Incidence and Prevalence of Incarceration in a Longitudinal Cohort of Women at Risk for Human Immunodeficiency Virus in the United States, 2007–2017

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Abstract

Background: To estimate the incidence, prevalence, frequency, and duration of incarceration and to identify risk factors for incarceration among women at risk for human immunodeficiency virus (HIV) in the United States.
Methods: During semiannual study visits in a multicenter cohort study, 970 HIV sero-negative participants at risk for HIV were asked about their own incarceration (10/2007–09/2017) and incarceration of sexual partners (10/2013–09/2017). We used descriptive statistics and multivariable log-binomial regression to identify baseline predictors of incident incarceration.
Results: Median follow-up time across the 970 participants was 5.5 years (IQR 3.5–9.5). Nearly half ($n = 453$, 46.7%) of participants were incarcerated during or before the study, and the incarceration rate was 5.5 per 100 person-years. In multivariable models, incident incarceration was associated with prior incarceration (RR 5.20, 95% CI: 3.23–8.41) and noninjection drug use (RR 1.57, 95% CI: 1.10–2.25).
Conclusions: Incarceration is common for women at risk for HIV. Prevention interventions that address the complex interplay of drug use, sex exchange, and housing instability for women who have experienced incarceration have the potential to reach an important group of U.S. women at risk of HIV infection.

Keywords: incarceration, women, HIV risk, PrEP

Introduction

For women in the United States (U.S.), incarceration and other involvement with the criminal justice system are associated with high-risk sexual and drug use behaviors, which are known risk factors for acquisition of the human immunodeficiency virus (HIV). Women who have been incarcerated are more likely to have multiple sexual partners, engage in sex exchange, and have condomless sex compared to women who have never been incarcerated.[1–8] Furthermore, approximately half of all women incarcerated in the U.S. have a history of substance use, and one quarter have injected

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drugs.[9,10] Among U.S. women, intersections of poverty, racism, discrimination, racial segregation, policing, drug policy, and mass incarceration of men of color have also disproportionately concentrated risk for both HIV acquisition and incarceration among Black and Latina women.[11,12] The shifting epidemiology of injection drug use in the setting of the opioid epidemic and the several hundred-fold increase in hepatitis C virus infection in recent years also suggest that rural White women form an emerging risk group for both HIV acquisition and incarceration.[13,14] In this context, most incarcerated women also meet Centers for Disease Control and Prevention (CDC) criteria for pre-exposure prophylaxis (PrEP) for HIV.[15–17]

As of 2018, CDC estimates that there are 176,670 heterosexual women in the U.S. at substantial enough risk for HIV to warrant PrEP, and the number of women eligible for PrEP due to injection drug use is growing.[13,18,19] These numbers largely represent unmet need for PrEP, however, as women's awareness and initiation of and persistence with PrEP in the U.S. have been limited.[20,21] Given the overall low HIV prevalence among U.S. women, individually identifying and reaching all of the women who would consider using PrEP, even within high-risk groups, would require a broad campaign of engagement with women's health care providers to consider women's sexual histories, individual vulnerabilities to HIV, and personal risk assessment.[22,23]

We, and others, have suggested that providing HIV prevention interventions to women who have experienced incarceration would help to address HIV risk among populations involved in the criminal justice system.[24,25] However, it is not known whether interventions with these groups would reach a substantial proportion of all women at risk for HIV in the U.S., as there are no published estimates of the incidence or prevalence of incarceration among women at risk for HIV. To address this gap in the literature, we estimated: (1) the incidence, prevalence, frequency, and duration of incarceration; (2) risk factors for incarceration; and (3) the frequency of incarceration of their sexual partners, within a longitudinal cohort of women at high risk for HIV in the U.S.

Materials and Methods

Study population

The Women's Interagency HIV Study (WIHS) is a geographically diverse multicenter cohort study of women living with or at risk for HIV in the U.S.; recruitment, retention, and participant characteristics are described elsewhere.[26] Since initiation of the cohort in 1993, women were recruited in four waves. The current clinical sites are in Bronx, NY, Brooklyn, NY, Washington, DC, San Francisco, CA, Chicago, IL, Chapel Hill, NC, Atlanta, GA, Miami, FL, Birmingham, AL, and Jackson, MS; the Southern sites (NC, GA, FL, AL, and MS) were added and the Los Angeles, CA site was discontinued in 2013.

HIV-seronegative women were eligible for the most recent wave of the WIHS if they had at least one self-reported high HIV risk characteristic in the preceding 5 years. High-risk characteristics included sexually transmitted infection diagnosis, condomless sex with three or more men, sex with six or more men, sex exchange for money or drugs; sex with an HIV-seropositive man, injection drug use, or use of crack cocaine, cocaine, heroin, or methamphetamine; or any partner who had any of the previously mentioned risk characteristics. The HIV sero-negative WIHS participants are socioeconomically and racially similar to WIHS participants with HIV and to the general U.S. population of women living with HIV: the majority are Black, and most are poor.[26] Women at risk for HIV were not offered PrEP as part of their WIHS participation, but receipt of PrEP during the study period was captured in the dataset. Visits occur approximately every 6 months.

