Published in final edited form as:

Sex Transm Dis. 2012 June ; 39(6): 424–430. doi:10.1097/OLQ.0b013e318254c81a.

Limiting options: Sex ratios, incarceration rates and sexual risk behavior among people on probation and parole

Traci C. Green, MSc, PhD¹, Enrique R. Pouget, PhD², Magdalena Harrington, MA¹, Faye S. Taxman, PhD³, Anne G. Rhodes, PhD³, Daniel O'Connell, PhD⁴, Steven S. Martin, PhD⁴, Michael Prendergast, PhD⁵, and Peter D. Friedmann, MD, MPH¹

¹Rhode Island Hospital/Brown Medical School, Providence, RI, USA

²National Development and Research Institutes, Inc, New York, NY, USA

³George Mason University, Fairfax, VA, USA

⁴University of Delaware, Wilmington, DE, USA

⁵University of California, Los Angeles, CA, USA

Abstract

Background—To investigate how incarceration may affect risk of acquiring HIV and other sexually transmitted infections, we tested associations of ex-offenders' sexual risk behavior with the male-female sex ratio and the male incarceration rate.

Methods—Longitudinal data from 1287 drug-involved persons on probation and parole as part of the Criminal Justice Drug Abuse Treatment Studies were matched by county of residence with population factors, and stratified by race/ethnicity and gender. Generalized estimating equations assessed associations of having unprotected sex with a partner who had HIV risk factors, and having more than 1 sex partner in the past month.

Results—Among non-Hispanic Black men and women, low sex ratios were associated with greater risk of having unprotected sex with a risky partner (Adjusted relative risk (ARR) = 1.76, 95% confidence interval (CI) = 1.29, 2.42; ARR = 2.48, 95% CI = 1.31, 4.73, respectively). Among non-Hispanic Black and non-Hispanic White women, low sex ratios were associated with having more than 1 sex partner (ARR = 2.00, 95% CI = 1.02, 3.94; ARR = 1.71, 95% CI = 1.06, 2.75, respectively). High incarceration rates were associated with greater risk of having a risky partner for all men (non-Hispanic Black: ARR = 2.14, 95% CI = 1.39, 3.30; non-Hispanic White: ARR = 1.39, 95% CI = 1.05, 1.85; Hispanic: ARR = 3.99, 95% CI = 1.55, 10.26) and having more than one partner among non-Hispanic White men (ARR = 1.92, 95% CI = 1.40, 2.64).

Conclusions—Low sex ratios and high incarceration rates may influence the number and risk characteristics of sex partners of ex-offenders. HIV-prevention policies and programs for ex-offenders could be improved by addressing structural barriers to safer sexual behavior.

Keywords

criminal justice; racial/ethnic health disparities; sex ratios; parole/probation; social determinants; HIV/AIDS

Address correspondence to: Traci C. Green, M.Sc., Ph.D., Division of General Internal Medicine, Rhode Island Hospital, 593 Eddy Street, Providence, RI 02903. Telephone: (401) 444-3845; Fax: (401) 444-5040; traci.c.green@brown.edu.

There are no conflicts of interest to report for the authors of this manuscript.

Introduction

In the United States (US), one in every 100 adults is currently incarcerated, the highest rate in the world.[1] Racial and ethnic disparities in the criminal justice experience parallel those observed in HIV/AIDS, with Non-Hispanic Blacks (NHBs) and Hispanics representing about 13% and 14% of the general population, respectively,[2] but about 41% and 22% of those incarcerated,[3] and 49% and 19% of recent AIDS diagnoses.[4] Better understanding the determinants of behavior that facilitate HIV transmission among the population that experiences incarceration may be critical for understanding both overall HIV/AIDS epidemiology and trends in racial/ethnic disparities in HIV/AIDS.

Incarceration affects the inmates' sexual partnerships, social networks, families, and communities, and these effects may extend throughout the period of community supervision. People on probation and parole are required to meet regularly with a parole or probation officer and abide by supervision conditions. In 2007, 5.1 million people were on probation or parole.[5] Returning to the community may also entail a return to drug use and sexual behaviors and, for some, to an increase beyond pre-incarceration levels.[6] Prisoners returning to the community may also have limited social and economic opportunities, often experiencing homelessness, poverty and unstable living circumstances, which can contribute to vulnerability to HIV infection. People under community supervision can be especially vulnerable to population determinants of sexual behavior, and may be more likely to engage in relationships with risky sex partners. For example, high rates of relationship dissolution, difficulties finding housing or employment upon release, and relapse to drug use may encourage some ex-inmates to engage in sexual relationships in exchange for housing or money. The relative availability of partners in communities where inmates are released may facilitate or impede development of sexual relationships with multiple partners, or with partners that may be more likely to be infected with HIV or other sexually transmitted infections (STIs) themselves, or that may belong to a sexual network that includes infected individuals.

