The effects of intimate partner violence on women's risk of HIV acquisition and engagement in the HIV treatment and care cascade: a pooled analysis of nationally representative surveys in sub-Saharan Africa

Kuchukhidze S[1] MPH, Panagiotoglou D[1] PhD, Boily MC[2] PhD, Diabaté S[3,4,5] MD, Eaton JW[2] PhD, Mbofana F[6] MD, Sardinha L[7] PhD, Schrubbe L[8] MSc, Stöckl H[9] PhD, Wanyenze RK[10] PhD, and Maheu-Giroux M[1,*] ScD

Affiliations

1- Department of Epidemiology and Biostatistics, School of Population and Global Health, McGill University, Montréal, Canada
2- MRC Centre for Global Infectious Disease Analysis, School of Public Health, Imperial College London, London, United Kingdom
3- Département de médecine sociale et préventive, Université Laval, Québec, QC Canada
4- Centre de recherche du CHU de Québec, Université Laval, Québec, QC, Canada
5- Université Alassane Ouattara, Bouaké, Côte d'Ivoire
6- Conselho Nacional de Combate ao HIV/Sida, Maputo, Mozambique
7- School for Policy Studies, University of Bristol, Bristol, United Kingdom
8- Department of Population Health, Faculty of Epidemiology and Population Health, London School of Hygiene & Tropical Medicine, London, UK
9- Institute for Medical Information Processing, Biometry, and Epidemiology, Ludwig-Maximilians-Universität in Munich, Munich, Germany
10- Department of Disease Control and Environmental Health, School of Public Health, College of Health Sciences, Makerere University, Kampala, Uganda

***Corresponding author**

Mathieu Maheu-Giroux
2001 Avenue McGill College, Suite 1200
Montréal, Québec
H3A 1G1, CANADA
mathieu.maheu-giroux@mcgill.ca

Summary

Background:

Achieving the 95-95-95 targets for HIV diagnosis, treatment, and viral load suppression (VLS) to end the HIV/AIDS epidemic hinges on eliminating structural inequalities, including intimate partner violence (IPV). Sub-Saharan Africa (SSA) has among the world's highest prevalence of IPV and HIV. We aim to examine the impacts of IPV on recent HIV infection and women's engagement in the HIV care cascade.

Methods:

We pooled individual-level data from nationally representative surveys with information on physical and/or sexual IPV and HIV in SSA (2000-2020). We used Poisson regression to estimate adjusted prevalence ratios (aPR) of past year experience of physical and/or sexual IPV on recent HIV infection (measured using recency assays), HIV testing in the past year, antiretroviral therapy (ART) uptake, and VLS among ever-partnered women. Models were adjusted for women's age, age at sexual debut, residence type, marital status, education, and the survey's identifier.

Findings:

Fifty-seven surveys with data on past year IPV were available from thirty countries, encompassing 280,259 (N_i) women. One-fifth of respondents reported past year physical and/or sexual IPV. Six surveys had information on recent HIV infection and seven had data on ART uptake and VLS. Women experiencing past year IPV were 3·22 times (95%CI: 1·51-6·85, N_i=19,179) more likely to have a recent HIV infection, adjusting for potential confounders. Past year IPV was not associated with HIV testing (aPR=0·99, 95%CI: 0·98-1·01, N_i=274,506), and our results were inconclusive for ART uptake (aPR=0·96, 95%CI:0·90-1·02, N_i=5,629). Women living with HIV experiencing IPV in the past year were 9% less likely to achieve VLS (aPR=0·91, 95%CI: 0·84-0·98, N_i=5,627).

Interpretation:

Past year IPV was associated with recent HIV acquisition and lower VLS. Preventing IPV is inherently imperative but eliminating IPV could contribute to ending HIV/AIDS.

Funding:

Canadian Institutes of Health Research, Canada Research Chair, and Fonds de recherche du Québec-Santé.

Research in Context

Evidence before this study

Our study builds on more than two decades of research devoted to IPV and HIV. We summarized this scholarship by searching PubMed for empirical studies (April 8, 2022), without language restrictions using the terms: HIV AND women AND (violence OR intimate partner OR domestic violence OR GBV OR IPV) AND (Africa* OR sub-Sahara*).

Several systematic and scoping reviews have been conducted on the impacts of IPV on HIV with mixed results. Most studies used HIV seropositivity as the outcome. In sub-Saharan Africa, a multi-country study of cross-sectional surveys found no association between IPV and HIV serostatus. However, it has been subsequently suggested that women experiencing IPV are more likely to be living with HIV if the chosen referent group is composed of women not experiencing overlapping dimensions of IPV. Longitudinal studies in Uganda and South Africa suggest that women experiencing IPV are more likely to acquire HIV compared to those who are not. However, two other prospective cohort studies among youth and serodiscordant couples did not find significant associations.

