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A Prospective Cohort Study of Intimate Partner Violence and Unprotected Sex in HIV-Positive Female Sex Workers in Mombasa, Kenya

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Abstract

We conducted a prospective cohort study to test the hypothesis that intimate partner violence (IPV) is associated with unprotected sex in HIV-positive female sex workers in Mombasa, Kenya. Women completed monthly visits and quarterly examinations. Any IPV in the past year was defined as 1 act of physical, sexual, or emotional violence by the current or most recent emotional partner ('index partner'). Unprotected sex with any partner was measured by self-report and prostate specific antigen (PSA) test. Recent IPV was associated with significantly higher risk of unprotected sex (adjusted relative risk [aRR] 1.91, 95 % CI 1.32, 2.78, $p = 0.001$) and PSA (aRR 1.54, 95 % CI 1.17, 2.04, $p = 0.002$) after adjusting for age, alcohol use, and sexual violence by someone besides the index partner. Addressing IPV in comprehensive HIV programs for HIV-positive women in this key population is important to improve wellbeing and reduce risk of sexual transmission of HIV.

Keywords

Intimate partner violence; Unprotected sex; Female sex workers; Africa; Prospective study

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Compliance with Ethical Standards

Conflict of Interest None to declare.

Ethical approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Introduction

Gender based violence (GBV) is a health and human rights problem, and an important barrier to an effective response to the HIV pandemic [1, 2]. Intimate partner violence (IPV), which can include physical, sexual, and emotional violence by a regular partner, is the most common form of GBV in women [3]. A meta-analysis of 79 studies reported a 36 % lifetime prevalence of sexual and physical IPV in Africa [4]. According to a national household survey in Kenya, 41 % of ever married women reported IPV in the past year [5]. Negative outcomes associated with IPV include depression [6], substance use disorders [7], sexual risk behaviors [8], unintended pregnancy [9], and HIV infection [10, 11]. Intimate partner violence may result in higher risk of HIV acquisition through reduced sexual relationship power, less ability or motivation to negotiate condoms, or increased substance use, which leads to more frequent unprotected sex with any sexual partner [12–14]. Intimate partner violence may persist following HIV seroconversion [15], and represent an important and ongoing risk factor for unprotected sex in HIV-positive women.

In Africa, female sex workers (FSWs) are a key population that is disproportionately affected by violence [16, 17], substance use problems [18], and HIV [19–21]. In Kenya, FSWs represent an estimated 1 % of the population and contribute 14 % of new HIV transmissions [22]. Prior studies on violence against FSWs in relation to HIV acquisition and transmission have focused on exposure to violence from clients and other men [23, 24]. While most FSWs have long-term emotional partners (i.e. boyfriends, husbands) [25], exposure to IPV by a current or most recent ‘emotional’ partner using a standardized measure is often not assessed. Further, while prior studies have shown that IPV is a risk factor for unprotected sex in general population samples of HIV-negative women [8, 10], these samples are different from FSWs. The relationship between IPV and unprotected sex in HIV-positive FSWs may have important public health implications that are distinct from this relationship in HIV-negative FSWs. While, unprotected sex tends to decline following seroconversion and initiation of ART [26, 27], higher rates of unprotected sex associated with IPV could increase the risk of onward HIV transmission [28]. Importantly, IPV as a potential risk factor for sexual transmission of HIV in HIV-positive FSWs is unclear. To address these knowledge gaps, we conducted a prospective study to test the hypothesis that recent IPV would be associated with a higher rate of unprotected sex in HIV-positive FSWs in Kenya.

