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A prospective study of intimate partner violence as a risk factor for detectable plasma viral load in HIV-positive women engaged in transactional sex in Mombasa, Kenya

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Abstract

We conducted a prospective cohort study to evaluate intimate partner violence (IPV) as a risk factor for detectable plasma viral load in HIV-positive female sex workers (FSWs) on antiretroviral therapy (ART) in Kenya. IPV in the past year was defined as ≥1 act of physical, sexual, or emotional violence by the index partner (i.e. boyfriend/husband). The primary outcome was detectable viral load (≥180 copies/ml). In-depth interviews and focus groups were included to contextualize results. Analyses included 195 women (570 visits). Unexpectedly, IPV was associated with significantly lower risk of detectable viral load (adjusted relative risk 0.21, 95% CI 0.05-0.84, p=0.02). Qualitative findings revealed that women valued emotional and financial support from index partners, despite IPV. IPV was not a major barrier to ART adherence. The observed association between IPV and lower risk of detectable viral load in FSWs may be due to unmeasured personal and relationship factors, warranting further research.

Abstract

Se realizó un estudio de cohorte prospectivo para evaluar la violencia en la pareja (VP) como un factor de riesgo para la carga viral detectable en plasma en las trabajadoras sexuales (TS) con VIH-positivo en el tratamiento antirretroviral (TAR) en Kenia. La violencia de pareja en el último año se definió como ≥1 acto de violencia física, sexual o emocional por parte de la pareja (novio/

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marido). El resultado principal fue la carga viral detectable (≥ 180 copias /ml). Entrevistas de profundidad y grupos de enfoque fueron realizados para contextualizar los resultados. Los análisis incluyeron 195 mujeres (570 visitas). Inesperadamente, la violencia de pareja se asoció con un riesgo significativamente menor en la carga viral detectable (riesgo relativo ajustado: 0.21; IC del 95%: 0.05 a 0.84; p = 0.02). Los resultados cualitativos revelaron que las mujeres valoran el apoyo emocional y financiero de sus parejas, a pesar de la violencia de pareja. La violencia de pareja no era un obstáculo importante para el cumplimiento del TAR. La asociación observada entre la violencia de pareja y un más bajo riesgo en la carga viral detectable en las trabajadoras sexuales puede ser debido a factores personales y de relación que no fueron medidos, y que merecen ser investigados en profundidad.

INTRODUCTION

The goal of antiretroviral therapy (ART) is to achieve sustained plasma viral load suppression to reduce the risk of HIV disease progression (1), drug resistance (2), and secondary transmission (3). High adherence (>80%) is essential to optimize ART for treatment and prevention (4). In Africa, which accounts for an estimated 70% of the 35 million HIV infections worldwide, over 7.6 million adults are on ART (5). However, gaps remain in each step of the HIV care cascade from HIV testing, linkage to and retention in care, and sustained viral suppression (5). In 2012, one quarter of African adults on ART were not virally suppressed (5). In high-burden countries such as Kenya, levels of adherence and viral suppression vary widely by population and region (6).

There are many structural, interpersonal, and individual barriers to adherence, including transportation costs (7), stigma (8), low social support (9), poor mental health (10), and alcohol use (11). In Kenya, a country with a generalized HIV epidemic, intimate partner violence (IPV) against women is common (12). According to the 2008/9 Kenyan Demographic and Health Survey, 41% of ever married women reported experiencing any physical, sexual, or emotional IPV by a boyfriend or husband in the past 12 months (13). Relationship violence (i.e. IPV) is associated with higher risk of negative outcomes including HIV infection (14, 15), poor self-rated health (16), and psychiatric conditions (17). A recent meta-analysis of cross-sectional studies from general-population women in high-income countries found that lifetime IPV was associated with about a 40% lower likelihood of viral suppression and a 50% lower likelihood of optimal adherence (18). Qualitative studies of HIV-positive women in Zimbabwe (19) and the US (20) suggest that low motivation or partner interference may undermine women's ability to remain adherent.

Female sex workers (FSWs) in Africa are disproportionately affected by HIV, social sigma, and violence in the work setting (21-23). In Kenya, an estimated 1% of women report engaging in sex work; and 32% of FSWs are living with HIV (24, 25). Most FSWs in Africa also have long-term boyfriends or husbands (26, 27). Studies from Kenya that focused on IPV (variously defined) against FSWs have reported estimates ranging from 15% (28) to 70% (27). Individual, dyad, and community-based interventions that strengthen women's communication and coping skills have been shown to reduce IPV and negative health consequences in other settings (21, 29-31). As such, IPV may also be a modifiable risk

factor for sub-optimal ART adherence and unsuppressed viral load, and could be targeted in future interventions for African women in key populations.

