RESEARCH ARTICLE

Maternal priorities for preventive therapy among HIV-positive pregnant women before and after delivery in South Africa: a best–worst scaling survey

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Abstract

Introduction: Pregnant women newly diagnosed with HIV during pregnancy are often lost to follow up and their adherence rates drop after delivery. We quantified changes in priorities related to isoniazid preventive therapy (IPT) and antiretroviral therapy (ART) among pregnant women living with HIV.

Methods: We enrolled pregnant women recently diagnosed with HIV from 14 primary health clinics during pregnancy and followed them after delivery in Matlosana, South Africa. Best–worst scaling (BWS) was used to determine the women’s priorities out of 11 attributes related to preventive therapy in the ante- versus postpartum periods. Aggregate BWS scores were calculated based on the frequency with which participants selected each attribute as the best or worst among five options (across multiple choice sets). Individual BWS scores were also calculated and rescaled from 0 (always selected as worst) to 10 (always selected as best), and changes in BWS scores in the ante- versus postpartum periods were compared, using a paired t-test. Factors associated with the changes in BWS scores were examined in multiple linear regressions. Spearman’s rho was used to compare the ranking of attributes.

Results: Out of a total of 204 participants, 154 (75.5%) completed the survey in the postpartum at the median 15 (IQR: 11 to 27) weeks after delivery. Trust in healthcare providers was most highly prioritized both in the ante- (individual BWS Score = 7.34, SE = 0.13) and postpartum periods (BWS = 7.21 ± 0.11), followed by living a long life (BWS = 6.77 ± 0.09 in the ante- vs. BWS = 6.86 ± 0.10 in the postpartum). Prevention for infants’ health was more prioritized in the post- (BWS = 6.54 ± 0.09) versus antepartum periods (BWS = 6.11 ± 0.10) (p = 0.05). This change was associated with IPT initiation at enrolment (regression coefficient = 0.78 ± 0.33, p = 0.001). Difficulty in daily pill-uptake was significantly more prioritized in the postpartum than in the antepartum (BWS = 5.03 ± 0.11) vs. (BWS = 4.43 ± 0.10) (p < 0.01). Transportation cost and worry about side effects of pills were least prioritized. Overall ranking of attributes was similar in both time periods (Spearman’s rho = 0.90).

Conclusions: Comprehensive interventions to build trust in healthcare providers and support adherence may increase uptake of preventive therapy. Counselling needs to emphasize medication benefits for both maternal and infant health among HIV-positive pregnant women.

Keywords: Pregnant women; preventive therapy; maternal priorities; preferences; HIV; TB; South Africa

Additional Supporting Information may be found online in the Supporting information tab for this article.

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1 INTRODUCTION

In 2016, there were 10.4 million new cases of tuberculosis (TB) and 1.3 million deaths associated with it worldwide [1]. South Africa has some of the highest rates of HIV and TB in the world and over 50% of TB incident cases are co-infected with HIV. Pregnancy is often the gateway for HIV diagnosis in women of reproductive age, in which HIV seroprevalence was about 30.8% in 2015 [2]. TB increases maternal mortality and adverse infant outcomes among HIV-positive women during pregnancy and in the postpartum period [3-5].

Antiretroviral therapy (ART) and isoniazid preventive therapy (IPT) are two key interventions to reduce TB incidence and ensure better long-term health outcomes of both HIV-positive pregnant women and their infants [1,6]. When taken together with ART, IPT can decrease the risk of developing...
active TB up to 90% among people living with HIV (PLWH) [7,8]. Since January 2015, the South African national guideline recommends immediate initiation of lifelong ART (i.e. Option B+) and IPT up to 36 months for HIV-positive pregnant women [6]. While ≥95% of pregnant women with HIV presented at ANC received ART in 2015 [9], up to 50% have been reported as lost to follow-up (LFU) after delivery [10]. However, the implementation of IPT remains poor. The coverage of IPT among PLWH is highly variable, ranging 2% to 73% [1], and over-reporting of IPT initiation has been reported in South Africa [11].