Regarding the impacts of IPV on HIV treatment, most included studies in a 2019 scoping review by Leddy did not find an association between IPV and HIV testing; though two reported a reduction in testing associated with IPV among pregnant and postpartum women. A 2015 meta-analysis of 13 cross-sectional studies, mostly from the United States, found that IPV is associated with lower current ART use, adherence, and viral suppression. Studies from Zambia and South Africa point to an association between IPV and unsuppressed viral loads among adolescents/youth and postpartum women. Overall, comparison of estimates and outcomes is difficult due to a lack of standardization in survey instruments, recall period for IPV, outcome measurement, and populations considered (e.g., pregnant and/or young women, sex workers).

Added value of this study

Using individual-level data from population-based surveys, we conducted a comprehensive study on the impacts of IPV on HIV in African countries: from HIV acquisition to engagement in HIV care cascade. Our results generally corroborate previous findings, but we expanded the scope of previous studies by considering the whole continuum of care: from HIV acquisition to viral suppression. Further, our use of nationally representative data mitigates some of the challenges associated with the generalizability of clinical samples.

The implications of all the available evidence

The *2021 Political Declaration on AIDS* commits to eliminating sexual and gender-based violence, including IPV, to combat the AIDS epidemic. Experience of IPV could lead to HIV acquisition and pose a barrier to viral suppression in sub-Saharan Africa. The overlap between IPV and HIV deserves renewed and urgent attention in both interventions research and health systems policy.

Introduction

Despite significant progress to curb HIV epidemics worldwide, 1.5 million new HIV infections occurred in 2020.[1] This burden of new infections disproportionately affects women: they account for 63% of new HIV infections in sub-Saharan Africa.[1] The global HIV agenda is guided by the "95-95-95" targets to end AIDS by 2030 —an ambitious plan that calls for achieving 95% diagnosis coverage, 95% antiretroviral therapy (ART) uptake among those diagnosed, and 95% of viral suppression among those on treatment.[1] Reaching these targets partly hinges upon addressing structural vulnerabilities such as inequitable gender and social norms, and violence against women and girls. Worldwide, over one in four women has experienced physical and/or sexual intimate partner violence (IPV) in their lifetime, with prevalence reaching highs of approximately 40% in Central and Eastern sub-Saharan Africa.[2] This violence often co-occurs with HIV and could pose barriers to women's ability to prevent HIV acquisition, to access HIV care, and to remain in care if living with the virus. The *2021 United Nations General Assembly* adopted the *Political Declaration on HIV and AIDS* with bold new global targets for 2025, which commit to elimination of all forms of sexual and gender-based violence, including IPV as a key enabler of the HIV epidemic.[3] Improving our understanding of the relationships between IPV and HIV is essential to meet this commitment.

In sub-Saharan Africa, women being subjected to IPV could be at increased risk of HIV acquisition and adverse HIV outcomes.[4-6] It has been hypothesized that the increased HIV acquisition risk among women experiencing IPV could be due to partners' characteristics (e.g., concurrency, HIV prevalence, unsuppressed viral load), be mediated by condom use, or a direct consequence of sexual violence itself.[7,8] Beside this potential impact on HIV incidence, IPV could compromise access to the HIV prevention and care cascade: from HIV testing, to ART uptake and retention,[9,10] and, ultimately, to viral suppression.[9,11,12] Adverse mental health effects of IPV, and associated male controlling behaviors, could be driving these negative outcomes.[10,13] Overall, the evidence-base suggesting that IPV and HIV interact could be strengthened. Previous studies either focused on a single country,[5,14] and/or recruited specific populations such as pregnant women,[10] youth,[15] female sex workers,[16] or women who use substances.[17] This makes generalization of the study's results challenging. Previous population-based research from sub-Saharan Africa has provided mixed results[18] or focused on HIV seroprevalence rather than the full spectrum of IPV's impacts on women's engagement in HIV care.[4] Furthermore, the definitions of IPV (e.g., severity of acts, physical only, sexual only, or both),[19] the period (e.g., lifetime or past year),[20] and inclusion criteria (e.g., currently partnered or ever-partnered women) have varied, making it difficult to systematically compare effect size estimates, and generate robust evidence on population-level effects of IPV.[9] Over the last decade, several large, nationally-representative, population-based surveys have collected information on IPV and HIV, including recency assays, ARV biomarkers, and viral suppression. These surveys use standardized and robust methodology, providing researchers opportunities to overcome some of the limitations of previous studies.