Limitations to existing literature on IPV as a risk factor for detectable viral load and poor adherence include the lack of epidemiologic studies from Africa, lack of prospective data, and lack of focus on key populations at high risk for transmitting HIV to sexual partners (23, 32). Importantly, the Kenyan government has called for more evidence to better address gender-based violence (including IPV) in key populations, as part of the national HIV treatment and prevention strategy to achieve zero new infections by 2030 (33). To address these research gaps, we conducted a prospective cohort study to evaluate the association between IPV in the past year, detectable viral load, and poor ART adherence in HIV-positive FSWs in Mombasa, Kenya.

METHODS

We conducted a longitudinal analysis of data from women enrolled in an ongoing cohort study at our research clinic to evaluate the relationship between reproductive lifecourse events and risk factors for HIV transmission. Details of these methods are described elsewhere (28). New participants were recruited through community outreach activities at bars and hotels and informational meetings at our clinic. Participants were age 18 or older, laboratory-confirmed HIV-positive, eligible for ART according to Kenyan National Guidelines in 2012 (CD4 ≤350 cells/mm^3 or World Health Organization (WHO) stage 3 or 4 or TB co-infection). All participants were FSWs, defined on the basis of reporting exchanging sex for cash or in-kind payment at the time of screening for enrollment in the parent cohort. This broad definition included informal, part-time, and full time work.

At enrollment, women completed a standardized face-to-face interview in their preferred language (Kiswahili or English) with a trained Kenyan study nurse to collect health and behavioral data. A study clinician conducted a physical examination including a speculum-assisted pelvic examination for collection of genital samples. Women returned for monthly follow-up visits for behavioral data collection and ART refills. Every three months, a genital examination was performed and CD4 testing was repeated. Blood samples were collected every six months for plasma viral load testing (Hologic/Gen Probe San Diego, CA). Participants received free outpatient care at our research clinic, including risk reduction education, ART according to Kenyan National Guidelines, and STI screening and treatment. Women who reported experiencing violence were offered on-site counseling or referral (34). This study was approved by the ethics committees of Kenyatta National Hospital and the University of Washington. All participants provided written informed consent.

The primary outcome was detectable plasma viral load, defined as HIV ribonucleic acid at or above 180 copies per milliliter (c/mL) by Hologic/Gen-Probe second generation assay. This cut-point was higher than the lower limit of linear quantitation for this assay (<30 c/mL) because some 100 mL samples had to be diluted 6-fold to a final volume of 600 mls before testing. The secondary outcome was poor ART adherence in the past month, defined as >48 hours late for a scheduled refill based on our pharmacy data (‘late refill’, hereafter) (35). We have previously shown that late refill using this definition is a strong predictor of

detectable plasma viral load, genotypic resistance to ART, and HIV shedding in genital secretions (35, 36).

We also evaluated adherence in the past 30 days using a validated single-item self-rating scale (37). The self-rating scale asked “rate your adherence in the last month” with response categories “very poor, poor, fair, good, very good, and excellent.” We created a binary outcome of less than “very good or excellent,” which corresponded to <80% adherence in a prior validation study conducted in a clinic sample of HIV-positive adults in the US (37).

The primary exposure was any IPV in the past year, defined as responding yes to at least one of 13 questions about acts of IPV in the past 12 months committed by that participant's current or most recent emotional partner. Questions were adapted from the WHO survey on violence against women, a standardized instrument with good internal consistency (38-40). All women were asked whether they had an emotional partner with whom they had a sexual relationship, such as a boyfriend or husband, and whom they did not consider to be a client or a casual partner. Any woman without an emotional partner at the time of the interview was asked about her most recent emotional partner. The current or most recent emotional partner was identified as the ‘index partner’, and participants were asked whether they had experienced IPV by that partner. If a participant reported ever experiencing a specific act of IPV by her index partner, she was then asked whether that act occurred in the past 12 months. There were six questions on physical violence (included being slapped, pushed, hit, kicked, choked, threatened or used a weapon against you), four on emotional violence (e.g. Has he done things to scare or intimidate you on purpose, such as by the way he looked at you, by yelling or smashing things? Has he threatened to hurt you or someone you care about?), and three on sexual violence (e.g. Has he physically forced you to have sexual intercourse when you did not want to? Did you have sexual intercourse you did not want to because you were afraid of what he might do? Did you have sexual intercourse you did not want to because you were afraid of what he might do?) (38, 40). Our definitions of index partner, and all questions about IPV, were pilot tested with women from the study population to ensure that these items were understandable. Exposure to IPV was assessed annually. Women with no index partner were classified as having no IPV at that visit and all subsequent visits until the next annual IPV assessment. All women were asked about history of sexual or physical violence since age 15 by someone other than their index partner (enrollment, annually) (38). 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 participants may have experienced violence by other men, we evaluated two other forms of violence as exposures in exploratory analyses. Any gender-based violence (GBV) in the past year was defined as responding yes to any IPV or yes to sexual or physical violence in the past year by someone besides the index partner. Any non-partner GBV was defined as yes to sexual or physical violence by someone besides the index partner in the past year.