The current analysis included HIV-seronegative women at risk for HIV who attended a study visit during the study period between October 2007 and September 2017 and who were ever queried about incarceration during that time frame. Four women who acquired HIV during the study period were excluded. We also conducted analyses on three subsamples of these participants, as shown in Table 1 and Figure 1.

Measures

Incarceration. During their first visit during the study period, women were asked whether they had ever been incarcerated. At subsequent visits they were asked whether they had been incarcerated in the past 6 months. The interview did not distinguish between jail versus prison incarceration and provided no information on the charge or conviction that resulted in incarceration.

Incident incarceration. Participants were asked whether they had been incarcerated in the past 6 months. Study staff also indicated visits conducted during an incarceration and missed visits due to incarceration based on information provided by the participant during or after the visit.

Incarceration frequency and duration. Women who reported incarceration since the last visit were asked about the incarceration frequency and duration. Women who indicated at their first visit during the study period that they had ever been incarcerated were asked about incarceration frequency and duration before the study period.

Partner incarceration. Participants were asked whether they had any male sexual partners and whether any of these male sexual partners had been incarcerated in the past 6 months.

Demographics. Age at incarceration was calculated for incarcerations which occurred during the study period. Race was categorized as ''Black,'' ''White,'' or ''other.'' Hispanic ethnicity and completion of high school or equivalent were dichotomous variables.

Housing instability. Participants were asked about housing at every visit and were considered unstably housed if they reported living in a rooming/boarding/halfway house, in a shelter or welfare hotel, or on the street in the prior 6 months.

Sex exchange. Women reported at each visit whether they had exchanged sex for drugs, money, or shelter in the past 6 months; this was treated as a binary variable.

Drug use. Drug use was specified with two dichotomous variables, indicating (1) any injection drug use and (2) any noninjection drug use (crack, cocaine, heroin, marijuana, hallucinogens, club drugs, or methamphetamines) in the past 6 months.

TABLE 1. ANALYSIS SAMPLES AND SUBSAMPLES OF PARTICIPANTS AT RISK FOR HUMAN IMMUNODEFICIENCY VIRUS INFECTION, WOMEN'S INTERAGENCY HUMAN IMMUNODEFICIENCY VIRUS STUDY, 2007–2017

	Inclusion criteria	*Timeframe*	*Analysis*	N
Sample				
Women at risk for HIV infection	Participants had a study visit and were asked about incarceration during the study period	Oct 2007–Sept 2017	Incidence and prevalence of incarceration	970
Subsample				
Total incarcerated time (Subsample 1)	Participants responded to baseline questions about the total amount of time incarcerated before the study period	Oct 2010–Sept 2017	Total amount of time spent incarcerated over the lifetime	290
Risk factors for incarceration (Subsample 2)	Participants who enrolled in the WIHS before the start of the study period who contributed one or more visits within the study period	Oct 2007–Sept 2017	Estimation of relative risk of any incident incarceration	603
Partner incarceration (Subsample 3)	Participants had at least one male sexual partner and ever responded to questions about partner incarceration during the study period	Oct 2013–Sept 2017	Prevalence of partner incarceration	614

To address missing data at the first visit during the study period, we carried forward previously reported values and then filled remaining missing characteristics with values reported at the next visit. Missing values for age, race, and site were logically imputed based on baseline data. Except where noted, we did not impute incarceration characteristics (status, duration, or number of episodes); descriptive analyses of these characteristics are complete case analyses. The log-binomial regression analyses were conducted on a dataset with similar rates of missingness handled in the same ways.

Statistical analysis

Prevalence of incarceration was calculated using an aggregate of women's responses to: (1) incarceration before the study period; (2) incarceration since the prior visit during the study period; and study staff report of (3) visits conducted during incarceration; and (4) missed visits due to incarceration. The numerator included women who had been incarcerated by any of these measures. The denominator was the number of women with nonmissing responses to at least one of these incarceration measures. Women who had reported not being incarcerated at one or more time points but who had one or more missing visits were assumed to be not incarcerated during those periods. Details regarding the sample and subsamples used for each of these analyses are shown in Table 1 and Figure 1.

The total number of lifetime incarcerations experienced by women was calculated as the sum of the number of prestudy period incarcerations and the number of incarcerations during the study period. Women were excluded from this calculation if they did not provide a number of incarcerations at any time period. A small number of women were asked the number of prestudy period incarcerations at two visits; women with conflicting responses were assigned the highest of the numbers they reported. All periods in which the number of incarcerations was not reported among women who responded to this question at other time periods were assumed to have no episodes of incarceration.

