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Intimate partner violence and HIV treatment adherence in urban South Africa: Mediating role of perinatal common mental disorders

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ABSTRACT

Background: Antiretroviral therapy (ART) has potential to eliminate perinatal HIV infections, but adherence to ART in late pregnancy and postpartum is often suboptimal. Intimate partner violence (IPV) may influence non-adherence among perinatal women living with HIV (WWH), but few quantitative studies have examined this over time or explored mechanisms for this association.

Methods: We used secondary data from a parent trial in Johannesburg comprising WWH from the control arm (n=63) and WWH ineligible for the trial (n=133). Trained nurse researchers administered questionnaires at first antenatal visit on past-year psychological, physical, and/or sexual IPV (WHO instrument), socio-demographics (age, food security, education), and perinatal common mental symptoms of depression (Hospital Anxiety and Depression Screener-d); anxiety (HADS-a); post-traumatic stress disorder (PTSD; Harvard Trauma Questionnaire). At endline visit 2-4 months postpartum, nurse researchers assessed self-reported ART adherence using a visual analog scale (with ≥95% considered "good"). We fitted structural equation models (SEM) in MPlus to explore direct and indirect effects of IPV on ART adherence.

Results: Of 196 perinatal WWH, 53.1% reported IPV exposure at baseline. The majority of participants (85.7%) had good perinatal ART adherence. In adjusted models, IPV at baseline was associated with halved odds of good adherence (aOR=0.51, 95%CI=0.20-0.96). IPV was associated with higher adjusted odds of probable depression (aOR=4.64), anxiety (aOR=2.85), and PTSD (aOR=3.42). In SEM, IPV had a direct (standardized coef=-0.22) and indirect effect (coef=-0.05) on ART via common mental disorders. The total effect of IPV on perinatal adherence was of moderate size (coef= -0.27) and the model had good fit (CFI=0.972; TLI=0.969; RMSEA=0.045; SRMR=0.076).

Conclusion: IPV was longitudinally associated with perinatal ART non-adherence in part due to its relationship with mental health symptomology. Addressing IPV within clinical care has potential to improve perinatal mental health, maternal HIV outcomes, and HIV-free infant survival.

1. Introduction

Antiretroviral therapy (ART) has potential to eliminate perinatal transmission of HIV and promote maternal health (Mofenson, 2010). Among perinatal women living with HIV (WWH), postpartum treatment adherence is associated with a 60% relative reduction in the rate of

Abbreviations: IPV, intimate partner violence; HIV, human immonodeficiency virus; WWH, women living with HIV; ART, antiretroviral therapy; PTSD, post-traumatic stress disorder; T0, baseline timepoint; T1, endline timepoint.

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vertical HIV transmission by 38 weeks of age (Davis et al., 2014). Successful ART scale-up around the time of pregnancy and breastfeeding has nearly halved rates of new infant HIV infections over the past decade (UNAIDS, 2020). Despite these promising health gains, across sub-Saharan African settings adherence tends to be sub-optimal and worsen during the postpartum phase (Henegar et al., 2015; Ngarina et al., 2015). This means that progress towards eliminating new infant infections has stalled, and in 2018 approximately 31,000 infants were born with vertical infection (UNAIDS, 2020).

Multiple social determinants of health frame perinatal ART adherence, including poverty (Jones et al., 2005; Mepham et al., 2011), food insecurity (Awiti Ujiji et al., 2011; Kirsten et al., 2011), and stigma (Bwirire et al., 2008; Turan & Nyblade, 2013; Watts et al., 2010). Intimate partner violence (IPV) may be another important social determinant, though fewer studies have examined this factor in the perinatal phase. Among non-pregnant women IPV is associated with 55% lower odds of self-reported ART adherence and 36% decreased odds of viral suppression (Hatcher et al., 2015). In pregnant populations, IPV exposure has been associated with ART non-adherence and elevated viral loads (Brittain et al., 2019; Hampanda, 2016). In a longitudinal modeling study, perinatal women exposed to IPV had higher $\log_{10}$ viral loads 3–6 months later, and the effect of IPV on elevated viral loads was strongest postpartum (Hatcher et al., 2021a).

Mental ill health is theorized to be a pathway linking IPV to HIV-related health outcomes (Hatcher et al., 2016; Pantalone et al., 2010a). Common mental disorders, including depression, anxiety, and post-traumatic stress are strongly related to women's experience of IPV. In longitudinal studies, IPV exposure is associated with depression (Buller et al., 2014; Devries et al., 2013), anxiety (Dillon et al., 2013; Lagdon et al., 2014) and post-traumatic stress disorder (Dillon et al., 2013; Lagdon et al., 2014). In turn, depression is associated with declines in ART adherence over time (Kacanek et al., 2010), and a bidirectional relationship may cause each condition to worsen the other (Wagner et al., 2020). Anxiety (Willie et al., 2016) and post-traumatic stress (Glynn et al., 2021; Whetten et al., 2013) are associated with worse ART adherence in cross-sectional studies Less research, to our knowledge, has examined common mental disorders during the perinatal phase.

Research from other samples and methodologies posit how perinatal common mental disorders may mediate the IPV-adherence relationship over time. Among non-pregnant WWH, qualitative research suggests that psychological distress resulting from IPV can feel overwhelming and cause women to unintentionally avoid medication (Murray et al., 2009; Ngarina et al., 2013). In a South African qualitative study with perinatal WWH, treatment interruptions were described as intentional decision to self-harm in situations where women feel extremely distressed by violent partnerships (Hatcher et al., 2016). Elsewhere, WWH have expressed being so fearful of partner violence and abandonment that they would 'rather die' than risk losing their marriage (Nachega et al., 2006; Ware et al., 2009). Quantitative evidence on the mental health pathway linking IPV to non-adherence is limited to cross-sectional findings. A cross-sectional study in Haiti among non-pregnant men and women suggests that the relationship between IPV and adherence is mediated by depression (Malow et al., 2013). A cross-sectional U.S. study among men who have sex with men found that IPV led to mental health problems, which in turn reduced ART adherence (Pantalone et al., 2010b). Emerging qualitative and cross-sectional findings could be bolstered by longitudinal quantitative data.

We conducted secondary analysis of longitudinal data alongside a randomized controlled trial in urban South Africa. Pregnant WWH were recruited during their first antenatal visit and followed to 3 months postpartum. We assessed associations between IPV exposure at baseline and self-reported perinatal ART adherence at endline. We examined mental health as a possible mediator in the association between IPV and ART adherence.

2. Methods

2.1. Study setting

The research was conducted at four antenatal clinics in inner-city Johannesburg, South Africa, an urban setting where patients often move from rural areas in search of work. An estimated 29% of pregnant women attending public clinics in Johannesburg are living with HIV (Wabiri et al., 2016).

2.2. Recruitment and procedures

During 2015–16 a prospective cohort was nested within a randomized controlled trial testing an intervention to reduce exposure to perinatal IPV (Garcia Moreno et al., 2017). The trial recruited pregnant women (n=1543) to take part in baseline questionnaires at T0, of whom 525 (34.0%) were WWH (Fig. 1). Participants were eligible for baseline if they were adult women (>18 years), currently pregnant, accessing antenatal care in one of four antenatal clinics in Johannesburg, speaking a study language (English, isiZulu, Sesotho), and willing to sign written informed consent. Those who reported past-12 month physical and/or sexual IPV were eligilbe to participate in the parent trial so long as they were not at immediate safety risk (of homicide, suicide, or harm to their children) (Pallitto et al., 2016). A total of 423 women were randomized to an intervention or to an enhanced standard of care arm, of whom one-quarter (n=132) were living with HIV.

For this secondary analysis we included all WWH randomized to the trial's control arm (n=63) plus additional WWH not eligible for the trial because they reported no baseline physical or sexual IPV (n=133). This composed a sample of 196 women followed from first antenatal visit at baseline to 3 months postpartum T1.

2.3. Data collection and measures

Antenatal and postpartum visits entailed a 1-h questionnaire administered by a trained nurse researcher. The paper questionnaire was completed in English or the local language of the participant's choice (isiZulu or Sesotho).