Covariate data were collected at different intervals, depending on the measure. Socio-demographic characteristics included age (enrollment), marital status (ever married; annually); years in sex work (<5, 5-9, ≥10; enrollment), highest education level (<8 years

versus 8 or more; enrollment), and workplace (bar, nightclub, home/other; enrollment). Reproductive characteristics included use of modern contraceptives (none/condoms only, hormonal contraceptive pills, hormonal injections, intrauterine device, tubal ligation, hysterectomy; monthly) and laboratory-confirmed pregnancy (quarterly). Exposure to controlling behaviors was defined as experiencing at least one of seven acts by the index partner (e.g. Keeps you from seeing friends; Insists on knowing where you are at all times; Is often suspicious that you are unfaithful; Requires permission to get health care; annually) (38). Women were also asked about any casual partners in the last three months (quarterly).

Depressive symptoms in the past two weeks were assessed by the Patient Health Questionnaire-9 (PHQ-9) (6-monthly) (41). 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 alcohol use disorders identification test (AUDIT) (annually) (42). Scores were categorized as non-drinkers (zero), minimal (1-6), moderate (7-15), and severe problem or possible alcohol use disorder (AUD) (≥16) (42). Disclosure of HIV status was assessed by asking whether women had ever shared their results with someone, and if so, whom (e.g. sibling, friend, health worker; 6-monthly) (43). CD4 testing was performed using an automated method (FACSCount, Becton Dickinson, Forrest Lakes, NJ). Time on ART was a time-updated measure based on time (days, converted to years) since the first date of ART use according to our pharmacy records or by self-report at enrollment, whichever came first.

Statistical analysis

Women who enrolled between October 2012 and September 2014 and were receiving ART at our research clinic contributed data to this analysis. Follow-up visits were included until administrative censoring (September 30, 2014). Exposure status was carried forward for all visits until the next annual IPV assessment to account for the 6-monthly visits with viral load samples that did not have corresponding exposure data. This approach also aligns with previous studies that suggest that recent IPV is a strong predictor of recurrent IPV (44), and that the effects of IPV may persist over time (45). Covariate values collected less than monthly were carried forward until the next assessment.

For the primary analysis, we tested the hypothesis that IPV in the past year was associated with increased risk of detectable plasma viral load (≥180 copies/ml). Because each woman contributed multiple outcomes to the analysis, log-binomial generalized estimating equations (GEE) were used to generate relative risks (RR) and 95% confidence intervals (CI) (46). Wald tests were used for hypothesis test statistics. All models used independence working correlation structure and robust standard errors. Age (restricted cubic spline) and education level (<8 years versus 8 or more) were included as *a priori* confounding factors in the multivariate models based on prior studies (47-49). Additional covariates were considered for inclusion in multivariate models if they were plausible confounding factors based on prior research and causal diagrams (47, 49-55). These included number of live births, years in sex work, workplace, AUDIT score (enrollment value), PHQ-9 score (enrollment value), controlling behaviors by the index partner, previous sexual or physical violence by someone other than the index partner, and HIV status disclosure. Manual forward selection was

performed, entering variables in order of decreasing effect size with respect to viral load detection. None of the additional covariates changed the primary effect estimate by ≥10%, so only the pre-specified confounding factors were retained in the final model (56).

Several sensitivity analyses were conducted. We repeated all analyses restricted to visits where women reported an index partner. We also evaluated IPV severity level (severe, moderate, or no IPV) (57). We further examined whether the associations between IPV in the past year and detectable viral load differed after excluding visits during women's first six months on ART, when viral load may have been detectable, but declining, in response to ART initiation.

Because we hypothesized that IPV in the past year would be associated with detectable plasma viral load due to the hypothesized effect of IPV on ART adherence, we conducted a separate analysis of the association between IPV in the past year and two measures of adherence, late ART refill (>48 hours) and poor adherence by self-rating scale (<80%). These analyses included the same covariates in the final multivariate model as our primary analysis.

We evaluated whether the association between IPV and detectable plasma viral load differed between women who remained in follow-up compared to those who had not returned for at least 6 months at the time of censoring date (58). Missing data for viral load were <10% and for all other variables <2%, so we performed complete case analysis. All analyses were conducted in STATA Version 13.0.

