A Prospective Study of Exposure to Gender-Based Violence and Risk of Sexually Transmitted Infection Acquisition in the Women's Interagency HIV Study, 1995–2018

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Abstract

Background: Our objectives were to estimate the association of gender-based violence (GBV) experience with the risk of sexually transmitted infection (STI) acquisition in HIV-seropositive and HIV-seronegative women, to compare the STI risks associated with recent and lifetime GBV exposures, and to quantify whether these associations differ by HIV status.

Methods: We conducted a multicenter, prospective cohort study in the Women's Interagency HIV Study, 1994–2018. Poisson models were fitted using generalized estimating equations to estimate the association of past 6-month GBV experience (physical, sexual, or intimate partner psychological violence) with subsequent self-reported STI diagnosis (gonorrhea, syphilis, chlamydia, pelvic inflammatory disease, or trichomoniasis).

Results: Data from 2868 women who reported recent sexual activity comprised 12,069 person-years. Higher STI risk was observed among HIV-seropositive women (incidence rate [IR] 5.5 per 100 person-years) compared with HIV-seronegative women (IR 4.3 per 100 person-years). Recent GBV experience was associated with a 1.28-fold (95% confidence interval [CI] 0.99, 1.65) risk after adjustment for HIV status and relevant demographic, socioeconomic, and sexual risk variables. Other important risk factors for STI acquisition included unstable housing (adjusted incidence rate ratio [AIRR] 1.81, 95% CI 1.32–2.46), unemployment (AIRR 1.42, 95% CI 1.14–1.76), transactional sex (AIRR 2.06, 95% CI 1.52–2.80), and drug use (AIRR 1.44, 95% CI 1.19–1.75). Recent physical violence contributed the highest risk of STI acquisition among HIV-seronegative women (AIRR 2.27, 95% CI 1.18–4.35), whereas lifetime GBV experience contributed the highest risk among HIV-seropositive women (AIRR 1.59, 95% CI 1.20–2.10).

Conclusions: GBV prevention remains an important public health goal with direct relevance to women's sexual health.

Keywords: intimate partner violence, sexual violence, physical violence, sexually transmitted infections, HIV

Introduction

GENDER-BASED VIOLENCE (GBV), defined as physical, sexual, psychological, or economic abuse of girls and women,¹ is a risk factor for acquisition of HIV² and other

sexually transmitted infections (STI).^{3–6} GBV includes abuse within an intimate relationship (intimate partner violence [IPV]) as well as non-partner violence. A systematic review and meta-analysis of IPV and HIV among women found that the experience of physical, sexual, or psychological IPV was

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associated with a 1.41-fold (95% confidence interval [CI] 1.16–1.73) increased odds of HIV-seropositive status in cross-sectional studies, and a 1.28-fold (95% CI 1.00–1.64) increased risk of HIV seroconversion in longitudinal studies.⁷

Associations between the experience of GBV and the acquisition of other STIs^{3,4} or the presence of STI symptoms^{5,6} have been also been documented.⁸ Since an increased risk of IPV after disclosure of HIV^{9,10} or other STIs¹¹ has been observed, longitudinal study designs are valuable in elucidating associations between GBV and STI.

High rates of lifetime and recent GBV experience have been documented among women living with HIV (WLHIV),^{12–14} with rates of recent physical or sexual IPV victimization ranging from 20% (among 286 sexually active WLHIV in the HIV Cost and Services Utilization Study, 1998)¹⁵ to 42% (among 239 WLHIV recruited from an HIV clinic in Baltimore, 2014–2015).^{14,16,17} Recently, Decker et al. reported that 61% of Women's Interagency HIV Study (WIHS) participants had a lifetime history of physical or sexual violence at enrollment.¹⁴

Among WLHIV, GBV experience has been linked to less engagement in medical care,¹⁸ lower self-reported antiretroviral therapy adherence,⁹ lower rates of viral load suppression,⁹ having a CD4 count <200,¹⁶ and increased mortality.¹⁹ In addition, Ghosh et al. recently demonstrated that chronic sexual abuse and depression are associated with levels of immune biomarkers related to inflammation and wound healing in the female reproductive tract, with some differences observed by HIV status.²⁰ Thus, damage to the genital tract and the mental health sequelae of abuse may interact with the immune system differentially by HIV status to increase susceptibility to STI. In summary, associations between GBV experience and STI acquisition may differ by HIV status.

There are several pathways by which GBV can directly and indirectly increase risk of HIV/STI acquisition. Forced sex can directly increase susceptibility to HIV infection *via* damage to the genital tract and resultant alterations to the local immune system.^{20,21} In addition, higher odds of HIV/STI diagnosis^{22–24} and HIV/STI risk behaviors^{22,25,26} have been described among male perpetrators of IPV.