Intimate partner violence was measured at T0 using 13 items from the IPV instrument of the WHO Multi-Country Study questionnaire (Garcia-Moreno et al., 2006). This instrument measures physical, sexual, and psychological IPV in the past year and has been used in sites globally to measure IPV prevalence, including in South African studies (Dunkle et al., 2004; Jewkes et al., 2010; Jina et al., 2012; Townsend et al., 2011). Each item asks behaviorally-specific questions (e.g. "How often has your partner pushed you or shoved you or pulled your hair?") and responses were scored on a four-point Likert-type scale with choices of 0 ("never"), 1 ("once"), 2 ("a few times"), or 3 ("many times"). We summed *z-scores* for each item (scores standardized to the mean) with a total sum score ranging from −5.7 to 36.9. As others using the approach have noted, the absolute summed value has no meaning but higher scores indicate more IPV intensity (Kling et al., 2007; Tsai et al., 2016). Intensity represents a combination of IPV severity (multiple types of violence experienced) and frequency (number of times each type of violence occurred). The measure loaded as a single factor during confirmatory factor analysis, and the index had good internal reliability (Cronbach's $\alpha = 0.82$). The WHO instrument was also analyzed as a dichotomous outcome of 1 = any past-year psychological, physical and/or sexual IPV and 0 = no past-year exposure to these forms of IPV. To note, this definition of a "case" of IPV is distinct from the parent trial, so in sensitivity analyses we examined the dichotomous outcome of IPV indicated by 1 = any past-year physical and/or sexual IPV and 0 = no past-year exposure to any form of IPV.

Common mental disorder symptomology was assessed at T0 and conceptualized as including anxiety, depression, and post-traumatic stress symptoms. The Hospital Anxiety and Depression Scale was used

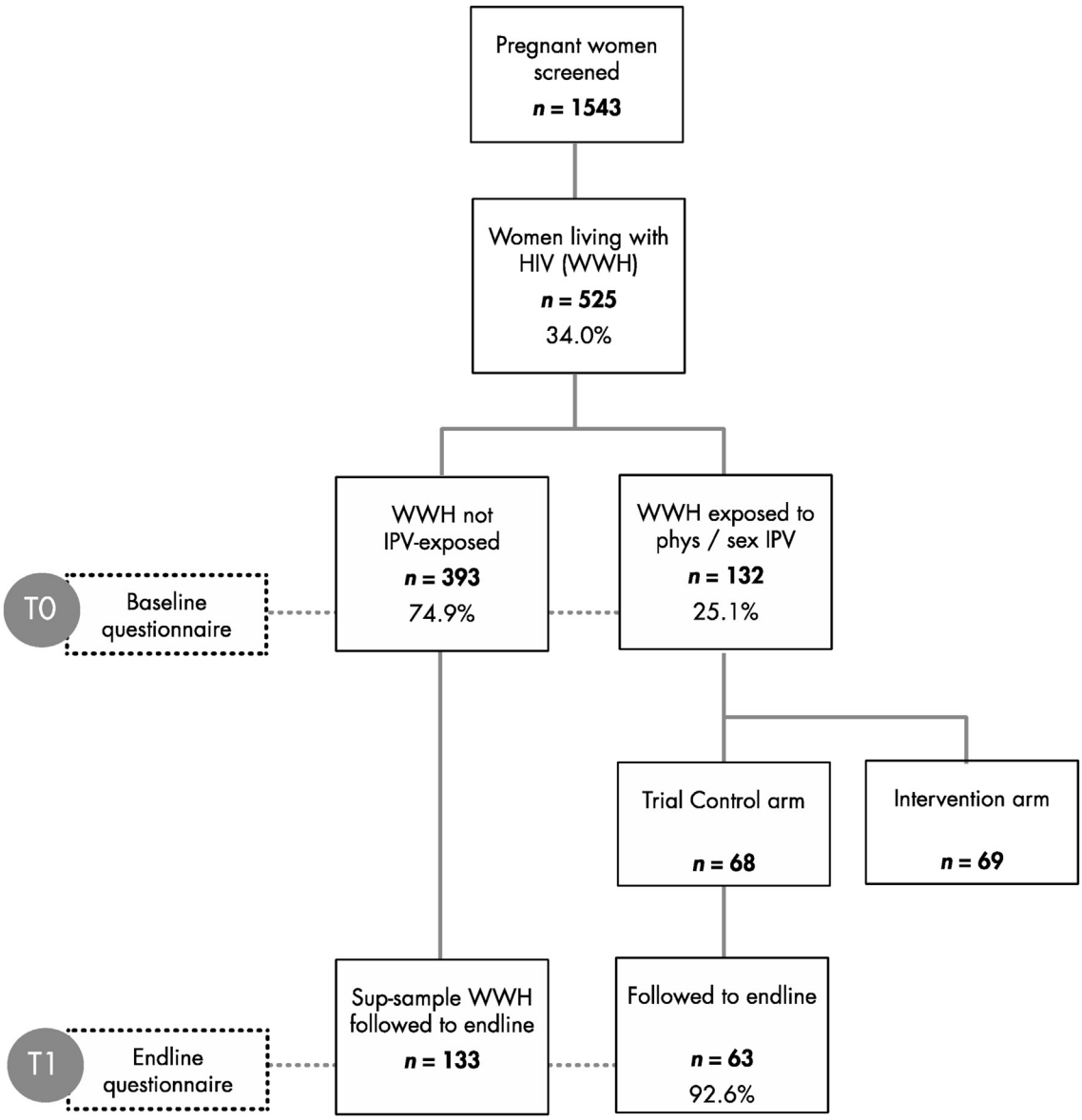


Fig. 1. Secondary analysis flow diagram.

as a brief screener of anxiety and depression (Zigmond & Snaith, 1983). The scale has been validated in South Africa (Wouters et al., 2012). Women are asked about 7 symptoms of anxiety and 7 symptoms of depression, and asked to rate the frequency of experiencing each symptom over the past week on a 4-point Likert scale. Summing the scores for anxiety items or depressive items gives an overall score for symptomology of each condition, and the scale demonstrated acceptable reliability for anxiety (Cronbach's $\alpha = 0.74$) and depressive symptoms subscales (Cronbach's $\alpha = 0.84$). A score of ≥ 8 is considered clinically significant (Pappin et al., 2012). The Harvard Trauma Questionnaire (HTQ) asks women to rate on a 4-point Likert scale how often they experience a set of 15 trauma symptoms in the past week (Mollica et al., 1992). Mean scores ≥ 2.07 indicate probable PTSD in the South African setting (Myer et al., 2008). It is composed of two subscales: arousal/intrusion and avoidance/numbing (Vindbjerg et al., 2020). As only arousal/intrusion had good internal reliability (Cronbach's $\alpha = 0.87$) we omitted the avoidance/numbing subscale (Cronbach's $\alpha = 0.68$) from the final models. We analyzed anxiety, depressive, and PTSD symptoms as latent variables in a measurement model (described below).

Adherence to antiretroviral medication postpartum was measured at T1 through self-report using a visual analog scale (VAS). The 30-day VAS has been validated in South Africa and elsewhere (Peltzer et al., 2010; Walsh et al., 2002), and shows strong correlations with measures such as electronic medication monitoring and unannounced pill counts (Kalichman et al., 2009). The VAS asks individuals to mark a line at the point along a continuum showing how much ART they took in the past month (Giordano et al., 2004). We asked women at follow-up to report on their adherence during the final month of pregnancy and during the past 30-days postpartum. For bivariate analysis, we dichotomized adherence at 95%, a cut-off point based on previous studies and the expected adherence distribution (Davis et al., 2014; Mepham et al., 2011; Simoni et al., 2006). We present sensitivity analyses for 90% and 80% since these cut-points are often clinically relevant. For the final structural model, we analyzed VAS as a continuous measure of postpartum adherence (0–100% adherence).