The total amount of time spent incarcerated over the lifetime was calculated as the sum of the durations of all incarcerations before and during the study period. The total amount of prestudy period incarcerated time was only asked of women who enrolled in October 2010 or later, and so only these women were included in this calculation (Subsample 1, Table 1). The average length of an episode of incarceration was calculated using the duration of only those episodes of incarceration during the study period. Incarceration episodes with no reported duration were excluded.

The proportion of women with at least one incarcerated male partner was calculated by aggregating the question regarding partner incarceration in the past 6 months across all visits. These questions were asked after October 2013, and only those visits were included in this calculation (Subsample 3, Table 1). The numerator was the total number of women who ever reported incarceration of a male partner at any visit. The denominator was the number of women who had at least one male partner during the study period. Visits at which women reported no sexual partners or only female sexual partners during a given 6-month period were not asked partner incarceration questions and were excluded.

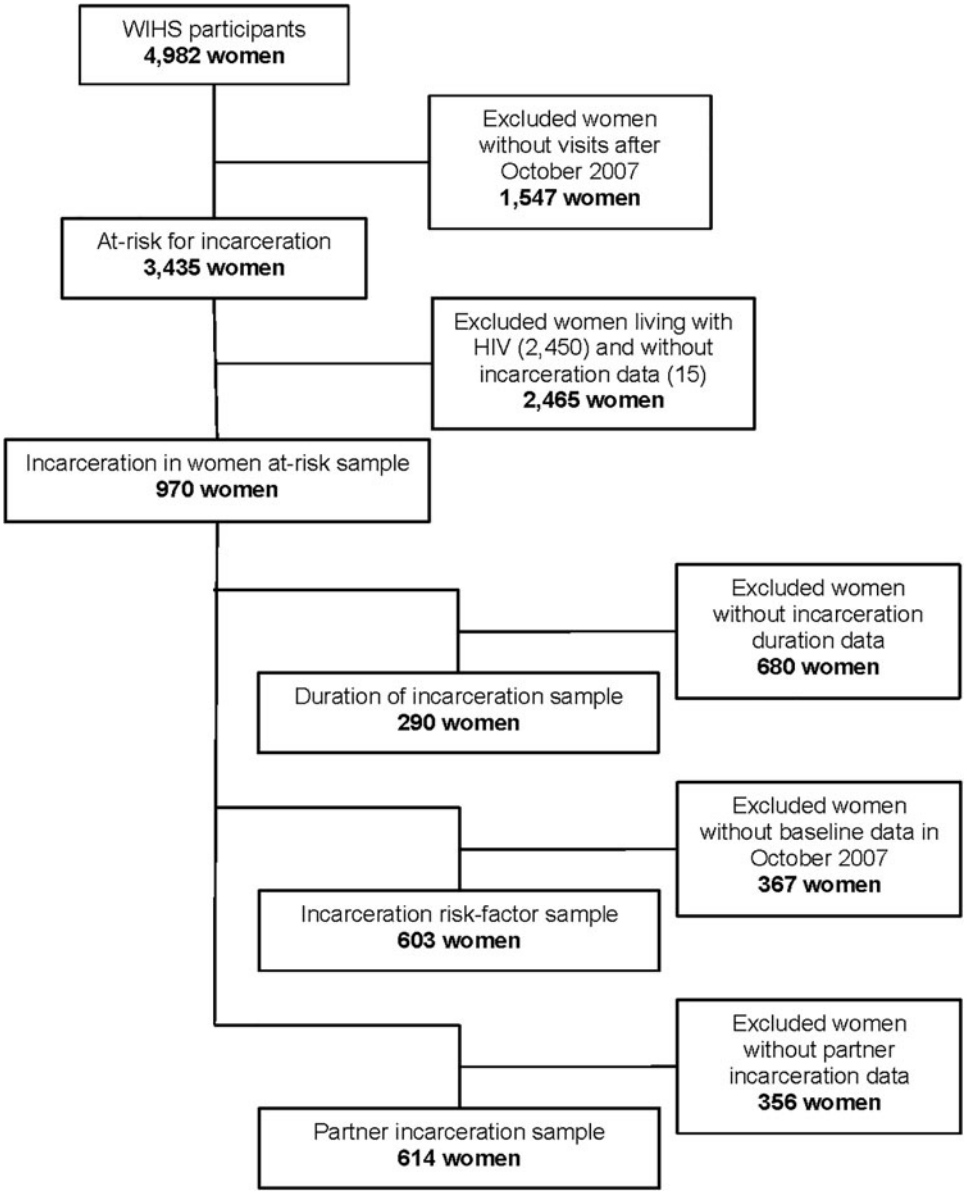

FIG. 1. Sample Sizes and Numbers of Participants Excluded at Each Step of Eligibility for Estimation of Incident and Prevalent Incarceration, Duration of Incarceration, Risk Factors for Incarceration, and Partner Incarceration among Participants at Risk for HIV Infection, Women's Interagency HIV Study, 2007–2017. HIV, human immunodeficiency virus.