Further, past GBV experience may indirectly heighten the risk of STI acquisition *via* psychosocial mechanisms. Past experiences of violence in response to requests for condom use can result in fear of condom negotiation and lower rates of condom use.^{27,28} Finally, survivors of abuse may have less economic stability^{14,29} and higher rates of depression,^{30,31} post-traumatic stress disorder,^{30,32} and substance use,²⁸ all of which may increase vulnerability to sexual risk.^{33–35} Thus, experiences of GBV may increase both short-term and long-term risks of STI acquisition.

Considering evidence that GBV increases risk of STI and is associated with adverse health outcomes, particularly among WLHIV, there is a need to better characterize the association between GBV exposure and STI acquisition among women with and without HIV. Our primary objective was to estimate the association between recent GBV experience and subsequent risk of STI acquisition in a cohort representative of U.S. WLHIV and HIV-seronegative counterparts. In addition, we compared the risks of STI acquisition associated with different forms of recent GBV as well as lifetime GBV before study entry, and we quantified whether these associations differed by HIV status.

Methods

Study participants and design

The WIHS, funded by the National Institutes of Health, is the largest prospective cohort study of HIV-seropositive and HIV-seronegative women in the U.S.^{36,37} HIV-seropositive participants are representative of U.S. WLHIV in demographics and HIV risk profile.³⁶

WIHS recruitment and study protocols have been described elsewhere.^{36–38} Briefly, the initial recruitment occurred during 1994–1995 at six U.S. sites. Participants were recruited from clinical sites such as HIV primary care clinics and hospital-based programs, as well as community-based programs including women's support groups and drug rehabilitation programs.³⁶ Frequency matching was used to achieve balance on demographic and HIV risk variables among HIV-seropositive and HIV-seronegative participants.³⁶ Additional participants were recruited in 2001–2002, 2011–2012, and 2013–2015, at which time four southern U.S. sites were added.^{37,38} Study visits occur every 6 months and include standardized face-to-face interviews, physical and gynecologic examinations, and laboratory specimen collection. This study was approved by the Johns Hopkins School of Public Health Institutional Review Board.

Unit of analysis

We used two consecutive study visits (referred to as a visit pair) as the unit of analysis. Individuals could contribute multiple visit pairs. Within each visit pair, GBV exposure and time-varying covariates were assessed at the first (index) visit, and STI diagnosis was assessed at the next visit. Data on recent GBV experience and time-varying covariates refer to experience since the participant's previous WIHS study visit (generally a period of 6 months and no longer than a year).

Inclusion/exclusion criteria

We included data from participants at the Bronx, NY, Brooklyn, NY, Washington, DC, Chicago, IL, and San Francisco, CA sites (1994–2018), and the Chapel Hill, NC, Atlanta, GA, Miami, FL, and Birmingham, AL/Jackson, MS sites (2013–2018). The southern sites were grouped together in analyses due to fewer years of follow-up. Data from the Los Angeles, CA site were excluded, because GBV data were not consistently collected.

Participants were eligible for inclusion in the analysis if they were ≥18 years old when lifetime abuse history was assessed, and subsequently contributed at least one visit pair between 1994 and 2018 ($N=3461$ participants, 59,239 visit pairs) (Fig. 1). Visit pairs were included if the participant provided complete data on recent (past 6-month) GBV experience at the index visit and recent STI diagnosis at the index and follow-up visits. Exclusion criteria on the visit pair level included recent STI diagnosis at the index visit ($n=940$); no recent sexual activity at the second visit ($n=13,324$); and HIV seroconversion over the course of a visit pair ($n=5$). The final sample consisted of 24,040 visit pairs from 2868 participants.

Measurement of exposure, outcome, and covariates

Physical and sexual violence data were collected at all study visits during 1994–1999, at alternating visits during

FIG. 1. Flow diagram of participants.

2000–2013, and subsequently at every visit. Intimate partner psychological violence data were collected at every study visit. Only visits at which all three forms of violence were assessed were eligible for inclusion in this analysis.

Assessment of physical and sexual violence was based on the Revised Conflict Tactics Scale.³⁹ Physical violence was assessed with the question “Since your [previous] study visit,

have you experienced serious physical violence (physical harm by another person)? By that I mean were you ever hurt by a person using an object or were you ever slapped, hit, punched, kicked?” Sexual violence was assessed with the question “Since your [previous] study visit, has anyone pressured or forced you to have sexual contact? By sexual contact I mean them touching your sexual parts, you touching their sexual

parts, or sexual intercourse.” Questions about physical and sexual violence did not specify a perpetrator relationship.

In contrast, assessment of psychological violence was specific to IPV. Intimate partner psychological violence consisted of controlling behaviors perpetrated by a current or former partner: threatening to hurt or kill the participant, or preventing the participant from entering or leaving her home, accessing medical care, having a job, or pursuing education. Participants who reported experience of any form of violence were referred to counseling services; GBV treatment data were not collected.

We defined recent GBV as experience of physical violence, sexual violence, or intimate partner psychological violence in the past 6 months. At each index visit, participants who endorsed recent experience of any form of GBV were considered exposed, whereas participants who reported not experiencing any form of GBV were considered unexposed.

