



Self-reported sexually-transmitted infections and criminal justice involvement among women who use drugs



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ARTICLE INFO

Keywords:

Criminal justice involvement
Sexually-transmitted infection
Sex exchange
Drug use

ABSTRACT

Background: Women involved in the criminal justice system in the United States have high rates of sexually transmitted infections (STI). It is unknown whether criminal justice involvement is a marker for other risk behavior, such as sex exchange or drug use, or criminal justice involvement itself increases risk directly.

Methods: This study examines the relationship between STI and the frequency and duration of arrest, probation, and incarceration in a sample of women who use drugs ($n = 394$) in Oakland, California who reported having been tested for STI in the past six months. Logistic regression models of STI using criminal justice measures as independent variables were used, and subsequent estimates were adjusted for demographics, sex exchange, specific drugs used, and number of sexual partners.

Results: Any time spent in jail in the past year was associated with higher odds of recent STI (UOR = 2.28, 95%CI [1.41–3.51]), and short incarcerations (2–3 weeks) in jail most substantially increased the odds of an STI diagnosis (UOR = 7.65, 95%CI [1.03, 56.68]). Arrest and probation were not significantly associated with STI. After adjusting for the covariates, particularly sex exchange and opioid use, none of the criminal justice-related variables were significantly associated with STI.

Conclusions: A substantial portion of the increased risk of STI that is associated with criminal justice involvement for women who use drugs is likely due to sex exchange. Longitudinal studies are needed to temporally separate criminal justice exposures, drug use, sex exchange, and STI outcomes.

1. Introduction

Women involved in the criminal justice (CJ) system have a high prevalence of sexually transmitted infections (STI), with rates of chlamydia, gonorrhea, and trichomonas that are more than double those seen in women without CJ involvement. (Datta, Torrone, Kruszon-Moran, et al., 2012; Fox, Whittington, Levine, et al., 1996; Hardick, Hsieh, Tulloch, et al., 2003; Joesoef, Weinstock, Kent, et al., 2009; Kouyoumdjian, Leto, John, et al., 2012; Mertz, Schwebke, Gaydos, et al., 2002; Nijhawan, Chapin, Salloway, et al., 2012) These high rates are consistent with findings that women who have been arrested or incarcerated are more likely to report high risk partnerships, multiple new partnerships, unprotected sex, and transactional sex than women who have never been incarcerated. (Epperson, Khan, Miller, et al., 2010; Khan, Epperson, Mateu-Gelabert, et al., 2011; Khan, Miller, Schoenbach, et al., 2008; Rogers, Khan, Tan, et al., 2012; Widman, Noar, Golin, et al., 2014; Wise, Finlayson, Nerlander, et al., 2017) In

addition, CJ involved women also disproportionately come from communities with high rates of CJ involvement for men, which alters sexual networks and the male-to-female sex ratio in ways that may favor STI transmission. (Dauria, Elifson, Arriola, et al., 2015; Dauria, Oakley, Arriola, et al., 2015; Knittel, Snow, Riolo, et al., 2015)

Although the data demonstrating associations between CJ involvement and STI are generally quite strong and consistent, addressing the confounding influences of sex exchange and drug use is often challenging for researchers. Women who engage in sex exchange are more likely to be involved in the criminal justice system and also have more sexual partners and thus more potential exposures to STI, and their ability to negotiate for condom use varies by context. (Fogel & Belyea, 1999; Hankel, Heil, Dewey, et al., 2015) Women who use drugs bear a disproportionate burden of criminal justice involvement and are more likely engaged in high risk sexual behaviors and to have high risk sexual partners. (Cotten-Oldenburg, Jordan, Martin, et al., 1999; Lorvick, Comfort, Kral, et al., 2017) It remains unclear whether an arrest,

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<https://doi.org/10.1016/j.abrep.2019.100219>

Received 13 March 2019; Received in revised form 14 August 2019; Accepted 8 September 2019

Available online 11 September 2019

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episode of probation or incarceration is simply a marker for a combination of measured and unmeasured risk factors for STI, including sex exchange and drug use, or whether the CJ involvement itself increases risk. Although some studies take into account the effects of drug use, surprisingly few address sex exchange as another factor that may independently affect both the likelihood of criminal justice involvement and risk for STI. (Hankel et al., 2015; Khan, Epperson, et al., 2011; Rich, Cortina, Uvin, et al., 2013; Rogers et al., 2012; Wise et al., 2017) Understanding the relationships between CJ involvement and STI risk as well as sex exchange and drug use will help public health practitioners, correctional health professionals, and mental health and substance use treatment providers identify appropriate points of intervention to decrease STI risk for this population.