To calculate an incidence rate of incarceration, we included all visits during the study period where women reported their incarceration status in the prior 6 months as described above. The number of incarcerations was the sum of incarcerations reported over the prior 6 months across all included visits. The number of years at risk was calculated by converting visits to person-years and then subtracting the total amount of time (in years) that incarcerated women reported being in prison/jail across included visits. For visits where a woman was incarcerated one or more times but did not provide the length of incarceration, the duration of incarceration was set to the overall median duration of incarceration from incarcerations during the study period.

The incidence rate was also calculated after excluding the first visit in which a woman reported the number of incarcerations in the prior 6 months and the incarceration events she reported to reduce the effect of telescoping, in which respondents to surveys tend to overestimate the number of events that occurred during a given period of time.[27] For example, although incarceration is likely to be a notable event in a woman's life, telescoping could have resulted in an incarceration that occurred 8 months before the baseline visit being erroneously reported as being in the past 6 months, inflating the estimated incarceration rate. After the initial visit in which participants provided the number of incarcerations during the prior 6 months, subsequent estimates were bounded by the previous response, a method to reduce telescoping errors in longitudinal surveys.[28]

For baseline characteristics, we reported medians with interquartile ranges (IQRs), and for categorical measures, we described frequency distributions. To identify predictors of any incident incarceration, we limited the analysis to those women with baseline data before the start of the study period (Subsample 2, Table 1) and used an aggregate measure of any incident incarceration during the study period. We used bivariate log binomial regression to estimate risk ratios (RRs)

and 95% confidence intervals (CIs) of any incident incarceration during the study period for baseline risk factors; this allowed us to avoid the limitations of using odds ratios with outcomes that are relatively common and to improve interpretability of the results.[29] The baseline risk factors for bivariate models (age, race, education, housing instability, injection and noninjection drug use, and sex exchange) were chosen based on literature identifying these as important predictors of incarceration in the general population.[30–33] A multivariable log-binomial regression model was used to estimate adjusted RR for only variables found to be significant in the bivariate analyses where the 95% CI for the unadjusted RR did not cross one.

We also estimated the number of women lost to follow-up due to incarceration using study staff reports. In general, women who could be reached by study staff while incarcerated were interviewed during their incarceration or completed the interview during that visit period after they returned to the community. Women who missed a visit due to incarceration and then never returned to the study were considered to have been lost to follow-up due to incarceration after excluding deaths. For the above estimates of incarceration prevalence and incidence, as well as descriptive statistics about incarceration in the sample, all nonmissed visits were used. Women were considered lost to follow-up only if they never returned after a missed visit; any visit where a woman returned to the WIHS and answered questions about her incarceration status in the past 6 months was included.

Women consented to the use of their data as part of their overall WIHS participation, and specific regulatory approval was obtained for this secondary data analysis by the institutional review board at our institution (UNC IRB #17-3215). Statistical analyses were conducted in SAS version 9.4 (SAS Institute, Inc., Cary, NC) and Stata version 13.3.

Results

A total of 970 participants responded to any of the incarceration questions during the study period (2007–2017); four of these women responded only to the question about prior incarceration, but not incarceration in the past 6 months. Median follow-up time across the 970 participants was 5.5 years (IQR 3.5–9.5).

The baseline characteristics of the overall sample are shown in Table 2. The median age at first visit during the study period was 42 years (IQR 34–49). The majority were Black (69.9%, $n=678$), with 16.8% identifying as White ($n=163$), and about two-thirds (67.2%, $n=649$) of women completed at least high school or a high school equivalent. There were 68 women (7.0%) who reported unstable housing at baseline. Few women reported injection drug use (2.5%, $n=24$), but 32.4% ($n=314$) reported noninjection drug use. Almost seven percent of women ($n=64$) had exchanged sex for drugs or money.