The outcome was self-reported diagnosis of STI at the second visit of a visit pair. The WIHS assesses STI at all study visits with the interview question, “Since your [previous] study visit, have you been told by a health care provider that you had gonorrhea, syphilis, chlamydia, pelvic inflammatory disease, genital herpes, genital warts, or trichomoniasis?” We did not consider genital herpes or genital warts as incident infections, as HSV and HPV cause latent infection and diagnosis likely would not reflect a recent infection. Due to the low event rate, we used a composite outcome of incident gonorrhea, syphilis, chlamydia, pelvic inflammatory disease, or trichomoniasis.

Data for all variables except HIV status, year of study enrollment, and study site were self-reported. Variables measured at WIHS entry included race/ethnicity, educational attainment, and lifetime GBV history at baseline (physical, sexual, or intimate partner psychological violence, or no GBV). Time-varying data were available for HIV status, WIHS site, marital status, residence, employment, income, drug use, transactional sex, number of recent sex partners, and condom use.

Marital status was categorized as married, living together, never married, or other. Residence was categorized as own house/apartment, parent’s residence, someone else’s residence, or unstable housing (including a shelter, boarding house, street, correctional facility, or residential substance

use treatment facility). Average yearly household income was dichotomized as $\leq \$18,000$ or $> \$18,000$.¹⁴ Drug use included injected and non-injected recreational drugs, and was categorized as any or none. Transactional sex was defined as trading sex for drugs, money, or shelter. Number of recent sex partners was collected as a continuous variable and was categorized as zero, one, two to four, or more than four, based on the data distribution.

Separate questions addressed past 6-month condom non-use for vaginal and anal intercourse. For both questions, response options included yes (did not always use condoms), no (always used condoms), and N/A (did not have vaginal or anal intercourse, respectively). Categorical variables were modeled as nominal variables.

Statistical methods

We compared the distributions of covariates by recent GBV experience, using data from each participant’s first visit in the analysis. To estimate rates of STI, we fitted population-averaged Poisson models using generalized estimating equations with an exchangeable correlation structure to account for within-subject correlation. Crude incidence rates (IRs) and incidence rate ratios of STI per 100 person-years were estimated by levels of the exposure and covariates. An offset term for time in days (log-transformed) was used to account for unequal times between visits.

Multivariable models were used to estimate the risk of STI acquisition after GBV experience. Covariates were selected using a directed acyclic graph approach.⁴⁰ We did not adjust for variables likely to mediate the association between GBV and STI acquisition, i.e., condom use and number of recent sex partners.⁴¹ Specifically, we conceptualized condom use and number of sex partners as subsequent effects of recent GBV experience (the latter was previously demonstrated in this cohort),⁴¹ whereas other sexual risk-related variables were conceptualized as preceding and contributing to acute GBV risk.

The adjusted model controlled for HIV status as well as age, race/ethnicity, year of WIHS enrollment, study site, marital status, residence, employment, household income, GBV history at baseline, recent drug use, and recent transactional sex. The adjusted model used a complete case

FIG. 2. Forms of GBV reported in the WIHS, 1995–2018 ($N = 24,040$ visits). Percentages do not sum to 100.0 due to rounding. Questions about physical and sexual violence did not specify a perpetrator relationship, whereas psychological violence was specific to controlling behaviors perpetrated by a current or former partner. GBV, gender-based violence; WIHS, Women’s Interagency HIV Study.