Methods

This longitudinal analysis included data from women enrolled in an open cohort study that began in 2012 to evaluate the relationship between reproductive lifecourse events and HIV transmission risk behaviors in Mombasa, Kenya. Eligible women were age 18 or older and laboratory-confirmed HIV-positive. All participants were FSWs, defined on the basis of reporting exchanging sex for cash or in-kind payment at their screening visit. About 80 % of participants were in follow-up in the Mombasa Cohort when this study began in 2012. The Mombasa Cohort was initiated in 1993 [27]. New participants were recruited through our community outreach activities and informational meetings at our clinic. At enrollment, women completed a standardized face-to-face interview in their preferred language

(Kiswahili or English) with a Kenyan study nurse in a private room to collect data on health, demographics, sexual risk behaviors, and exposure to violence. A study clinician conducted a physical examination including a speculum-assisted pelvic examination for collection of genital swabs for laboratory testing for sexually transmitted infections (STIs) and the presence of semen. Women returned monthly for clinical and behavioral data collection. Physical examinations with specimen collection were conducted quarterly. Participants received free outpatient care at our research clinic, including risk reduction education, antiretroviral therapy (ART) if eligible according to Kenyan National Guidelines, and STI screening and treatment. Women who reported experiencing violence were offered counseling on site or referral for follow-up care. All participants received 250 Kenyan shillings in reimbursement for travel (~\$3.00 US dollars). This study was approved by the ethics committees of Kenyatta National Hospital and the University of Washington. All participants provided written informed consent.

Measures

The primary exposure was any IPV in the past 12 months, assessed annually ('recent IPV' hereafter). This variable was defined as responding yes to at least one of 13 questions about acts of IPV. Questions were adapted from the World Health Organization (WHO) survey on violence against women, which has high internal consistency [3]. This tool was chosen because it focuses on IPV, an important form of gender-based violence committed by a specific regular emotional partner. During the interview, women were asked whether they had an 'emotional' partner, such as a boyfriend or husband, who they did not consider to be a client or casual partner. This distinction was made to ensure that women did not misinterpret the question and report violence by any man with whom they had a sexual relationship. If they did not have such a partner at the time of the interview, they were asked about their most recent emotional partner. This man was identified as the index partner. Participants who identified having an index partner were then asked about any acts of IPV by the index partner. If a participant reported ever experiencing IPV by that partner, she was then asked whether that act occurred in the past 12 months to identify ongoing exposures that could be modified. This partner-specific approach to asking about IPV is consistent with other studies that have used the WHO tool, and permits a more precise understanding of who is committing this violence [3, 29]. There were six questions on physical violence (hit, slapped, kicked, pushed, choked, or threatened with a weapon), four on emotional violence (insulted, belittled, intimidated, or threatened to hurt someone you care about), and three on sexual violence (forced sex, coerced sex, forced to perform degrading sexual behavior). Asking behaviorally-specific questions has been shown to elicit more accurate recall than asking more general questions about exposure to IPV [3]. In addition to the primary exposure, we created a categorical variable for IPV severity (severe, moderate, meaning any act that was not severe, and none). Severe IPV was defined as being hit, kicked, choked, approached with a weapon, and any act of sexual IPV [30]. Women who reported no index partner were classified as unexposed to IPV by an index partner at that visit. All questions were pilot tested in our target population to ensure that women understood the terms used. Further, our prior qualitative research in this population has shown that women readily distinguish 'regular' or 'emotional' partners from other types of sexual partners and clients [31].

All women were also asked about any violence committed by someone other than the index partner since age 15, and in the last 12 months (annually). Exposure to sexual violence was defined as being forced to have sex or perform a sexual act. Physical violence was defined as beaten or physically mistreated. Because women may experience violence from other men, we also created variables for any GBV and any non-index partner violence for exploratory analyses. Any GBV in the past year was defined as any IPV by the index partner (i.e. current or most recent emotional partner) and/or any sexual violence or physical violence by a man who was not the index partner. Any non-index partner violence in the past year, was defined as any sexual or physical violence by someone other than the index partner, regardless of exposure to IPV.

The primary outcome was unprotected sex in the past week, measured monthly. This variable was computed based on responses to four questions about total sex acts and total sex acts with a condom. Women were asked separately about vaginal and anal sex. Unprotected sex was defined as the number of total sex acts exceeding the number of sex acts with a condom. The proportion of visits at which women reported no sex in the past week was also evaluated in the full cohort. In the subset of visits where women reported sexual activity in the past week, the total number of sexual partners, total sex acts, and the proportion with 100 % condom use were evaluated. The proportion with detection of any STI at quarterly examination visits, defined as presence of *Neisseria gonorrhoeae*, *Chlamydia trachomatis*, or *Trichomonas vaginalis* by nucleic acid amplification test (APTIMA; Hologic, San Diego, CA), cervical gram stain, or wet preparation were also evaluated.