The male-female sex ratio and the male incarceration rate may represent structural or population factors outside of individual control that can affect sexual behavior and membership in sexual networks that may help explain the link between racial/ethnic disparities in HIV prevalence and in incarceration. The sex ratio is calculated as the number of men per 100 women. Although slightly more boys are born than girls, women tend to outnumber men in adulthood, as male mortality rate surpasses that of females throughout the lifespan. Incarceration, military service and migration can also lower the sex ratio. These effects may be more pronounced in some geographic areas and racial/ethnic groups. For example, a high African-American male incarceration rate may have a large impact on a city's or county's sex ratio for African-Americans in the reproductive age range (ages 15-49), but may not be noticeable at the neighborhood or state level, and may have no association with sex ratios of other racial/ethnic or age groups. A low sex ratio, indicating a shortage of men, reflects an increased demographic opportunity for the men remaining in the community to accrue more heterosexual partners. For people on probation or parole, opportunities for sexual partnerships with low-risk partners may be limited by the assortative nature of sexual partnerships and by the perception among potential partners that ex-offenders are members of a high-risk group.

While the incarceration rate may directly relate to HIV incidence through incarceration of injection drug users (IDUs), it may also serve as an independent indicator of the rate of relationship disruption or of relationship vulnerability.[6-7] Among men with primary partners, incarceration for longer than a month can lead to relationship dissolution and to having multiple sex partners upon release.[6] Having a partner who was recently

incarcerated has been associated with having multiple, transactional, concurrent, and risky partners, as well as with having had a recent HIV or STI diagnosis.[8-9] Partner characteristics are likely to reflect characteristics of risk networks. Thus, incarceration may decrease the ability of former prisoners to maintain safer social and sexual networks they may have had before incarceration. Few studies have examined sexual risk behavior during parole and probation [10-14], with most focused on individual knowledge and attitudes or relationship factors.

This study aimed to explore the influence, before and during community supervision, of two potential population determinants of sexual behavior thought to increase exposure to HIV and other STIs: the sex ratio and the male incarceration rate in the county of residence.

Materials and Methods

Sample

Data came from two completed studies with overlapping instruments that were part of the Criminal Justice Drug Abuse Treatment Studies-1 (CJDATS) cooperative agreement. One study, Transitional Case Management, tested whether case management during reentry increases participation in community drug abuse treatment, enhances access to social services, and improves outcomes over a nine-month follow-up. Eligible participants were: (a) at least 18 years old; (b) referred to a community-based substance abuse treatment program; (c) within 2-3 months of release; and (d) released to a metropolitan area where case management activities were being conducted. The second study, Step'n Out, examined the effect of collaborative behavioral management that integrated treatment counseling and community supervision versus standard parole on crime, drug use, and re-arrest over nine-month follow-up. Parolees with pre-incarceration substance use disorders at moderate-to-high-risk of recidivism constituted the target population. Inclusion criteria were: (a) at least 18 years old; (b) English speaking; (c) probable drug dependence immediately prior to incarceration (i.e., TCU Drug Screen II [15] score ≥ 3 or mandated drug treatment); (d) substance use treatment as a mandated or recommended condition of parole; (e) moderate-to-high-risk of drug relapse and/or recidivism (i.e., LCSF score ≥ 7 [16] or a history of ≥ 2 prior drug abuse treatment episodes or drug-related convictions). Neither study aimed to alter HIV risk behavior, and intervention content did not directly address HIV. Study descriptions and findings are reported elsewhere.[17-18]

Data for the present analysis included 1287 drug-involved participants on probation and parole across 23 locations and up to three time points. Study sites were located in Rhode Island, Connecticut, Delaware, Virginia, Oregon, Kentucky and Colorado.

Variables

Individual-level factors—Baseline self-reported age, race/ethnicity, gender and marital status (married/living as married with partner=1, else 0), a time-varying variable, were assessed at each interview.

Population factors—Using decennial Census data, we estimated three population factors: sex ratios, incarceration rates, and poverty rates for the participants' counties of recruitment and follow-up, which were used as an indicator for county of residence. Poverty rate served as a control variable. County was assumed to approximate the catchment area of potential sexual partners. Two separate sex ratios were calculated for each racial/ethnic group. An assortative or *matched* sex ratio was calculated for the NHB, non-Hispanic White (NHW), and Hispanic populations. A *disassortative* sex ratio was also calculated for each race/ethnicity using the sum of the population in racial/ethnic categories other than that of the

target racial/ethnic group. To facilitate comparisons, a median split defined categories of the population factors for each race/ethnicity and gender, where low sex ratios and high incarceration and poverty rates were dummy coded (1/0). In locations with sparse data for a given racial category, the population factor was set to missing, but was retained in the analysis as a separate category. Table 1 defines the population factor cut-points.

Outcomes—HIV/AIDS risk behaviors were collected by interview at baseline, three- and nine-month follow-up using a modified version of the NIDA Risk Behavior Assessment.[18] We analyzed two sexual risk behaviors reported in the past 30 days: sex with multiple partners (any gender) and unprotected sex with a risky partner. Sex with multiple partners was defined as reporting two or more to the following question: “In the past 30 days, how many different people have you had sex (vaginal, anal, or oral) with?”. People who reported 0 or 1 partner were included in the reference group. Engaging in unprotected sex with a risky partner was defined as greater than 0 response to any of the following questions: “How many times in the past 30 days have you had unprotected sex (vaginal, anal or oral) with: a) someone who is not your primary partner; b) someone who shot drugs with needles; c) someone who sometimes smokes crack/cocaine and/or methamphetamine; or d) while trading sex for drugs, money or gifts?”. People who reported 0 to all of these questions or who reported no sex in the past 30 days were included in the reference group.