Nearly half ($n=453$, 46.7%) of women were incarcerated either before or during the study period. Incarceration

Table 2. Baseline Demographic and Risk Characteristics of Participants at Risk for Human Immunodeficiency Virus Infection, Women's Interagency Human Immunodeficiency Virus Study, 2007–2017

		Overall (n = *970*)		*Incarcerated during study period* (n = *163*)[a]		*Not incarcerated during study period* (n = *807*)	
Characteristics	*Category*	N	*% or median (IQR)*	n	*% or median (IQR)*	n	*% or median (IQR)*
Median age, years		970	42 (34–49)	163	40 (34–47)	807	43 (34–49)
Education: high school or more		649	67.2	93	57.1	556	69.2
Race	White	163	16.8	25	15.3	138	17.1
	Black	678	69.9	117	71.8	561	69.5
	Any Other Race	129	13.3	21	12.9	108	13.4
Hispanic/Latina ethnicity		192	19.8	28	17.2	164	20.3
Site	Bronx, NY	144	14.8	22	13.5	122	15.1
	Brooklyn, NY	141	14.5	16	9.8	125	15.5
	Washington, DC	110	11.3	16	9.8	94	11.6
	Los Angeles, CA	111	11.4	20	12.3	91	11.3
	San Francisco, CA	130	13.4	30	18.4	100	12.4
	Chicago, IL	100	10.3	23	14.1	77	9.5
	Chapel Hill, NC	51	5.3	9	5.5	42	5.2
	Atlanta, GA	85	8.8	15	9.2	70	8.7
	Miami, FL	41	4.2	4	2.5	37	4.6
	Birmingham, AL	28	2.9	4	2.5	24	3.0
	Jackson, MS	29	3.0	4	2.5	25	3.1
Had sex for drugs, money, or shelter in past 6 months		64	6.6	22	13.5	42	5.2
Injection drug use in past 6 months		24	2.5	12	7.4	12	1.5
Noninjection drug use in past 6 months		314	32.4	88	54.0	226	28.0
Unstable housing in past 6 months		68	7.0	19	11.7	49	6.1

Baseline responses to the sex exchange, drug use, and housing variables reflect the 6 months before the first visit in the study period.
[a]Those with missing incarceration status during the study period were assumed to have not been incarcerated
IQR, interquartile range.

characteristics are shown in Table 3. Women who had ever been incarcerated experienced a lifetime median of three incarcerations (IQR 1–6), and the median lifetime total amount of incarcerated time was 243 days (IQR 61–805) or approximately 8 months (IQR 2–26). Of episodes of incarceration that occurred during the study period where the duration was reported ($n = 316$), the median length was 7 days (IQR 1–61). At time of incarcerations during the study period, women were aged 25–63 years, and the largest number of incarceration episodes occurred when women were aged 45–49 (62 episodes, 22.9%).

Missingness for housing instability ($n = 115$, 11.9%), sex exchange ($n = 116$, 12.0%), educational attainment ($n = 117$, 12.1%), and injection and noninjection drug use (same number missing for each, $n = 116$, 12.0%) was addressed as described above.

For the incidence rate estimate, there were 966 women who reported whether they had been incarcerated during the last 6 months at a total of 11,420 visits. At these visits, 148 women reported 344 incarcerations totaling 566 months. The total time at risk for incarceration was 5,663 person-years, with a median time at risk of 5.5 years per woman (IQR 3.5–9.5), resulting in a rate of 6.1 incarcerations per 100 person-years. Excluding the first visit at which the number of incarcerations in the prior 6 months was provided, 938 women at 10,454 total visits reported 286 incarcerations during 5,192 years at risk, with a median time at risk of 5.0 years per woman (IQR 3.0–9.0) yielding an incidence rate of 5.5 incarcerations per 100 person-years.

Table 3. Incarceration Characteristics by Participant and by Episode of Incarceration Among Participants at Risk for Human Immunodeficiency Virus Infection, Women's Interagency Human Immunodeficiency Virus Study, 2007–2017

Characteristics by participant	n	*% or median (IQR)*
Number of lifetime incarcerations		
0	517	54.4
1	117	12.3
2	77	8.1
3	51	5.4
4	37	3.9
5+	151	15.9
Total	950	100.0
Median lifetime total days incarcerated	161	243 (61, 805)
Characteristics by Episode of Incarceration[a]		
Length of incarceration, days	316	7 (1, 61)
Age at visit in which 1+ episodes of incarceration were reported		
25–29	17	6.3
30–34	42	15.5
35–39	41	15.1
40–44	46	17.0
45–49	62	22.9
50–54	35	12.9
55–59	22	8.1
60–66	6	2.2
Total	271	100.0

The number of lifetime incarcerations was calculated for women who reported ever having been incarcerated and responded to baseline questions about the frequency and duration of incarceration before the study period. Any incarcerations during the study period were also included.

[a]The characteristics of individual episodes of incarceration were only calculated for episodes of incarceration that occurred during the study period. The duration of incarcerations reported as occurring before the study period were only reported as an aggregate of total time incarcerated before the baseline interview and did not include the age at the time of that incarceration.

A total of 603 women were included in the regression analyses to identify baseline demographic risk factors that predicted incarceration during the study period of 2007–2017, (Subsample 2, Table 1). Baseline characteristics are shown in Table 4. This subsample was similar to the overall sample in terms of age, education, and race. The subsample had a slightly higher proportion of women with Hispanic/Latina ethnicity and slightly lower rates of sex exchange, noninjection drug use, and unstable housing, compared with the overall sample. The most substantial demographic difference was the exclusion of women enrolled after 2007, which resulted in the exclusion of women enrolled at the Southern sites.