In-depth interviews and focus group discussions

Because IPV is a complex phenomenon that may not be fully captured in a structured survey (12), we conducted in-depth interviews (IDIs) and focus group discussions (FGDs) to enhance our understanding individual experiences and norms around IPV in HIV-positive FSWs (59). The qualitative sample was recruited from observational cohort participants. The study nurse sequentially recruited women who reported experiencing any IPV in the past year to participate in either an IDI or FGD. No woman refused to participate. We estimated that 10-12 women for the IDIs, and two groups of 6-10 women each for the FGDs, would be needed to reach thematic saturation (59). Topic guides were informed by an ecological theory of violence against women, which identifies structural, community, interpersonal, and individual determinants of IPV (60). Topic guides were pilot-tested, and included semi-structured questions about dynamics of emotional partnerships, patterns of IPV, impact of IPV on women's health and HIV care, and coping strategies. Probes included how women handled disclosure of their HIV status, ART adherence, and condom use. A Kenyan qualitative researcher performed all data collection. Interviews were conducted in either Kiswahili or English, according to the participant's preference. Data collection was conducted in a private room at our research clinic, and audio-recorded. Each session lasted between 60 and 90 minutes. Field notes were used to supplement the transcripts. The audio tapes were transcribed and translated into English. Two researchers (KW and GW) separately coded and reviewed all transcripts, and developed an initial codebook informed by the topic guide. The codebook was refined throughout the coding process, allowing for new themes to emerge. Any discrepancy between coders was resolved through discussion.

Thematic analysis was conducted in Atlas.ti (GmbH, Berlin, Germany). As a validation measure, we conducted a modified member check, where preliminary findings were shared with a group of women from the full cohort who had not participated in the qualitative component, to verify whether our interpretation resonated with their experiences (61).

RESULTS

Overall, 214 women contributed 3,189 follow-up visits for inclusion in the analyses. Their baseline characteristics are presented in Table I. The median age was 40 years (interquartile range (IQR) 36-45)). Median time in transactional sex was 11 years (IQR 8-17). Most women (146, 68.2%) had disclosed their HIV status to another person, most often to a sibling (57, 26.6%), health worker outside our clinic (51, 23.8%), or friend (44, 20.6%). Fewer had ever disclosed to a boyfriend (31, 14.6%) or husband (14, 6.6%). Most women were divorced or widowed (146, 68.2%), and were in relationships with other men whom they identified as their index partners (164, 76.6%). Median time on ART was 3.8 years (IQR 1.3-6.6).

Longitudinal association between IPV in the past year and detectable plasma viral load

The primary analysis was restricted to 195 women who contributed 570 viral load visits and 189 person-years of follow-up. Women contributed a median of three plasma viral load outcomes to the analysis (IQR 2-4). Twenty-three women (11.8%) were lost to follow-up. Of 570 visits included in this analysis, 88 (15.4%, 45 women) were exposed to IPV in the past year. There were 68 (11.9%, 37 women) visits with detectable viral load. The median plasma viral load at visits with detectable viral load was 10,799 c/ml (IQR 1,712-91,763 c/ml).

Unexpectedly, there was a lower prevalence of detectable viral load at visits with IPV in the past year compared to visits where women did not report IPV (3/88, 3.4% versus 65/482, 13.5%; RR 0.25, 95% CI 0.06-1.08; Wald 3.42, p-value=0.06). This association became statistically significant after adjusting for age and education (adjusted RR [aRR] 0.21, 95% CI 0.05-0.84; Wald (5) 14.0, p-value=0.03). Results were similar after excluding visits contributed by women who reported that they had no index partner (aRR 0.20, 95% CI 0.05-0.79; Wald (5) 15.8, p-value=0.02), and after restricting the analysis to visits where women had been taking ART for more than six months (aRR 0.21, 95% CI 0.06-0.87; Wald 14.2, p-value=0.03). Results were also similar when any GBV in the past year was analyzed as the exposure (6/120, 5.0% vs. 62/450, 13.8%; aRR 0.31, 95% CI 0.11-0.88; Wald 10.5, p-value=0.03). Exposure to violence in the past year by someone other than the index partner was infrequent, and not associated with detectable viral load (3/41, 7.3% vs. 65/529, 12.3%, aRR 0.57, 0.13-2.43; Wald 4.44, p-value=0.45).

Longitudinal association between IPV in the past year and poor ART adherence

A total of 214 women contributed a median of 21 (IQR 14-24) monthly follow-up visits to this analysis. Of 3,189 visits, late ART refill occurred at 560 (17.6%) visits and exposure to IPV in the past year occurred at 517 (16.2%). Reporting IPV in the past 12 months was not significantly associated with late refill (81/517, 15.7% versus 479/2,672, 18.0%; RR 0.87,

95% CI 0.65-1.18; Wald 0.76, p-value=0.40). The association was similar after adjusting for age and education (aRR 0.84, 95% CI 0.61-1.14; Wald (5) 8.01, p-value=0.26) (Table II). Recent IPV was also not significantly associated with <80% adherence (<"very good/ excellent") by self-rating scale (5/530, 1.0% versus 13/2,661, 0.50%; aRR 1.58, 95% CI 0.52-4.74; Wald 8.23, p-value=0.43).