Socio-demographics included a range of self-reported measures assessed at T0. *Age* was measured in self-reported years. *Food insecurity* was measured using the 3-item, validated Household Hunger Scale (Deitchler et al., 2010), and a woman was considered food secure if she had no or little household hunger (score of ≤ 2). *Level of education* was measured using self-report of the highest grade completed. Education was dichotomized as high school education vs. less than high school

education. HIV clinical covariates were assessed at T1. *Time on ART* was based on self-report of the date of ART initiation, and calculated in days from initiation to endline study visit. *New HIV diagnosis* was assessed as women who tested positive for the first time during this pregnancy.

2.4. Data analysis

We conducted all descriptive and regression analysis in Stata 16 (StataCorp LLC, College Station, TX). We assessed internal consistency of all the scales by evaluating the Cronbach's alpha. We conducted bivariate analyses of the outcome variable against the exposure variable and other selected socio-demographic variables. Bivariate analyses (*t*-test, χ^2 test) were conducted to examine differences by adherence status for normally distributed variables. Nonparametric bivariate analyses (Wilcoxon test) were conducted for non-normally distributed study variables (children, education, time with partner, time on ART, intensity of IPV). We conducted several sensitivity analyses at the bivariate level to explore alternate adherence cut-off points for adherence ($\geq$90% and $\geq$80%) and an alternate definition of IPV "caseness" (any physical and/or sexual violence).

We employed log binomial regression to determine the association between recent IPV (as a dichotomous predictor) and perinatal common mental disorders in a cross-sectional model. We also used log binomial regression to assess IPV (dichotomous) as a longitudinal predictor of adherence (dichotomous). In all models we accounted for socio-demographics theoretically associated with adherence (food security, education, time on ART) and retained these socio-demographic controls regardless of statistical significance. In a supplemental analysis we used a modified poisson regression to model the association of IPV (as a continuous predictor of intensity) on ART adherence while accounting for socio-demographics only (adjusted Model 1) and mental health mediators (adjusted Model 2).

We fitted a measurement model for common mental disorders as a latent variable in MPlus 8 (Muthén & Muthén, Los Angeles, CA). We used confirmatory factor analysis to assess anxiety as a latent variable composed of 4 items from the HADS-a subscale, depression from 9 items of the HADS-d subscale, and PTSD symptoms from 9 items of the arousal/intrusion subscale HTQ. As all items were likert-type responses they were modeled as ordered categorical. Together with latent anxiety and depression, PTSD symptoms were modeled as a latent perinatal common mental symptoms variable.

Also in MPlus 8 a structural model was fitted to examine fit in these data from IPV intensity (as a standardized measured continuous variable) to mental health (as the latent construct) to adherence (as a measured continuous variable). Third, after deriving a path solution, we added the following covariates as endogenous continuous predictors: age (years); food security (household hunger scale); education (years completed); time since ART initiation (days). Finally, once model fit was satisfactory, non-significant paths of $p<0.20$ were trimmed (omitting age and time on ART from the model). Measures for model fit included an absolute measure (standardized root-mean-square residual (SRMR)), a parsimonious measure (root-mean-square error of approximation (RMSEA)) and two incremental measures: Bentler's comparative fit index (CFI) and the Tucker Lewis Index (TLI). Acceptable model fit assumed the model met the following criteria: SRMR$<$0.08; RMSEA$<$0.05; CFI$\geq$0.95; TLI$\geq$0.95 (Asparouhov and Muthén, 2018; Bentler, 1990; Hu & Bentler, 1999; Steiger, 1990).

2.5. Ethical and safety considerations

The parent trial received approval from the University of the Witwatersrand Human Research Ethics Committee (M121179) and WHO Ethics Research Committee (RPC471). The additional data collection related to HIV-positive participants was approved by the University of Witwatersrand (M140451).

Given the special considerations of researching IPV, this study was designed to adhere to the WHO ethical guidance on IPV research (WHO, 2001). The research was presented broadly so that the specific nature of the study was not made public. Only when the participant and interviewer were alone did the researcher provide further information that the study involved HIV and IPV. A 30-h technical training alongside weekly mentorship and debriefing by senior team members ensured all nurse researchers had the technical knowledge, support, and therapeutic skills required to appropriately deal with disclosure of violence. Women were invited to participate in the longitudinal study through follow-up phone calls using information they provided on their locator form. Phone calls were initiated by the nurse who enrolled participants in the trial initially, in order to ensure participants felt safe and comfortable. Male partners were never informed about a woman's participation in the research because of the potential for an abusive partner to react violently. When phoning participants, to address the risk that partners may hear them, nurses were trained to ask "is this a safe time to speak?" before continuing. A full distress protocol included appropriate researcher responses in cases of violence disclosure, psychological distress, high emotionality, or a need for onwards referrals.

3. Results

3.1. Descriptive characteristics

The cohort was comprised of 196 pregnant women living with HIV. Table 1 presents the distributions of baseline characteristics. Participants were between 18 and 49 years old and just over one-third had high school education. Participants had a median of 1 child prior to this pregnancy and had, on average, been with their current partner for 4 years.

The majority of participants (85.7%) reported good ART adherence ($\geq$95%) at endline. Many women in the cohort (58.2%) were diagnosed with HIV during the current pregnancy, and 82.2% had disclosed their HIV status to a male partner. At baseline, 53.1% of the sample had experienced at least one form of physical, sexual, and/or psychological IPV in pregnancy (Table 1).

The burden of perinatal common mental disorders was high. At baseline, half (50.9%) had symptoms of probable depression and just over one-third (39.3%) had symptoms consistent with probable anxiety.

Table 1
Descriptive characteristics of perinatal cohort (n = 196).

T0 assessed at first antenatal visit	Median (IQR) or Number (%)	T1 assessed 6–24 weeks postpartum	Median (IQR) or Number (%)
Socio-demographics			
Race (Black)	193 (98.4%)		
Age (years)	29 (25–33)		
High school education	80 (40.8%)		
Number of children	1 (1–2)		
Food secure	167 (85.0%)		
HIV-related Characteristics			
HIV diagnosed in this pregnancy	114 (58.2%)	Time from ART initiation (days)	267 (201–721)
Disclosed to partner	159 (81.1%)	Adherent (VAS $\geq$ 95%)	168 (85.7%)
IPV exposure			
Any past-year IPV	104 (53.1%)		
Physical or Sexual IPV	63 (32.1%)		
Mental Health			
Probable depression	92 (46.9%)	Probable depression	65 (33.2%)
Probable anxiety	71 (36.2%)	Probable anxiety	27 (13.8%)
Probable PTSD	49 (25.0%)		

IQR: inter-quartile range; ANC: antenatal care; ART: antiretroviral treatment; VAS: visual analog scale; PTSD: post-traumatic stress disorder.

Elevated symptoms consistent with probable PTSD occurred within one-quarter (26.8%) of the sample. At follow-up, depressive symptoms were significantly lower: one-third (33.2%) reported symptoms consistent with probable depression and probable anxiety was reported by 27 participants (13.7%). At follow-up, the time from first initiation of ART was less than one year for the majority of participants (median time on ART: 259 days).

3.2. Bivariate and multivariate results

A significantly higher proportion of women reporting IPV at baseline were non-adherent compared to non-exposed counterparts (19.2% versus 8.7%, Pearson $\chi^2 = 4.42$, $p = 0.035$). In adjusted log binomial regression (Table 2), IPV exposure was associated with lower odds of good adherence (aOR = 0.40, 95% confidence interval [CI] = 0.17–0.97).

Findings in the sensitivity analysis using alternate cutpoints for adherence were qualitatively similar using ≥ 90% as an indicator of good adherence. The sample size was insufficient for detecting a significant association at ≥ 80% level, though findings trend in the same direction. Findings were also similar if we defined a case of IPV as exposure to physical and/or sexual violence in pregnancy (supplemental online Table 1).

IPV had a strong cross-sectional relationship with perinatal common mental disorders. In adjusted log binomial models, IPV at baseline was associated with higher odds of symptoms consistent with probable depression (aOR = 4.64, 95%CI = 2.44–8.81). Similarly IPV was associated with probable anxiety disorder (AOR = 2.85, 95%CI = 1.46–5.58) and probable PTSD symptomology (AOR = 3.28, 95%CI = 1.55–6.97).