Analysis

Because of known race and gender differences in criminal justice populations,[1] drug use, [19] health equity,[20] and HIV risk behaviors,[21] we stratified the analyses into: NHB males, NHW males, Hispanic Males, NHB females, and NHW females. Hispanic females (N=39) and all other race categories (N=55) were excluded due to small population sizes. To adjust for similarities within site and across time on the same participant, generalized estimating equations with a log link (to estimate relative risks) were built. Because our goal was to generate population-average estimates of the association between population-level determinants and HIV sexual risk behavior and given their greater statistical flexibility, GEEs were preferred over non-linear mixed models (e.g., SAS Proc GLIMMIX). Parallel analyses were conducted using Proc GLIMMIX as a sensitivity analysis. Similar findings for many of the analyses were detected but appeared less robust when there were smaller sample sizes with only 2-3 points per person, a known drawback of this modeling approach[22]. Multicollinearity was checked for the full models using variance inflation factors and, when indicated, reduced, parsimonious models are presented. All models controlled for individual-level factors and time (as a fixed effect). Individual-level factors included: age, time, CJDATS study (Transitional Case Management or Step’n’Out), and marital status. Time interactions were tested but were either not significant or unstable (due to sparse data), therefore we present only main effects.

This study was approved by the Rhode Island Hospital Institutional Review Board (IRB) and, for the two underlying studies, by each site IRB and the federal Office of Human Research and Protection.

Results

Sample characteristics and pre-incarceration HIV risk behaviors

Analysis included 1051 males and 236 females. Men were a median 34 years old, less than one third had completed high school, and a minority were married or living as married with a partner prior to incarceration (Table 2). Women were a median 35 years old and also had low educational attainment. Pre-incarceration HIV sexual risk behaviors were common. Having multiple sex partners in the past 30 days was reported by more than a third of men,

and slightly under a third of women. NHB men had the highest prevalence of having multiple sex partners in the 30 days prior to incarceration. Both NHB men and women had the lowest prevalence of having unprotected sex with a risky partner in the 30 days prior to incarceration.

Population factors differed greatly across racial/ethnic groups (Table 1). NHB participants had higher median rates for incarceration and lower median sex ratio values compared to both NHW and Hispanic participants.

Social determinants and HIV sex risk behaviors during community supervision

Table 3 reports unadjusted and adjusted relative risk ratios for the population determinants of interest, stratified by gender and race/ethnicity.

Non-Hispanic Black participants

Among NHB male participants, both unadjusted (RR 1.35 [1.03, 1.77] and adjusted (ARR 2.14 [1.39, 3.30]) models revealed significant associations of higher incarceration rate with increased risk of having unprotected sex with a risky partner. Adjusted (ARR 1.76 [1.29, 2.42]) models detected significant associations of lower matched sex ratio with increased risk of having unprotected sex with a risky partner. Sex ratios and incarceration rates were not significantly associated with having multiple recent sex partners among NHB male participants.

In unadjusted analyses among NHB female participants, the matched sex ratio exhibited a strong association with the risk of engaging in unprotected sex with a risky partner (RR 2.37 [1.27, 4.39]) and having multiple sex partners (RR 2.14 [1.12, 4.09]). However, the adjusted model demonstrated multicollinearity between the poverty rate and sex ratio variables. Therefore, reduced models were fit that removed the variables in a stepwise fashion. Reduced models without poverty rate confirmed the previously detected associations between the matched sex ratio and the risk of engaging in unprotected sex with a risky partner during community supervision (ARR 2.48 [1.31, 4.73]) and with a low matched sex ratio and greater risk of having multiple sex partners (ARR 2.00 [1.02, 3.94]).

Non-Hispanic White participants

For the NHW males, a higher incarceration rate (ARR 1.39 [1.05, 1.85]) was associated with both increased risk of engaging in unprotected sex with a risky partner and with having multiple sex partners (ARR 1.92 [1.40, 2.64]).

Unadjusted models for the NHW females revealed associations between the low *disassortative* sex ratio (RR 1.72 [1.03, 2.88]) and having multiple sex partners. Multicollinearity between poverty and both sex ratios precluded multivariable analysis of having multiple partners. Reduced adjusted models that removed poverty and age and included either sex ratio found an association between lower sex ratio and having multiple partners (matched ARR 1.71 [1.06, 2.75] or *disassortative* sex ratio ARR 1.72 [1.06, 2.77]), Table 3. GEEs with logit links were also fit to these data: low sex ratios (matched Adjusted Odds Ratio 4.16 [1.55, 11.1]; *disassortative* sex ratio AOR 4.17 [1.57, 11.08]) were associated with increased odds of having multiple partners, controlling for age and poverty.

Hispanic participants

Among Hispanic males, a higher incarceration rate (ARR 3.99 [1.55, 10.26]) and a lower *disassortative* sex ratio (ARR 2.99 [1.63, 5.51]) were associated with increased risk of having unprotected sex with a risky partner in the adjusted model (Table 3). Sex ratios and

incarceration rates were not significantly associated with having multiple recent sex partners in this group.