Association between ART adherence measures and plasma viral load

We also evaluated whether our adherence measures were reasonable predictors of detectable plasma viral load. Late refill was associated with a significantly higher risk of detectable viral load (RR 95% CI 3.02, 1.66-5.48; Wald 13.21, p-value<0.001). Similarly, although <80% adherence by self-rating scale was observed at only 18/3,191 (0.6%) visits, this marker for poor adherence was associated with a significantly increased risk of detectable viral load (RR 4.43, 95% CI 1.06-18.50; Wald 4.17, p-value=0.04).

Results from the in-depth interviews and focus group discussions

Results from the IDIs and FGDs were used help interpret and contextualize the unexpected findings from the epidemiologic study. Eleven women completed the IDIs and 12 women completed the two FGDs. The median age of women was 36 years old (32-40), and they all had at least one child. Women referred to their emotional partners (i.e. the index partner) as their '*mzee*' (Kiswahili for "old man"), and identified their *mzees* as distinct from clients or former husbands. The average relationship duration was 5 years (range 1-10). About half of the women were living with their *mzees,* and had children with them. An example of this type of relationship is illustrated by one woman's quote: "He takes care of me. Especially my children he pays their school fees, my house rent, ration, he takes care of me like his wife." Key themes and relevant quotes are summarized in Table III.

Patterns and perceptions of IPV

Physical violence and insults were the most frequently mentioned forms of IPV. The most common situations when IPV would occur were when the participant's partner was drunk, or she did not have money to buy food. Most of the women rejected social norms that condoned IPV, and would fight back or try to deescalate relationship conflict. One woman confronted her partner after she spoke with a counselor at the research clinic, and convinced him to stop beating her: "I explained to him that wives should not be beaten and that if he beat me he would be arrested... At the clinic, they said I should eat properly, so if you love me, you should ensure that I eat properly. He said it is ok...So these days he leaves me around 200 shillings..." Most women described IPV as one of many stressors in their lives. Other stressors were lack of money for rent, concern about their children's future, their own survival, and HIV-related stigma.

Relationship features that support HIV care and adherence to ART

All women were asked about how relationship conflict may have affected their engagement in HIV care, including use of ART. A notable finding was that none of the women reported that experiencing IPV made it more difficult to engage in HIV care, initiate ART, or take their medication. Women described several ways that they navigated relationship conflict,

while trying to prioritize their own health and survival. Resilience, social support, relationship commitment, and non-disclosure of HIV status emerged as important factors that may help to explain why IPV was not an important barrier to ART adherence.

All participants conveyed a sense of resilience in the face of relationship violence and challenges of living with HIV. A powerful example of women's resilience was the decision to start ART. Over half of the participants were taking ART at the time of the IDIs or FGDs. Many women described starting ART as ‘taking a stand’ on life, rather than succumbing to early death. They committed to adhering to medication, and also taking pro-active steps to improve other parts of their lives. One participant explained this process well: “You know, taking medication, it's your decision to live. It is not that another person has decided that you live...”.

Most women sought some form of support after an episode of IPV. Notably, about half of the women were attending HIV support groups at the research clinic, where they could share experiences and strategies for coping with HIV. This social support helped some women feel more able to adhere to ART, as one participant explained: “Even the learning I am doing here (at the research clinic) is for me to help myself not you...For me, my life is important. Now when it gets to the time to swallow medication, I won't be worried...”

Another important theme was the role of love and financial support in these relationships. Women had sought out boyfriends as a way to reduce their involvement in sex work, which was characterized by short-term partnerships, financial uncertainty, and risk of exploitation by clients and police. Most women intended to stay with their *mzees*. For example, one woman explained: “I am still with him because I love him, because I wanted a family.” The stability of a long-term relationship, despite IPV, may have indirectly helped women to engage in HIV care and adhere to ART.

Most women chose not to disclose their HIV status to their *mzees* to avoid the possibility of negative reaction, loss of support, or abandonment. They would hide their pills, taking them when their *mzees* were not around. As such, most *mzees* could not directly interfere with women's medication use because they were unaware of her HIV status. On the contrary, the one woman who had disclosed her HIV status to her *mzee* explained that he was the one who reminded her to take her ART: “He knows everything. He is even the one who reminds me to take my (HIV) medicine ...”

The findings from the FGDs confirmed what was observed in the IDIs. An important theme that women discussed was hiding medication from their *mzees* as a strategy to stay adherent and avoid disclosure. One woman described this experience: “I used to take one [pill] and hide, when I wander around [on the street] I take one, when the time comes for me to take it whether it's the morning or evening, I never let a day pass by...”. Although secrecy required by non-disclosure may inhibit medication taking, hiding medication from partners did not emerge as an important barrier to adherence for participants.