In a modified poisson regression we build three models presenting the unadjusted and adjusted coefficients associating IPV intensity at baseline with adherence (online Supplemental Table 2). Each increased unit of intensity is associated with small but significantly worse adherence after controlling for socio-demographics. Upon adding perinatal common mental disorders into the model, the relationship between IPV and adherence is partially attenuated but remains significant.

3.3. Measurement model

The confirmatory factor analysis for perinatal common mental disorders confirmed a single latent construct comprising depressive, anxiety, and intrusive PTSD symptoms. Depression was a latent construct comprising items from HADS-d subscale, anxiety was comprised of items from HADS-a subscale, and PTSD was assessed using items from the arousal/intrusion subscale of HTQ. Each of these three latent variables were regressed on items measured as ordered categorical responses (Online supplemental Table 3). The overall latent construct of common mental disorders had good fit in the measurement model (CFI = 0.974; RMSEA = 0.055 (90%CI 0.044–0.066); SRMR = 0.062).

3.4. Structural equation model

Fig. 2 shows the final structural equation model for adherence postpartum. IPV intensity worsened ART adherence independently, with a moderately sized direct effect after controlling for food insecurity, education, and mental health (standardized coefficient = −0.22). IPV had a large indirect effect on adherence through mental health as a latent construct (coef = 0.42). Mental health, in turn, was associated with worse adherence (coef = −0.13) for a small indirect effect (coef = −0.05). The total effect of IPV on adherence was of moderate size (coef = −0.27) and overall model fit was good (CFI = 0.972; TLI = 0.969; RMSEA = 0.045 (90% CI 0.034–0.055); SRMR = 0.076). Table 3 presents the full measurement specifications of the final model.

Table 2
Associations between baseline violence exposure, adherence, and mental health.

	ART adherence ≥95%				Probable Depression				Probable Anxiety				Probable PTSD			
	aOR	LB	–	UB	p value	aOR	LB	–	UB	p value	aOR	LB	–	UB	p value	aOR	LB	–	UB	p value
Any IPV at baseline	0.51	0.20	–	0.96	0.044	4.64	2.44	–	8.81	<0.001	2.85	1.46	–	5.58	0.002	3.42	1.61	–	7.28	0.001
Age	1.01	0.93	–	1.09	0.897	0.99	0.94	–	1.05	0.843	0.96	0.91	–	1.02	0.236	1.00	0.94	–	1.07	0.908
Education	1.22	0.70	–	2.12	0.480	0.63	0.42	–	0.94	0.024	0.66	0.44	–	1.01	0.056	0.91	0.58	–	1.43	0.687
Food insecurity	0.83	0.70	–	0.98	0.029	1.22	1.03	–	1.45	0.025	1.42	1.18	–	1.70	<0.001	1.22	1.04	–	1.43	0.013
Time on ART	1.00	1.00	–	1.00	0.392	1.00	1.00	–	1.00	0.653	1.00	1.00	–	1.00	0.577	1.00	1.00	–	1.00	0.266

a Log binomial regression.
ART: antiretroviral treatment; IPV: intimate partner violence; PTSD: post-traumatic stress disorder.

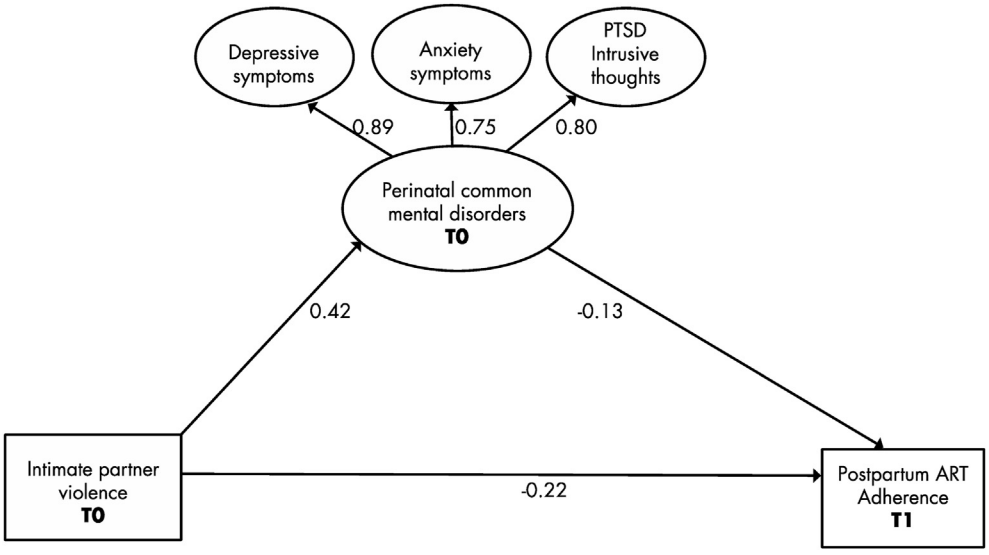


Fig. 2. Structural model of longitudinal relationship between IPV, perinatal common mental disorders, and ART adherence (n = 195).
Relationships represented by standardized parameter estimates, with boxed indicating measured variables and oval representing latent variable. All relationships significant at the p<0.05. Model controls for education and food security.
IPV: intimate partner violence; T0: baseline data; T1: endline data. Goodness of model fit Chi-square = 402 (df = 289); CFI = 0.972; RMSEA = 0.045 (90% CI 0.034 - 0.055). SRMR=0.076.

Table 3
Structural equation model measurement.

	Standardized coefficient	SE	p value
IPV in pregnancy			
Food insecurity	0.19	0.06	0.001
Mental health pregnancy			
IPV intensity	0.42	0.05	<0.001
Education	−0.22	0.08	0.004
Food insecurity	0.24	0.07	<0.001
Adherence			
Mental health symptoms	−0.13	0.04	0.040
IPV intensity	−0.22	0.04	<0.001
Food insecurity	−0.18	0.04	<0.001
Mental health pregnancy			
Depressive symptoms	0.89	0.04	<0.001
Anxiety symptoms	0.75	0.06	<0.001
Intrusive PTSD symptoms	0.80	0.03	<0.001
Free Parameters	107		
Chi-Square Test of Fit	402		
Degrees of Freedom	289		
P-Value	<0.001	90 Percent C.I.	
RMSEA	0.045	0.034	0.055
CFI	0.972		
TLI	0.969		
SRMR	0.076		

4. Discussion

In an urban South African cohort, IPV identified during antenatal care was associated with lower odds of perinatal ART adherence. Even after accounting for mediating symptoms of depression, anxiety, and PTSD, IPV intensity retained a direct association with worsened ART adherence. Past-year IPV exposure assessed during pregnancy was associated with 49% lower adjusted odds of peripartum ART adherence. This association aligns with one cross-sectional Zambian study which showed similar marked effects of IPV on ART adherence in pregnancy (Hampanda, 2016), though other sub-Saharan African studies have found no such association (Cordoba et al., 2021). Our study is among the first, to our knowledge, to explore potential mediating pathways between IPV and ART adherence.

This association between IPV and ART adherence appears to be driven in part by effects of violence exposure on perinatal common mental disorders. Within this sample of urban, pregnant WWH mental health symptomology was pronounced. Antenatal depression (50.9%), anxiety (39.3%), and probable PTSD symptoms (26.8%) were higher than expected based on literature among pregnant women elsewhere in sub-Saharan African studies (Mahenge et al., 2013; Sawyer et al., 2010Pappin et al., 2012). The finding around high prevalence of perinatal common mental disorders is not generalizable and may be a result of the recruitment strategy that focused on identifying a higher proportion of patients who experienced IPV than is found in the general population of pregnant patients. An estimated 25–35% of South African pregnant women report recent physical and/or sexual IPV (Groves et al., 2012; Hoque et al., 2009), whereas our sampling strategy for this secondary analysis may have slightly over-sampled this group (41%). Those WWH reporting IPV exposure had considerably greater odds of reporting symptoms consistent with probable depression (aOR = 4.64), probable anxiety (aOR = 2.85), and probable PTSD (aOR = 3.42). This finding alone underscores the important clinical implications of high levels of IPV exposure reported in this setting and has concomitant effects on the health and development of infants.