Discussion

In this sample of people on probation and parole, sex ratios and incarceration rates in the county of residence predicted the quantity and HIV risk characteristics of recent sex partners. NHB male and female participants living in counties with low NHB sex ratios had greater risk of having unprotected sex with a risky partner. For these groups, the interaction between having been incarcerated and living in an area with a shortage of men may facilitate participation in or entrance into riskier sexual networks. This could partly explain elevated HIV and STI rates among African Americans compared to whites. For NHB women, low NHB sex ratios were also associated with having multiple partners. The status of NHB men as ex-offenders may have limited their opportunities to acquire less risky partners.

Significant associations were also observed among NHW and Hispanic participants. High incarceration rates were associated with greater risk of having unprotected sex with a risky partner among Hispanic men and of having both unprotected sex with a risky partner and having more than one partner among NHW men. Hispanic men were *more* likely to have unprotected sex with a risky partner if the *disassortative* sex ratio was low. NHW women were more likely to have multiple partners if they lived in a county with low matched *or* *disassortative* sex ratios. The associations of *disassortative* sex ratios among NHW women and Hispanic men may reflect more inter-racial/ethnic opposite sex partnerships with risky partners.

A recent national population-based study found that low sex ratios and high male incarceration rates were associated with a greater likelihood of having multiple partners in the past year among NHB men, but not among NHB women.[23] While the population and sexual behavior questions differ from those of the current study, the findings among NHB men are similar. One other study of the affects of sex ratios and incarceration rates on sexual behavior among African-Americans showed no association among men, and a *positive* association among women.[24] Further analyses indicated that this finding was the result of less sex work among women in low sex ratio areas. However, that study employed sex ratio data from the census tract (a smaller geographic unit) in a single geographic area, and it is unclear how well this unit describes the area in which people seek partners.[25] Geographic studies of mobility of drug-involved parolees suggest this population changes residences across moderate distances.[26] Thus, county of residence may provide a reasonable estimate of the catchment area for potential sex partners.

Poverty was treated as a control variable in our analyses, and was retained whenever possible in the models. Modeling problems arose when collinearity with one or more of the exposures of interest. As this happened only in instances among the women, and sample sizes for the women were the smallest, it is not possible to entirely disentangle the effects of small cell sizes (a statistical problem) from sex-specific vulnerabilities (a sociological problem). That is, collinearity may have been due to high levels of the female probationer/parolee's particular vulnerabilities, linked to syndemics [27-29] of sex work, transactional sex, limited social support and family ties, proclivity to return to neighborhoods with concentrated poverty, high male incarceration rates, and fewer same-race male partners. Analyses to explore these associations in a larger sample of women under community supervision are needed.

Results underscore the fragility of the re-entry period and the need to focus efforts on housing, work assistance and job placement in the community. Ex-offenders are disqualified

from many sources of public support, have difficulty finding employment [11], and people convicted of state or federal felonies involving the use or sale of drugs are banned from receiving cash benefits or food stamps.[30] These diminished life opportunities may decrease ex-offenders' ability to develop and maintain committed sexual partnerships or marriage. This may be more pronounced among NHB males because of high levels of unemployment and incarceration.

Our findings have several limitations. First, data were self-reported and may have been affected by measurement error. Sexual risk behavior outcomes did not distinguish between vaginal, anal and oral sex, and between same-gender and opposite-gender sex. Further, it was not possible to distinguish all instances of condom use from sex and thus, results may conflate influences on both frequency of sex and frequency of condom use. The sample may not have provided sexual risk or population data that were representative of all racial/ethnic populations on community supervision. The lack of a control group precludes analysis of incarceration as an individual factor. For the Transitional Case Management study, which recruited participants in prison, county of recruitment may be a poor proxy for county of residence. However, sensitivity analyses iteratively eliminating Transitional Case Management sites indicated no fundamental change in the magnitude or direction of the observed associations. The relatively small size of racial/ethnic subsamples precluded testing nonlinear associations with sex ratios, which are known to exist [23]. We were unable to include data from counties with small populations. Last, our exploratory analyses detected statistically significant and valid associations, but the use of GEEs with a log link returned unstable RRs in some strata, especially the women. Replication of these findings in a larger sample of women recently released from incarceration is recommended.