In addition to the self-reported behavioral outcomes, we evaluated the relationship between IPV in the past year and semen detection in the genital secretions by prostate specific antigen test (PSA) test, a biomarker of unprotected sex collected at quarterly examination visits (ABACard; West Hills, CA, USA). The PSA test is most sensitive for detecting semen within 24–48 h of unprotected sex [32].

Covariate data were collected at different intervals, depending on the measure. Socio-demographic characteristics collected included age (enrollment); marital status (ever married; annually); years in sex work (<5, 5–9, 10; enrollment); early sexual debut (first sex 15 years; enrollment); highest education level (<8 years vs 8 or more; enrollment); and workplace (bar, nightclub, home/other; enrollment). Reproductive characteristics included use of modern contraceptives (no method, condoms only, injectable hormonal contraception, oral contraceptives, intrauterine device, tubal ligation, hysterectomy, or other; monthly); fertility desire (quarterly); laboratory-confirmed pregnancy (quarterly); postpartum status (< 9 months since last delivery); and post-menopausal status (clinical algorithm; annually). Partner data included questions on any casual partners (quarterly) and an index partner's expected reaction to a future pregnancy (excited, neutral, upset; annually). Controlling behaviors by the index partner were defined as responding yes to at least one of seven statements (e.g. he acts suspicious that you are unfaithful; he requires permission to get health care; annually).

Depressive symptoms, alcohol use, and male controlling behaviors were measured with standardized tools used in similar African populations [33–35]. Depressive symptoms in the past 2 weeks were assessed by Patient Health Questionnaire-9 (PHQ-9) (6-monthly) [35]. Scores were categorized as 0–4 (minimal), 5–9 (mild), 10 or higher (moderate or severe; consistent with a major depressive disorder). Alcohol use in the past year was assessed by the Alcohol Use Disorders Identification Test (AUDIT) (annually) [36]. Scores were categorized as non-drinkers (zero), minimal [1–6], moderate [7–15], and severe problem or possible alcohol use disorder (AUD) (≥ 16). Disclosure of HIV status was assessed by asking whether women had ever shared their results with someone, and if so, with whom (e.g. sibling, friend, health worker; 6-monthly) [37].

Statistical Analysis

Women who enrolled between October 12, 2012 and September 25, 2014 contributed data to this analysis. Follow-up visits were included until administrative censoring (September 30, 2014). The primary exposure status was carried forward for all visits until the next IPV assessment. This approach is consistent with evidence that recent IPV is a strong predictor of ongoing IPV [38]. All covariate values collected less frequently than monthly were imputed forward until the next assessment. This assumption was tested in sensitivity analyses using alternative ways of modeling the exposure window.

For the primary analysis, we tested the hypothesis that IPV in the past year was associated with increased risk of unprotected sex in the past week. Because women contributed multiple outcomes to the analysis, log-binomial generalized estimating equations (GEEs) with robust standard errors were used to estimate the relative risk (RR), 95 % confidence intervals (95 % CI) of the outcome comparing exposed to unexposed visits. GEEs are appropriate for longitudinal data, and can provide consistent estimates where there are unequal numbers of visits per woman, missing data, and time varying exposures and covariates [39]. Wald test statistics were used for all models, and reported as χ^2 (degrees of freedom). Multivariate models included age (restricted cubic spline) and any sexual violence since age 15 by someone besides the index partner (enrollment value) as a priori confounding factors. Additional covariates were considered for inclusion in the adjusted models if they could potentially confound the association between IPV and unprotected sex, based on causal diagrams [40]. These variables were tested in the regression model in order of decreasing effect size for their association with unprotected sex. Covariates that changed the primary effect estimate by ≥ 10 % were retained in the final model [41]. Enrollment values of depressive symptoms and alcohol use were evaluated in the multivariate models. The time-updated values for these variables were not used, because both characteristics could also act as steps in the causal pathway linking IPV and unprotected sex [42]. Baseline alcohol use was the only covariate that changed the primary effect estimate by ≥ 10 %. As such, the final model included only baseline alcohol use and the pre-specified confounding factors.