Incarceration RRs and 95% CIs from the bivariate and multivariable models are shown in Table 5. In the bivariate models, we identified significant associations between any incident incarceration and prior incarceration (RR 5.92, 95% CI: 3.73–9.43), sex exchange (RR 3.25, 95% CI: 1.89–5.57), injection drug use (RR 2.46, 95% CI 1.23–4.94), noninjection drug use (RR 1.91, 95% CI: 1.32–2.75), and unstable housing (RR 2.62, 95% CI: 1.60–4.28). In the multivariable model, only prior incarceration (RR 5.20, 95% CI: 3.23–8.41) and noninjection drug use (RR 1.57, 95% CI: 1.10–2.25) were significantly associated with incident incarceration.

Of the 614 women with at least one male sexual partner during the study period who ever responded to the question about incarceration of male sexual partners (Subsample 3, Table 1), 21.8% ($n = 134$) had one or more partners who were incarcerated in the 6 months preceding at least one of their visits. Among women who had reported ever being incarcerated ($n = 301$), more than one-quarter (28.6%, $n = 86$) reported that one or more male sexual partners had been incarcerated in the 6 months preceding at least one of their visits.

Loss to follow-up due to incarceration was infrequent. Some women in our sample who were incarcerated were interviewed while they were in jail or prison ($n = 22$, 33 visits), and 66 women missed visits due to incarceration. Only 27.3% ($n = 18$) of those who missed a visit due to incarceration were lost to follow-up afterward.

Discussion

Incarceration was a common experience among women at risk for HIV in the WIHS, with nearly half of women having experienced incarceration at some point in their lives and an incident incarceration rate of 5.5 per 100 person-years compared with an estimated 0.16 per 100 person-years for women in the U.S. overall.[34] Nearly three-quarters of women in this sample who had ever experienced incarceration were incarcerated more than once, and prior incarceration was the strongest predictor of future incarceration. These findings support what has been termed *churning* in the criminal justice system, where incarcerated individuals are unable to extricate themselves from the system before experiencing a series of

Table 4. Baseline Demographic and Risk Characteristics of the Regression Analysis Subset of Participants at Risk for Human Immunodeficiency Virus Infection, Women's Interagency Human Immunodeficiency Virus Study, 2007–2017

		Overall (N = 603)		*Incarcerated during study period (N = 97)*[a]		*Not incarcerated during study period (N = 506)*	
Characteristics	*Category*	n	*% or median (IQR)*	n	*% or median (IQR)*	n	*% or median (IQR)*
Median age, years		603	41 (33–48)	97	39 (34–46)	506	41 (33–48)
Education: high school or more		391	65.1	50	51.5	341	67.7
Race	White	114	18.9	12	12.4	102	20.2
	Black	387	64.2	68	70.1	319	63.0
	Any Other Race	102	16.9	17	17.5	85	16.8
Hispanic/Latina ethnicity		154	25.5	21	21.6	133	26.3
Site	Bronx, NY	138	22.9	22	22.7	116	22.9
	Brooklyn, NY	123	20.4	13	13.4	110	21.7
	Washington, DC	81	13.4	9	9.3	72	14.2
	Los Angeles, CA	99	16.4	17	17.5	82	16.2
	San Francisco, CA	93	15.4	20	20.6	73	14.4
	Chicago, IL	69	11.4	16	16.5	53	10.5
Had sex for drugs, money, or shelter in past 6 months		14	2.4	7	7.2	7	1.4
Injection drug use in past 6 months		15	2.5	6	6.2	9	1.8
Noninjection drug use in past 6 months		172	28.5	44	45.4	128	25.3
Unstable housing in past 6 months		27	4.5	12	12.4	15	3.0

The participants included in the regression analytic subset were women with baseline visits before the start of the study period who contributed one or more visits within the study period, to use their baseline information as predictors of incident incarceration during the study period.

[a]Those with missing incarceration status during the study period were assumed to have not been incarcerated.

incarcerations and episodes of community supervision due to missed supervision meetings, other technical violations, or recidivism.[35]

These results, combined with our previous work showing incarceration as a structural force with a collateral increase in HIV risk, suggest a vicious cycle of criminal justice involvement and risk for HIV acquisition. The high prevalence and incidence of incarceration in this group support not only targeted HIV prevention interventions for women who have experienced incarceration but also interventions to disrupt the cycle of criminal justice involvement.