Our overarching aim was to improve the understanding of the associations between women's experience of IPV and HIV acquisition, and engagement with the HIV prevention and treatment cascade. To achieve this, we estimated the impact of recent (past 12 months) physical and/or sexual IPV on the following four outcomes: recent HIV infection, self-reported HIV testing in the past year, ART uptake, and viral suppression.

Methods

Data sources and study population

We reviewed all available nationally-representative, cross-sectional, population-based surveys from sub-Saharan Africa over 2000-2020 with individual participant data on both IPV and HIV. We searched data catalogs (i.e., the *Global Health Data Exchange*, the *International Household Survey Network*), examined surveys included in the *Global Estimates for Violence Against Women Statistics* systematic review,[21] a previous review of surveys with information on HIV testing,[22] and complemented these with expert knowledge.

The types of surveys considered included *Demographic and Health Surveys* (DHS), *AIDS Indicator Surveys* (AIS) (https://dhsprogram.com/Data/), *Population-based HIV Impact Assessment* (PHIA) (https://phia-data.icap.columbia.edu/datasets) and *South Africa National HIV Prevalence, Incidence, Behavior and Communication Survey* (SABSSM) (http://datacuration.hsrc.ac.za/search/browse/alpha/S), as well as country-specific surveys. *Violence Against Children Surveys* were excluded due to their specific focus on youth 13-24 years old.[23] Study population included all ever-partnered (currently or formerly married or cohabitating) women and girls aged ≥15 years (Figure 1A).

Measurements of intimate partner violence

In all surveys, data on IPV was collected from one randomly selected woman in each household for PHIA and SABSSM, and from a fraction of households in DHS/AIS. The primary exposure was experience of physical and/or sexual IPV in the past year (Table S1, pp 2-4). All surveys used acts-specific instruments based on the modified *Conflict Tactics Scale* to collect information on IPV.[24]

The secondary exposures were a) lifetime experience of physical IPV only, b) lifetime experience of sexual IPV only, c) lifetime experience of physical and/or sexual IPV, d) lifetime experience of severe physical and/or sexual IPV, and d) frequent past year experience of physical and/or sexual IPV. Measurements are generally consistent across surveys, although PHIAs collected information on past year IPV only (no lifetime measure) (Table S1, pp 2-4). In SABSSM, past year IPV pertains to physical violence only (i.e., no information on sexual violence). In the SABSSM and PHIA, frequency of past year IPV pertains only to physical IPV, while in other surveys to the frequency of physical and/or sexual IPV. Whenever the survey did not collect the information, we extrapolated the frequency of physical IPV to that of physical and/or sexual IPV based on the strong relationship between both measures.

Outcome measurements

Our primary outcome is recent HIV infection (as a proxy for HIV incidence) among women at risk of HIV acquisition (i.e., excluding those living with non-recent HIV). Recency was measured via the LAg avidity assay performed on all participants found to be seropositive for HIV. The recency algorithm used to identify recent infections –those that were acquired less than four to five months before sample collection[25]– accounted for ARV biomarkers and viral suppression to minimize false positives.

Other outcomes are related to the HIV prevention and treatment cascade. (Table S2, pp 5) First, we considered self-reported HIV testing histories (lifetime and past year testing and receipt of result) among all women. Second, ART uptake was measured among ever-partnered women living with HIV (WLHIV), irrespective of their self-reported HIV status. ART uptake was defined based on the qualitative detection of ARV biomarkers in blood samples, complemented by self-report of being on ART. Surveys that only collected self-reported ART uptake were excluded. Finally, WLHIV were considered virally suppressed if their HIV RNA viral load was <1000 copies/mL. Women with a recent HIV infection were excluded from the ART uptake and viral suppression analyses (Table S2, pp 5).

Statistical analyses

Individual-level data from each survey were pooled to calculate crude and adjusted prevalence ratios (PR) for the association between IPV and recent HIV infection, HIV testing, ART uptake and viral suppression. Adjusted prevalence ratios (aPR) were estimated accounting for potential confounders: women's age, residence type (rural/urban), women's marital status, women's education, and survey-level fixed effects (survey country and year). An additional adjustment variable for the HIV recency analysis was age at sexual debut. These confounders were available from all surveys and had been previously identified as being potentially linked to both IPV and the outcomes.[4,18] The survey-level fixed effects allowed us to control for any measured/unmeasured survey-level confounders.

Modified Poisson regression models were used to obtain the crude and adjusted PR based on Generalized Estimating Equations (GEE) with robust standard errors that accounted for the sampling design (i.e., exchangeable correlation structure with the primary sampling units as the clustering variable). Survey weights were not included in the regression[4,18] as they are often unwarranted to obtain unbiased estimates.[26] We used a complete case analysis since the proportion of missing observations was small for all outcomes ($\lesssim$4%). Supplemental materials include information on the missing observations and the analyses of potential biases due to missingness (Supplement 2, pp 6-8). The R software (4.0.0) was used for all analyses.