Pregnant women diagnosed with HIV are often motivated to take ART to prevent HIV transmission during pregnancy but might stop seeking care once they have safely protected their infants from infection [12]. Changes in circumstances, such as taking care of a new baby and returning to work, or negative treatment from clinic staff have been reported as factors related to ART discontinuation in the postpartum period [13-15]. Fear of side effects and non-disclosure of HIV status were also associated with low uptake of IPT among PLWH [16]. Yet previous qualitative studies reported that HIV-positive pregnant women who perceived the benefits of ART as "life-giving" and received treatment support from healthcare workers could achieve better adherence in the postpartum period [17,18].

Understanding maternal priorities for preventive therapy is crucial to deliver services in the most acceptable way to these women. BWS is a stated-preference method which allows to analyse preferences among a set of attributes characterizing goods or services and has been used in over 50 different applications in healthcare or services research [19-21]. In this study, we quantified how HIV-positive pregnant women evaluate and prioritize different factors related to infant health, their own health and structural challenges regarding uptake of ART and IPT using BWS and examined factors associated with changes in maternal priorities before and after delivery. All interviews were conducted in a private room to protect patients' confidentiality. Written informed consents were obtained from all participants. The study was approved by both the institutional review boards at the Johns Hopkins School of Medicine and the University of Witwatersrand.

2.2 | Study design
We conducted a longitudinal survey incorporating an object case BWS instrument. All pregnant women were enrolled during pregnancy and scheduled to complete follow-up visits at 6 and 14 weeks postpartum, aligning with their infants’ routine immunization visits [6]. However, most participants only completed either 6 or 14 weeks visit thus only one postpartum visit per respondent was included for the analysis. The 14 weeks visit was included as the primary point; if a participant missed the 14 weeks visit, 6 weeks or later than 14 weeks visit, whichever was closer to the scheduled 14 weeks visit, was included. We conducted sensitivity analyses to examine potential impact of different timing of postpartum visits (See supplement).

To our knowledge, this is the first study to use BWS among HIV-positive pregnant women. BWS is based on the assumption that a respondent has underlying utility associated with each attribute and can choose the best (most important) and the worst (least important) attribute from a set of available options in a given choice task as a rational choice maker [25-28]. Of three variants of BWS, object case BWS allows to rank the relative importance of attributes in a continuous quantitative scale [21]. Recently, various ways have been suggested to test reliability and validity of BWS [21,29].

2.3 | Selection of attributes
We identified the attributes most likely to influence women's decision-making regarding uptake of preventive therapy through literature review and prior in-depth interviews about patients’ experiences and perceptions of ART and IPT [16,23,30,31]. Four themes emerged: treatment benefits for maternal and infant health, interpersonal support, trust in healthcare services, and structural barriers. A total of 11 attributes were chosen, including roughly equal numbers of potential barriers and facilitators for initiation of IPT (Table 1). Attributes were converted to simple statements, which were then reviewed and refined by clinical experts and healthcare providers in the clinics. Identification and refinement of statements followed the framework for instrument development of a choice experiment [28].

2.4 | Experimental design
We used a balanced incomplete block design in a main-effects orthogonal array, which allows for repetition of different combinations of attributes in the subsets of all possible choice scenarios [32]. Each respondent was presented with five statements in each given choice task and asked to choose one statement out of the five that best described her thoughts and another statement that worst described her thoughts. Each of the 11 statements appeared five times across 11 separate choice tasks (Figure 1).
2.5 | Sociodemographic, clinical variables and adherence measurement

Participants’ sociodemographic and clinical information was obtained at enrolment. Details related to delivery and history of breastfeeding were obtained in the postpartum visits. Infant HIV status was recorded if the HIV test results were available. Participants were asked about the degree of support they received from healthcare workers, family or friends with regard to taking medications and whether they were satisfied with that support. Self-reported adherence rates to ART and IPT were measured by the AIDS Clinical Trials Group (ACTG) Adherence Questionnaire, which is based on a four-day recall with five items. This questionnaire has been extensively used and validated in other studies [33-36]. Adherence to ART or IPT was also measured by testing eligible participants’ urine samples by IsoScreen kit (GFC Diagnostics Limited, Oxfordshire, UK).