We also tested the hypothesis that IPV in the past year was associated with increased risk of PSA detection in vaginal secretions. This analysis was limited to quarterly examination

visits. The same adjusted model as the primary analysis was used, substituting PSA detection as the outcome.

We used a similar model building approach to evaluate IPV as a risk factor for the exploratory outcomes, and adjusted for the same covariates as in the primary analysis. We evaluated the association between recent IPV and self-reported abstinence from sex in the past week. At visits where women reported sexual activity, the association between IPV and total sex partners (binary ≥ 2 vs <2), total sex acts (binary ≥ 3 or <3), and proportion of visits with 100 % condom use was evaluated. Because continuous measures of total number of sex partners and total sex acts were highly skewed, these values were dichotomized at the median. We also evaluated the association between recent IPV and laboratory-confirmed STI. Sensitivity analyses were conducted using different definitions of the exposure (e.g. any IPV defined as 2 or more acts versus 1 or fewer [10]) and outcomes (e.g. a person-level analysis where each woman's outcome was defined as any unprotected sex summarized over the past year to correspond to the recall period for IPV of 1 year).

Missing data for the exposures, outcomes, and covariates were <2 %, so complete case analysis was used. We evaluated loss to follow-up in the cohort, which we defined as the most recent follow-up visit occurring at least six months prior to the censoring date [43]. All analyses were conducted in STATA Version 13.0.

Results

Overall, 389 women contributed 4934 visits and 488 person-years to the analysis. Of those women, 264/389 (67.9 %) had at least one annual visit, and 138/389 (35.5 %) had two annual visits at the time of censoring for this analysis. The median number of follow-up visits was 14 (interquartile range [IQR] 5–23). Enrollment characteristics are presented Table 1. Women's median age was 39 years ([IQR] 32–44). Most women worked in bars or restaurants (228/389, 58.6 %). The majority of women were able to identify an index partner (310/389, 79.6 %). History of physical violence (134/389, 34.5 %) and sexual violence (62/389, 15.9 %) since age 15 by someone other than the index partner was common.

Longitudinal Analysis of Recent IPV as a Risk Factor for Unprotected Sex

Of 4934 total study visits contributed by 389 women, 110 (28.2 %) women were exposed to IPV in the past year at 863 (17.5 %) visits. Unprotected sex was reported by 127 (32.6 %) women at 436 (8.8 %) visits. Any IPV in the past year was associated with a significantly increased risk of self-reported unprotected sex in the past week (146/863, 16.9 % vs. 290/4071, 7.1 %; RR 2.37, 95 % CI 1.65, 3.42, $\chi^2 = 21.6$ (1), $p < 0.001$) (Table 2). This association was attenuated, but remained statistically significant after adjusting for age, lifetime history of sexual violence by someone besides the index partner, and baseline alcohol use (aRR 1.91, 95 % CI 1.32, 2.78; $\chi^2 = 41.0$ (8), $p = 0.001$). The results were similar in sensitivity analyses restricted to visits contributed by women who reported an index partner (aRR 1.63, 95 % CI 1.11, 2.38; $\chi^2 = 15.5$ (8), $p = 0.006$). When the exposure was categorized by severity, there was a suggestion of a higher risk of unprotected sex in visits exposed to higher IPV severity level (severe IPV RR: 3.02, 95 % CI 1.15, 6.04; moderate IPV RR: 2.32, 95 % CI 1.59, 3.40; $\chi^2 = 23.8$ (2), $p < 0.001$). These findings were

similar in the multivariate model used in the primary analysis (severe IPV aRR: 2.50, 95 % CI 1.35, 4.65; moderate IPV aRR: 1.87, 95 % CI 1.27, 2.76; $\chi^2 = 45.9$ (9), $p < 0.001$).