Implications

A lack of adequate primary and secondary HIV preventive interventions suggests that new approaches are needed to reduce HIV transmission to and from minority populations [31]. To this end, efforts to address population factors may return greater HIV prevention effects. For instance, interventions to reduce the incarceration rate in a community, such as through the use of drug courts,[32] or implementation research that realigns police and parole/probation officer interventions with public health goals [33], could help reduce sexual risk behavior and sexual network dynamics that facilitate HIV transmission. This kind of policy intervention could improve outcomes by both reducing the number of individuals experiencing incarceration, and by reducing the contribution of high rates of incarceration to sex ratio imbalance. Improving access to treatment for drug-dependent inmates prior to release and upon re-entry can reduce recidivism, improve health outcomes,[34] and, in time, may promote lifestyle and sexual partnership stability. Other policy interventions, such as lifting restrictions against people with criminal histories from receipt of public housing or other support, can influence community HIV risk by reducing a structural barrier that undermines committed partnerships.[11] Public health may be served by helping incarcerated men and women maintain their marriages or other important partnerships, especially considering that most incarcerations last under 1 year,[3], many people are reincarcerated.[1], and relationship dissolution has been found to be related to subsequent sexual risk behavior.[6]

In conclusion, our findings suggest that ex-offenders living in counties with a low sex ratio or a high incarceration rate are particularly vulnerable to sexual behavior and partner characteristics that may put them at risk for HIV or other STIs, particularly for those living in high prevalence areas. Research is needed to determine if racial/ethnic differences in sex ratios or incarceration rates contribute to racial/ethnic disparities in sexual transmission of HIV or other STIs.

Acknowledgments

Funding for this work was provided under a cooperative agreement from the National Institute on Drug Abuse, National Institutes of Health (NIDA/NIH), with support from the Center for Substance Abuse Treatment, SAMHSA; the Centers for Disease Control and Prevention (CDC); the National Institute on Alcohol Abuse and Alcoholism (all part of the U.S. Department of Health and Human Services); and from the Bureau of Justice Assistance of the U.S. Department of Justice. The funding source had no role in the design or conduct of the study, including, data collection, analysis, interpretation, writing or decision to publish.

References

1. Pew Charitable Trust. One in 100: Behind Bars in America 2008. 2008
2. US Bureau of the Census. 2009
3. West, HC.; Sabol, W.; Cooper, M. Prisoners in 2008. Washington, D.C.: U.S. Department of Justice, Bureau of Justice Statistics; 2009.
4. Centers for Disease Control and Prevention. HIV/AIDS Surveillance by Race/Ethnicity (through 2008). 2009
5. Glaze LE, Bonczar TP. Edited by Statistics BoJ. Probation and Parole in the United States, 2007 Statistical Tables. 2008
6. Khan MR, Behrend L, Adimora AA, Weir SS, Tisdale C, Wohl DA. Dissolution of Primary Intimate Relationships During Incarceration and Associations With Post-Release STI/HIV Risk Behavior in a Southeastern City. *Sex Transm Dis*. 2011; 38:43–47. [PubMed: 20739913]
7. Thomas JC, Torrone E. Incarceration as forced migration: The community health effects. *Am J Public Health*. 2006; 96:1762–1765. [PubMed: 17008570]
8. Khan, MR.; Epperson, M.; Mateu-Gelabert, P.; Bolyard, M.; Sandoval, M.; Friedman, S. *Am J Public Health*. Brooklyn, NY: A Social Network Perspective; 2009. Incarceration, Sex with an STI/HIV-Infected Partner, and STI/HIV Infection Status in Bushwick.
9. Epperson M, El-Bassel N, Gilbert L, Chang M. Examining the temporal relationship between criminal justice involvement and sexual risk behaviors among drug-involved men. *Journal of Urban Health*. 2010; 87:324–336. [PubMed: 20143270]
10. Belenko S, Langley S, Crimmins S, Chaple M. HIV risk behaviors, knowledge, and prevention education among offenders under community supervision: a hidden risk group. *AIDS Educ Prev*. 2004; 16:367–385. [PubMed: 15342338]
11. Blankenship KM, Smoyer AB, Bray SJ, Mattocks K. Black-white disparities in HIV/AIDS: The role of drug policy and the corrections system. *J Health Care Poor Underserved*. 2005; 16:140–156. [PubMed: 16327113]
12. Oser CB, Leukefeld CG, Tindall MS, Havens JR, Webster JM, Smiley-McDonald HM, et al. Male and female rural probationers: HIV risk behaviors and knowledge. *AIDS Care*. 2006; 18:339–344. [PubMed: 16809111]
13. Martin SS, O'Connell DJ, Inciardi JA, Surratt HL, Beard RA. HIV/AIDS among probationers: an assessment of risk and results from a brief intervention. *J Psychoactive Drugs*. 2003; 35:435–443. [PubMed: 14986872]
14. Knudsen HK, Leukefeld C, Havens JR, Duvall JL, Oser CB, Staton-Tindall M, et al. Partner relationships and HIV risk behaviors among women offenders. *J Psychoactive Drugs*. 2008; 40:471–481. [PubMed: 19283951]
15. Peters RH, Greenbaum PE, Steinberg ML, Carter CR, Ortiz MM, Fry BC, et al. Effectiveness of screening instruments in detecting substance use disorders among prisoners. *J Subst Abuse Treat*. 2000; 18:349–358. [PubMed: 10812308]
16. Walters GD, McDonough JR. The Lifestyle Criminality Screening Form as a predictor of federal parole/probation/supervised release outcome. *Legal and Criminological Psychology*. 1998; 3:173–181.
17. Prendergast ML. Interventions to promote successful re-entry among drug-abusing parolees. *Addict Sci Clin Pract*. 2009; 5:4–13. [PubMed: 19369913]