2.6 | Data analysis

The outcome was the participants' choice of best and worst statements in each subset of statements presented to them in the ante- and postpartum periods [37]. The frequency of being chosen as the best and worst statement across all choice tasks was calculated, resulting in a relative BWS score [38]. Each statement chosen as best received a score of 2, while the statement chosen as worst received a score of 0 and all other non-selected statements a score of 1. Since each statement appeared five times per respondent, the scores for each statement ranged from 0 (always selected as worst) to 10 (always selected as best) for individual BWS scores. The aggregate BWS score was also calculated as the mean score across all respondents, rescaled from 0 to 100. Thus, a mean score of 50 would mean either no selection or neutral selection (i.e. an attribute is chosen as best and worst for the equal number of times). Previous studies have shown that a simple BWS score has good validity, compared to more sophisticated regression-based methods, including conditional logistic regression [39], and good discrimination compared to rating or ranking scales [40].

The difference in the ante- versus postpartum periods was calculated and compared, using a paired t-test. We examined the potential association between individual BWS scores and clinical factors (CD4 cell counts, IPT initiation, perceived risk of TB in next year and adherence to ART) and sociodemographic factors (transportation cost to the clinic and number of previous pregnancy) in multiple linear regressions. Final multiple linear regression models were fitted adjusting for individual covariates with \( p \)-value <0.05. All analyses were conducted in STATA 13.

Table 1. Selected attributes related to preventive therapies tested in the best–worst scaling task

| Attributes                                                                 | Statements                                                                 |
|---------------------------------------------------------------------------|---------------------------------------------------------------------------|
| Trust in healthcare providers for infant’s health                         | I trust that doctors and nurses know what is best for infant’s health     |
| Prevention for infant’s illness                                           | Medications I take prevent my infant to get infected or become sick       |
| Side effects on infant                                                    | I worry that if I take pills, it can cause side effects on my infant      |
| Strength                                                                   | Medications to prevent disease help me feel stronger                     |
| Long life                                                                 | I can live as long as someone without HIV if I take care of myself        |
| Interpersonal support for pill take                                       | Friends and families help me to take medications                         |
| Fear of unintended disclosure of HIV status                               | I worry that taking pills every day tells other people that I have HIV    |
| Knowledge on pill purpose                                                 | I know the purpose of each different medication I take                   |
| Difficulty in daily adherence                                             | I have trouble taking medication on a daily basis                        |
| Travel cost                                                               | Getting to the clinic costs me too much money                            |
| Lack of time                                                              | I am too busy to come to regular clinic visits                           |

Figure 1. Example of a best–worst scaling choice task with five attributes related to preventive therapies among HIV-positive pregnant women.
3.1 Patient characteristics at baseline and follow-up

Of the 204 pregnant women enrolled, 47 (23%) did not complete the follow-up visits: 20 participants were lost to follow up, 23 were contacted three times but could not be reached, and 4 lost interest in the study or refused to participate further. The baseline characteristics of participants who completed follow-up visits did not differ from those lost to follow up.

Of 154 who completed at least one follow-up visit, 77 (50%) were followed at 14 weeks, 33 (21%) at 6 weeks and 44 (29%) at later than 14 weeks visits. The median time since delivery at follow-up visits was 15 (IQR: 11 to 27) weeks. At enrolment, approximately 30% (n = 45) were receiving IPT, while 98% (n = 151) were on ART (Table 2). The time from initial HIV diagnosis was slightly longer in those receiving IPT (78 ± 68 days) than in those not receiving IPT at enrolment (45 ± 41 days, p < 0.001). About 80% (n = 125) of the participants had disclosed their HIV status to their partners.

Table 2. Baseline characteristics by the current status of Isoniazid Preventive Therapy (IPT) among 154 HIV-positive pregnant women, South Africa