Recent IPV was associated with a significantly lower proportion of visits where women reported no sex in the past week (aRR 0.67, 95 % CI 0.54, 0.83; $\chi^2 = 117.1$ (1), $p < 0.001$). In a subset of visits where women had reported any sex in the past week, 100 % condom use was significantly less common when women reported IPV (aRR 0.90, 95 % CI 0.82, 0.99; $\chi^2 = 9.9$ (1), $p = 0.03$). Results were robust to alternative definitions of the exposure and outcome in sensitivity analyses (data not shown).

Longitudinal Analysis of Recent IPV as a Risk Factor for Semen Detection by PSA Test

Semen detection by PSA test was more than twice as common as unprotected sex by self-report, occurring at 359 of 2207 exam visits (16.3 %, in 175 women). Notably, PSA was detected in vaginal secretions at 284/1993 (14.3 %) of examination visits when no unprotected sex was reported. Positive PSA results were more frequent at visits where women reported IPV compared to visits when no IPV was reported (aRR 1.54, 95 % CI 1.17, 2.04; $\chi^2 = 33.4$ (8), $p = 0.002$).

Exploratory Analyses of any GBV, Unprotected Sex, and Semen Detection by PSA Test

In exploratory analysis of other forms of violence, any GBV in the past year (by the index partner and/or any physical or sexual violence by someone other than the index partner) was frequent (1225/4924 visits, 22.8 % in 154 women), and associated with significantly higher risk of unprotected sex (179/1225, 14.6 % vs. 257/3699, 7.0 %, aRR 1.69, 95 % CI 1.51, 2.49; $\chi^2 = 40.1$ (1), $p = 0.007$), and semen detection by PSA test (119/546, 21.8 % vs. 240/1656 14.5 %, aRR 1.37, 95 % CI 1.06, 1.78; $\chi^2 = 29.7$ (8), $p = 0.02$) in adjusted analyses. Exposure to any non-index partner physical or sexual violence in the past year was less frequent (447/4924, 9.1 % in 63 women), and not associated with higher risk of unprotected sex (aRR 1.04, 95 % CI 0.60, 1.80; $\chi^2 = 32.4$ (8), $p = 0.90$) or PSA detection (aRR 1.16, 95 % CI 0.77, 1.73; $\chi^2 = 22.2$ (8), $p = 0.48$).

Differences between women who were retained in follow-up and women who had not returned for a follow-up visit for at least 6 months before the censoring date were assessed. Overall, 105 (26.9 %) women were lost to follow-up by this definition. The adjusted association between IPV in the past year and unprotected sex was moderately larger in the group that was lost to follow-up (aRR 2.23, 95 % CI 0.82, 6.08; $\chi^2 = 23.1$ (8), $p = 0.12$) compared to the group that was retained (aRR 1.80, 95 % CI 1.20, 2.76; $\chi^2 = 40.6$ (8) $p = 0.005$). Similarly, in women who were lost to follow-up, there was a larger association between recent IPV and semen detection by PSA test (aRR 2.26, 95 % CI 1.28, 4.00; $\chi^2 = 16.8$ (8), $p = 0.005$) compared to the group that was retained (aRR 1.50, 95 % CI 1.11, 2.04; $\chi^2 = 32.8$ (8), $p = 0.009$). Recent IPV was not associated with a significantly higher risk of loss to follow up (aRR 1.02, 95 % CI 0.56, 1.85; $\chi^2 = 12.7$ (8), $p = 0.96$).

Discussion

In this prospective study of high-risk HIV-positive FSWs, IPV in the past year was associated with a significantly higher risk of unprotected sex by self-report. Recent IPV was also associated with a significantly higher risk of semen detection by PSA test.

These findings complement studies among high-risk, primarily HIV-negative women in Africa [16, 17, 19]. A study conducted among HIV-negative FSWs recruited from bars and nightclubs in Kenya reported that violence by an ‘emotional partner’ in the last year was associated with a higher frequency of inconsistent condom use in the last 3 months (no effect estimate reported) [29]. The association between recent IPV and unprotected sex in our sample was similar to results from one prospective study that included HIV-positive women on methadone treatment in the US [7]. Our primary effect estimate was modestly larger than the estimate reported in a longitudinal analysis of data from HIV-negative African women enrolled in a contraceptive trial [8]. Our results differ from two prospective studies in population-based samples of HIV-negative women in South Africa [10] and Uganda [11], which did not find an association between recent IPV and higher risk of unprotected sex. Our study adds to the literature by demonstrating that recent IPV is an important risk factor for unprotected sex in high-risk, HIV-positive women.