Our aim with this secondary analysis was to examine the relationship between self-reported STI and criminal justice involvement among women who use drugs. We hypothesized that episodes of incarceration could increase self-reported STI risk by disrupting relationships and increasing economic hardship (through loss of housing, employment, etc) with an associated increased engagement in sex exchange. (Hankel et al., 2015; Rich et al., 2013) We also hypothesized that arrest and probation, both less intense types of involvement in the criminal justice system, might also disrupt relationships due to the increased burden of court appearances, increased scrutiny by police, or stigma. We further hypothesized that if these articulated relationships were correct then we would see a dose-response relationship, with increased frequency of criminal justice involvement associated with increased risk for self-reported STI, and a mediation effect of sex exchange.

2. Methods

2.1. Study design

This study is a secondary analysis of the Oakland Women's Health Study, a cross-sectional survey which aimed to measure unmet healthcare needs and the range and accumulation of criminal justice involvement in a population of women who use illicit drugs. A detailed description of the primary study are published elsewhere. (Lorvick et al., 2017) From September 2014 to August 2015, targeted sampling methods were used to recruit 631 adult women in Oakland, California, who had used crack/cocaine, methamphetamine, or heroin within the 30 days prior to recruitment. (Kral, Malekinejad, Vaudrey, et al., 2010) An outreach worker who was very familiar with the community drug use scene recruited women from street settings, parking lots, homeless encampments, and similar venues centrally located in two neighborhoods with high levels of poverty, police activity, drug trade, and urban blight. Potential participants were referred to the study field site for eligibility screening. The survey was administered by trained interviewers, who read items aloud and recorded responses in a laptop-based survey instrument. The measures described below were selected from the study interview for this secondary analysis. Study staff referred participants to local services and provide resources for support such as shelters and food pantries in addition to the study incentive. All procedures were reviewed and approved by the institutional review board (IRB) at RTI International, and this secondary data analysis was approved by the IRB at the University of California, San Francisco.

2.2. Measures

2.2.1. STI

Respondents indicated the date of their last STI testing and self-reported whether they had been told they had either gonorrhea, chlamydia, or trichomonas at that time. The primary survey did not include questions about other STIs, and so our analyses was limited to these three. The time between the last test and the date of the interview was calculated, and respondents whose last test was in the six months prior to the interview were considered to have a recent test.

2.2.2. Criminal justice involvement

We asked respondents whether they had ever been arrested, their age at the time of first arrest, and how many times they had been arrested. We also asked whether they had been arrested in the past year. We elicited jail incarceration experiences by asking whether the individual had ever spent time, even one day, in city or county jail, with follow-up questions asking the number of lifetime jail incarcerations, the total time spent in jail as an adult, and their age at the first time they were sent to jail as an adult. We also asked respondents how many times they had been to jail in the past year, and the total amount of time in the past year they had spent in jail. We repeated this same series of questions for prison incarceration. We asked women about probation and parole in the past year, and questions further detailed the amount of time in the past year spent under each probation and parole supervision. Relatively few women reported prison incarceration or parole in the past year, and so these variables were ultimately not used for analyses.

2.2.3. Demographics

We asked women their ages directly, and this was confirmed using their dates of birth. We defined educational level as whether the respondent had completed a high school diploma or equivalent. Women were asked to indicate whether they considered themselves White, African American/not Latina, Latina/not African American, African American Latina, Asian, Pacific Islander, or Native American. We created dummy variables for African American race, White race, and Latina ethnicity to use in this analysis. Fewer than 5% each of the respondents were Asian, Pacific Islander, or Native American.

2.2.4. Drug use

We asked respondents which drugs, in the past six months, they had used, including marijuana, crack or rock cocaine, powder cocaine by itself, heroin by itself, speedball (heroin plus cocaine or crack), other opioids (Oxycontin, codeine, Percocet, etc) without a prescription, benzodiazepines (Valium, Klonopin, Xanax etc.), methamphetamine (crystal), or methadone without a prescription. The question about other opioids was situated in the interview with other questions about non-prescribed and/or illegal drug use, but did not specify whether the other opioids had been prescribed or not.