| N (%) | Receiving IPT at enrolment (N = 45) | No IPT (N = 109) | p-valuea |
|-------|----------------------------------|-----------------|----------|
| Age (years), Mean (±SD) | 28 (±6) | 27 (±6) | 0.89 |
| Gestational week at first ANC visit, Mean (±SD) | 19 (±6) | 18 (±8) | 0.70 |
| Gestational week at enrolment, Mean (±SD) | 27 (±7) | 24 (±9) | 0.05 |
| Time since HIV diagnosis (days), Mean (±SD) | 78 (±68) | 45 (±41) | <0.001 |
| CD4 cell count (cells/mm³), Mean (±SD)b | 481 (±227) | 467 (±248) | 0.79 |
| Perceived risk of developing TB within next yearc | | | |
| Slightly likely | 16 (35.6) | 12 (11.1) | <0.001 |
| It is not at all likely | 29 (64.4) | 96 (88.9) | |
| Educationb | | | |
| ≤9th grade | 9 (25.0) | 21 (26.9) | 0.83 |
| >9th grade | 27 (75.0) | 57 (73.1) | |
| Employment status | | | |
| Full time | 2 (4.4) | 11 (10.1) | 0.35 |
| Part time or piece jobs | 5 (11.1) | 7 (6.4) | |
| Unemployed | 38 (84.4) | 91 (83.5) | |
| Mode of transportation to clinic | | | |
| On foot | 23 (51.1) | 61 (56.0) | 0.86 |
| Public taxi or bus | 21 (46.7) | 46 (42.2) | |
| Private car or motorbike | 1 (2.2) | 2 (1.8) | |
| Transportation cost (Rand) | | | |
| Median (IQR) | 0 (0, 20) | 0 (0, 16) | 0.14 |
| Marital status | | | |
| Married | 7 (18.4) | 10 (9.3) | 0.31 |
| Living with partner | 13 (34.2) | 39 (36.1) | |
| Not living with partner | 18 (47.4) | 59 (54.6) | |
| Disclosure of HIV status to partner | | | |
| Yes | 28 (62.2) | 54 (50.5) | 0.18 |
| No | 17 (37.8) | 53 (49.5) | |

aPearson χ² test (discrete variables), t-test (mean comparison for continuous variables) and Mann–Whitney test (median comparison for continuous variables) were used.
bSome variables have missing data.
cNo one chose other categories of moderately likely, very likely or extremely.

3 | RESULTS

3.1 Patient characteristics at baseline and follow-up

Of the 204 pregnant women enrolled, 47 (23%) did not complete the follow-up visits: 20 participants were lost to follow up, 23 were contacted three times but could not be reached, and 4 lost interest in the study or refused to participate further. The baseline characteristics of participants who completed follow-up visits did not differ from those lost to follow up.

Of 154 who completed at least one follow-up visit, 77 (50%) were followed at 14 weeks, 33 (21%) at 6 weeks and 44 (29%) at later than 14 weeks visits. The median time since delivery at follow-up visits was 15 (IQR: 11 to 27) weeks. At enrolment, approximately 30% (n = 45) were receiving IPT, while 98% (n = 151) were on ART (Table 2). The time from initial HIV diagnosis was slightly longer in those receiving IPT (78 ± 68 days) than in those not receiving IPT at enrolment (45 ± 41 days, p < 0.001). About 80% (n = 125) of the participants had disclosed their HIV status to their partners.

Two (1.3%) infants were found to be HIV-positive, 125 (89.3%) HIV-negative and 13 (8.4%) had unknown HIV status. HIV test results were not available for 10 (6.5%) infants. Nearly 90% (n = 132) of participants had ever breastfed their infants, and 57% (n = 88) were still breastfeeding at the time of follow-up including 52 women having exclusively breastfed. While 91% (n = 139) reported they received some or a lot of support from healthcare providers to remind them about taking medications, 47% (n = 72) got this from friends and family (p < 0.001), and 21% (n = 32) were somewhat or very dissatisfied with treatment support received from friends and family. Ninety-five percent (142/150) of patients on ART reported...
I worry that taking pills every day tells me I worry that if I take pills it can cause side effects on my infant. Getting to the clinic costs me too much money. I am too busy to come to regular clinic visits. Friends and families help me to take medications. I have trouble taking medication on a daily basis. I know the purpose of each different medication I take. Medications to prevent disease help me feel stronger. Medications I take prevent my infant to get infected or become sick. I can live as long as someone without HIV if I take care of myself. I trust that doctors and nurses know what is best for my infant’s health. That they were informed about the side effects and the reasons to take it compared to 72% (23/32) of people on IPT.