There are several mechanistic pathways that may help to explain the relationship between recent IPV and increased risk of unprotected sex. First, IPV can reduce women’s self-efficacy and mental health, which can lead to decreased ability to negotiate condoms [44]. Randomized trials in South Africa have shown that empowering women by strengthening their skills to deescalate relationship conflict can reduce recurrent IPV and unprotected sex [45, 46]. Second, IPV may lead to negative coping strategies such as problem substance use, resulting in a reduced ability or motivation to use condoms [19]. Third, condom use tends to be lower with emotional partners than with clients [47, 48]. A qualitative study of HIV positive FSWs in Nairobi revealed that the stronger bonds with emotional partners made it harder for women to insist on using condoms [48]. Finally, IPV may be a marker of relationships with risky men, who have a history of violent behavior or a sense of sexual entitlement, and with whom unprotected sex is more likely to occur [49]. Future research on the social, psychological and behavioral pathways linking IPV and unprotected sex in high-risk women may help to guide the identification of optimal intervention targets.

This study is one of the first to evaluate the association between IPV and semen detection in vaginal secretions by PSA test. Our finding that recent IPV was associated with a significantly increased risk of positive PSA test supports the results from the primary analysis based on self-reported unprotected sex. We found that 14 % of visits at which no unprotected sex was reported had positive PSA results, which was similar to previous studies in high-risk women [50, 51]. Discrepancies between self-reported unprotected sex and PSA test are expected, because they do not measure precisely the same thing [52]. The lower frequency of self-reported unprotected sex compared to semen detection by PSA was likely due to underreporting [50]. In addition, even when women reported condom use accurately, semen exposure may have occurred due to condom failure or genital exposure before applying or after removing a condom [50]. It is also expected that some self-reported

unprotected intercourse may be missed by PSA test. Specifically, since PSA is rapidly excreted in 24–48 h [32], some acts of unprotected sex reported in the past week may have occurred outside the window of detection. These results highlight the value of using both behavioral and biological markers of sexual behavior to gain a more complete understanding of the relationship between IPV and unprotected sex.

This study had several strengths. The longitudinal design with time-updated exposure and outcome measurements permitted evaluation of the temporal sequence between recent IPV and unprotected sex. The inclusion of a semen biomarker for unprotected sex is novel in the field of violence and HIV research, and cross-validated our self-reported measures. Standardized tools were used to measure the IPV exposure [3], unprotected sex [53], alcohol use [36], and depressive symptoms [35], which should enhance comparability to other studies using these measures. This attention to methodological considerations is a valuable contribution to the violence and HIV literature. We also examined whether our results were sensitive to loss to follow-up in the cohort. The association between recent IPV and unprotected sex was modestly larger in the visits by women lost to follow-up, suggesting that we may have underestimated the true effect of IPV on unprotected sex. Finally, our study focused on HIV-positive women, all of whom reported engaging in transactional sex at screening. These women represent a key population in Africa, with unique needs for comprehensive HIV prevention and care [54, 55].