TABLE 1. CHARACTERISTICS OF PARTICIPANTS AT FIRST INDEX VISIT, BY RECENT EXPERIENCE OF GENDER-BASED VIOLENCE

	Total (N=2868)	No recent GBV ^{a,b} (n=2564)	Recent GBV ^{a,b} (n=304)
	N (column %)	N (row %)	
HIV status at visit ^{a,b}			
HIV-seronegative	822 (29)	712 (87)	110 (13)
HIV-seropositive	2046 (71)	1852 (91)	194 (9)
Age at visit, median (IQR)	39 (32–45)	39 (33–45)	37 (31–44)
Study enrollment year ^c			
1994–1995	1329 (46)	1159 (87)	170 (13)
2001–2002	602 (21)	553 (92)	49 (8)
2011–2013	279 (10)	253 (91)	26 (9)
2013–2015	658 (23)	599 (91)	59 (9)
Race/ethnicity ^c			
Black non-Hispanic	2027 (71)	1816 (90)	211 (10)
Hispanic	461 (16)	418 (91)	43 (9)
White non-Hispanic	294 (10)	258 (88)	36 (12)
Other	86 (3)	72 (84)	14 (16)
Marital status ^b			
Married	579 (21)	526 (91)	53 (9)
Living with partner	346 (13)	293 (85)	53 (15)
Never married	1010 (37)	910 (90)	100 (10)
Other	803 (29)	721 (90)	82 (10)
Residence ^b			
Own residence	2153 (75)	1956 (91)	197 (9)
Parent's residence	203 (7)	186 (92)	17 (8)
Someone else's residence	319 (11)	268 (84)	51 (16)
Unstable housing	192 (7)	153 (80)	39 (20)
Educational attainment ^c			
<High school	981 (34)	867 (88)	114 (12)
≥High school	1885 (66)	1696 (90)	189 (10)
Employment ^b			
Employed	955 (33)	888 (93)	67 (7)
Unemployed	1911 (67)	1674 (88)	237 (12)
Household income ^b			
≤\$18,000	1882 (66)	1667 (89)	215 (11)
>\$18,000	812 (28)	747 (92)	65 (8)
Missing	174 (6)	150 (86)	24 (14)
GBV history at baseline ^c			
No	881 (31)	853 (97)	28 (3)
Yes	1975 (69)	1699 (86)	276 (14)
Recent drug use ^b			
No	2059 (72)	1910 (93)	149 (7)
Yes	807 (28)	652 (81)	155 (19)
Recent transactional sex ^b			
No	2768 (97)	2498 (90)	270 (10)
Yes	98 (3)	64 (65)	34 (35)
Number of recent sex partners ^b			
0	584 (20)	550 (94)	34 (6)
1	1733 (61)	1571 (91)	162 (9)
2–4	472 (17)	393 (83)	79 (17)
>4	77 (3)	48 (62)	29 (38)
Condom use with vaginal intercourse ^b			
Always used condoms	1121 (39)	1024 (91)	97 (9)
Did not always use condoms	1016 (36)	866 (85)	150 (15)
No vaginal intercourse	723 (25)	668 (92)	55 (8)
Condom use with anal intercourse ^b			
Always used condoms	84 (3)	75 (89)	9 (11)
Did not always use condoms	99 (4)	75 (76)	24 (24)
No anal intercourse	2675 (94)	2406 (90)	269 (10)

^aPhysical violence, sexual violence, and/or intimate partner psychological violence.

^bTime-varying variables, measured with respect to the past 6 months.

^cVariables measured at baseline.

GBV, gender-based violence; IQR, interquartile range.

approach for missing data due to low levels of missingness (<3% per variable).

To compare the risks of STI acquisition associated with different forms of GBV, we included recent physical violence, recent sexual violence, recent intimate partner psychological violence, and lifetime GBV history as separate independent variables in a mutually adjusted model. This model included the same covariates used in the main adjusted model. We assessed whether the association of GBV with STI acquisition differed by HIV status by adding an interaction term for GBV and HIV status to the adjusted model. Finally, we assessed whether the associations of different forms of GBV with STI acquisition differed by HIV status by including interaction terms for each form of GBV and HIV status in the mutually adjusted model.

Analyses were conducted by using Stata 13.1 software (StataCorp, College Station, TX), using an alpha level of 0.05 for statistical significance.

Results

Overall, 2868 participants contributed 24,040 visit pairs to the analysis (12,069 person-years). The median number of visit pairs contributed per participant was 6 (range 1–31, interquartile range 3–12). Recent GBV experience was reported at 1572 index visits (7%) by 778 participants (Fig. 2), most commonly intimate partner psychological violence ($n = 1022$ index visits).

We assessed baseline characteristics at the first visit that each participant contributed to the analysis. Recent GBV experience was reported at 304 (11%) of 2868 participants' first index visits (Table 1). The majority (71%) of participants were HIV-seropositive at their first index visit; HIV-seronegative women reported a higher prevalence of recent GBV (13% vs. 9%). Demographic characteristics associated with recent GBV experience included study site (not shown) and younger age. GBV prevalence was highest among women enrolled in 1994–1995 (13%) and decreased subsequently (8%–9%). The majority (69%) of participants reported GBV history at baseline.

Incident STI was reported at 581 visit pairs by 444 participants (Table 2). The most commonly reported incident STI was trichomoniasis ($n = 369$ cases, 299 unique participants, IR 3.2 per 100 person-years), followed by chlamydia ($n = 100$ cases, 87 participants, IR 0.9 per 100 person-years). Fewer diagnoses of pelvic inflammatory disease ($n = 76$ cases, 63 participants, IR 0.6 per 100 person-years), gonorrhea ($n = 51$ cases, 48 participants, IR 0.4 per 100 person-years), and syphilis ($n = 41$ cases, 36 participants, IR 0.4 per 100 person-years) were reported.

The overall IR of STI was 5.1 per 100 person-years (95% CI 4.6–5.6). Recent GBV experience was bivariate associated with 2.17-fold (95% CI 1.71–2.75) risk of STI acquisition (Table 3). The risk of STI acquisition did not significantly differ between women who had vaginal intercourse in the past 6 months and always used condoms versus those who did not always use condoms (Wald test p -value=0.21). A similar pattern was observed with respect to condom use with anal intercourse (Wald test p -value=0.74).