2.2.5. Sexual risk

Respondents were asked about the total number of male and female sexual partners they had in the past six months. We used the number of male partners for our analyses, and specified this as a dichotomous indicator of having ten or more male partners in the past six months because of evidence of rounding (i.e., reports of numbers of partners that were multiples of five or ten) and because our descriptive analyses suggested few differences between groups of women with fewer than ten partners (data not shown). Concurrency was assessed by asking "did any of [these sex partners] overlap? In other words you had sex with partner A, then partner B, and then partner A again." Sexual exchange was measured with two questions by asking respondents whether, in the past six months, any male sex partners had given them money in exchange for sex or drugs in exchange for sex.

2.3. Statistical approach

Descriptive statistics for the study sample were generated to provide a foreground of respondents' experiences with the criminal justice system and their demographics, sexual behavior, and drug use. This included means with standard deviations (SD) and medians with interquartile ranges (IQR) for continuous variables, and proportions for dichotomous variables. We used two-sided *t*-tests and chi-square tests with Fisher's exact test to compare the complete study sample with the subsample that had recent STI testing. Bivariate logistic regression models were created to calculate unadjusted odds ratios for self-

Table 1
Description of the study sample, non-criminal justice variables, and the comparison between the subsample with recent STI testing and those without and *p*-values from Fisher's exact test.

| Variable | Complete study sample (<i>n</i> = 631) ^a Percent (N) | Subsample with recent STI test (<i>n</i> = 394) ^a Percent (N) | <i>p</i> -value ^b |
|---|--|---|------------------------------|
| Age | | | (< 0.01) |
| 18–24 | 3.2 (20) | 3.6 (14) | |
| 25–34 | 13.9 (88) | 17.0 (67) | |
| 35–44 | 21.9 (138) | 24.6 (97) | |
| 45–54 | 37.1 (234) | 34.3 (135) | |
| 55–64 | 21.1 (133) | 17.5 (69) | |
| 65 and over | 2.9 (18) | 3 (12) | |
| Race and ethnicity | | | |
| Black | 86.1 (543) | 86.8 (342) | (0.48) |
| White | 5.1 (32) | 3.6 (14) | (0.03) |
| Latinx | 4.8 (30) | 5.1 (20) | (0.03) |
| Native American | 2.4 (15) | 1.3 (5) | (0.03) |
| Asian | 0.3 (2) | 0.5 (2) | (0.53) |
| Pacific Islander | 0.3 (2) | 0.3 (1) | (1.00) |
| Educational attainment | | | (0.01) |
| Less than high school/GED | 36.8 (232) | 40.9 (161) | |
| High school/GED or more | 63.2 (399) | 59.1 (233) | |
| Drug use in the past six months | | | |
| Marijuana | 63.9 (402) | 62.9 (248) | (0.55) |
| Crack | 80.8 (508) | 79.4 (313) | (0.30) |
| Cocaine | 35.5 (223) | 38.8 (153) | (0.03) |
| Heroin | 40.2 (253) | 37.6 (148) | (0.09) |
| Speedball | 13.4 (84) | 14.0 (55) | (0.63) |
| Other opioids | 32.3 (203) | 30.7 (121) | (0.29) |
| Benzodiazepines | 21.9 (138) | 19.8 (78) | (0.11) |
| Methamphetamines | 26.4 (166) | 26.1 (103) | (0.85) |
| Methadone | 10.4 (65) | 9.2 (36) | (0.22) |
| Currently have a steady partner | 47.1 (297) | 50.0 (197) | (0.06) |
| Number of male partners (six months) | | | (0.07) |
| 0 | 19.7 (124) | 16.8 (66) | |
| 1 | 33.4 (211) | 33.2 (131) | |
| 2–3 | 18.2 (115) | 18.3 (72) | |
| 4–10 | 11.4 (72) | 11.9 (47) | |
| > 10 | 17.3 (109) | 19.8 (78) | |
| Number of female partners (six months) | | | (0.61) |
| 0 | 89.4 (564) | 88.8 (350) | |
| 1 | 5.7 (36) | 5.3 (21) | |
| 2–3 | 3.3 (21) | 4.1 (16) | |
| 4–10 | 0.3 (2) | 0.3 (1) | |
| > 10 | 1.3 (8) | 1.5 (6) | |
| Concurrent male sexual partners | 39.8 (250) | 44.3 (174) | (< 0.01) |
| Sex exchange (six months, male partners) | 55.3 (260) | 54.4 (168) | (0.63) |
| Self-reported STI at last test ^c | 21.7 (107) | 13.4 (37) | (< 0.01) |

Boldface indicates significance.