DISCUSSION

In this prospective cohort study of FSWs taking ART in Kenya, we did not find evidence to support our hypothesis that IPV in the past year was associated with a higher risk of detectable plasma viral load. Surprisingly, IPV in the last year was associated with a lower risk of detectable plasma viral load. Findings from our qualitative component suggest that other personal and relationship factors may support women's engagement in HIV care and adherence to ART, even in the context of IPV.

Our results contrast with studies that have reported that IPV was associated with significantly greater likelihood of detectable viral load in HIV-positive women (50, 52, 62, 63). These studies were conducted in high-income countries with general-population samples of HIV-positive women. For example, a cross-sectional study of HIV-positive women of color in the US reported that lifetime IPV was associated with a 38% lower likelihood of viral suppression (52). That study included women who were not engaged in HIV care, and likely had a combination of risk factors related to barriers to engagement in care and ART initiation. In our study, all women had initiated ART. Many had been on treatment for several years, and may have already overcome some adherence barriers. Furthermore, the cultural, economic, and epidemiologic context of these Kenyan FSWs are likely distinct from those of women in other settings (64).

Overall, we observed a lower proportion of women with poor adherence and detectable viral load compared to studies in US women (16, 47, 63) and to a study of FSWs in Benin (65). In our population, the 15% prevalence of IPV in the past year was also lower than estimates of 25-50% reported in the US in studies of predominately HIV-positive women of color (62, 63). These differences could be due to actual differences in risk for IPV or to differences in reporting. Different studies have used a variety of measures for IPV and ART adherence, so comparisons between studies should be made with caution (18). Nonetheless, our finding that recent IPV was associated with a significantly lower risk of detectable plasma viral load in this population of FSWs is distinctly different from other published studies of this association.

We and others have hypothesized that IPV would be associated with a higher risk of detectable viral load because of detrimental effects of IPV on ART adherence (16, 47, 52, 62, 63). Specifically, we felt that IPV could lead to poor adherence through psychological and behavioral pathways including stress (62), shame and denial (19), and poor coping skills, including harmful substance use (66). Partners may also directly interfere with women's ability to take ART consistently or to return to the clinic for medication refills (19, 67). Given our unexpected findings, these mechanisms may be overly simplistic, and fail to capture key personal or contextual features that have a major impact on adherence in HIV-positive FSWs.

In an effort to explain the observed association between exposure to IPV in the last year and lower risk of detectable viral load in our population, we have developed a number of new hypotheses that are supported by our qualitative findings. One possibility is that women who reported IPV were also more resilient, defined as the capacity to regain mental health despite

adversity (68). As such, they may have had better coping skills and been more motivated to stay adherent to ART compared to women who did not report IPV. A cross-sectional study of HIV-positive US women on ART found that higher resilience was associated with better adherence in women who had experienced recent IPV, but not in women without recent IPV (48).

A key theme from our qualitative data was women's strong commitment to take their HIV medications while managing relationship conflict. The added stress of IPV may have made them more determined to do what they could, within the scope of their own control, to stay healthy for themselves and for their children, including adhering to ART. A second explanation is that women who were experiencing IPV were more motivated to get help from friends or our clinic staff. The added social support may have reinforced their ability to adhere to ART.

A third possible explanation is that reporting IPV may be a marker for certain positive features of long-term partnerships (69). Our qualitative findings revealed that many women wanted to stay with their *mzees*, despite episodes of IPV, because of love, companionship, and financial stability. In a qualitative study in the US of IPV experiences in HIV-negative women who used substances, most women had several reasons to stay with their partners, and tried to mitigate IPV rather than end the relationship (70). As such, deeper understanding of the positive and negative features of a long-term partnership is likely important for understanding how IPV may relate to adherence in this population.

A fourth explanation was that most *mzees* were unaware of women's HIV status and medication use, and therefore, did not interfere with women's HIV care. Non-disclosure emerged as a strategy to reduce the risk of a *mzee's* violent reaction or abandonment. Notably, about half of the women did not live with their *mzees*, which may have made it easier for them to hide their medication. As such, one proposed pathway linking IPV and poor adherence and detectable viral load, through a partner's direct interference with her medication use (19), was not a major theme in this sample.

A fifth explanation for our findings is that the association between IPV and detectable viral load may have been due to chance (type-1 error). Future studies in similar populations will be necessary to address this possibility. Given these combined findings, it seems likely that our original hypothesis, that IPV would be associated with poor adherence leading to detectable viral load in this population, was incorrect.