In the adjusted model, recent GBV experience was associated with a 1.28-fold (95% CI 0.99–1.65) risk of STI acquisition (Table 3). HIV-seropositive status was associated

TABLE 2. INCIDENCE OF SEXUALLY TRANSMITTED INFECTIONS IN THE WOMEN'S INTERAGENCY HIV STUDY, 1995–2018

STI	No. of incident STI cases	No. of unique participants	IR (95% CI) per 100 person-years
Trichomoniasis	369	299	3.2 (2.9–3.6)
Chlamydia	100	87	0.9 (0.7–1.1)
Pelvic inflammatory disease	76	63	0.6 (0.5–0.8)
Gonorrhea	51	48	0.4 (0.3–0.6)
Syphilis	41	36	0.4 (0.3–0.5)
Total	581 ^a	444 ^b	5.1 (4.6–5.6)

$N = 24,040$ visit pairs contributed by 2868 participants.

^aNumber of follow-up visits at which any STI was reported; more than one STI could be reported at a follow-up visit.

^bNumber of participants reporting any STI at a follow-up visit.

CI, confidence interval; IR, incidence rate; STI, sexually transmitted infection.

with a 1.28-fold (95% CI 1.03–1.58) risk of STI acquisition. Other risk factors for STI acquisition in the adjusted model included unstable housing (adjusted incidence rate ratio [AIRR] 1.81, 95% CI 1.32–2.46), unemployment (AIRR 1.42, 95% CI 1.14–1.76), GBV history at baseline (AIRR 1.35, 95% CI 1.07–1.71), recent drug use (AIRR 1.44, 95% CI 1.19–1.75), and recent transactional sex (AIRR 2.06, 95% CI 1.52–2.80).

When we included recent physical violence, recent sexual violence, recent psychological violence, and GBV history at baseline as separate independent variables in a mutually adjusted model (Fig. 3), recent physical violence (AIRR 1.42, 95% CI 1.01–2.00) and GBV history at baseline (AIRR 1.36, 95% CI 1.07–1.72) were associated with an increased risk of STI acquisition. Recent sexual violence and recent intimate partner psychological violence were not associated with risk of STI acquisition in the mutually adjusted model.

In the interaction model for recent GBV and HIV status, there was no evidence of interaction ($p_{\text{interaction}} = 0.42$). However, different results by HIV status were observed when forms of GBV were included as separate variables. Among HIV-seronegative women, recent physical violence was strongly associated with increased risk of STI acquisition (AIRR 2.27, 95% CI 1.18–4.35) (Table 4). In contrast, among HIV-seropositive women, recent intimate partner psychological violence (AIRR 1.37, 95% CI 0.94–2.00) and GBV history at baseline (AIRR 1.59, 95% CI 1.20–2.10) were associated with increased risk of STI acquisition. The associations of intimate partner psychological violence and GBV history at baseline with increased risk of STI acquisition differed significantly by HIV status ($p_{\text{interaction}} < 0.05$).

Discussion

In this prospective cohort study representative of U.S. WLHIV, recent GBV experience was associated with an increased risk of STI acquisition. The overall association of recent GBV experience with the risk of STI acquisition did not differ by HIV status. However, we observed significant

TABLE 3. INCIDENCE RATES, CRUDE INCIDENCE RATE RATIOS, AND ADJUSTED INCIDENCE RATE RATIOS OF SEXUALLY TRANSMITTED INFECTION ACQUISITION