This study also had a number of limitations. First, both IPV and sexual behavior are sensitive topics that are subject to underreporting because of social desirability bias. We tried to minimize underreporting of IPV through interviewer training and use of a standardized tool that included several questions about specific acts of physical, sexual, and emotional IPV [3]. Nonetheless, underreporting could have occurred because we asked about IPV in the past year on an annual basis, rather than more frequently. In addition, underreporting of IPV may have occurred because women had more than one emotional partner in the past year, either concurrently or sequentially [48]. We chose to collect this information once a year, and focus on a single partner for two reasons. We wanted to adhere to the 1-year recall period of the WHO tool, to allow for comparability with other studies. We also felt that asking a comprehensive set of questions about IPV by more than one emotional partner at more frequent intervals might place too great a burden on both participants and study staff. As such, we had to balance our interest in collecting more comprehensive data on IPV more frequently with practical issues related to the data collection instrument and study design. Second, the decision to carry forward IPV exposure status until the next annual visit may have resulted in bias if a woman's true exposure changed between assessments. Notably, incorrect classification of exposure status that changed between assessments (nondifferential misclassification), would most likely have led to underestimation of the true association. Third, data were collected on unprotected sex generally, rather than unprotected sex with different types of partners. Unprotected sex may be higher with regular partners than with clients [25]. However, we were unable to determine whether unprotected sex by self-report or semen detection by PSA in vaginal secretions occurred with the index partner, a different regular partner, a casual partner, or a client. Fourth, bias due to unmeasured confounding by perceived gender power imbalance and partner characteristics, including his HIV status, was possible [49]. Fifth, this study

sample included HIV-positive FSWs. As such, results may not reflect the association between recent IPV and unprotected sex in women in the general population. However, these results are likely to be relevant to other high-risk women in Africa, and may help to inform targeted HIV prevention strategies for this key population.

Conclusion

Violence against FSWs is a serious problem with important implications for women's health and global HIV treatment and prevention [2]. Our study demonstrates that IPV, which by definition was committed by an emotional partner who is not a client, was common in this population of HIV-positive FSWs, and was associated with an overall higher rate of unprotected sex. Consistent condom use and high adherence to ART are essential for reducing risk of HIV transmission from HIV-positive FSWs. Our results show that there are important public health implications of IPV in HIV-positive FSWs. Exposure to IPV in this key population may increase risk for onward HIV transmission, in addition to its negative health effects on women. One promising intervention that could be adapted for HIV-positive FSWs in Kenya is a brief, empowerment-based behavioral intervention designed for substance-using women [12]. This model has been shown to be efficacious at reducing the prevalence of substance use, unprotected sex, and IPV in trials in South Africa in HIV-negative and HIV-positive women [12, 46]. Implementation research is needed to assess feasibility, acceptability, and effectiveness of such interventions for FSWs in Kenya, and to identify optimal modes of service delivery. Ultimately, a combination of behavioral [12, 46] and community mobilization interventions with FSWs [55] should be evaluated as strategies to reduce violence, improve women's wellbeing, and lower the risk of sexual transmission of HIV.

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Table 1

Baseline characteristic of the study sample (N = 389)

Characteristic	Median (IQR) or n (%)
Age (years)	39 (32,44)
Years in sex work	9 (5,15)
Less than 8 years of education	163 (41.9)
Ever married	301 (77.4)
Workplace	
Bar/restaurant	228 (58.6)
Nightclub	94 (24.2)
Home/other	67 (17.2)
Has an index partner ^a	310 (79.6)
Any controlling behaviors by the index partner	186 (47.8)
Any IPV in the past year	62 (15.9)
Casual partner in the past 3 months	178 (45.8)
Number of previous live births (n = 388)	2 (1,3)
Contraceptive use by method duration	
None or condoms only	272 (69.7)
DMPA or OCP	75 (19.3)
IUD, TL, norplant, hysterectomy, other	42 (10.8)
Partner attitude about pregnancy (n = 303) ^b	
Excited	170 (56.1)
Neutral	79 (26.1)
Upset	54 (17.8)
Depressive symptoms by PHQ-9	
Minimal (0–4)	279 (71.7)
Mild (5–9)	83 (21.3)
Mod/Severe (10 or higher)	27 (6.9)
Alcohol use problems by AUDIT	
Non drinkers	193 (49.6)
Minimal (1–6)	113 (29.1)
Moderate (7–15)	69 (17.7)
Severe/possible AUD (16 or higher)	14 (3.6)
Sexual behavior in the past 7 days	
Unprotected sex	30 (7.7)
No sex	155 (39.9)
100 % condom use (n = 234) ^c	204 (87.2)
Number of sex acts (n = 234) ^c	2 (1,3)
2 sexual partners (n = 234)	115 (49.2)
Disclosed HIV status to anyone in the past (n = 388)	247 (63.5)
Disclosed to a boyfriend ^d	53 (13.6)