Even after modeling the mediating role of perinatal common mental disorders, IPV retained a significant association with ART non-adherence. This may suggest that other plausible pathways influence the IPV-adherence relationship. Qualitative studies among WWH in the US (Njie-Carr et al., 2012) and East Africa (Larsson et al., 2012; Lugalla et al., 2012; Rujumba et al., 2012) suggest IPV exposure may lead WWH to avoid partner disclosure. This has been confirmed in quantitative findings from sub-Saharan Africa (Medley et al., 2004). In Kenya and South Africa WWH describe difficulties taking medication openly at home when in violent relationships (Awiti Ujiji et al., 2011; Hatcher et al., 2016). In a longitudinal study in the U.S., women's inability to take medication openly at home halved the odds of being on HIV treatment at the time of follow-up (Sayles et al., 2006). Qualitative research from the US suggests violent partners may control medical care access of WWH by limiting movement to the clinic (Lichtenstein, 2006; Wilson et al., 2007). Certainly IPV exposure is associated meta-analytically with worse access to antenatal and contraceptive services (Maxwell et al., 2015). In a qualitative study in Johannesburg, WWH reported partners restricting their ability to attend HIV clinical care (Hatcher et al., 2016). What is less clear within this emerging literature is the extent to which difference in study setting may influence these pathways.

Many women reported good adherence to ART despite partner violence. Several explanations are worth exploring to make sense of this finding. Prevalence of both anxiety and depression declined in the postpartum period, which aligns with findings from other settings (Heron et al., 2004). This finding may reflect how social support during the perinatal phase is protective for mental health (Hagaman et al., 2021;

Zhong et al., 2018), though we did not measure this explicitly in our study. It is also plausible that our study did not follow women long enough to detect many episodes of non-adherence, since ART adherence tends to worsen later in the postpartum phase (Henegar et al., 2015; Ngarina et al., 2015). After giving birth, family social support may help buffer the effects of ongoing stressors and mental health (Glazier et al., 2004). The motherhood identity may offer resilience for many women in this setting, helping them adhere to ART for the sake of their strong bond with their children (Hatcher et al., 2016). Relatedly, the relative volatility of IPV may encourage some WWH to harness medication adherence as a realm within their control, leading to improved adherence (Hatcher et al., 2016; Wilson et al., 2016). Future quantitative studies should include measures of motivation, resilience, and motherhood identity to understand how these dynamics may improve women's adherence despite IPV.

4.1. Limitations

The sampling strategy recruited women in the context of a trial of IPV in pregnancy. As all participants reported being in heterosexual relationships, this study cannot assess pregnant people in other types of relationships despite knowledge that violence exposure in this setting is higher among lesbian, bisexual, transgender, and queer populations (Hatcher et al., 2021b). Data collection at two time points does not allow for full longitudinal modeling and thus causality is not possible to determine. Future studies should conduct multiple study visits and include baseline adherence as a covariate. Adherence data were self-reported and may be subject to social desirability bias (Mills et al., 2006), although several studies suggest that self-reported adherence is reliably predictive of positive clinical outcomes (Ferradini et al., 2006; Oyugi et al., 2004; Wools-Kaloustian et al., 2006). High adherence in this sample may demonstrate that women have better adherence around the time of pregnancy (Vaz et al., 2007; Zorrilla et al., 2003), or may suggest measurement bias. Nevertheless, the directionality of the relationship with IPV and adherence would trend towards the null if the entire cohort systematically over-reported good adherence.

Mental health screening tools developed primarily in resource-rich setting may be less appropriate for sub-Saharan African settings (Tsai et al., 2013). Given the challenges associated with identifying culturally-specific cut-points for symptoms of depression, anxiety, and PTSD, we included these symptoms as continuous variables in the final models. This choice recognizes that even when symptomology fails to meet a clinical diagnosis, it can lead to psychosocial effects that are important to consider in public health programming (Judd et al., 1998). Our brief mental health screener, HADS, was validated in South Africa (Wouters et al., 2012) but may be a better measure for general distress than either anxiety or depression alone (Norton et al., 2013). We used confirmatory factor analysis to guide a two-factor loading at baseline but future studies should use more comprehensive individual measures of depressive symptoms and anxiety symptoms. Creating a latent construct comprising depressive symptoms, anxiety symptoms, and intrusive thoughts is valuable for this relatively small sample, but larger studies could explore how each mental health disorder on its own – or as co-morbid conditions - contributes to clinical outcomes and ART adherence. It is possible that the effects of IPV was greater as intensity was higher, as has been suggested elsewhere (Tsai et al., 2016), but we modeled the entire distribution.

4.2. Implications for future research and programs

Since IPV seems to worsen ART adherence, in part, because of its influence on perinatal mental disorders, mental health treatment has potential to ameliorate this pathway. Several interventions have shown promise in reducing mental health symptoms among HIV-positive populations. In South Africa and Kenya, brief mental health treatment delivered by non-specialists were associated with fewer symptoms of depression, PTSD, and anxiety (Meffert et al., 2021; Psaros et al., 2022; Sikkema et al., 2018). However, none of these three studies reported measurable gains in ART adherence or viral suppression, perhaps due to the pilot nature of the study samples. Male and female patients randomized to receive nurse-led cognitive behavioral therapy in South Africa reported fewer depressive symptoms, better ART adherence, and higher odds of suppressed viral loads (Safren et al., 2021). These promising interventions should be adapted to the time of pregnancy in order to improve HIV outcomes for women and infants.

Another implication of these findings is that reducing IPV exposure could have potential impact on both mental health and HIV outcomes. Research for preventing IPV around the time of pregnancy is nascent, with emerging evidence that screening women and offering brief safety planning and referrals may reduce perinatal violence exposure (Garcia Moreno et al., 2017; Kiely et al., 2010; Tiwari et al., 2005). However, several trials for addressing IPV in perinatal populations have failed to show a reduction in IPV (McFarlane et al., 2006; Parker et al., 1999; Sullivan et al., 1994) and no studies, to our knowledge, have assessed whether reductions in IPV may lead to improved perinatal HIV and overall health outcomes. Future interventions among WWH should aim to enhance relationship safety while improving perinatal mental health.

5. Conclusion

IPV in pregnancy affects women's ability to stay adherent to ART in urban South Africa. Mental health problems associated with IPV are one possible mechanism, and there also seems to be an independent effect of IPV on ART adherence. Other pathways, such as partner control or HIV status disclosure, deserve examination in future longitudinal studies. Addressing IPV and mental health in pregnancy may bolster HIV care and treatment and will be important for securing maternal and infant health.

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Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ssmmh.2022.100112.

References

Asparouhov, T., & Muthén, B. (2018). *SRMR in Mplus. Retreived From*. http://www.statmodel.com/download/SRMR2. pdf.

Awiti Ujiji, O., Ekstrom, A. M., Ilako, F., Indalo, D., Wamalwa, D., & Rubenson, B. (2011). Reasoning and deciding PMTCT-adherence during pregnancy among women living with HIV in Kenya. *Cult. Health Sex., 13*, 829–840.

Bentler, P. M. (1990). Comparative fit indexes in structural models. *Psychol. Bull., 107*, 238.

Brittain, K., Phillips, T. K., Zerbe, A., Abrams, E. J., & Myer, L. (2019). Long-term effects of unintended pregnancy on antiretroviral therapy outcomes among South African women living with HIV. *AIDS, 33*, 885–893.

Buller, A. M., Devries, K. M., Howard, L. M., & Bacchus, L. J. (2014). Associations between intimate partner violence and health among men who have sex with men: a systematic review and meta-analysis. *PLoS Med., 11*, Article e1001609.

Bwirire, L. D., Fitzgerald, M., Zachariah, R., Chikafa, V., Massaquoi, M., Moens, M., et al. (2008). Reasons for loss to follow-up among mothers registered in a prevention-of-mother-to-child transmission program in rural Malawi. *Trans. R. Soc. Trop. Med. Hyg., 102*, 1195–1200.