	<i>IR per 100 person-years (95% CI)</i>	<i>Crude IRR (95% CI)</i>	<i>AIRR^a (95% CI)</i>
Recent GBV experience ^{b,c}			
No	4.7 (4.2–5.2)	1.00 (Ref.)	1.00 (Ref.)
Yes	10.3 (8.2–13.1)	2.17 (1.71–2.75)	1.28 (0.99–1.65)
HIV status at visit ^c			
HIV-seronegative	4.3 (3.6–5.1)	1.00 (Ref.)	1.00 (Ref.)
HIV-seropositive	5.5 (4.9–6.1)	1.25 (1.01–1.55)	1.28 (1.03–1.58)
Age at visit			
18–29	8.2 (6.3–10.8)	2.12 (1.59–2.83)	1.93 (1.42–2.62)
30–39	6.5 (5.7–7.5)	1.57 (1.30–1.90)	1.54 (1.26–1.88)
40–49	4.2 (3.6–4.9)	1.00 (Ref.)	1.00 (Ref.)
50–81	3.4 (2.7–4.3)	0.78 (0.60–1.02)	0.75 (0.58–0.99)
Year of enrollment in WIHS ^d			
1994–1995	5.3 (4.7–6.0)	1.00 (Ref.)	1.00 (Ref.)
2001–2002	2.7 (2.1–3.6)	0.51 (0.37–0.68)	0.57 (0.42–0.77)
2011–2012	3.7 (2.5–5.4)	0.69 (0.46–1.05)	0.62 (0.40–0.95)
2013–2015	9.1 (7.4–11.0)	1.68 (1.34–2.12)	1.44 (0.15–14.08)
Race/ethnicity ^d			
Non-Hispanic Black	6.0 (5.4–6.7)	1.00 (Ref.)	1.00 (Ref.)
Hispanic	2.7 (2.0–3.7)	0.46 (0.34–0.64)	0.60 (0.43–0.83)
Non-Hispanic White	2.9 (1.9–4.4)	0.49 (0.32–0.74)	0.46 (0.30–0.70)
Other	4.9 (3.0–8.0)	0.84 (0.49–1.45)	0.95 (0.55–1.64)
Marital status ^c			
Married	2.7 (2.1–3.4)	1.00 (Ref.)	1.00 (Ref.)
Living with partner	4.6 (3.6–5.9)	1.75 (1.25–2.44)	1.42 (1.01–1.99)
Never married	7.2 (6.3–8.3)	2.52 (1.93–3.28)	1.73 (1.31–2.27)
Other	4.8 (4.1–5.7)	1.63 (1.23–2.16)	1.43 (1.08–1.91)
Residence ^c			
Own residence	4.0 (3.6–4.5)	1.00 (Ref.)	1.00 (Ref.)
Parent's residence	8.7 (6.5–11.6)	2.13 (1.57–2.90)	1.28 (0.93–1.77)
Someone else's residence	10.2 (8.2–12.6)	2.43 (1.91–3.08)	1.66 (1.29–2.13)
Unstable housing	13.0 (9.9–17.0)	2.95 (2.18–3.98)	1.81 (1.32–2.46)
Educational attainment ^d			
<High school	5.6 (4.9–6.5)	1.18 (0.97–1.43)	—
≥High school	4.8 (4.3–5.5)	1.00 (Ref.)	—
Employment status ^c			
Employed	3.3 (2.8–3.9)	1.00 (Ref.)	1.00 (Ref.)
Unemployed	6.1 (5.5–6.8)	1.75 (1.44–2.13)	1.42 (1.14–1.76)
Household income ^c			
≤\$18,000	6.0 (5.4–6.7)	1.75 (1.43–2.14)	1.20 (0.96–1.49)
>\$18,000	3.1 (2.6–3.6)	1.00 (Ref.)	1.00 (Ref.)
Missing	7.8 (5.4–11.2)	2.28 (1.53–3.40)	1.84 (1.07–3.17)
GBV history at baseline ^{b,d}			
No	3.7 (3.0–4.5)	1.00 (Ref.)	1.00 (Ref.)
Yes	5.7 (5.1–6.3)	1.51 (1.20–1.90)	1.35 (1.07–1.71)
Recent drug use ^c			
No	3.9 (3.4–4.3)	1.00 (Ref.)	1.00 (Ref.)
Yes	8.4 (7.3–9.7)	2.07 (1.74–2.47)	1.44 (1.19–1.75)
Recent transactional sex ^c			
No	4.7 (4.2–5.1)	1.00 (Ref.)	1.00 (Ref.)
Yes	21.8 (16.7–28.3)	4.28 (3.24–5.66)	2.06 (1.52–2.80)
No. of recent sex partners ^c			
0	3.8 (2.8–5.2)	1.00 (Ref.)	—
1	3.8 (3.4–4.3)	1.08 (0.79–1.48)	—
2–4	10.6 (8.9–12.5)	2.81 (2.01–3.91)	—
>4	20.0 (14.4–27.6)	5.11 (3.29–7.93)	—

(continued)

TABLE 3. (CONTINUED)

	<i>IR per 100 person-years (95% CI)</i>	<i>Crude IRR (95% CI)</i>	<i>AIRR^a (95% CI)</i>
Condom use with vaginal intercourse ^c			
Always used condoms	5.0 (4.4–5.8)	1.52 (1.13–2.04)	—
Did not always use condoms	5.8 (5.1–6.6)	1.71 (1.27–2.29)	—
No vaginal intercourse	3.4 (2.6–4.5)	1.00 (Ref.)	—
Condom use with anal intercourse ^c			
Always used condoms	6.8 (4.3–10.8)	1.33 (0.86–2.04)	—
Did not always use condoms	6.2 (4.2–9.2)	1.21 (0.81–1.79)	—
No anal intercourse	5.1 (4.6–5.6)	1.00 (Ref.)	—

Sexually transmitted infection acquisition was defined as self-reported diagnosis by a health care provider of gonorrhea, syphilis, chlamydia, pelvic inflammatory disease, or trichomoniasis since the participant's previous study visit (past 6 months).

^a*N*=23,384 visit pairs contributed by 2826 participants. Model was additionally adjusted for study site (Bronx, Brooklyn, DC, San Francisco, Chicago, or Southern).

^bPhysical violence, sexual violence, and/or intimate partner psychological violence.

^cTime-varying variables, measured with respect to the past 6 months.

^dVariables measured at baseline.

AIRR, adjusted incidence rate ratio; IRR, incidence rate ratio; WIHS, Women's Interagency HIV Study

interactions by HIV status when assessing the independent associations of different forms of GBV with the risk of STI acquisition. Recent physical violence was strongly associated with STI acquisition among HIV-seronegative women, whereas the experience of GBV before study entry and recent intimate partner psychological violence (*i.e.*, controlling behaviors) were associated with a higher risk of STI acquisition among WLHIV. Thus, pathways linking violence and STI among women may vary by HIV status.