18. Friedmann PD, Katz EC, Rhodes AG, Taxman FS, O'Connell DJ, Frisman LK, et al. Collaborative Behavioral Management for Drug-Involved Parolees: Rationale and Design of the Step'n Out Study. *J Offender Rehabil.* 2008; 47:290–318. [PubMed: 19809591]
19. Van Etten ML, Neumark YD, Anthony JC. Male-female differences in the earliest stages of drug involvement. *Addiction.* 1999; 94:1413–1419. [PubMed: 10615725]
20. Committee on Quality of Health Care in America IoM. *Crossing the Quality Chasm: A New Health System for the 21st Century.* Washington, D.C.: 2001.
21. Kaiser Family Foundation. *Women and HIV/AIDS in the United States.* 2008
22. Allison, PD. *Logistic Regression Using SAS: Theory and Application.* Cary, NC: SAS Institute Inc.; 1999.
23. Pouget ER, Kershaw TS, Niccolai LM, Ickovics JR, Blankenship KM. Associations of sex ratios and male incarceration rates with multiple opposite-sex partners: potential social determinants of HIV/STI transmission. *Public Health Rep.* 2010; 125(Suppl 4):70–80. [PubMed: 20626195]
24. Senn TE, Carey MP, Vanable PA, Urban MA, Sliwinski MJ. The male-to-female ratio and multiple sexual partners: multilevel analysis with patients from an STD clinic. *AIDS Behav.* 2010; 14:942–948. [PubMed: 18483848]
25. Fossett MA, Kiecolt KJ. A methodological review of the sex ratio: alternatives for comparative research. *J Marriage Fam.* 1991; 53:941–957.
26. Cahill, M.; LaVigne, N. Residential mobility and drug use among parolees in San Diego, California, and implications for policy. In: Thomas, YF.; Richardson, D.; Cheung, I., editors. *Geography and Drug Addiction.* Springer; 2008.
27. Romero-Daza N, Weeks M, Singer M. “Nobody gives a damn if I live or die”: violence, drugs, and street-level prostitution in inner-city Hartford, Connecticut. *Med Anthropol.* 2003; 22:233–259. [PubMed: 12893541]
28. Singer M, Clair S. Syndemics and public health: reconceptualizing disease in bio-social context. *Med Anthropol Q.* 2003; 17:423–441. [PubMed: 14716917]
29. Singer MC, Erickson PI, Badiane L, Diaz R, Ortiz D, Abraham T, et al. Syndemics, sex and the city: understanding sexually transmitted diseases in social and cultural context. *Soc Sci Med.* 2006; 63:2010–2021. [PubMed: 16782250]
30. Allard, P. *Life sentences: denying welfare benefits to women convicted of drug offenses.* Washington, DC: The Sentencing Project; 2002.
31. Hallfors DD, Iritani BJ, Miller WC, Bauer DJ. Sexual and drug behavior patterns and HIV and STD racial disparities: the need for new directions. *Am J Public Health.* 2007; 97:125–132. [PubMed: 17138921]
32. Gottfredson DC, Kearley BW, Najaka SS, Rocha CM. The Baltimore City Drug Treatment Court: 3-year self-report outcome study. *Eval Rev.* 2005; 29:42–64. [PubMed: 15604119]
33. Davis CS, Beletsky L. Bundling occupational safety with harm reduction information as a feasible method for improving police receptiveness to syringe access programs: evidence from three U.S. cities. *Harm Reduct J.* 2009; 6:16. [PubMed: 19602236]
34. Haig T. Randomized controlled trial proves effectiveness of methadone maintenance treatment in prison. *Can HIV AIDS Policy Law Rev.* 2003; 8:48. [PubMed: 15108656]

TABLE 1

Population factors per 10,000 population: median splits defined

	Males			
	Matched sex ratio	Disassortative sex ratio	Incarceration rate	Poverty rate*
Non-Hispanic White: <cutoff	97.5	105	147	Continuous
Non-Hispanic Black: <cutoff	80.5	98.3	800	10.89
Hispanic: <cutoff	100	96	600	10.89
	Females			
	Matched sex ratio	Disassortative sex ratio	Incarceration rate	Poverty rate*
Non-Hispanic White: <cutoff	98.1	95	145	Continuous
Non-Hispanic Black: <cutoff	80.63	98.36	800	10.02

Control variable, not exposure variable

TABLE 2
Socio-demographics, drug use, and sexual risk behavior baseline characteristics of the analytic sample