^a Categories do not sum to the total if there was missing data or participants were allowed to select more than one option, as was the case for race/ethnicity and drug use.

^b The *p*-values are associated with chi-square statistics for comparison of proportions.

^c Sexually transmitted infections (STI) included gonorrhea, chlamydia, and trichomonas.

reported STI with the independent variables of demographics, criminal justice involvement, and drug use. Then, multivariable logistic regression models were constructed containing those variables which were significant at the 0.05 level in the bivariate analyses. We did not include demographic covariates that were not statistically significant in order to create the most parsimonious and precise models possible. We examined sex exchange as a mediating factor in the relationship between criminal justice involvement and STI using the strategies outlined by Baron and Kenny (Baron & Kenny, 1986).

3. Results

Of the 631 women in the overall sample, 394 had STI testing in the past six months and comprised the study subsample (Table 1). Compared with those who had not been tested for STI in the past six months, those with recent STI testing tended to be younger, identify as White, Latina, or Native American, and fewer had completed high school or equivalent. They were more likely to be cocaine users and to have concurrent male partners. A smaller proportion reported an STI at the time of their last test. The study subsample did not significantly differ from the overall sample in terms of the proportion engaging in sex exchange, the proportion with a steady partner, nor in the distribution of numbers of sexual partners. In terms of criminal justice involvement, those with recent STI testing were more likely to have been arrested or on probation in the past 12 months, but did not differ in terms of their jail or prison experiences.

The majority of the women in the study subsample identified as African American and were aged 18–68, with mean age of 44 years (SD 10.94). Just over 40% had not completed high school or equivalent. All of the participants had used drugs in the past six months, with the majority reporting crack use (79%), followed by cocaine use (39%), heroin use (37%), other opioid use (31%) and methamphetamine use (26%). The majority of the subsample also used marijuana (63%). Exactly half reported having a steady partner, and more than half had engaged in sex exchange in the past six months. The mean number of male partners in the past six months was 17.2 (SD 63.14), although this was inflated significantly by those women reporting up to 500 partners, as the median of male partners in the past six months was one (IQR 1–4). A relatively small proportion of women had female partners in the past six months.

Over 80% of the subsample with recent STI testing had ever been arrested or spent time in jail during their lives, 25% and 30% had been arrested or in jail, respectively, in the past year, and just over 20% had ever spent time in prison. On average, they were first arrested as adults at the age of 24, although first arrests happened to women as young as 18 and as old as 57. Women had spent an average of 23 months in jail and 4.7 years in prison. Criminal justice involvement is shown in Table 2.

There were 37 (13.4%) women with recent STI testing who reported gonorrhea, chlamydia, or trichomonas diagnosis at the time of their last test. Including those whose test had been more than six months prior, there were 107 (21.7%) who reported that they had been told they had an STI at the time of that test.

In the bivariate analyses, significant associations between recent STI infection and the non-criminal justice involvement variables were found with sex exchange, number of sexual partners, concurrent partners, and opioid use apart from heroin or methadone, as shown in Table 3. Engaging in sex exchange in the past six months was associated with a more than fourfold increase in the odds of STI in the past six months, as was the use of other opioids. There was a small but significant effect of each additional male partner in the past six months, with a 0.4% increase in the odds of STI with each additional partner.

Notably, concurrency and sex exchange were highly correlated, and there were very few women who endorsed having concurrent partnerships in the past six months who were not also engaged in sex exchange (correlation coefficient = 0.67, *n* = 33, data not shown). As a result, the decision was made to include only sex exchange in the multi-variable models, as we determined that the majority of concurrent sexual partnerships were captured by using the variable for sex exchange. The correlation coefficient for sex exchange and having more than ten sexual partners was 0.48. Opioid use apart from heroin and methadone was not correlated with sex exchange, concurrency, or having ten or more sexual partners (correlation coefficients = 0.05, 0.09, 0.02, respectively). The other significant variables from the bivariate analyses (having ten or more sexual partners and opioid use apart from heroin and methadone) were included in the adjusted

Table 2
Description of the study sample, criminal justice variables, and the comparison between the subsample with recent STI testing and those without.