### 3.2 Adherence to ART and IPT

Everyone was on ART in the postpartum visits. Over 90% (140/149) were fully adherent to ART. Of 36 initiated on IPT prior to enrolment, 14 were still prescribed to take IPT in the postpartum period, and all participants (n = 10) who completed the adherence questionnaires were adherent as reported by the IsoScreen test. Among 18 participants initiated on IPT after enrolment, 14 completed the adherence questionnaires: 13 (93%) self-reported as adherent. Trust in healthcare providers was prioritized most highly both in the antepartum (BWS = 7.34, SE = 0.13) and postpartum periods (BWS = 7.21 ± 0.11), and these did not significantly differ (p = 0.46) (Figure 2). Having a long life was similarly prioritized in the antepartum (BWS = 6.77 ± 0.13) and postpartum periods (BWS = 6.86 ± 0.10) (p = 0.56). Compared to the antepartum period, prevention of infant illness was slightly more prioritized in the postpartum period (p = 0.05) as well as difficulty in taking pills daily (p < 0.01) and lack of time to make regular clinic visits (p = 0.01). Fear of unintended disclosure of HIV status was least prioritized in both antepartum and postpartum periods (BWS = 2.73 ± 0.14 vs. 2.45 ± 0.18, p = 0.19).

### 3.3 Aggregate BWS scores in the antepartum and postpartum periods

Trust in healthcare providers was prioritized most highly in the postpartum period (BWS = 72.1, SE = 2.6), followed by having a long life (BWS = 68.6 ± 2.5). This did not differ significantly from the antepartum period (Table 3). Prevention of infant illness had significantly higher scores in the postpartum period (BWS = 65.4 ± 2.4) than in the antepartum period (BWS = 61.1 ± 2.2) (p < 0.01). Travel costs and side effects for infants were less prioritized in the postpartum period.

### 3.4 Individual BWS scores in the antepartum and postpartum periods

When individual BWS scores were compared in the antepartum versus postpartum periods, we observed similar patterns of prioritization (Table 4). Trust in healthcare providers for infants’ health was prioritized most highly both in the antepartum (BWS = 7.34, SE = 0.13) and postpartum periods (BWS = 7.21 ± 0.11), and these did not significantly differ (p = 0.46) (Figure 2). Having a long life was similarly prioritized in the antepartum (BWS = 6.77 ± 0.13) and postpartum periods (BWS = 6.86 ± 0.10) (p = 0.56). Compared to the antepartum period, prevention of infant illness was slightly more prioritized in the postpartum period (p = 0.05) as well as difficulty in taking pills daily (p < 0.01) and lack of time to make regular clinic visits (p = 0.01). Fear of unintended disclosure of HIV status was least prioritized in both antepartum and postpartum periods (BWS = 2.73 ± 0.14 vs. 2.45 ± 0.18, p = 0.19).

### 3.5 Association between changes in individual BWS scores and other factors

Several factors were examined for the association with changes in the individual BWS scores in the antepartum versus postpartum periods using multiple linear regressions. IPT initiation at enrolment was associated with significantly higher individual BWS scores for prevention of infant illness (β = 0.99 ± 0.34, p = 0.01) after adjusting for perceived risk of TB in next year. IPT initiation was also associated with the decrease in the BWS scores for side effects for infants (β = −1.19 ± 0.35, p < 0.01). Being adherent to ART was significantly associated with higher BWS scores for living a long life (β = 1.42 ± 0.65, p = 0.03) after adjusting for IPT initiation.

### 4 DISCUSSION

Pregnant women newly diagnosed with HIV are faced with the decision to commit to lifelong ART, and this decision is...
overwhelmingly base on the health of their infants. Our study findings show that pregnant women with a recent HIV diagnosis who opt for receiving lifelong ART prioritized their trust in healthcare providers and prevention of infant illness most highly and these preferences persisted after delivery. Women also continued to highly prioritize having a long life and the benefit of medication for their own health compared to other structural barriers. However, the perceived difficulty in adherence and lack of time to attend regular clinic visits were more significant in the postpartum period. These reflect the complicated challenges mothers face after delivery and provide important insights to design and deliver effective interventions to increase uptake of ART and IPT.

The fact that trust in healthcare providers was most highly prioritized indicates how much positive influence providers can have on maternal perception about preventive therapy and engagement in clinical care, similar to findings from other studies [44,42]. Over 90% of our study participants reported receiving help from clinical staff to remember to take their medications, which is reassuring. A recent study among HIV-positive women in Ethiopia and Mozambique has shown that respectful care by providers was the most important determinant for seeking continued care after delivery [42]. We found that mothers also continued to highly prioritize medication benefits for their own health in the postpartum period, almost two times higher than they did for structural barriers. Furthermore, knowledge about the purpose of different medications and adherence to ART were significantly associated with the higher BWS score for living a long life in the postpartum period.