Our estimated incarceration rate of 5.5 per 100 person-years in this national cohort of HIV-seronegative women from 2007 to 2017 is higher compared to all U.S. women. The overall U.S. incarceration rate for 2015 was 0.87 per 100 adults, and for U.S. women, the imprisonment rate was 0.082 per 100 adult women, although this does not include jail incarcerations.[10,36] The Prison Policy Initiative has estimated

Table 5. Risk Ratios for Risk Factors for Incident Incarceration Among the Regression Analysis Subset of Participants at Risk for Human Immunodeficiency Virus Infection, Women's Interagency Human Immunodeficiency Virus Study, 2007–2017

	Bivariate		*Multivariable*	
Variable	*RR*[a]	*95% CI*[b]	*RR*	*95% CI*
10-year increase in age	0.89	0.75–1.06		
Education (reference = high school or more)	0.99	0.16–5.97		
Race (reference = White)				
Black	1.45	0.73–2.90		
Other	1.57	0.88–2.78		
Hispanic ethnicity	0.78	0.50–1.24		
Prior incarceration	**5.92**	**3.73–9.43**	**5.20**	**3.23–8.41**
Had sex for drugs, money, or shelter in past 6 months	**3.25**	**1.89–5.57**	1.34	0.79–2.29
Injection drug use in past 6 months	**2.46**	**1.23–4.94**	0.96	0.46–1.98
Noninjection drug use in past 6 months	**1.91**	**1.32–2.75**	**1.57**	**1.10–2.25**
Unstable housing in past 6 months	**2.62**	**1.60–4.28**	1.54	0.96–2.47

The participants included in the regression analytic subset were 603 women with baseline visits before the start of the study period who contributed one or more visits within the study period, to use their baseline information as predictors of incident incarceration during the study period.

[a]RR, risk ratio. RRs were estimated using log-binomial models.

[b]CI, confidence interval; bolded estimates are statistically significant with $p < 0.05$.

that slightly over half of all incarcerated women are incarcerated in jails, which would give an overall incarceration rate for women of $\sim$0.16 per 1000 adult women.[34] In addition, during 2007–2017, the overall incarceration rate for women in prisons and jails was increasing, so we would expect the inclusion of earlier years to bias our estimates in a downward direction relative to the general population estimates from 2015.[34] To our knowledge, there is no prior estimate of the incarceration rate for U.S. women at risk for HIV to which we can compare.

We also found evidence that incarceration in this population was associated with noninjection drug use, consistent with other examinations of women's pathways into the criminal justice system.[37,38] In other studies, drug use has also been associated with increased sexual risk behaviors, suggesting that women at highest risk for HIV may also be at highest risk for incarceration.[39–41] The historical and current contexts of policing focused on arresting and incarcerating people who use drugs, particularly in communities of color, have produced overlapping epidemics of drug use and incarceration.[42]

The effects of the composite noninjection drug use variable in our analysis of the WIHS were largely driven by marijuana use; in our regression subsample, 80% of the women who reported baseline noninjection drug use reported marijuana use, and 67% reported only marijuana use. Although the wave of marijuana legalization in the U.S. may result in fewer incarcerations for some women who use marijuana, for women in many states, and particularly for women of color and women who have already experienced incarceration, marijuana possession and use are likely to continue to lead to episodes of incarceration.[43–45]

We found weaker associations between incarceration and sex exchange, injection drug use, and housing instability, which mirror prior work describing the lives of women who experience incarceration.[38,40] Indeed, criminal justice involvement, HIV, and all of these factors together have been described as a ''syndemic,''meaning multiple concurrent epidemics with biological, social, and structural interactions, which exacerbate the prognosis and burden of disease.[46,47] Targeting HIV prevention interventions to women who experience incarceration is likely to reach a large proportion of those who are at the highest risk for HIV, and women are likely to be best served by the implementation of multilevel integrated interventions that also decrease their ongoing risk of over-policing and incarceration, for example, offering housing support, PrEP, and substance use treatment, including medications for opioid use disorder.[48–50]

Our findings that women at risk for HIV experience a high burden of incarceration and partner incarceration are consistent with prior reports that more than one-third of women who had been involved with the criminal justice system were eligible for PrEP based on the CDC eligibility criteria.[16,51] In separate analyses of the WIHS among participants at risk for HIV, only $\sim$10% were aware of PrEP and an even smaller percentage of participants had ever used PrEP, even though many were aware of their moderate to high levels of HIV risk.[21,52] Many women who have experienced incarceration and are eligible for PrEP do not perceive themselves as at risk for HIV and are unaware of PrEP as a tool for HIV prevention.[16,53] Interventions that address the subsequent early steps on the continuum will be critical, including increasing their HIV risk awareness and enhancing PrEP awareness.[51] In addition, as long as disproportionate rates of incarceration persist, collaborative implementation of screening, linkage to PrEP, and direct PrEP provision will be needed in jails and prisons, parole and probation offices, and diversion programs that serve as alternatives to incarceration.[24]

The addition of incarceration history as a clinical PrEP screening criterion could aid in identifying women who are at the highest risk for HIV, which is consistent with the American College of Obstetrics and Gynecology recommendation to consider PrEP for women who have experienced incarceration.[15] Our results suggest that this holds the potential to identify a substantial proportion of women eligible for PrEP in the U.S., with over half of women at risk for HIV in our sample either reporting incarceration themselves or the incarceration of a partner. Implementation of screening for a history of incarceration would also identify women who could benefit from multilevel integrated interventions to decrease incarceration risk itself.