Characteristic	Males				Females			
	Non-Hispanic White N = 433	Non-Hispanic Black N = 455	Hispanic N = 163		Non-Hispanic White N = 151	Non-Hispanic Black N = 85		
Median age [lsqb]25%, 75%[rsqb]	35 [lsqb]28, 42[rsqb]	34 [lsqb]26, 41[rsqb]	31 [lsqb]25, 38[rsqb]	$\chi^2(2) = 12.14$	35 [lsqb]27, 42[rsqb]	37 [lsqb]29, 43[rsqb]	$\chi^2(1) = 1.66$	pvalue 0.2
Completed High School, N(%)	145 (33.49%)	157 (34.51%)	28 (17.18%)	$\chi^2(2) = 18.22$	65 (43.33%)	26 (30.59%)	$\chi^2(1) = 0.69$	0.41
Married/living with partner, N(%)	56 (12.93%)	74 (16.26%)	32 (19.63%)	$\chi^2(2) = 4.52$	27 (18.00%)	11 (12.94%)	$\chi^2(1) = 0.05$	0.83
Baseline past 30 d sexual risk behavior, N (%)								
>1 sex partner	137 (31.64%)	199 (44.32%)	55 (33.74%)	$\chi^2(2) = 16.25$	46 (30.46%)	25 (29.76%)	$\chi^2(1) = 0.01$	0.91
Number of multiple partners, median [lsqb]25%, 75%[rsqb]	3 [lsqb]2, 4[rsqb]	3 [lsqb]2, 5[rsqb]	3 [lsqb]2, 4[rsqb]	$\chi^2(2) = 0.20$	4 [lsqb]2, 11[rsqb]	3 [lsqb]2, 5[rsqb]	$\chi^2(1) = 0.51$	0.48
Unprotected sex with a risky partner	216 (52.55%)	161 (36.84%)	66 (42.31%)	$\chi^2(2) = 21.47$	86 (59.72%)	27 (35.06%)	$\chi^2(1) = 6.55$	0.01

TABLE 3
Unadjusted and adjusted race/ethnicity- and gender-stratified generalized estimating equation regression results

		Non-Hispanic Black Participants					
Unprotected sex with a risky partner in the past 30 d		Men (n = 455)			Women (n = 85)		
		Unadjusted	Adjusted	Unadjusted	Unadjusted	Reduced	
		RR (95% CI)	RR (95% CI)	RR (95% CI)	RR (95% CI)	RR (95% CI)	
Male Incarceration Rate	High	1.35 [lsqb]1.03, 1.77[rsqb]	2.14 [lsqb]1.39, 3.30[rsqb]	0.97 [lsqb]0.53, 1.75[rsqb]	1.05 [lsqb]0.35, 3.10[rsqb]		
	Low	1.0 -	1.0 -	1.0 -	1.0 -		
Matched Sex Ratio	Low	1.25 [lsqb]0.96, 1.63[rsqb]	1.76 [lsqb]1.29, 2.42[rsqb]	2.37 [lsqb]1.27, 4.39[rsqb]	2.48 [lsqb]1.31, 4.73[rsqb]		
	Not calculated*	1.41 [lsqb]0.98, 2.01[rsqb]	1.84 [lsqb]0.46, 7.39[rsqb]	-	-		
Disassortative Sex Ratio	High	1.0 -	1.0 -	1.0 -	1.0 -		
	Low	0.98 [lsqb]0.76, 1.27[rsqb]	0.70 [lsqb]0.44, 1.11[rsqb]	1.22 [lsqb]0.66, 2.25[rsqb]	0.73 [lsqb]0.24, 2.25[rsqb]		
Sex with more than 1 partner in the past 30 d	Not calculated	1.28 [lsqb]0.91, 1.80[rsqb]	0.97 [lsqb]0.27, 3.53[rsqb]	-	-		
	High	1.0 -	1.0 -	1.0 -	1.0 -		
		Men (n = 455)			Women (n = 85)		
		Unadjusted	Adjusted	Unadjusted	Unadjusted	Reduced	
		RR (95% CI)	RR (95% CI)	RR (95% CI)	RR (95% CI)	RR (95% CI)	
Male Incarceration Rate	High	0.92 [lsqb]0.75, 1.14[rsqb]	1.14 [lsqb]0.81, 1.63[rsqb]	0.93 [lsqb]0.49, 1.75[rsqb]	0.60 [lsqb]0.31, 1.19[rsqb]		
	Low	1.0 -	1.0 -	1.0 -	1.0 -		
Matched Sex Ratio	Low	1.20 [lsqb]0.97, 1.48[rsqb]	1.15 [lsqb]0.92, 1.45[rsqb]	2.14 [lsqb]1.12, 4.09[rsqb]	2.00 [lsqb]1.02, 3.94[rsqb]		
	Not calculated	0.73 [lsqb]0.48, 1.11[rsqb]	1.21 [lsqb]0.41, 3.56[rsqb]	-	-		
Disassortative Sex Ratio	High	1.0 -	1.0 -	1.0 -	1.0 -		
	Low	0.84 [lsqb]0.67, 1.03[rsqb]	0.79 [lsqb]0.54, 1.16[rsqb]	0.88 [lsqb]0.45, 1.72[rsqb]	0.84 [lsqb]0.33, 2.15[rsqb]		
Unprotected sex with a risky partner in the past 30 d	Not calculated	0.57 [lsqb]0.37, 0.87[rsqb]	0.53 [lsqb]0.18, 1.53[rsqb]	-	-		
	High	1.0 -	1.0 -	1.0 -	1.0 -		
		Men (n = 433)			Women (n = 151)		
		Unadjusted	Adjusted	Unadjusted	Unadjusted	Reduced	
		RR (95% CI)	RR (95% CI)	RR (95% CI)	RR (95% CI)	RR (95% CI)	
Non-Hispanic White Participants							