| Variable | Complete study sample (n = 631) ^a Percent (N) | With recent STI test (n = 394) ^a Percent (N) | Without recent STI test (n = 237) ^a Percent (N) | p-values ^b |
|----------------------------|--|---|--|-----------------------|
| Ever arrested as an adult | 86.4 (539) | 86.7 (340) | 85.8 (199) | (0.81) |
| Ever been on probation | 69.7 (436) | 67.0 (264) | 74.1 (172) | (0.11) |
| Ever been in jail | 83.2 (519) | 82.9 (325) | 83.6 (194) | (0.91) |
| Ever been in prison | 21.5 (116) | 21.2 (72) | 22.1 (44) | (0.83) |
| Arrested in the past year | 26.3 (140) | 29.1 (98) | 21.4 (42) | (0.03) |
| Probation in the past year | 16.8 (71) | 21.0 (54) | 10.3 (17) | (< 0.01) |
| Jail in the past year | 23.1 (146) | 24.6 (97) | 20.7 (49) | (0.28) |

| Variable | Mean (SD) | Mean (SD) | Mean (SD) | p-values ^b |
|---|-------------|---------------|-------------|-----------------------|
| Age at first arrest | 24.5 (7.64) | 23.9 (7.41) | 25.4 (7.95) | (0.03) |
| Total number of arrests – past year | 0.20 (0.69) | 0.24 (0 0.81) | 0.13 (0.40) | (0.09) |
| Total time spent in jail – past year (weeks) | 1.1 (4.24) | 1.3 (4.69) | 0.7 (3.33) | (0.14) |
| Total time spent in prison – lifetime (years) | 1 (2.97) | 1.1 (2.95) | 0.9 (3.00) | (0.54) |

Boldface indicates significance.

^a Categories do not sum to the total if there was missing data or participants were allowed to select more than one option, as was the case for race/ethnicity and drug use.

^b The p-values are associated with chi-square statistics for comparison of proportions and Fisher's exact test for comparison of means.

Table 3
Unadjusted and adjusted^a odds ratios for the relationships between non-criminal justice variables and self-reported recent STI.

| Variable | Unadjusted | Adjusted |
|---|-----------------------------|-----------------------------|
| | OR (95% CI) | OR (95% CI) |
| Age over 45 | 0.73 (0.34, 1.45) | |
| Race and ethnicity | | |
| African American | 1.24 (0.32, 4.73) | |
| White | 2.60 (0.39, 17.46) | |
| Latina | 1.10 (0.19, 6.41) | |
| Educational attainment | 0.73 (0.37, 1.47) | |
| Sex exchange in the past six months (male partners) | 4.72 (1.74, 12.77)** | 3.24 (1.06, 9.92)* |
| Drug use in the past six months | | |
| Marijuana | 0.84 (0.38, 1.85) | |
| Crack | 2.64 (0.92, 7.58) | |
| Cocaine | 1.53 (0.69, 3.37) | |
| Heroin | 1.00 (0.39, 2.51) | |
| Speedball | 2.42 (0.82, 7.12) | |
| Other opioids | 4.08 (1.81, 9.17)** | 4.01 (1.77, 9.11)*** |
| Benzodiazepines | 0.55 (0.21, 1.43) | |
| Methamphetamines | 1.22 (0.49, 3.03) | |
| Methadone | 0.72 (0.22, 2.37) | |
| Ten or more male partners in the past six months | 2.79 (1.34, 5.78)* | 1.98 (0.80, 4.90) |
| Currently have a steady partner | 0.65 (0.32, 1.31) | |
| Concurrent male sexual partners | 3.04 (1.41, 6.53)* | |

Boldface indicates significance.

* $p < 0.05$.

** $p < 0.01$.

*** $p < 0.001$.

^a Adjusted for sex exchange for money or drugs, other opiate use, concurrent male sexual partners, and having ten or more male partners in the past six months.

models of the association between CJ involvement and STI.

The bivariate relationships between sex exchange in the past six months and criminal justice involvement were statistically significant for probation in the past year (OR 2.16, 95% CI [1.04, 4.48]), jail incarceration in the past year (OR 2.44, 95% CI [1.41, 4.20]), having one jail incarceration (OR 2.15, 95% CI [1.12, 4.13], reference = none), having two or more jail incarcerations (OR 3.00, 95% CI [1.29, 6.99], reference = none), and spending over 12 weeks in jail in the past year

(OR 6.05, 95% CI [1.75, 20.94], reference = 0–1 weeks). The relationships between sex exchange and arrest in the past year (OR 1.91, 95% CI [0.98, 3.69]), the frequency of arrest in the past year (OR 1.11, 95% CI [0.76, 1.62]), and having a partner in jail in the past year (OR 0.74, 95% CI [0.33, 1.65]) were not statistically significant.