Earlier studies documented that HIV-positive women were less likely to be motivated to seek care in the postpartum period once they had protected their infants from HIV transmision, largely due to the demands of everyday life coupled with a lack of understanding of the benefits of therapy for their own health [10,12,43,44]. Other studies have shown that receiving sufficient information about ART or IPT was associated with better adherence and retention in care among HIV-positive postpartum women [15,41] as well as among HIV-positive patients in general [45-47]. A recent study among HIV-positive pregnant women in South Africa showed that health education or counselling in clinics was perceived as more useful for linkage to and retention in care compared to financial incentives or home visits, as similarly shown among adults newly diagnosed with HIV in Mozambique [48,49]. Our study findings confirm that interventions focusing on building trust with healthcare providers and patient education about medication benefits can be highly effective in gaining patients’ utility and potentially encourage the uptake of adherence to preventive therapy [47].

Almost half of participants received no such support despite the perception that family was an important source of support to remain in care in our study setting [23]. About 20% were somewhat or very dissatisfied with the treatment support they received from friends and family and this corresponds to our finding that support from friends and family was only moderately ranked in both antepartum and postpartum periods. Having a good support system is vital for retention in care and adherence to ART and IPT among HIV-positive women [15,30,50]. Interventions to involve partners such as accompanying women to clinics or participating in couples counselling have been reported to increase ART adherence [51,52]. More studies are needed to effectively inform and engage family members and partners to support HIV-positive pregnant and postpartum women.

It may seem contradictory that the burden of transportation costs, lack of time and the stigma surrounding taking daily medication were least prioritized in this study, compared to other studies where these were identified as major barriers for uptake of ART and IPT [31,46,53]. At least three considerations may factor into this counterintuitive result. One, half of the participants in our study walked to their clinic visits; thus, the cost of transportation was often low or nonexistent. Two, recommended clinic visits for pregnant women are aligned with monthly ART pick-up in South Africa, such that any additional transport cost, inconvenience, and stigma related to

| Statement                                                   | Antepartum | Postpartum | Difference | p-value* |
|--------------------------------------------------------------|------------|------------|------------|----------|
| I trust that doctors and nurses know what is best for infant’s health | 7.34 0.13  | 7.21 0.11  | 0.12 0.17  | 0.46     |
| I can live as long as someone without HIV if I take care of myself | 6.77 0.13  | 6.86 0.10  | 0.09 0.16  | 0.56     |
| Medications I take prevent my infant to get infected or become sick | 6.11 0.12  | 6.54 0.09  | 0.43 0.15  | 0.01     |
| Medications to prevent disease help me feel stronger         | 6.09 0.10  | 5.83 0.07  | 0.26 0.13  | 0.05     |
| I know the purpose of each different medication I take       | 6.08 0.11  | 6.35 0.10  | 0.27 0.14  | 0.06     |
| I have trouble taking medication on a daily basis            | 4.43 0.10  | 5.03 0.11  | 0.59 0.14  | <0.01    |
| Friends and families help me to take medications             | 4.17 0.17  | 3.89 0.17  | 0.27 0.23  | 0.23     |
| Getting to the clinic costs me too much money.               | 3.90 0.11  | 3.52 0.09  | 0.38 0.14  | 0.01     |
| I am too busy to come to regular clinic visits               | 4.01 0.12  | 4.45 0.14  | 0.44 0.17  | 0.01     |
| I worry that if I take pills it can cause side effects on my infant | 3.36 0.12  | 2.84 0.10  | 0.52 0.16  | <0.01    |
| I worry that taking pills every day tells other people that I have HIV | 2.73 0.14  | 2.45 0.18  | 0.28 0.21  | 0.19     |

*p-values were calculated from Wald tests comparing mean BWS scores by timing of visits.
preventive therapy may have been small. Three, women may not have been concerned with pill burden because nearly all (98%) of our study population were receiving their antiretroviral therapy as one pill of fixed-dose combination tablets [12,54]. As most of our participants had already disclosed their HIV status to their partners, any concern about unintended disclosures was moderated. The lack of time to regularly attend clinic visits, however, was more prioritized in the postpartum period and more participants reported that they had trouble taking medication on a daily basis at this stage. These problems potentially reflect the life-changing impact of having and caring for a newborn baby and suggest that improved intervention and additional support for postpartum women are required.