Characteristic	Median (IQR) or n (%)
Disclosed to a husband ^d	24 (6.2)
Lifetime sexual violence by someone other than the index partner, (n = 388)	62 (15.9)
Any sexual violence in the past 12 months (n = 388)	33 (8.5)
Lifetime physical violence by someone other than the index partner	134 (34.5)
Any physical violence in past 12 months (n = 388)	30 (7.7)
CD4 count cells/ml ³	460 (333,630)
On ART ^e (n = 388)	235 (60.4)
Laboratory-confirmed STI (n = 382)	51 (13.1)

AUDIT alcohol use disorders identification test, *CT* Chlamydia trachomatis, *DMPA* depot medroxyprogesterone acetate, *IPV* intimate partner violence, *IUD* intrauterine device, *OCP* oral contraceptive pills, *PHQ-9* Patient Health Questionnaire 9, *TL* tubal ligation

^a 'Index' partner refers to a woman's current or most recent emotional partner who was not a client or casual partner. All IPV questions refer to acts committed by this index partner

^b Asked of women who reported an index partner

^c Restricted to visits where women reported at least one sex act in the past week

^d This question did not refer specifically to the index partner

^e ART use was determined by clinic records or, by self-report if the woman had not initiated ART at our research clinic at the time of enrollment. At enrollment, 121/235 (51.5 %) who reported taking ART were doing so at our research clinic

Table 2

Unadjusted and adjusted associations between IPV in the past year, sexual risk behaviors, and detection of PSA in vaginal secretions

Outcome	Visits IPV exposed	Visits IPV unexposed	RR (95 % CI) [‡]	χ^2 (df)	aRR (95 % CI) [§]	χ^2 (df)
Unprotected sex in the past week	146/863 (16.9)	290/4071 (7.1)	2.37 (1.65, 3.42)	21.6 (1)	1.91 (1.32, 2.78)	41.0 (8) **
Semen detection by PSA ^a	94/387 (24.3)	265/1820 (14.6)	1.67 (1.26, 2.21)	12.7 (1)	1.54 (1.17, 2.04)	33.4 (8) **
No sex in the past week	270/863 (31.3)	2174/4071 (53.4)	0.59 (0.47, 0.74)	21.0 (1)	0.67 (0.54, 0.83)	117.1 (8) ***
100 % condom use in the past week ^b	447/593 (75.4)	1607/1897 (84.7)	0.89 (0.81, 0.98)	5.4 (1) *	0.90 (0.82, 0.99)	9.9 (8) *
3 sex acts in the past week ^b	208/593 (35.1)	624/1897 (32.9)	1.07 (0.82, 1.39)	0.22 (1)	1.00 (0.79, 1.26)	61.5 (8)
2 sexual partners in the past week ^b	233/593 (39.3)	755/1897 (39.8)	0.99 (0.75, 1.30)	0.01 (1)	0.96 (0.76, 1.21)	58.1 (8)
Any STI ^a	34/387 (8.8)	157/1809 (8.7)	1.01 (0.64, 1.60)	0.00 (1)	0.88 (0.57, 1.37)	44.5 (8)

Df: degrees of freedom, IPV: intimate partner violence, PSA: prostate specific antigen test, RR: relative risk, aRR: adjusted relative risk, STI: sexually transmitted infection (positive for *Chlamydia trachomatis*, *Neisseria gonorrhoeae*, or *Trichomonas vaginalis*)

* p value <0.05,

** p value <0.01,

*** p value <0.001, based on Wald (Chi squared) tests (χ^2)

[‡]RRs estimated using generalized estimating equations with log link, independence correlation structure, and robust standard errors

[§]Multivariate models were adjusted for age (restricted cubic spline), baseline alcohol use level, and lifetime history of sexual violence since age 15 by someone other than the index partner (enrollment value). The adjusted model in the primary analysis included 389 women and 4933 visits. The adjusted model for the secondary analysis included data from 389 women and 2206 examination visits

^aRestricted to exam visits when genital samples were collected

^bRestricted to 2490 monthly follow-up visits where women reported being sexually active during the past week