Of the criminal justice variables, having been in jail in the past year was associated with increased odds of reporting a recent STI in the bivariate analyses (Table 4, Column 1). Although longer durations of jail incarceration did not significantly increase risk, having spent 2–3 weeks in jail in the past year was associated with an increased odds of recent STI diagnosis. Neither the number of jail incarcerations nor partner incarceration were significantly associated with STI diagnosis. Once the significant covariates of sex exchange for money or drugs, other opioid use, and the number of male partners in the past six months were added into the models, the effects of all of the criminal justice-related variables lost statistical significance, although remained in the same direction. These are shown in Table 4, Column 2. When the multivariable models included age and race, the point estimates for all of the variables were nearly identical, but the confidence intervals were wider (data not shown).

4. Discussion

At the outset, we hypothesized that there would be a dose-response relationship between criminal justice involvement and reported STIs, with different proposed mechanisms for arrest, probation and incarceration. Our results did not support this hypothesis, and suggest instead a different conceptual model for the relationships between episodes of criminal justice involvement and risk for STI among women who use drugs. Our findings suggest that their risk of STI is not significantly affected by arrest, probation, or either very short or very long episodes of incarceration. Risk is increased for women who experience episodes of jail time that last 2–3 weeks, although drug use accounts for some of this observed association and there may be partial mediation by engagement in sex exchange. Our results support prior findings that sexual risk behavior is increased after shorter incarceration episodes but not necessarily after longer ones, and suggest that this may be due to drug use and sex exchange (Khan et al., 2008).

Our findings overall support that engagement sex exchange mediates to some extent the relationship between criminal justice involvement and STI, in that it is significantly associated with criminal justice involvement and also significantly associated with STI, and when it is

Table 4
Unadjusted and adjusted^a odds ratios (OR) for the relationships between criminal justice variables and recent STIs.

| Variables | Unadjusted | | Adjusted | |
|--|-------------|---------------------------------|----------|---------------|
| | OR | CI (95%) | OR | CI (95%) |
| Ever arrested as an adult | 4.44 | (0.58, 33.7) | | |
| Arrest in the past year | 1.91 | (0.93, 3.91) | | |
| Each additional arrest in the past year | 1.11 | (0.76, 1.61) | | |
| Ever been on probation | 1.00 | (0.97, 1.03) | | |
| Probation in the past year | 1.47 | (0.62, 3.46) | | |
| Ever been in jail | 6.45 | (0.86, 48.5) | | |
| Jail in the past year | 2.28 | (1.12, 4.61)[*] | 1.84 | (0.80, 4.27) |
| Number of jail incarcerations in the past year (Ref = 0) | | | | |
| Once | 2.12 | (0.89, 5.02) | | |
| More than once | 2.49 | (1.00, 6.19) | | |
| Time in jail in the past year – weeks (Ref = 0–1) | | | | |
| 2–3 | 7.65 | (1.03, 56.7)[*] | 6.47 | (0.62, 67.63) |
| 4–12 | 1.46 | (0.46, 4.58) | 1.31 | (0.329, 5.30) |
| Over 12 | 2.25 | (0.77, 6.61) | 1.67 | (0.48, 5.76) |
| Steady partner in jail in the past year (Ref = No) | 0.81 | (0.23, 2.91) | | |
| Ever been in prison | 0.87 | (0.38, 2.04) | | |

Boldface indicates significance.

^{*} $p < 0.05$.

^a Adjusted for sex exchange for money or drugs, other opiate use, and having ten or more male partners in the past six months.

included in the multivariable models, the effect sizes and statistical significance of the relationships between criminal justice involvement and STI are reduced. (Baron & Kenny, 1986) This is consistent with several of our hypothesized mechanisms through which criminal justice involvement could lead to increased STI risk. An episode of incarceration lasting two to three weeks is long enough to disrupt housing and employment arrangements, potentially increasing the need to engage in sex trade activity. This duration of incarceration is also long enough to result in permanent disruption of relationships, as has been described for incarcerated men. (Khan, Behrend, Adimora, et al., 2011) The ending of a committed partnership may result in financial instability and a subsequent increase in the exchange of sex for money, housing, or drugs, placing recently incarcerated women at an increased risk of sexual violence and unprotected sexual encounters. (Fogel & Belyea, 1999; Fogel, Gelaude, Carry, et al., 2014) We speculate that among our high risk study population, an arrest, probation, or an overnight jail stay is not enough to disrupt relationships and as such arrests and very short episodes of incarceration are not associated with increased risk of STI.