Sensitivity analyses

We examined the robustness of our results by only including women testing outside of antenatal care (ANC) in the analyses of HIV testing to examine if IPV has a differential impact by HIV testing modality. We estimated the effects of IPV on HIV testing over time to understand whether HIV testing scale-up could impact our results. We explored the effect of IPV on ART adherence by estimating the mean number of missed ART pills in the past month among women who self-reported being on ART. We restricted the analysis of viral suppression to women on ART (i.e., conditioning on achieving this step in the cascade). To investigate if partner or couple's characteristics confound the relationship between IPV and HIV acquisition we linked data for married or cohabiting men and women who both declared to be co-habiting. We then calculated proportions of male partners living with HIV, male partner age, partner education, alcohol consumption, mean partner age discrepancy and condom use at women's most recent sex, stratified by experience of past year IPV. Finally, we explored heterogeneity of effect size estimates across survey for each outcome by calculating survey-specific crude PR and pooling them using a random-effect meta-analysis.

We followed the *Strengthening the Reporting of Observational Studies in Epidemiology* (STROBE) guidelines (Supplement 4).[27]

Ethics statement

All secondary data analyses were performed on de-identified and anonymized data. DHS/AIS survey protocols are approved by the *Internal Review Board* of *ICF International* in Calverton (USA) and by the relevant country authorities for other surveys. Ethics approval was obtained from the *Institutional Review Board* of McGill University's Faculty of Medicine and Health Sciences (A12-B95-21B).

Role of the funding source

The funders had no role in the study's design, data analysis, interpretation, manuscript writing, and decision to publish.

Results

We identified 100 nationally representative surveys that included information on HIV testing (the most reported outcome), of which 64 had data on IPV (51 DHS/AIS,5 PHIA,1 SABSSM) (Figure 1A). 7 surveys with no physical IPV questions, with over 96% of missing data on past year IPV, or if data on IPV and HIV were collected from different subgroups of women were excluded. 57 surveys conducted in 30 countries and encompassing 280,259 unique female respondents aged 15-64 years were included (Table S6, pp 12-13). Fifteen countries had more than one survey included, and the median year of data collection was 2013. Most surveys were from Eastern Africa (51%; N_{surv}= 29). Only 10% of surveys had information on recent HIV infection (N_{surv}=6) and 12% had data on ART uptake and viral suppression (N_{surv}=7; Figure 1B).

Overall, over one fifth (59,456/280,259) of all ever-partnered women had experienced physical and/or sexual IPV in the past year and 29% (81,555/280,259) in their lifetime. Central Africa had the highest prevalence of past year physical and/or sexual (29%; 9,552/32,759) IPV, followed by Eastern (23%; 31,679/139,908), Western (17%; 17,254/101,337) and Southern (16%; 971/6,255) Africa (Table S6, pp 12-13). Women who had experienced past year physical and/or sexual IPV were younger than those who had not (Table S7-S10, pp 15-17). Among women not living with HIV, close to half of those reporting physical and/or sexual IPV in the past year had only primary education, compared to 36% (78,326/217,646) of those who did not report IPV (Table S8, pp 15).

Among the six surveys with information on recent infections a total of 45 women had recently acquired HIV (Table 1). Women not living with HIV who had experienced past year physical and/or sexual IPV had 0·5%-point higher proportion of recent HIV infections compared to those who had not (8/1,158 versus 37/18,777). The crude PR for recent HIV infections is 3·51 (95%CI: 1·64-7·51; N_{surv}=6; Table 2). Adjusting for potential confounders, women who had experienced past year physical and/or sexual IPV were 3·22 times more likely (95%CI: 1·51-6·85; N_{surv}=6) to have a recent HIV infection than those who had not experienced IPV. As a robustness check, we examined the HIV status of the cohabiting partners, partners' age discrepancy, partner education, partner alcohol consumption, and condom use at women's last sex as potential confounders (Table S11-S14, pp 18-20). Partner age discrepancy and partner

alcohol consumption varied between women having experienced past year physical and/or sexual IPV and those who had not. The point estimates of the effect sizes were robust to confounding by these variables although their uncertainty increased due to the reduced sample size.

