 (0.18, 31.25)	1.40 (0.10, 19.25)
Washington, DC			
No Incarceration (n=130)	2 (1.5%)	Referent	Referent
Incarceration (n=10)	1 (10.0%)	6.50 (0.64, 65.74)	3.41 (0.30, 39.03)
Boston			
No Incarceration (n=121)	1 (0.8%)	Referent	Referent
Incarceration (n=25)	0 (0%)	0.00 (0.00, 0.00)	0.00 (0.00, 0.00)
Los Angeles			
No Incarceration (n=138)	8 (5.8%)	Referent	Referent
Incarceration (n=18)	2 (11.1%)	1.92 (0.44, 8.34)	2.12 (0.49, 9.20)
San Francisco			
No Incarceration (n=117)	4 (3.4%)	Referent	Referent
Incarceration (n=16)	0 (0%)	0.00 (0.00, 0.00)	0.00 (0.00, 0.00)

Sex Transm Dis. Author manuscript; available in PMC 2023 April 01.

Table 3a.

Unadjusted and Adjusted (Weighted) Risk Ratios (RRs) and 95% Confidence Intervals (CIs) for the Associations for Incarceration and STI/HIV-related Sexual Risk Behaviors, among MSMO, MSMW, and Transgender Women

	Multiple Partnership			Buying Sex			Selling Sex			Condomless Sex with HIV+/HIV unknown (among HIV- at baseline)		
	n (%)	**Unadjusted RR (95% CI)**	**Weighted RR (95% CI)**	**n (%)**	**Unadjusted RR (95% CI)**	**Weighted RR (95% CI)**	**n (%)**	**Unadjusted RR (95% CI)**	**Weighted RR (95% CI)**	**n (%)**	**Unadjusted RR (95% CI)**	**Weighted RR (95% CI)**
MSMO												
No Incarceration (n=578)	196 (33.9%)	Referent	Referent	31 (5.4%)	Referent	Referent	29 (5.0%)	Referent	Referent	70 (16.1%)	Referent	Referent
Incarceration (n= 53)	16 (30.2%)	0.90 (0.59, 1.37)	0.68 (0.41, 1.12)	4 (7.5%)	1.37 (0.50, 3.75)	0.88 (0.31, 2.55)	7 (13.2%)	2.56 (1.18, 5.57)	2.02 (0.85, 4.78)	4 (10.8%)	0.93 (0.46, 1.90)	0.93 (0.44, 1.94)
MSMW												
No Incarceration (n= 387)	160 (41.3%)	Referent	Referent	17 (4.4%)	Referent	Referent	34 (8.8%)	Referent	Referent	24 (7.2%)	Referent	Referent
Incarceration (n= 100)	56 (56.0%)	1.30 (1.07, 1.57)	1.34 (1.10, 1.63)	11 (11.0%)	2.22 (1.10, 4.50)	2.08 (0.97, 4.44)	15 (15.0%)	1.63 (0.93, 2.85)	1.45 (0.79, 2.69)	9 (10.0%)	1.46 (0.79, 2.71)	1.39 (0.71, 2.71)
Transgender												
No Incarceration (n= 37)	16 (43.2%)	Referent	Referent	2 (5.4%)	Referent	Referent	5 (13.5%)	Referent	Referent	3 (11.1%)	Referent	Referent
Incarceration (n= 12)	10 (83.3%)	1.68 (1.10, 2.57)	1.77 (1.22, 2.57)	2 (16.7%)	2.66 (0.42, 16.65)	3.45 (0.54, 22.04)	3 (25.0%)	1.56 (0.44, 5.51)	2.01 (0.57, 7.06)	2 (20.0%)	2.08 (0.49, 8.87)	2.90 (0.70, 11.93)

*The mean and median number of partners in the past six months reported at baseline was 6 and 3 partners, respectively, among MSMO; 12 and 6.5 partners, respectively, among MSMW; and 10 and 5 partners, respectively, among transgender women.

Table 3b.