Higher risk of STI acquisition was consistently observed among WLHIV. This finding may be due to immune suppression⁴²; alternatively, unmeasured social or behavioral risk factors may vary by HIV status. We observed rates of STI acquisition of 5.5 per 100 person-years among sexually active WLHIV and 4.3 per 100 person-years among sexually active HIV-seronegative women. The IRs of individual STI were

low, ranging from 0.4 per 100 person-years for gonorrhea and syphilis to 3.2 per 100 person-years for trichomoniasis.

Other studies have observed low rates of STI among women engaged in HIV care. In a demographically similar cohort of WLHIV, Dionne-Odom et al. observed low prevalence of chlamydia (1.0%), syphilis (1.6%), and gonorrhea (0.5%), but higher prevalence of trichomoniasis (13.3%).⁴³ The authors concluded that universal STI screening among WLHIV in the United States may not be warranted, as many women had few STI risk behaviors, and that improved understanding of predictors of STI risk among WLHIV is needed.⁴³ Lucar et al. observed an IR of 1.1 per 100 person-years for a composite outcome of chlamydia, gonorrhea, or syphilis infection among WLHIV in Washington, DC, 2011–2015, with low STI incidence observed among cisgender women aged 35–54.⁴⁴ Similarly, Raifman et al. observed an

FIG. 3. Associations of forms of GBV with STI acquisition. Results are from a model adjusted for all forms of GBV included as separate variables. Physical violence, sexual violence, and intimate partner psychological violence were measured in reference to the past 6 months, whereas past GBV refers to lifetime experience of GBV before WIHS entry (measured at baseline). STI was defined as self-reported diagnosis by a health care provider of gonorrhea, syphilis, chlamydia, pelvic inflammatory disease, or trichomoniasis since the participant's previous study visit (past 6 months). The model was additionally adjusted for HIV status, age, study site, year of WIHS enrollment, race/ethnicity, marital status, residence, employment, household income, recent drug use, and recent transactional sex. *N*=23,376 visit pairs contributed by 2824 participants. STI, sexually transmitted infection.

TABLE 4. ASSOCIATIONS OF FORMS OF GENDER-BASED VIOLENCE WITH SEXUALLY TRANSMITTED INFECTION ACQUISITION BY HIV STATUS

<i>GBV exposures</i>	<i>HIV-seronegative AIRR (95% CI)</i>	<i>HIV-seropositive AIRR (95% CI)</i>	<i>P_{interaction}</i>
Physical violence (recent)	2.27 (1.18–4.35)	1.25 (0.84–1.87)	0.13
Sexual violence (recent)	0.71 (0.21–2.43)	0.80 (0.44–1.45)	0.86
Intimate partner psychological violence (recent)	0.50 (0.23–1.11)	1.37 (0.94–2.00)	0.03
GBV history at baseline	0.91 (0.60–1.38)	1.59 (1.20–2.10)	0.03

Results are from a model adjusted for all GBV exposures included as separate variables, with interaction terms for HIV status. Physical violence, sexual violence, and intimate partner psychological violence were measured in reference to the past 6 months, whereas GBV history at baseline was measured at study entry. STI was defined as self-reported diagnosis by a health care provider of gonorrhea, syphilis, chlamydia, pelvic inflammatory disease, or trichomoniasis since the participant's previous study visit (past 6 months). The model was adjusted for age, study site, year of WIHS enrollment, race/ethnicity, marital status, residence, employment, household income, recent transactional sex, and recent drug use, as well as the main effects of forms of GBV and HIV status. $N=23,376$ visit pairs contributed by 2824 participants.

average test positivity for gonorrhea and chlamydia of 1.6% among sexually active women in the HIV Research Network, 2004–2014.⁴⁵ These studies did not assess the contribution of GBV experience to STI risk.

A few studies have compared forms of GBV with respect to STI risk.^{3,8,41,46} Early WIHS research among WLHIV identified a 2.8-fold higher odds of incident self-reported STI associated with recent physical violence, but not recent sexual violence.⁴¹ This association was mediated by the number of recent sex partners.⁴¹ In a study of 2180 married women in Goa, India, Weiss et al. observed that experience of sexual violence, but not physical or verbal abuse, was associated with a significant threefold higher odds of incident laboratory-diagnosed STI.³ In contrast, Allsworth et al. observed that past-year experience of physical violence without sexual violence was the strongest GBV risk factor for incident laboratory-diagnosed STI, associated with a 1.8-fold increased risk, in a study of 542 sexually active girls and women in Rhode Island.⁴⁷ In the Togo 2013–2014 Demographic and Health Survey, Nguyen et al. observed a significant threefold higher odds of self-reported past-year STI among women reporting physical IPV, sexual IPV, or both, compared with no IPV.⁴⁶