Cordoba, E., Parcesepe, A. M., Gallis, J. A., Headley, J., Soffo, C., Tchatchou, B., et al. (2021). The syndemic effects of mental ill health, household hunger, and intimate partner violence on adherence to antiretroviral therapy among pregnant women living with HIV in Yaoundé, Cameroon. *PLoS One, 16*, Article e0246467.

Davis, N. L., Miller, W. C., Hudgens, M. G., Chasela, C. S., Sichali, D., Kayira, D., et al. (2014). Adherence to extended postpartum antiretrovirals is associated with decreased breast milk HIV-1 transmission. *AIDS, 28*, 2739–2749.

Deitchler, M., Ballard, T. J., Swindale, A., & Coates, J. (2010). *Validation of a Measure of Household Hunger for Cross-Cultural Use*. Washington D.C: Food and Nutrition Technical Assistance Project.

Devries, K. M., Mak, J. Y., Bacchus, L. J., Child, J. C., Falder, G., Petzold, M., et al. (2013). Intimate partner violence and incident depressive symptoms and suicide attempts: a systematic review of longitudinal studies. *PLoS Med., 10*, Article e1001439.

Dillon, G., Hussain, R., Loxton, D., & Rahman, S. (2013). Mental and physical health and intimate partner violence against women: a review of the literature. *Int J Family Med*, Article 313909, 2013.

Dunkle, K. L., Jewkes, R. K., Brown, H. C., Gray, G. E., McIntryre, J. A., & Harlow, S. D. (2004). Gender-based violence, relationship power, and risk of HIV infection in women attending antenatal clinics in South Africa. *Lancet, 363*, 1415–1421.

Ferradini, L., Jeannin, A., Pinoges, L., Izopet, J., Odhiambo, D., Mankhambo, L., et al. (2006). Scaling up of highly active antiretroviral therapy in a rural district of Malawi: an effectiveness assessment. *Lancet, 367*, 1335–1342.

Garcia Moreno, C., Pallitto, C., Hatcher, A. M., Woollett, N., & Colombini, M. (2017). *Safe & Sound: a Randomized Controlled Trial of a Violence against Women Intervention in Antenatal Care*. Rio, Brazil: Sexual Violence Research Forum.

Garcia-Moreno, C., Jansen, H. A., Ellsberg, M., Heise, L., & Watts, C. H. (2006). Prevalence of intimate partner violence: findings from the WHO multi-country study on women's health and domestic violence. *Lancet, 368*, 1260–1269.

Giordano, T. P., Guzman, D., Clark, R., Charlebois, E. D., & Bangsberg, D. R. (2004). Measuring adherence to antiretroviral therapy in a diverse population using a visual analogue scale. *HIV Clin. Trials, 5*, 74–79.

Glazier, R. H., Elgar, F. J., Goel, V., & Holzapfel, S. (2004). Stress, social support, and emotional distress in a community sample of pregnant women. *J. Psychosom. Obstet. Gynaecol., 25*, 247–255.

Glynn, T. R., Mendez, N. A., Jones, D. L., Dale, S. K., Carrico, A. W., Feaster, D. J., et al. (2021). Trauma exposure, PTSD, and suboptimal HIV medication adherence among marginalized individuals connected to public HIV care in Miami. *J. Behav. Med., 44*, 147–158.

Groves, A. K., Kagee, A., Maman, S., Moodley, D., & Rouse, P. (2012). Associations between intimate partner violence and emotional distress among pregnant women in Durban. *J. Interpers Violence, 27*, 1341–1356.

Hagaman, A., LeMasters, K., Zivich, P. N., Sikander, S., Bates, L. M., Bhalotra, S., et al. (2021). Longitudinal effects of perinatal social support on maternal depression: a marginal structural modelling approach. *J. Epidemiol. Community Health, 75*, 936–943.

Hampanda, K. M. (2016). 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., 153*, 123–130.

Hatcher, A. M., Brittain, K., Phillips, T. K., Zerbe, A., Abrams, E. J., & Myer, L. (2021a). Longitudinal association between intimate partner violence and viral suppression during pregnancy and postpartum in South African women. *AIDS, 35*, 791–799.

Hatcher, A. M., de Kadt, J., Mkhize, S., & Parker, A. (2021b). Experiences of violence and safety. In J. de Kadt, C. Hamann, S. P. Mkhize, & A. E. Parker (Eds.), *Quality of Life Survey 6 (2020/21):Overview Report*. Johannesburg: Gauteng City-Region Observatory (GCRO).

Hatcher, A. M., Smout, E. M., Turan, J. M., Christofides, N., & Stoeckl, H. (2015). Intimate partner violence and engagement in HIV care and treatment among women: a systematic review and meta-analysis. *AIDS, 29*, 2183–2194.

Hatcher, A. M., Stockl, H., Christofides, N., Woollett, N., Pallitto, C. C., Garcia Moreno, C., et al. (2016). Mechanisms linking intimate partner violence and prevention of mother-to-child transmission of HIV: a qualitative study in South Africa. *Soc. Sci. Med., 168*, 130–139.

Henegar, C. E., Westreich, D. J., Maskew, M., Miller, W. C., Brookhart, M. A., & Van Rie, A. (2015). Effect of pregnancy and the postpartum period on adherence to antiretroviral therapy among HIV-infected women established on treatment. *J. Acquir. Immune Defic. Syndr., 68*, 477–480.

Heron, J., O'Connor, T. G., Evans, J., Golding, J., Glover, V., & Team, A. S. (2004). The course of anxiety and depression through pregnancy and the postpartum in a community sample. *J. Affect. Disord., 80*, 65–73.

Hoque, M. E., Hoque, M., & Kader, S. B. (2009). Prevalence and experience of domestic violence among rural pregnant women in KwaZulu-Natal, South Africa. *Southern Afr. J. Epidemiol. Infect., 24*, 34–37.

Hu, L.t., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: conventional criteria versus new alternatives. *Struct. Equ. Model.: A Multidiscip. J., 6*, 1–55.

Jewkes, R. K., Dunkle, K., Nduna, M., & Shai, N. (2010). Intimate partner violence, relationship power inequity, and incidence of HIV infection in young women in South Africa: a cohort study. *Lancet, 376*, 41–48.

Jina, R., Jewkes, R., Hoffman, S., Dunkle, K. L., Nduna, M., & Shai, N. J. (2012). Adverse mental health outcomes associated with emotional abuse in young rural South African women A cross-sectional study. *J. Interpers Violence, 27*, 862–880.

Jones, S. A., Sherman, G. G., & Varga, C. A. (2005). Exploring socio-economic conditions and poor follow-up rates of HIV-exposed infants in Johannesburg, South Africa. *AIDS Care, 17*, 466–470.

Judd, L. L., Akiskal, H. S., Maser, J. D., Zeller, P. J., Endicott, J., Coryell, W., et al. (1998). A prospective 12-year study of subsyndromal and syndromal depressive symptoms in unipolar major depressive disorders. *Arch Gen Psychiatry, 55*, 694–700.

Kacanek, D., Jacobson, D. L., Spiegelman, D., Wanke, C., Isaac, R., & Wilson, I. B. (2010). Incident depression symptoms are associated with poorer HAART adherence: a longitudinal analysis from the Nutrition for Healthy Living study. *J. Acquir. Immune Defic. Syndr., 53*, 266–272.

Kalichman, S. C., Amaral, C. M., Swetzes, C., Jones, M., Macy, R., Kalichman, M. O., et al. (2009). A simple single-item rating scale to measure medication adherence: further evidence for convergent validity. *J. Int. Assoc. Phys. AIDS Care, 8*, 367–374.

Kiely, M., El-Mohandes, A. A., El-Khorazaty, M. N., Blake, S. M., & Gantz, M. G. (2010). An integrated intervention to reduce intimate partner violence in pregnancy: a randomized controlled trial. *Obstet. Gynecol., 115*, 273–283.

Kirsten, I., Sewangi, J., Kunz, A., Dugange, F., Ziske, J., Jordan-Harder, B., et al. (2011). Adherence to combination prophylaxis for prevention of mother-to-child-transmission of HIV in Tanzania. *PLoS One, 6*, Article e21020.