Nearly half of all women reported ever being tested for HIV (Table 1). Self-reports of HIV testing in the past year were similar between women who had experienced IPV and those who had not. About a quarter of women in both groups had been tested in the past year: 28%, (16,392/58,993) and 27% (57,996/215,965) among those who experienced IPV and those who had not, respectively. The crude PR of past year physical and/or sexual IPV on recent HIV testing was 0·97 (95%CI: 0·96-0·98). Adjusting for potential confounders, experience of past year IPV had no effect on recent HIV testing (aPR=0·99; 95%CI: 0·98-1·01; N_{surv}=57). Women experiencing any lifetime IPV were 2% more likely to report lifetime testing (aPR=1·02; 95%CI: 1·02-1·03; N_{surv}=52; Table S15, pp 22). Experience of lifetime IPV was associated with a small increase in lifetime HIV testing among women who tested outside of the ANC (aPR=1·04; 95%CI: 1·03-1·05; N_{surv}=52; Table S16, pp 21-2). Sensitivity analysis of the effects over time shows that while our results remain robust, between 2000-2004, lifetime physical IPV was associated with a 16% reduction in recent HIV testing (aPR=0·84; 95%CI: 0·72-0·98; N_{surv}=3; Table S20, pp 25).

WLHIV who had reported past year physical and/or sexual IPV compared to those who had not, had 7%-point lower ART uptake (416/648 versus 3,717/5,215). (Table 1) The crude PR for ART uptake was 0·90 (95%CI: 0·85-0·96; N_{surv}=7). After adjustments, women who had reported past year IPV were 4% less likely to be on ART, compared to those who had not (aPR=0·96; 95%CI: 0·90-1·02; N_{surv}=7), but we cannot rule out the absence of a small effect (Table 3). Effect estimates were similar when using only biomarker-based and only self-reported measures of ART uptake (Table S21-S22, pp 26-27). Women who self-report being on ART and had experienced past year IPV missed 2·3 times more pills in the past month compared to those who had not (Table S23, pp 27), but this absolute difference was less than half a pill per month.

WLHIV who had experienced past year IPV compared to those who had not, had 11%-point lower viral suppression (375/661 versus 3,506/5,206) (Table 1). The crude PR was 0·85 (95%CI: 0·79-0·91; N_{surv}=7). After adjusting for confounders, women who had experienced past year IPV were 9% less likely to be virally suppressed, compared to those who had not (aPR=0·91; 95%CI: 0·84-0·98; N_{surv}=7; Table 4). Lifetime physical and/or sexual IPV had an adverse effect on viral suppression as well, though the confidence interval includes the null (aPR=0·94; 95%CI:0·86-1·02; N_{surv}=2). The effect size estimate between past year IPV and viral suppression among WLHIV on ART was smaller. WLHIV on ART who had experienced past year IPV were 5% less likely to be virally suppressed compared to women who had not (aPR=0·95; 95%CI: 0·90-1·00; N_{surv}=7; Table S24, pp 28). "*Often*" experiencing IPV in the past year was associated with a 14% reduction in the likelihood of viral suppression although the estimate was imprecise.

Heterogeneity of the crude effect size estimates across surveys was large for HIV testing and ART uptake, though not for viral suppression and recent HIV infection (Supplement 8, pp 28-31).

Discussion

In our pooled analysis of population-based surveys, women who had experienced physical and/or sexual IPV in the past year were over 3 times more likely to have acquired a recent HIV infection compared to those who had not. Although the impact of IPV on ART uptake was inconclusive, WLHIV who experienced IPV in the past year were 9% less likely to be virally suppressed. In line with the *United Nations 2021 Political Declaration* to end gender inequalities perpetuating the HIV/AIDS epidemic, the available evidence[5,6] suggest considerable overlap between IPV and HIV epidemics.

Longitudinal studies in South Africa and Uganda show that women who experienced physical and/or sexual IPV had 1.5 times the HIV incidence compared to those who had not.[5,14] Our study corroborates these results, but our effect size estimates are larger. This could be due to a number of reasons affecting cohort studies: differential risk of loss to follow-up,[14] selection of a sample that is different from the target population, and/or generalizability of effect estimates.[5,6] Other reasons explaining these differences in effect sizes could be attributable to discrepancies in measurements of IPV or to reverse causality affecting cross-sectional studies.[4,18-20] The latter could still apply to our work, even though we leveraged recent infection assays (in lieu of HIV prevalence), as a proxy for HIV incidence.

Pathways through which IPV can affect HIV acquisition are multifaceted. While the most direct path is through sexual violence, a growing body of evidence suggests that, at the population level, structural factors (e.g. gender norms, policy environment) surrounding IPV play a larger role.[7] Men who perpetrate IPV may be more likely to have concurrent sexual partners, use condoms inconsistently, and use substances, and thus more likely to be living with HIV which in turn could lead to HIV transmission.[7,8,28] However, crude descriptive analyses suggest that partner's age discrepancy and partner's alcohol consumption varied between women who had experienced IPV and those who had not; but the point estimates of the effect sizes for recent HIV acquisition remained robust to confounding by these covariates.