We found that recent physical violence had the strongest independent association with the risk of STI acquisition, particularly among HIV-seronegative women. Exposure to physical violence may reflect social vulnerability and reduced ability to negotiate safer sex. We adjusted for variables including residence, employment, and income; however, residual confounding is possible. Physical violence may also be a risk marker for partner- or network-level characteristics. Alternatively, previous WIHS research limited to WLHIV suggested that women who were physically abused exited violent relationships and sought out new partners, thus encountering elevated short-term risk of STI acquisition.⁴¹

We observed that GBV history at baseline was a strong independent predictor of STI acquisition, particularly among WLHIV. Lifetime experience of GBV, particularly childhood sexual abuse, is associated with subsequent experiences of GBV, substance use, and HIV/STI risk behaviors, due to trauma and other psychosocial consequences of abuse.^{12,13} Indeed, these pathways may play a stronger role in STI acquisition for WLHIV. We observed a stronger association of recent intimate partner psychological violence with STI acquisition among WLHIV. This finding may be due to interacting effects of HIV status and chronic psychosocial stress on

immune biomarkers in the reproductive tract,²⁰ although this line of research is in an early stage. Our findings support the relevance of a life course perspective on preventing, studying, and treating the effects of GBV, particularly among WLHIV.⁴⁸

Contrary to expectation, we did not observe significant associations between recent sexual violence and incident STI acquisition. The interview question, “Has anyone pressured or forced you to have sexual contact?,” may not adequately capture women's experiences of coerced sex or unequal power dynamics that increase STI risk.³⁵

Further, we did not observe an association between condom non-use and STI acquisition. Detailed data on condom use were not available; measures that account for frequency of unprotected sex and partner STI risk would likely be stronger predictors of incident STI. Likewise, we did not observe an interaction in the association between recent GBV experience and STI acquisition by HIV status. This may be because the null association of recent sexual violence with STI acquisition, which did not differ by HIV status, masked the significant interaction of recent intimate partner psychological violence with HIV status.

Adverse socioeconomic conditions increase vulnerability to GBV and HIV/STI acquisition. Recent research by Decker et al. in the WIHS found that low income and housing instability were associated with subsequent experience of GBV.¹⁴ Among low-income and unstably housed women, reliance on a partner for resources such as money or shelter is linked to condom non-use and vulnerability to violence due to unequal power dynamics.³⁵ Indeed, qualitative research by Frew et al. identified financial instability as a major driver of high-risk sexual behaviors among women at risk of HIV infection.³⁵ We found that unstable housing and unemployment were independently associated with 81% and 42% increased risk of STI acquisition, respectively, underscoring the relevance of women's socioeconomic conditions for sexual health.

Pathways linking substance use, GBV, and HIV/STI risk include reliance on a partner for drugs, transactional sex to procure drugs for oneself or a partner, reduced ability to avoid violence or negotiate condom use while under the influence, and the social vulnerability of drug-involved women.²⁸ In this study, recent drug use and transactional sex were strongly associated with GBV experience and risk of STI acquisition. Previous work in the WIHS identified several measures of substance use as risk factors for physical violence, whereas transactional sex

was more strongly associated with sexual violence.¹⁴ Our results support centering the physical and sexual safety needs of women who use drugs and women who trade sex.

Strengths of this study include generalizability, longitudinal design, and adjustment for several potential confounders. The WIHS is a well-described cohort, representative of cisgender WLHIV in several major U.S. cities.^{36–38} Limitations include use of a self-reported outcome, which is considered an acceptable method of data collection for STI but is likely subject to underreporting⁴⁹ and requires health care utilization. Pathways from violence to STI likely vary based on relationship context, partner STI status, and presence of vaginal trauma during sexual abuse; we lacked data on these factors. In addition, our measures of GBV did not take severity or frequency into account. We adjusted for several potential confounders; however, some of these variables may instead mediate the association between GBV and STI, potentially resulting in overadjustment.⁵⁰

We chose to focus on GBV exposures and STI outcomes at consecutive visits separated by 6 months; however, there are different etiologically relevant periods depending on the pathway from GBV experience to STI acquisition. Finally, the WIHS only includes individuals assigned female at birth but high rates of GBV and HIV/STI acquisition have been documented among transgender women.⁵¹ Future research and policy efforts to prevent GBV and HIV/STI should consider the unique needs of transgender women.

Conclusion

We identified recent GBV experience as an independent risk factor for STI acquisition. Our findings support recommendations for women's health clinicians to screen patients for IPV and provide appropriate resources and referrals,⁵² following a trauma-informed care framework.⁵³ We observed that the experience of GBV before study entry and recent intimate partner psychological violence were associated with risk of STI acquisition among WLHIV. This finding may inform risk stratification for STI screening among WLHIV, although further study using clinical STI diagnosis is warranted. Unstable housing, unemployment, transactional sex, and drug use were also important STI risk factors. Our results support a holistic approach to improving women's socioeconomic stability to reduce vulnerability to GBV and its sexual health sequelae.

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