Non-Hispanic Black Participants									
Unprotected sex with a risky partner in the past 30 d									
		Men (n = 455)			Women (n = 85)				
		Unadjusted		Adjusted	Unadjusted		Adjusted	Reduced	
		RR	(95% CI)	RR	RR	(95% CI)	RR	(95% CI)	RR
Male Incarceration Rate	High	1.20	[lsqb]0.99, 1.45[rsqb]	1.39	[lsqb]1.05, 1.85[rsqb]	1.18	[lsqb]0.86, 1.60[rsqb]	0.99	[lsqb]0.73, 1.33[rsqb]
	Low	1.0	-	1.0	-	1.0	-	1.0	-
Matched Sex Ratio	Low	1.13	[lsqb]0.94, 1.37[rsqb]	0.87	[lsqb]0.66, 1.15[rsqb]	1.46	[lsqb]1.08, 1.97[rsqb]	1.03	[lsqb]0.71, 1.49[rsqb]
	High	1.0	-	1.0	-	1.0	-	1.0	-
Disassortative Sex Ratio	Low	0.78	[lsqb]0.64, 0.95[rsqb]	0.79	[lsqb]0.63, 1.00[rsqb]	1.45	[lsqb]1.07, 1.96[rsqb]	-	-
	High	1.0	-	1.0	-	1.0	-	1.0	-
Sex with more than 1 partner in the past 30 d									
		Men (n = 433)			Women (n = 151)				
		Unadjusted		Adjusted	Unadjusted		Adjusted	Reduced	
		RR	(95% CI)	RR	RR	(95% CI)	RR	(95% CI)	RR
Male Incarceration Rate	High	1.37	[lsqb]1.05, 1.78[rsqb]	1.92	[lsqb]1.40, 2.64[rsqb]	0.81	[lsqb]0.49, 1.34[rsqb]	0.83	[lsqb]0.52, 1.30[rsqb]
	Low	1.0	-	1.0	-	1.0	-	1.0	-
Matched Sex Ratio	Low	1.10	[lsqb]0.85, 1.43[rsqb]	0.94	[lsqb]0.63, 1.39[rsqb]	1.67	[lsqb]1.00, 2.79[rsqb]	1.71	[lsqb]1.06, 2.75[rsqb]
	High	1.0	-	1.0	-	1.0	-	1.0	-
Disassortative Sex Ratio	Low	1.04	[lsqb]0.80, 1.35[rsqb]	1.33	[lsqb]0.91, 1.95[rsqb]	1.72	[lsqb]1.03, 2.88[rsqb]	-	-
	High	1.0	-	1.0	-	1.0	-	1.0	-

Hispanic Male Participants (n = 163)									
Unprotected sex with a risky partner in the past 30 d									
		Unadjusted		Adjusted					
		RR	(95% CI)	RR	(95% CI)				
Male Incarceration Rate	High	1.19	[lsqb]0.80, 1.78[rsqb]	3.99	[lsqb]1.55, 10.26[rsqb]				
	Low	1.0	-	1.0	-				
Matched Sex Ratio	Low	0.92	[lsqb]0.62, 1.38[rsqb]	0.72	[lsqb]0.40, 1.28[rsqb]				
	Not calculated	1.47	[lsqb]0.82, 2.63[rsqb]	-	-				
	High	1.0	-	1.0	-				
Disassortative Sex Ratio	Low	1.18	[lsqb]0.77, 1.79[rsqb]	2.99	[lsqb]1.63, 5.51[rsqb]				
	Not calculated	1.68	[lsqb]0.90, 3.14[rsqb]	5.54	[lsqb]1.73, 17.71[rsqb]				

Sex with more than 1 partner in the past 30 d		High	1.0	-	1.0	-
			Unadjusted		Adjusted	
			RR	(95% CI)	RR	(95% CI)
Male Incarceration Rate	High	1.03	[lsqb]0.74, 1.45[rsqb]		1.26	[lsqb]0.62, 2.60[rsqb]
	Low	1.0	-		1.0	-
Matched Sex Ratio	Low	0.99	[lsqb]0.64, 1.52[rsqb]		0.96	[lsqb]0.58, 1.58[rsqb]
	Not calculated	1.24	[lsqb]0.59, 2.59[rsqb]		-	-
Disassortative Sex Ratio	High	1.0	-		1.0	-
	Low	1.06	[lsqb]0.68, 1.64[rsqb]		1.03	[lsqb]0.58, 1.83[rsqb]
	Not calculated	1.29	[lsqb]0.60, 2.78[rsqb]		0.84	[lsqb]0.28, 2.56[rsqb]
	High	1.0	-		1.0	-

Not calculated due to population size < 1,000 residents within racial/ethnic category, after removing incarcerated population.

Not calculated due to population size < 1,000 residents within racial/ethnic category, after removing incarcerated population.
relative risk

Bold values are $P < 0.05$

Note. Adjusted models are adjusted for age, time, CJDATS study (Transitional Case Management or Step'N'Out), marital status, county poverty rate and the other factors in the table, except where noted.
Reduced models are adjusted for age, time, CJDATS study (Transitional Case Management or Step'N'Out), and marital status but include a reduced set of population factors, as defined in the manuscript text.