In accord with the findings of other studies and reports, IPT prescription at enrolment was low at around 30%, and adherence to IPT was sub-optimal, especially when measured using urine samples, although our sample size is too small [55]. Compared to those on ART, fewer individuals on IPT indicated that staff had informed them of the purpose or side effects of IPT at their last clinic visits. While overall prioritization of attributes regarding preventive therapy did not differ by receiving IPT or not, those who had initiated IPT during pregnancy were significantly more likely to perceive the benefits of medications on infant’s health in the postpartum period. To increase uptake of IPT and ensure better adherence, efforts to enhance the perception of its benefits for both maternal and infants’ health are warranted.

There are several limitations to this study. Firstly, recruitment and follow-up of participants were logistically difficult. Based on the District Health Information System data in South Africa, we estimate about 40% of all eligible women could not be recruited for this study, despite vigorous efforts to do so [56]. We used three interviewers to rotate through all 14 clinics for recruitment, which limited our capacity to enroll all eligible women presenting at ANC visits. Although we tracked down study participants who missed scheduled study visits, the completion of follow-up visits was sub-optimal and the timing of postpartum visits varied. We cannot ensure whether those lost to follow up may have had different priorities regarding health or structural barriers linked to care. However, the baseline characteristics did not differ between those lost to follow up and retained in care nor by the timing of completed postpartum visits. Secondly, we asked participants to choose between statements with both positive and negative connotations in the same choice task. Our results, therefore, can only infer which statements were perceived as best, and which were perceived as worst. However, we saw that the absolute rankings of preferences remained similar in the postpartum period, supporting the belief that our instrument likely had good face validity. Future efforts could expand on this work by elucidating the degree to which positive statements refer to facilitators of preventive therapy, and negative statements refer to barriers. Thirdly, we could not verify the validity of self-reported adherence for ART against other objective methods. However, we used a short recall period shown to have good association with more objective measures.

5 CONCLUSIONS

We have quantified maternal priorities for preventive therapy among HIV-positive pregnant women in the postpartum versus antepartum periods. Error bars show 95% confidence intervals, and p-values from Wald tests comparing mean BWS scores in the postpartum versus antepartum periods are presented to the right.

Figure 2. Changes in individual best-worst scaling (BWS) scores for 11 statements related to preventive therapies among HIV-positive pregnant women in the postpartum versus antepartum periods. Error bars show 95% confidence intervals, and p-values from Wald tests comparing mean BWS scores in the postpartum versus antepartum periods are presented to the right.
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COMPETING INTERESTS
The authors have no conflicts to declare.

AUTHORS’ CONTRIBUTION
All authors contributed to design the study. H-YK, CFH and NM helped to collect the data. JFPB and H-YK contributed to analyse the data. H-YK wrote the initial draft of the paper. All authors contributed to read and revised the final manuscript.