The study had several strengths. The longitudinal design allowed us to better understand the temporal sequence between exposure and outcomes. This is important because starting ART or being on treatment may also trigger episodes of IPV (19). We used an adapted version of a standardized WHO instrument to measure IPV, which facilitates comparability between studies. Our use of time-updated data on IPV helped to reduce the possibility of incorrectly classifying women's exposure status over time. Finally, we conducted several sensitivity analyses, demonstrating that the observed association between recent IPV and plasma viral load was robust across a range of approaches to measurement and classification of IPV, as well as selection of the analysis population.

Our unexpected findings demonstrate that the main limitation of this study was our lack of data on other personal and relationship characteristics, including women's resilience, relationship satisfaction, gender norms, or social support (70). We also did not collect data on number of children in the home, which may influenced women's motivation to stay adherent. Fortunately, our parallel qualitative data on experiences of IPV by *mzees* provided some insight into these characteristics that may help to explain our quantitative results (59). An additional limitation of this study is the potential for underreporting of IPV, because of the sensitivity of this topic, unmeasured forms of IPV including economic violence, and the possibility that some women may have been exposed to IPV by more than one index partner in the past year. We tried to minimize underreporting by using trained Kenyan study staff to conduct the interviews, and by asking behaviorally specific questions to facilitate disclosure (38). Finally, our study population consisted of HIV-positive Kenyan women, all of whom reported transactional sex at screening. In addition, all women were on ART at our research clinic. Conditions at our research clinic, including free medical care, transport reimbursements, and counseling, were such that participants in this study may have been more likely to be adherent. Multiple studies from diverse populations and locations, including key populations who are not engaged in HIV care, will be essential to inform research on IPV and HIV treatment behaviors and outcomes.

CONCLUSION

Intimate partner violence is a complex health and human rights problem that has been associated with many negative physical and psychological consequences. Achieving a 50% reduction in the global prevalence of GBV in the next 30 years will require sustained commitment to reducing IPV (71). In this context, expanding targeted screening and evidence-based programs to prevent or reduce IPV and its negative consequences are an essential part of women's health care in general. Our results caution against assertions that addressing IPV can be expected to improve viral load suppression in all populations. Further quantitative and qualitative research on resilience, relationship satisfaction, and social support may reveal novel factors that could be targeted to improve ART outcomes and overall health in female sex workers.

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Table I

Baseline characteristics of the participants (N=214)[¥]

	N (%) or IQR
Age	40 (36-45)
Highest education less than 8 years	89 (41.6)
Years in sex work (n=212)	11 (8-17)
Workplace	
Bar/Restaurant	147 (68.7)
Nightclub	30 (14.0)
Home/Other	37 (17.3)
Ever married	168 (78.5)
Has an index partner[1]	164 (76.6)
Casual partner in the last 3 months	71 (33.2)
Ever experienced controlling behaviors by the index partner[2]	88 (41.1)
Number of previous births (n=212)	2 (1-3)
Depressive symptoms by PHQ-9	
Minimal (0-4)	170 (79.4)
Mild (5-9)	36 (16.8)
Mod/Severe (10 or higher)	8 (3.7)
Alcohol use problems by AUDIT	
Non-drinkers	137 (64.3)
Minimal (1-6)	46 (21.5)
Moderate (7-15)	28 (13.1)
Severe/possible AUD (16 or higher)	3 (1.4)
Unprotected sex in the past week	16 (7.5)
No sex in the past week	104 (48.6)
100% condom use in the past week (n=110)	90 (83.3)
Number of sex acts in the past week (n=110)	2(1,3)
Has 2 or more sex partners in the past week (n=110)	36 (32.7)
Disclosed HIV status to anyone in the past	146 (68.2)
Ever disclosed to a boyfriend or husband	43 (20.1)
Ever had sexual violence by another person[3]	29 (13.6)
In the past 12 months[3]	14 (6.7)
Ever had physical violence by another person[3]	77 (36.0)
In the past 12 months[3]	13 (6.1)
CD4 count (n=212)	430 (326-586)
Time on ART (years)[4]	3.8 (1.3- 6.6)

ART, antiretroviral therapy ; AUDIT, Alcohol Use Disorders Identification Test; CT, Chlamydia trachomatis; GC, Neisseria gonorrhoeae; IPV, intimate partner violence; IQR, interquartile range; PHQ-9, Patient Health Questionnaire 9; TV, Trichomonas vaginalis.

[¥]Baseline refers to the visit date on or after initiating ART at our research clinic

[1]'Index' partner refers to a woman's current or most recent regular partner (i.e. boyfriend or husband) who was not a client or casual partner. If she did not have a current regular partner, she was asked to refer to her most recent regular partner. All IPV questions refer to acts committed by this index partner.

[2]Asked of women who reported an index partner at that visit.

[3]These questions refer to violence committed by someone other than the index partner.

[4]Based on self-report or pharmacy records at enrollment.