Kling, J. R., Liebman, J. B., & Katz, L. F. (2007). Experimental analysis of neighborhood effects. *Econometrica, 75*, 83–119.

Lagdon, S., Armour, C., & Stringer, M. (2014). Adult experience of mental health outcomes as a result of intimate partner violence victimisation: a systematic review. *Eur. J. Psychotraumatol., 5*.

Larsson, E. C., Thorson, A., Pariyo, G., Conrad, P., Arinaitwe, M., Kemigisa, M., et al. (2012). Opt-out HIV testing during antenatal care: experiences of pregnant women in rural Uganda. *Health Pol. Plann., 27*, 69–75.

Lichtenstein, B. (2006). Domestic violence in barriers to health care for HIV-positive women. *AIDS Patient Care STDS, 20*, 122–132.

Lugalla, J., Yoder, S., Sigalla, H., & Madihi, C. (2012). Social context of disclosing HIV test results in Tanzania. *Cult. Health Sex., 14*(Suppl. 1), S53–S66.

Mahenge, B., Likindikoki, S., Stockl, H., & Mbwambo, J. (2013). Intimate partner violence during pregnancy and associated mental health symptoms among pregnant women in Tanzania: a cross-sectional study. *BJOG, 120*, 940–946.

Malow, R., Devieux, J. G., Stein, J. A., Rosenberg, R., Jean-Gilles, M., Attonito, J., et al. (2013). Depression, substance abuse and other contextual predictors of adherence to antiretroviral therapy (ART) among Haitians. *AIDS Behav., 17*, 1221–1230.

Maxwell, L., Devries, K., Zionts, D., Alhusen, J. L., & Campbell, J. (2015). Estimating the effect of intimate partner violence on women's use of contraception: a systematic review and meta-analysis. *PLoS One, 10*, Article e0118234.

McFarlane, J. M., Groff, J. Y., O'Brien, J. A., & Watson, K. (2006). Secondary prevention of intimate partner violence: a randomized controlled trial. *Nurs. Res., 55*, 52–61.

Medley, A., Garcia-Moreno, C., McGill, S., & Maman, S. (2004). Rates, barriers and outcomes of HIV serostatus disclosure among women in developing countries: implications for prevention of mother-to-child transmission programmes. *Bull. World Health Organ., 82*, 299–307.

Meffert, S. M., Neylan, T. C., McCulloch, C. E., Blum, K., Cohen, C. R., Bukusi, E. A., et al. (2021). Interpersonal psychotherapy delivered by nonspecialists for depression and posttraumatic stress disorder among Kenyan HIV–positive women affected by gender-based violence: randomized controlled trial. *PLoS Med., 18*, Article e1003468.

Mepham, S., Zondi, Z., Mbuyazi, A., Mkhwanazi, N., & Newell, M. L. (2011). Challenges in PMTCT antiretroviral adherence in northern KwaZulu-Natal, South Africa. *AIDS Care, 23*, 741–747.

Mills, E. J., Nachega, J. B., Buchan, I., Orbinski, J., Attaran, A., Singh, S., et al. (2006). Adherence to antiretroviral therapy in sub-Saharan Africa and North America: a meta-analysis. *JAMA, 296*, 679–690.

Mofenson, L. M. (2010). Protecting the next generation—eliminating perinatal HIV-1 infection. *N. Engl. J. Med., 362*, 2316–2318.

Mollica, R. F., Caspi-Yavin, Y., Bollini, P., Truong, T., Tor, S., & Lavelle, J. (1992). The Harvard Trauma Questionnaire. Validating a cross-cultural instrument for measuring torture, trauma, and posttraumatic stress disorder in Indochinese refugees. *J. Nerv. Ment. Dis., 180*, 111–116.

Murray, L. K., Semrau, K., McCurley, E., Thea, D. M., Scott, N., Mwiya, M., et al. (2009). Barriers to acceptance and adherence of antiretroviral therapy in urban Zambian women: a qualitative study. *AIDS Care, 21*, 78–86.

Myer, L., Smit, J., Roux, L. L., Parker, S., Stein, D. J., & Seedat, S. (2008). Common mental disorders among HIV-infected individuals in South Africa: prevalence, predictors, and validation of brief psychiatric rating scales. *AIDS Patient Care STDS, 22*, 147–158.

Nachega, J. B., Knowlton, A. R., Deluca, A., Schoeman, J. H., Watkinson, L., Efron, A., et al. (2006). Treatment supporter to improve adherence to antiretroviral therapy in