Knowledge of HIV status among WLHIV –the first step in the treatment cascade– can be a key bottleneck. In our study, past year IPV did not impact HIV testing, even after excluding women who had tested at ANC (as HIV testing at ANC achieved high coverage). Overall, evidence regarding the effect of IPV on HIV testing is mixed. Some studies suggested lower rates of HIV testing due to a fear of violent reaction from one's partner if the HIV test comes back positive.[9,12] Other studies from low-and middle-income countries found a positive relationship between IPV and HIV testing, which might be due to a higher self-perceived risk among women experiencing IPV.[9] Our results suggest an adverse effect of lifetime physical IPV on HIV testing when stratifying to the 2000-2004 study period, which could imply that our null overall results may be due to the unprecedented scale-up of HIV-testing in sub-Saharan Africa in the past decade.[22]

Women who had experienced past year IPV were less likely to be on ART, compared to those who had not, though our results were inconclusive. Few existing studies conducted in low- and middle-income countries look at the effects of IPV on current ART use. Those that did, have not uncovered relationships between the two.[12] However, we found that IPV was adversely associated with viral suppression, which could imply that ART adherence is a possible bottleneck in WLHIV's success in the HIV care cascade. Pathways through which IPV affects ART uptake and adherence are complex. Some women might not disclose their HIV status due to

fear of their partner's reaction, making it difficult to enroll in HIV care and adhere to treatment.[9] Qualitative research has also demonstrated how depression and low self-esteem from experiencing IPV could further contribute to poor ART adherence.[12]

This study has some limitations. First, all surveys depend on self-reports of IPV and might be subject to under-reporting due to this topic's sensitive nature.[29] However, the surveys used appropriate measures to ensure confidentiality.[24] Underreporting of IPV is still likely however, especially in PHIAs.[30] When compared to other surveys, PHIA surveys estimated lower IPV prevalence and probably capture the more severe forms of violence.[30] If so, our effect size estimates could reflect the impact of severe IPV. HIV testing was also self-reported, though evidence shows that self-reported HIV-testing histories are generally accurate.[31] Second, some of the included surveys slightly differed in terms of the wordings of the IPV questions (e.g., frequency of past-year violence was a continuous variable and had to be categorized). Nevertheless, questions were all acts-based and modified from the *Conflict Tactics Scales*.[24] Third, we did not include emotional violence in the definition of intimate partner violence, due to a lack of consensus on how to define, conceptualize, and measure this construct cross-culturally.[32] Fourth, we used cross-sectional survey data and reverse causality remains a possibility. This limitation was partially addressed, however, by restricting our main exposure to IPV in the past year, and examining recent HIV infection, and ART uptake and viral suppression at the time of the interview. Finally, we cannot rule out residual confounding of the impact of IPV on recent HIV acquisition. Our descriptive analyses of male partner characteristics were based on a small sample of currently cohabiting women, and the number of women who recently acquired infection was small. Strengths of our study include a large sample size and a comprehensive analysis of available population-based surveys with information on IPV and HIV. Second, we examined the whole prevention and treatment cascade: from HIV acquisition to viral suppression. Third, we conducted several sensitivity analyses to assess the robustness of our findings.

Our results have important policy implications for HIV prevention and care delivery in high HIV burden settings. At a service delivery-level, healthcare provider training should include IPV-sensitive topics to safely disclose their experience of IPV. This could identify women at higher risk of disengagement from care who can subsequently be linked to HIV services that address the distinct vulnerabilities of women experiencing IPV. Given the role of mental health pathways between IPV and women's engagement in HIV care, culturally adapted, trauma-informed interventions could help increase the uptake of and adherence to ART.[33] Emergence of novel, patient-focused HIV service delivery platforms, also known as "*differentiated service delivery*" models could incorporate women-only community adherence groups or safe community-based medication pick-up points.[34] Finally, we highlight the importance of strengthening IPV and HIV research, especially work that aims to uncover causal mechanisms linking IPV and worsened HIV outcomes, as well as intervention research to prevent IPV and support women experiencing it. Violence beyond IPV, such as dating violence among youth, should be devoted greater attention given known HIV-vulnerabilities of young girls and women.

In conclusion, IPV could have important adverse effects on HIV epidemics by contributing to HIV acquisition risks and decreasing viral suppression among WLHIV. The intersecting epidemic of IPV and HIV needs explicit recognition by governments, societies, and communities if we are to eliminate violence against women and reduce women's HIV risk.

Contributions

SK and MMG conceived of the study. SK performed data curation and analyses. SK and MMG have accessed and verified the data. All authors contributed to the study methods and reviewing and editing the manuscript. SK wrote the initial draft of the manuscript. All authors reviewed and edited the manuscript, and approved the final version. All authors had full access to all the data in the study and had final responsibility for the decision to submit for publication.