This study has a number of strengths. The sample is drawn from 11 clinical research sites across the U.S. The WIHS intentionally recruited HIV at-risk women who were socioeconomically and racially similar to the participants living with HIV and the general U.S. population of women living with HIV.[26] The large sample size and longitudinal design allowed for observation of even relatively rare incident events like incarceration and for temporal sequencing of exposures and incident incarceration. The levels of missing data in this large data set were also relatively low.

However, this study also has several limitations. HIV-seronegative participants in the WIHS may not be representative of women at risk for HIV in the U.S. Women who chose to participate in the WIHS are likely different from women who chose not to participate or who do not live in an area with a WIHS site, limiting the generalizability of the findings. In particular, emerging risk groups for HIV, such as rural women who use drugs, were not explicitly recruited into the WIHS. Women who use drugs, both in rural and urban areas, are frequently involved in the criminal justice system, and we anticipate that inclusion of additional diverse groups of women who use drugs in future studies would increase the incarceration rate for women at risk for HIV.[14,31]

Although women in the WIHS regularly report stigmatized behaviors and experiences in interviews, the use of self-reported incarceration data could have resulted in underreporting of this outcome and, thus, led to underestimates of the incidence and prevalence of incarceration in this population.

Even with a relatively high incarceration rate in the WIHS, we had only sufficient power to use regression analyses to identify baseline risk factors for any incident incarceration, not frequency of incarceration or other more detailed measures. We selected a more temporally robust strategy (*i.e.,* using baseline data to predict any incident incarceration) rather than aggregating exposure data that would have increased our power to detect associations (*i.e.,* using risk factors at any visit to predict incident incarceration at any visit). This resulted in a smaller subsample for the regression analysis that excluded women enrolled in the WIHS after 2007, including women at the Southern sites. This analysis was likely underpowered to detect associations between incarceration and infrequently reported baseline risk factors, contributing to wider confidence intervals and

nonstatistically significant associations. In addition, the regression analysis did not account for loss to follow-up or adjust for time at risk. Despite these limitations, it is reassuring that all of the relationships we identified, including both statistically significant and nonsignificant associations, are consistent with extant literature identifying women's trajectories into the criminal justice system.

Although the cohort was initiated in 1993, questions about incarceration were not introduced until 2007. The estimated incarceration rate may be lower than if we had measured incarceration at an earlier point in the cohort. Of women imprisoned nationally in 2016, nearly half (46.3%) were under the age of 35.[10,54] The median age at our study baseline was 42, and $\sim$25% of the women in our sample were under age 35; thus, our estimated incidence of incarceration is not necessarily representative of the incidence among sociodemographically similar HIV at-risk U.S. women, who are generally younger. Indeed, nearly half of the women in our sample had been incarcerated earlier in their lives, before the start of the study period. Our characterization of incarceration experiences in this group is limited in that they do not capture details about jail versus prison incarceration and the associated charges.

The timing of the incarceration question also increases the possibility of recall bias, as women were asked to recount the frequency and duration of their episodes of incarceration. The introduction of the incarceration questions also likely produced some degree of telescoping, in which women reported episodes of incarceration that happened more than 6 months ago as having occurred in the first 6-month period when they could have reported it.[27] We calculated incidence rates both including and excluding the first visit at which incarceration could have been reported; these estimates were similar, suggesting minimal bias.

Conclusions

The experience of incarceration is common among women at risk for HIV in the U.S. Our findings suggest that there is a critical need to provide HIV prevention interventions for women who have experienced incarceration as part of a concerted effort to disrupt the cycle of HIV risk and incarceration. In particular, U.S. women who experience HIV risk due to drug use are also likely to bear a disproportionate burden of policing, arrest, and incarceration. Effective risk-reduction interventions that target individual, network, and structural factors for women who have experienced incarceration should be used to guide PrEP implementation within this group, in concert with interventions to decrease their exposure to prisons and jails.[55–57]

To our knowledge, this study includes the first estimates of the prevalence and incidence of incarceration among women at risk for HIV in a national cohort and supports the growing focus on the criminal justice system as a critical site for intervention. Mass *de*carceration will be a critical public health intervention to reduce HIV infections in women in the U.S.

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