Unadjusted and Adjusted (Weighted) Risk Ratios (RRs) and 95% Confidence Intervals (CIs) for the Associations for Incarceration and Incident STI, among MSMO, MSMW, and Transgender Women

	Any STI			Chlamydia			Gonorrhea			Rectal Chlamydia and/or Gonorrhea			Syphilis		
	n (%)	**Unadjusted RR (95% CI)**	**Weighted RR (95% CI)**	**n (%)**	**Unadjusted RR (95% CI)**	**Weighted RR (95% CI)**	**n (%)**	**Unadjusted RR (95% CI)**	**Weighted RR (95% CI)**	**n (%)**	**Unadjusted RR (95% CI)**	**Weighted RR (95% CI)**	**n (%)**	**Unadjusted RR (95% CI)**	**Weighted RR (95% CI)**
MSMO															
No Incarceration (n=578)	57 (9.9%)	Referent	Referent	36 (6.2%)	Referent	Referent	14 (2.4%)	Referent	Referent	40 (6.9%)	Referent	Referent	14 (2.4%)	Referent	Referent
Incarceration(n= 53)	10 (18.9%)	2.04 (1.05, 4.00)	1.87 (0.88, 3.95)	2 (3.8%)	0.63 (0.16, 2.55)	0.82 (0.21, 3.22)	4 (7.5%)	2.91 (0.98, 8.61)	2.51 (0.77, 8.12)	5 (9.4%)	1.39 (0.62, 3.11)	1.42 (0.61, 3.33)	4 (7.5%)	2.88 (1.02, 8.15)	2.23 (0.74, 6.71)
MSMW															
No Incarceration (n= 387)	11 (2.8%)	Referent	Referent	6 (1.6%)	Referent	Referent	4 (1.0%)	Referent	Referent	6 (1.6%)	Referent	Referent	4 (1.0%)	Referent	Referent
Incarceration (n= 100)	5 (5.0%)	1.36 (0.44, 4.18)	1.14 (0.34, 3.83)	3 (3.0%)	1.69 (0.45, 6.40)	1.28 (0.31, 5.21)	2 (2.0%)	1.54 (0.30, 7.98)	1.39 (0.25, 7.61)	3 (3.0%)	1.95 (0.68, 5.59)	1.59 (0.51, 4.89)	0 (0.0%)	0.00 (0.00, 0.00)	0.00 (0.00, 0.00)
Transgender															
No Incarceration (n= 37)	7 (18.9%)	Referent	Referent	4 (10.8%)	Referent	Referent	1 (2.7%)	Referent	Referent	4 (10.8%)	Referent	Referent	3 (8.1%)	Referent	Referent
Incarceration (n= 12)	1 (8.3%)	0.63 (0.08, 4.95)	1.37 (0.21, 9.14)	0 (0.0%)	0.00 (0.00, 0.00)	0.00 (0.00, 0.00)	1 (8.3%)	2.70 (0.18 39.81)	5.92 (0.45 77.20)	1 (8.3%)	0.58 (0.08, 4.51)	1.35 (0.21, 8.81)	0 (0.0%)	0.00 (0.00, 0.00)	0.00 (0.00, 0.00)

Table 4.

Correctional Facility-based STI/HIV Prevention and Care among Participants with a History of Incarceration at Baseline (N=686)*

Variable	N (%) in the Total Sample	Atlanta (N=207)	New York City (N=256)	Washington DC (N=177)	Boston (N=173)	Los Angeles (N=207)	San Francisco (N=149)	X^2 Test Statistic (P value)
HIV Testing	283 (24.2%)	72 (50.7%)	55 (38.5%)	13 (26.5%)	48 (41.4%)	65 (46.8%)	30 (30.9%)	X^2= 16.08 P value = 0.007
Information on how to prevent HIV	174 (25.4%)	32 (22.5%)	40 (28.0%)	10 (20.4%)	28 (24.1%)	39 (28.1%)	25 (25.8%)	X^2= 2.38 P value = 0.794
Condoms	69 (10.1%)	6 (4.2%)	16 (11.2%)	6 (12.2%)	5 (4.3%)	29 (20.9%)	7 (7.2%)	X^2= 28.84 P value < 0.001

* Indicators of correctional facility STI/HIV care were based on the following item: “While you were in jail/prison, did you receive (check all that apply): HIV testing, Information on how to prevent HIV, Condoms, Treatment for HIV infection?”