Acknowledgments

We are grateful and indebted to the survey teams who made their data publicly available and to all survey participants.

Funding

This study is funded by the Canadian Institutes of Health Research. MMG's research program is funded by a *Canada Research Chair* (Tier 2) in *Population Health Modeling.* SK is supported by a doctoral award from the *Fonds de recherche du Québec—Santé* (FRQS). MCB acknowledges funding from the MRC Centre for Global Infectious Disease Analysis (reference MR/R015600/1), jointly funded by the UK Medical Research Council (MRC) and the UK Foreign, Commonwealth & Development Office (FCDO), under the MRC/FCDO Concordat agreement and is also part of the EDCTP2 programme supported by the European Union.

Data sharing

Data used in the study are publicly available for investigators who submit an abstract and a data analysis plan as part of *Demographic and Health Surveys* (DHS), *AIDS Indicator Surveys* (AIS) (https://dhsprogram.com/Data/), *Population-based HIV Impact Assessment* (PHIA) (https://phia-data.icap.columbia.edu/datasets) and *South Africa National HIV Prevalence, Incidence, Behavior and Communication Survey* (SABSSM) (http://datacuration.hsrc.ac.za/search/browse/alpha/S). Analysis code and clean data that support the findings of the study are available upon request.

Declaration of interests

MM-G reports an investigator-sponsored research grant from the *World Health Organization* outside of the submitted work. JWE reports research grants from the *Bill & Melinda Gates Foundation*, *National Institutes of Health* (NIH), *Joint United Nations Programme on HIV/AIDS* (UNAIDS), *World Health Organization*, and the *United States Agency for International Development* (USAID), personal fees from *Oxford Policy Management*, and support for meeting travel from UNAIDS and SACEMA, all outside of the submitted work.

References

1. UNAIDS. UNAIDS Data 2021. 2021. https://www.unaids.org/sites/default/files/media_asset/JC3032_AIDS_Data_book_2021_En.pdf (accessed September 6 2022).
2. Sardinha L M-GM, Stockl H, Meyer S, Garcia-Moreno C. Global, regional and national prevalence estimates of physical and/or sexual intimate partner violence against women, 2018. *Lancet* 2022; **399**(10327): P803-13.
3. UNAIDS. Global AIDS update: Confronting inequalities. 2021. https://www.unaids.org/sites/default/files/media_asset/2021-global-aids-update_en.pdf (accessed September 6 2022).
4. Durevall D, Lindskog A. Intimate partner violence and HIV in ten sub-Saharan African countries: what do the Demographic and Health Surveys tell us? *Lancet Glob Health* 2015; **3**(1): e34-43.
5. Jewkes RK, Dunkle K, Nduna M, Shai N. Intimate partner violence, relationship power inequity, and incidence of HIV infection in young women in South Africa: a cohort study. *Lancet* 2010; **376**(9734): 41-8.
6. Kouyoumdjian FG, Calzavara LM, Bondy SJ, et al. Risk factors for intimate partner violence in women in the Rakai Community Cohort Study, Uganda, from 2000 to 2009. *BMC Public Health* 2013; **13**(566).
7. Dunkle KL, Decker MR. Gender-based violence and HIV: reviewing the evidence for links and causal pathways in the general population and high-risk groups. *Am J Reprod Immunol* 2013; **69**: 20-6.
8. Decker MR, Seage GR, 3rd, Hemenway D, et al. Intimate partner violence functions as both a risk marker and risk factor for women's HIV infection: findings from Indian husband-wife dyads. *J Acquir Immune Defic Syndr* 2009; **51**(5): 593-600.
9. Leddy AM, Weiss E, Yam E, Pulerwitz J. Gender-based violence and engagement in biomedical HIV prevention, care and treatment: a scoping review. *BMC Public Health* 2019; **19**(1): 897.
10. Hampanda KM. Intimate partner violence and HIV-positive women's non-adherence to antiretroviral medication for the purpose of prevention of mother-to-child transmission in Lusaka, Zambia. *Soc Sci Med* 2016; **153**: 123-30.
11. Merrill KG, Campbell JC, Decker MR, et al. Past-Year Violence Victimization is Associated with Viral Load Failure Among HIV-Positive Adolescents and Young Adults. *AIDS Behav* 2021; **25**(5): 1373-83.
12. Hatcher AM, Smout EM, Turan JM, Christofides N, Stockl H. Intimate partner violence and engagement in HIV care and treatment among women: a systematic review and meta-analysis. *AIDS* 2015; **29**(16): 2183-94.
13. Hatcher A, Turan J, Stockl H, Woollett N, Garcia-moreno C, Christofides N. Intimate partner violence and HIV treatment adherence in urban South Africa: Mediating role of perinatal common mental disorders. *SSM Mental Health* 2022; **2**(100112).
14. Kouyoumdjian FG, Calzavara LM, Bondy SJ, et al. Intimate partner violence is associated with incident HIV infection in women in Uganda. *AIDS* 2013; **27**(8): 1331-8.
15. Kidman R, Violari A. Dating Violence Against HIV-Infected Youth in South Africa: Associations With Sexual Risk Behavior, Medication Adherence, and Mental Health. *J Acquir Immune Defic Syndr* 2018; **77**(1): 64-71.
16. Lyons CE, Grosso A, Drame FM, et al. Physical and Sexual Violence Affecting Female Sex Workers in Abidjan, Cote d'Ivoire: Prevalence, and the Relationship with the Work Environment, HIV, and Access to Health Services. *J Acquir Immune Defic Syndr* 2017; **75**(1): 9-17.