HIV-infected South African adults. A qualitative study. *J. Acquir. Immune Defic. Syndr., 43*(Suppl. 1), S127–S133.
Ngarina, M., Kilewo, C., Karlsson, K., Aboud, S., Karlsson, A., Marrone, G., et al. (2015). Virologic and immunologic failure, drug resistance and mortality during the first 24 months postpartum among HIV-infected women initiated on antiretroviral therapy for life in the Mitra plus Study, Dar es Salaam, Tanzania. *BMC Infect. Dis., 15*, 175.
Ngarina, M., Popenoe, R., Kilewo, C., Biberfeld, G., & Ekstrom, A. M. (2013). Reasons for poor adherence to antiretroviral therapy postnatally in HIV-1 infected women treated for their own health: experiences from the Mitra Plus study in Tanzania. *BMC Publ. Health, 13*, 450.
Njie-Carr, V., Sharps, P., Campbell, D., & Callwood, G. (2012). Experiences of HIV-positive African-American and African Caribbean childbearing women: a qualitative study. *J. Natl. Black Nurses' Assoc. JNBNA, 23*, 21–28.
Norton, S., Cosco, T., Doyle, F., Done, J., & Sacker, A. (2013). The Hospital Anxiety and Depression Scale: a meta confirmatory factor analysis. *J. Psychosom. Res., 74*, 74–81.
Oyugi, J. H., Byakika-Tusiime, J., Charlebois, E. D., Kityo, C., Mugerwa, R., Mugyenyi, P., et al. (2004). Multiple validated measures of adherence indicate high levels of adherence to generic HIV antiretroviral therapy in a resource-limited setting. *J. Acquir. Immune Defic. Syndr., 36*, 1100–1102.
Pallitto, C. C., Garcia-Moreno, C., Stockl, H., Hatcher, A. M., MacPhail, C., Mokoatle, K., et al. (2016). Testing a counselling intervention in antenatal care for women experiencing partner violence: a study protocol for a randomized controlled trial in Johannesburg, South Africa. *BMC Health Serv. Res., 16*, e1–10.
Pantalone, D. W., Hessler, D. M., & Simoni, J. M. (2010a). Mental health pathways from interpersonal violence to health-related outcomes in HIV-positive sexual minority men. *J. Consult. Clin. Psychol., 78*, 387.
Pantalone, D. W., Hessler, D. M., & Simoni, J. M. (2010b). Mental health pathways from interpersonal violence to health-related outcomes in HIV-positive sexual minority men. *J. Consult. Clin. Psychol., 78*, 387–397.
Pappin, M., Wouters, E., & Booysen, F. L. (2012). Anxiety and depression amongst patients enrolled in a public sector antiretroviral treatment programme in South Africa: a cross-sectional study. *BMC Publ. Health, 12*, 244.
Parker, B., McFarlane, J., Soeken, K., Silva, C., & Reel, S. (1999). Testing an intervention to prevent further abuse to pregnant women. *Res. Nurs. Health, 22*, 59–66.
Peltzer, K., Friend-du Preez, N., Ramlagan, S., & Anderson, J. (2010). Antiretroviral treatment adherence among HIV patients in KwaZulu-Natal, South Africa. *BMC Publ. Health, 10*, 111.
Psaros, C., Stanton, A. M., Raggio, G. A., Mosery, N., Goodman, G. R., Briggs, E. S., et al. (2022). Optimizing PMTCT adherence by treating depression in perinatal women with HIV in South Africa: a pilot randomized controlled trial. *Int. J. Behav. Med.*, 1–15.
Rujumba, J., Neema, S., Byamugisha, R., Tylleskar, T., Tumwine, J. K., & Heggenhougen, H. K. (2012). Telling my husband I have HIV is too heavy to come out of my mouth": pregnant women's disclosure experiences and support needs following antenatal HIV testing in eastern Uganda. *J. Int. AIDS Soc., 15*, 17429.
Safren, S. A., O'Cleirigh, C., Andersen, L. S., Magidson, J. F., Lee, J. S., Bainter, S. A., et al. (2021). Treating depression and improving adherence in HIV care with task-shared cognitive behavioural therapy in Khayelitsha, South Africa: a randomized controlled trial. *J. Int. AIDS Soc., 24*, Article e25823.
Sawyer, A., Ayers, S., & Smith, H. (2010). Pre- and postnatal psychological wellbeing in Africa: a systematic review. *J. Affect. Disord., 123*, 17–29.
Sayles, J. N., Wong, M. D., & Cunningham, W. E. (2006). The inability to take medications openly at home: does it help explain gender disparities in HAART use? *J Womens Health (Larchmt), 15*, 173–181.
Sikkema, K. J., Mulawa, M. I., Robertson, C., Watt, M. H., Ciya, N., Stein, D. J., et al. (2018). Improving AIDS care after trauma (ImpACT): pilot outcomes of a coping intervention among HIV-infected women with sexual trauma in South Africa. *AIDS Behav., 22*, 1039–1052.
Simoni, J. M., Pearson, C. R., Pantalone, D. W., Marks, G., & Crepaz, N. (2006). Efficacy of interventions in improving highly active antiretroviral therapy adherence and HIV-1 RNA viral load. A meta-analytic review of randomized controlled trials. *J. Acquir. Immune Defic. Syndr., 43*(Suppl. 1), S23–S35.
Steiger, J. H. (1990). Structural model evaluation and modification: an interval estimation approach. *Multivariate Behav. Res., 25*, 173–180.
Sullivan, C. M., Campbell, R., Angelique, H., Eby, K. K., Davidson, W. S., & 2nd. (1994). An advocacy intervention program for women with abusive partners: six-month follow-up. *Am. J. Community Psychol., 22*, 101–122.
Tiwari, A., Leung, W. C., Leung, T. W., Humphreys, J., Parker, B., & Ho, P. C. (2005). A randomised controlled trial of empowerment training for Chinese abused pregnant women in Hong Kong. *BJOG International Journal of BJOG Intern. J. Gynecol. Obstet., 112*, 1249–1256.
Townsend, L., Jewkes, R., Mathews, C., Johnston, L. G., Flisher, A. J., Zembe, Y., et al. (2011). HIV risk behaviours and their relationship to intimate partner violence (IPV) among men who have multiple female sexual partners in Cape Town, South Africa. *AIDS Behav., 15*, 132–141.
Tsai, A. C., Scott, J. A., Hung, K. J., Zhu, J. Q., Matthews, L. T., Psaros, C., et al. (2013). Reliability and validity of instruments for assessing perinatal depression in African settings: systematic review and meta-analysis. *PLoS One, 8*, Article e82521.
Tsai, A. C., Tomlinson, M., Comulada, W. S., & Rotheram-Borus, M. J. (2016). Intimate partner violence and depression symptom severity among South African women during pregnancy and postpartum: population-based prospective cohort study. *PLoS Med., 13*, Article e1001943.
Turan, J. M., & Nyblade, L. (2013). HIV-related stigma as a barrier to achievement of global PMTCT and maternal health goals: a review of the evidence. *AIDS Behav.*
UNAIDS. (2020). *UNAIDS Calls for Greater Urgency as Global Gains Slow and Countries Show Mixed Results towards 2020 HIV Targets 2019*.
Vaz, M. J., Barros, S. M., Palacios, R., Senise, J. F., Lunardi, L., Amed, A. M., et al. (2007). HIV-infected pregnant women have greater adherence with antiretroviral drugs than non-pregnant women. *Int. J. STD AIDS, 18*, 28–32.
Vindbjerg, E., Carlsson, J., Mortensen, E. L., Makransky, G., & Nielsen, T. (2020). A rasch-based validity study of the harvard trauma questionnaire. *J. Affect. Disord., 277*, 697–705.
Wabiri, N., Chersich, M., Shisana, O., Blaauw, D., Rees, H., & Dwane, N. (2016). Growing inequities in maternal health in South Africa: a comparison of serial national household surveys. *BMC Pregnancy Childbirth, 16*, 256.
Wagner, G. J., Ghosh-Dastidar, B., Mukasa, B., & Linnemayr, S. (2020). Changes in ART adherence relate to changes in depression as well! Evidence for the Bi-directional longitudinal relationship between depression and ART adherence from a prospective study of HIV clients in Uganda. *AIDS Behav., 24*, 1816–1824.
Walsh, J. C., Mandalia, S., & Gazzard, B. G. (2002). Responses to a 1 month self-report on adherence to antiretroviral therapy are consistent with electronic data and virological treatment outcome. *AIDS, 16*, 269–277.
Ware, N. C., Idoko, J., Kaaya, S., Biraro, I. A., Wyatt, M. A., Agbaji, O., et al. (2009). Explaining adherence success in sub-Saharan Africa: an ethnographic study. *PLoS Med., 6*, e11.
Watts, C., Zimmerman, C., T, E., & Nyblade, L. (2010). In *Modelling the Impact of Stigma on HIV and AIDS Programmes: Preliminary Projections for Mother-To-Child Transmission. Washington, D.C.: International Center for Research on Women, London School of Hygiene & Tropical Medicine*.
WHO, 2001, Putting women first: ethical and safety recommendations for research on domestic violence against women, http://apps.who.int/iris/handle/10665/65893. (Accessed 13 May 2022).
Whetten, K., Shirey, K., Pence, B. W., Yao, J., Thielman, N., Whetten, R., et al. (2013). Trauma history and depression predict incomplete adherence to antiretroviral therapies in a low income country. *PLoS One, 8*, Article e74771.
Willie, T. C., Overstreet, N. M., Sullivan, T. P., Sikkema, K. J., & Hansen, N. B. (2016). Barriers to HIV medication adherence: examining distinct anxiety and depression symptoms among women living with HIV who experienced childhood sexual abuse. *Behav. Med., 42*, 120–127.
Wilson, K. S., Silberberg, M. R., Brown, A. J., & Yaggy, S. D. (2007). Health needs and barriers to healthcare of women who have experienced intimate partner violence. *J Womens Health (Larchmt), 16*, 1485–1498.
Wilson, K. S., Wanje, G., Yuhas, K., Simoni, J. M., Masese, L., Vander Stoep, A., et al. (2016). 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. *AIDS Behav., 20*, 2065–2077.
Wools-Kaloustian, K., Kimaiyo, S., Diero, L., Siika, A., Sidle, J., Yiannoutsos, C. T., et al. (2006). Viability and effectiveness of large-scale HIV treatment initiatives in sub-Saharan Africa: experience from western Kenya. *AIDS, 20*, 41–48.
Wouters, E., Booysen, F.l. R., Ponnet, K., & Baron Van Loon, F. (2012). Wording effects and the factor structure of the Hospital Anxiety & Depression Scale in HIV/AIDS patients on antiretroviral treatment in South Africa. *PLoS One, 7*, Article e34881.
Zhong, Q.-Y., Gelaye, B., VanderWeele, T. J., Sanchez, S. E., & Williams, M. A. (2018). Causal model of the association of social support with antepartum depression: a marginal structural modeling approach. *Am. J. Epidemiol., 187*, 1871–1879.
Zigmond, A. S., & Snaith, R. (1983). The hospital anxiety and depression scale. *Acta Psychiatr. Scand., 67*, 361–370.
Zorrilla, C. D., Santiago, L. E., Knubson, D., Liberatore, K., Estronza, G., Colon, O., et al. (2003). Greater adherence to highly active antiretroviral therapy (HAART) between pregnant versus non-pregnant women living with HIV. *Cell Mol Biol (Noisy-le-grand), 49*, 1187–1192.