Given the cross-sectional design of our study, it is also possible that the STI preceded the episode of incarceration. A short jail stay of 2–3 weeks may be just long enough for women to receive an STI test during their incarceration, resulting in an association between this duration of incarceration and STI risk. This suggests that jails should routinely screen for STIs among women as early as is feasible during their incarceration.

We also note that for both transactional and non-transactional sexual relationships, short-term relationship disruption due to criminal justice involvement may be associated with the development of concurrency if a partner who remains in the community develops new sexual relationships during the period of incarceration and then resumes the previous relationship when the incarcerated partner is released from jail. (Knittel, Lambdin, Comfort, et al., 2019) Although better described for the female partners of incarcerated men, the male partners of incarcerated women likely also have emotional needs, physical desires, and financial constraints that cannot be met by their incarcerated partner and which could lead to new partnerships during the time that the partner is incarcerated. We speculate that an incarceration lasting several weeks is long enough for new sexual relationships to occur while the partner is incarcerated, but short enough that the initial relationship resumes, which would result in concurrency.

In sum, we propose that episodes of incarceration lasting two to three weeks are long enough to disrupt women's relationships, housing, and employment sufficiently that they may rely more heavily on exchanging sex to meet their basic needs, with an associated increase in STI risk. In addition, two-to-three week jail incarcerations are short enough to disrupt some sexual relationships only temporarily, with a potential increase in concurrent partnerships. Qualitative studies that examine women's own explanations for changes in their sexual partnerships and engagement in sex exchange after an episode of incarceration as well as larger studies of women's criminal justice involvement and STI risk will be needed to improve our understanding of these issues. Our findings depart from those that describe a consistent and statistically significant relationship between all measures of criminal justice involvement and STI, likely due to the ability of our study to account for the previously unmeasured contribution from exchanging sex for drugs or money to the risk of STI. (Khan, Epperson, et al., 2011; Rogers et al., 2012; Wise et al., 2017)

We also found that there was a highly significant relationship between opioid use other than heroin and STI risk, and that this accounted for some of the association between criminal justice involvement and STI risk. There have been relatively few studies examining the associations between non-medical use of prescription opioids and STI. One study identified opioid-dependent women as less likely to delay sex in order to obtain a condom, potentially increasing risk for STI, but in a large, nationally representative sample, non-prescription opioid use was not associated with STI diagnosis after adjusting for demographics and other drug use. (Herrmann, Hand, Johnson, et al., 2014; Tetrault, Fiellin, Niccolai, et al., 2010) Our findings may reflect a more recent association between non-medical use of prescription opioids and STI, given that the negative findings were from data collected in 2005, or may reflect a more regional or local dynamic in which the complex relationships between opioid use, other drug use, and sex exchange result in increased risk for STI. In either circumstance, our results highlight that addressing the opioid epidemic may improve sexual health outcomes and even the increase in HIV risk that is directly related to injection drug use.

The limitation of our study sample to women who use drugs clearly affects the conclusions that we draw, and may have limited our ability to identify a separate effect of criminal justice involvement. Women in our study were not clinically evaluated for substance use disorder; however, the high rates of homelessness, criminal justice involvement, and other adverse consequences of substance use that have been

documented in the study suggest that most would meet clinical criteria for substance use disorder. (Lambdin, Comfort, Kral, et al., 2018; Lorvick et al., 2017) Women who use drugs are disproportionately represented in the criminal justice system, and as such also suffer the physical, social, and economic collateral consequences of criminal justice involvement. (Lorvick et al., 2017; Rich et al., 2013) Women who use drugs also engage in high risk sexual behaviors and have higher rates of STI than their non-drug-using counterparts, complicating our analyses further. (Bogart, Kral, Scott, et al., 2005; Flom, Friedman, Kottiri, et al., 2001) Although women who use drugs are a unique marginalized group, and an important target for multilevel STI and HIV prevention interventions, excluding women who do not use drugs makes separation of the effects of drug use from the effects of criminal justice involvement much more difficult. We attempted to address this limitation by testing the associations between specific kinds of drug use and reports of STI in our sample, and then including significant confounders in our adjusted models. We are hopeful that these results may inspire further data collection among broader groups of women at risk for criminal justice involvement.