17. Wechsberg WM, van der Horst C, Ndirangu J, et al. Seek, test, treat: substance-using women in the HIV treatment cascade in South Africa. *Addict Sci Clin Pract* 2017; **12**(1): 12.
18. Harling G, Msisha W, Subramanian SV. No association between HIV and intimate partner violence among women in 10 developing countries. *PLoS One* 2010; **5**(12): e14257.
19. Li Y, Marshall CM, Rees HC, Nunez A, Ezeanolue EE, Ehiri JE. Intimate partner violence and HIV infection among women: a systematic review and meta-analysis. *J Int AIDS Soc* 2014; **17**: 18845.
20. Kouyoumdjian FG, Findlay N, Schwandt M, Calzavara LM. A systematic review of the relationships between intimate partner violence and HIV/AIDS. *PLoS One* 2013; **8**(11): e81044.
21. Stockl H, Sardinha L, Maheu-Giroux M, Meyer SR, Garcia-Moreno C. Physical, sexual and psychological intimate partner violence and non-partner sexual violence against women and girls: a systematic review protocol for producing global, regional and country estimates. *BMJ Open* 2021; **11**(8): e045574.
22. Giguere K, Eaton JW, Marsh K, et al. Trends in knowledge of HIV status and efficiency of HIV testing services in sub-Saharan Africa, 2000-20: a modelling study using survey and HIV testing programme data. *Lancet HIV* 2021; **8**(5): e284-e93.
23. CDC. Violence Against Children and Youth Surveys. 2022. https://www.cdc.gov/violenceprevention/childabuseandneglect/vacs/index.html (accessed April, 22 2022).
24. Kishor S. Domestic violence measurement in the demographic and health surveys: The history and the challenges. Geneva, Switzerland, 2005.
25. Population-based HIV Impact Assessment (PHIA) Data Use Manual. New York, 2021.
26. Solon GH, S and Wooldridge J. [Working paper] What Are We Weighting For? In: Research NBoE, editor.; 2013.
27. STROBE (Strengthening the reporting of observational studies in epidemiology) 2022. https://www.strobe-statement.org/checklists/ (accessed August 22 2022).
28. Jewkes R, Sikweyiya Y, Morrell R, Dunkle K. The relationship between intimate partner violence, rape and HIV amongst South African men: a cross-sectional study. *PLoS One* 2011; **6**(9): e24256.
29. Ellsberg M, Heise L, Peña R, Agurto S, Winkvist A. Researching domestic violence against women: methodological and ethical considerations. *Stud Fam Plann* 2001; **32**(1): 1-16.
30. Currie DW, Apondi R, West CA, et al. A comparison of two population-based household surveys in Uganda for assessment of violence against youth. *PLoS One* 2021; **16**(12): e0260986.
31. Xia Y, Milwid RM, Godin A, et al. Accuracy of self-reported HIV-testing history and awareness of HIV-positive status in four sub-Saharan African countries. *AIDS* 2021; **35**(3): 503-10.
32. Heise L, Pallitto C, Garcia-Moreno C, Clark CJ. Measuring psychological abuse by intimate partners: Constructing a cross-cultural indicator for the Sustainable Development Goals. *SSM Popul Health* 2019; **9**: 100377.
33. Sikkema KJ, Mulawa MI, Robertson C, et al. Improving AIDS Care After Trauma (ImpACT): Pilot Outcomes of a Coping intervention Among HIV-Infected Women with Sexual Trauma in South Africa. *AIDS Behav* 2018; **22**(3): 1039-52.
34. Roy M, Bolton Moore C, Sikazwe I, Holmes CB. A Review of Differentiated Service Delivery for HIV Treatment: Effectiveness, Mechanisms, Targeting, and Scale. *Curr HIV/AIDS Rep* 2019; **16**(4): 324-34.