Table II

Univariate and multivariate associations between IPV in the past year and detectable PVL, late ART refill, and self-rated adherence

Outcome	Visits IPV exposed	Visits IPV unexposed	RR (95% CI)[¥]	χ^2 (df)	aRR (95% CI)[2]	χ^2 (df)
		n (%)	n (%)			
Detectable plasma viral load[1]	3/88 (3.4)	65/482 (13.5)	0.25 (0.06, 1.08)	3.42 (1)	0.21 (0.05, 0.84)	14.0 (5) *
Late refill (>48 hours)[2]	81/517 (15.7)	479/2,672 (18.0)	0.87 (0.65, 1.18)	0.76 (1)	0.84 (0.61, 1.14)	8.01 (5)
< 80% by self-rating scale[3]	5/530 (1.0)	13/2,661 (0.50)	1.93 (0.68, 5.47)	1.23 (1)	1.58 (0.52, 4.74)	8.23 (5)

**; p-value<0.01

***; p-value<0.001

ART, antiretroviral adherence; df, degrees of freedom; IPV, intimate partner violence; PVL, plasma viral load; RR, Relative Risk; aRR, adjusted Relative Risk

*p-value<0.05

¥RRs estimated using generalized estimating equations with log link, independence correlation structure and robust standard errors. The Wald (Chi-squared) test was used for all test statistics.

+Multivariate models adjusted for age (restricted cubic spline) and education (<8 vs. 8 or more years)

1≥180 viral copies per milliliter. The adjusted model and included 195 women and 570 visits when viral load testing was performed.

2The adjusted model included 214 women and 3,189 visits when women were taking ART.

3The adjusted model included 213 women and 3,190 visits when women were taking ART.

Table III

Key themes and illustrative quotes from qualitative findings on IPV experiences in HIV-positive FSWs in Kenya

Key Theme	Illustrative quote
Relationship with the *mzee* (index partner)	*"He's not my husband, he is just someone who helps me I even had my first child with him. No I don't live with him. It's just helping me out in case of anything when I tell him he takes care of it. he has his family..." - Age 30* *"He takes care of me. Especially my children he pays their school fees, my house rent, ration, he takes care of me like his wife." - Age 40*
Resilience	*You know, taking medication, it's your decision to live. It is not that another person has decided that you live.* *- Age 39* *You've been beaten and you're using medication you wake up with aches and in using the medication you also have to eat, you have to eat, now how will you go out and find work? or will you stay and heal?...* *- Age 49* *I explained to him that wives should not be beaten and that if he beat me he would be arrested... At the clinic, they said I should eat properly, so if you love me, you should ensure that I eat properly. He said it is ok...So these days he leaves me around 200 shillings. These days I cook beef or chicken...* *- Age 32* *I just give myself strength...yeah sometimes I give myself morale, I don't think, I don't even drink anything...* *- Age 31* *I even wanted to kill myself (after learning her status), but I said now if I kill myself what about my children? I told myself let me pray to God that I live to look after my children.* *- Age 25*
Social support	*Even the learning I am doing here (at Ganjoni Health Centre) is for me to help myself not you...For me, my life is important. Now when it gets to the time to swallow medication I won't be worried...* *- Age 39* *The counseling has helped us a lot...You hear from your peer talk 'ohh so that's what it's like.'...It (a support group) helps sometimes (because) you can have thoughts or have an illness that bothers you or your body feels tired or your body is itching. You can say maybe it's just me who feels like this but when you come there when you ask your peer they tell you they also feel like that, so you say ok maybe that's normal.* *- Age 49*
Relationship satisfaction and love	*He takes care of me. Especially my children, he pays their school fees, my house rent, and rations. He takes care of me like his wife.* *- Age 40* *I am still with him because I love him, because I wanted a family* *- Age 38* *I have chased him away but he won't go (laughs). Yes, now what can I do? (laughs). When I chase him away, he starts saying 'Oh, I love you even with HIV/AIDS'* *- Age 32* *He knows everything. He is even the one who reminds me to take my (HIV) medicine. But I think that is (his) fear of testing...* *- Age 32*
Hiding HIV status	*"I told him we go get tested he told me he knows he is fine so I told myself I will not insist and I will not tell him of my status..."* *Interviewer: and for instance if he knows you're HIV + what do you think his reaction will be?* *Participant: that is why I don't want to tell him I think he will get mad and not help me. - Age 31*

Key Theme	Illustrative quote
	"I can't say that I know and I can't judge and say that he knows my status, no. no one knows the others status..." - Age 39 *"We live together, but once he tests me and finds out I am like this [HIV-positive], then that's when he disappears for good..."* *Focus group participant, Age 33* *"I used to take one [pill] and hide, when I wander around I take one, when the time comes for me to take it whether it's the morning or evening, I never let a day pass by".* *Focus group participant, Age 39*