The self-reported STI outcome that we used for our analysis is not as reliable as a biological test for STI, which is a limitation that cannot be overcome with data analysis. Women with STIs may never have been tested and/or notified of their diagnosis, women who were diagnosed with an STI nearly six months before the survey interview may have had poor recall regarding the timing of their STI, and social desirability bias may have limited the STIs that were reported to the interviewers. However, we do note that nearly two-thirds of our overall sample reported having an STI test in the past six months. In addition, recall bias and social desirability bias likely affected all of the women relatively equally, suggesting that while systematic underreporting of STIs may have diminished our ability to identify a significance difference in the groups if one existed, these two forms of bias are unlikely to have influenced the direction of the relationships we observed. In addition, from other analyses we know that most women in our sample had some form of health insurance, but those women with higher levels of criminal justice involvement were more likely to have unmet health needs. (Lorvick et al., 2017) If CJ involved women were overall less likely to be screened and as a result had fewer of their infections diagnosed, our results may represent an underestimate of the effect of CJ involvement on STI.

Although the primary study from which this secondary analysis sample was drawn includes an impressive number of women who use drugs, our subsample of women with recent STI testing was smaller. This meant that there were also smaller numbers of women in each of the categories of criminal justice involvement, and contributed to the extremely broad confidence intervals that we reported. There was also multicollinearity affecting the indicators of sexual risk, exacerbated by the smaller sample size. To mitigate this, we minimized the number of variables we included in the multivariable models, and did not attempt to model more complex relationships such as mediation or moderation, but a larger sample size would have allowed us to estimate more precise effects.

Finally, in terms of the limitations of this study, we note that no cross-sectional study allows for conclusions regarding causality and that issues of temporality plague studies that address the complex intersecting social forces that result in disproportionate exposure to disease, also called syndemics, such as drug use, criminal justice involvement, and STIs. (Brennan, Kuhns, Johnson, et al., 2012; Kelly, Cheng, Spencer-Carver, & Ramaswamy, 2014; Singer, Erickson, Badiane, et al., 2006) This highlights a need for longitudinal data collection focused on women's experiences with each of these issues, and for the inclusion of questions about criminal justice involvement in clinical and social science research. We are optimistic that, lacking the data to allow for compelling causal arguments, our results demonstrating associations between criminal justice involvement, sex exchange, drug use, and STI will motivate the development of prevention interventions that focus on

each of these components.

Taking the findings and the limitations of this study together, we conclude that criminal justice involvement broadly represents a marker of risk for STI, and a substantial portion of the effect of criminal justice involvement on STI risk may be accounted for by sex work and drug use among CJ involved women. Given this, criminal justice involvement certainly represents an optimal time for intervention, regardless of whether an episode of incarceration independently increases risk for STI after reentry into the community. In addition, our finding that STI risk may be increased following 2–3 week episodes of incarceration suggest that this may be a particularly fruitful point of intervention, whether to help women talk about concurrency and STI risk while maintaining supportive and safe relationships during periods of incarceration, or to equip them with additional skills and tools for the prevention of STIs on their return to the community. The relationships between criminal justice involvement, sex exchange, and drug use are ultimately driven by the criminalization of sex exchange and drug use, poor access to evidence-based therapies for substance use disorders, and the lack of a social safety net for women experiencing poverty. Substantially decreasing the risk of STI for women who are involved in the criminal justice system will require not only individual intervention for women involved in the criminal justice system to reduce risk in their relationships, but also policy intervention to improve education, skills training, housing, and employment assistance, decriminalize sex exchange, and treat substance use disorders such that criminal justice involvement itself is reduced.

Declaration of competing interest

The authors declare that they have no conflicts of interest.

Acknowledgements

Dr. Knittel received support from the University of North Carolina at Chapel Hill Center for AIDS Research (CFAR), an NIH funded program (P30 AI50410). Dr. Lorvick's work on this study and the original data collection was supported by a grant from NIMHD (RO1MD007679). The authors would like to thank Ms. Reana Thomas for her assistance with manuscript preparation.

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