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REFERENCES
1. World Health Organization. Global Tuberculosis Report. 2017. Geneva, Switzerland; 2017.
2. National Department of Health. The 2015 National Antenatal Sentinel HIV & Syphilis Survey. South Africa.
3. Gupta A, Bhosale R, Kinakar A, Gupta N, Bhuradwaj R, Kagal A, et al. Maternal tuberculosis: a risk factor for mother-to-child transmission of human immunodeficiency virus. J Infect Dis. 2011;203(3):538–63.
4. Mathad JS, Gupta A. Tuberculosis in pregnant and postpartum women: epidemiology, management, and research gaps. Clin Infect Dis. 2012;55(11):1522–49.
5. Gupta A, Nayak U, Ram M, Bhosale R, Patil S, Basavraj A, et al. Postpartum tuberculosis incidence and mortality among HIV-infected women and their infants in Pune, India, 2002-2005. Clin Infect Dis. 2007;45:241–9.
6. Department of Health Republic of South Africa. National consolidated guidelines for the prevention of mother-to-child transmission of HIV (PMTCT) and the management of HIV in children, adolescents and adults. Pretoria, South Africa; 2014.
7. Golub JE, Saraceni V, Cavalcante SC, Pacheco AG, Moulton LH, King BS, et al. The impact of antiretroviral therapy and isoniazid preventive therapy on tuberculosis incidence in HIV-infected patients in Rio de Janeiro, Brazil. AIDS. 2007;21(11):1441–8.
8. Akolo C, Adetifa I, Shepperd S, Volmink J. Treatment of latent tuberculosis infection in HIV infected persons. Cochrane Database Syst Rev. 2010;1:CD000171.
9. UNAIDS. Get on the fast-track: the life-cycle approach to HIV. Switzerland; 2016.
10. Clouse K, Pettifor A, Shearer K, Maskew M, Basset J, Larson B, et al. Loss to follow-up before and after delivery among women testing HIV positive during pregnancy in Johannesburg, South Africa. Trop Med Int Heal. 2013;18(4):451–60.
11. Martinson NA, McLeod KE, Milovanovic M, Msandiwa R, Lebina L. Implementation of isoniazid preventive therapy for HIV-infected adults: overstate- ment of district reports. Int J Tuberc Lung Dis. 2014;18(8):1005.
12. Clouse K, Schwartz S, Van Rie A, Basset J, Yende N, Pettifor A. What they wanted was to give birth; nothing else. J Acquir Immune Defic Syndr. 2014;67 (1):e12–8.
13. Mellins CA, Chu C, Malee K, Allison S, Smith R, Harris L, et al. Adherence to antiretroviral treatment among pregnant and postpartum HIV-infected women. AIDS Care. 2008;20(9):958–66.
14. Phillips T, Thebus E, Bekker L-G, McIntyre J, Abrams EJ, Myer L. Disengagement of HIV-positive pregnant and postpartum women from antiretroviral therapy services: a cohort study. J Int AIDS Soc. 2014;17(1):19242.
15. Hodgson I, Plummer ML, Konopka SN, Colvin CJ, Jonas E, Albertini J, et al. A systematic review of individual and contextual factors affecting ART initiation, adherence, and retention for HIV-infected pregnant and postpartum women. PLoS ONE. 2014;9(11):e111423.
16. Gust DA, Mosimaneletsile B, Mathebula U, Chingapanu B, Gaul Z, Pals SL, et al. Risk factors for non-adherence and loss to follow-up in a three-year clinical trial in Botswana. PLoS ONE. 2011;6(4):e18435.
17. Loggenberg F, Gray D, Gengiah S, Kunepe P, Gengiah TN, Naikoo D, et al. A qualitative study of patient motivation to adhere to combination antiretroviral therapy in South Africa. AIDS Patient Care STDS. 2015;29(5):299–306.
18. Kumarasamy N, Safen SA, Raminani SR, Pickard R, James R, Krishnan AKS, et al. Barriers and facilitators to antiretroviral medication adherence among patients with HIV in Chennai, India: a qualitative study. AIDS Patient Care STDS. 2005;19(8):526–37.
19. Cheung KL, Wijnen BF, Hollin IL, Janssen EM, Bridges JF, Evers SMAA, et al. Using best–worst scaling to investigate preferences in health care. Pharmacoeconomics. 2016;34(12):1195–209.
20. Brown L, Lee T, De Allegri M, Rao K, Bridges JF. Applying stated-preference methods to improve health systems in sub-Saharan Africa: a systematic review. Expert Rev Pharmacoconomics Res. 2017;17(5):441–58.
21. Mühlbacher AC, Kaczynski A, Zweifel P, Johnson FR. Experimental measurement of preferences in health and healthcare using best-worst scaling: an overview. Health Econ Rev. 2016;6:112.
22. Golub J, Lebina L, Qomfu C, Chon S, Cohn S, Masonoke K, et al. Implementation of Quantiferon®: TB Gold In-Tube test for diagnosing latent tuberculosis among newly diagnosed HIV-infected patients in South Africa. In: In: 46th World Conference on Lung Health of the International Union Against Tuberculosis and Lung Disease (The Union). Cape Town, South Africa; 2015. p. Abstract OA-399-05.
23. Tudor C, Kerrigan D, Variea E, Golub J, Motshatheng K, Lebina L, et al. Institutional and structural barriers to TB screening in South Africa: qualitative insights from healthcare providers and patients from the TEKO trial. In: In: 46th World Conference on Lung Health of the International Union Against Tuberculosis and Lung Disease (The Union). Cape Town, South Africa; 2015. p. Abstract EP-133-04.
24. Statistics South Africa. General Household Survey. 2015.
25. Louviere J, Lings I, Islam T, Guderian S, Flynn T. An introduction to the application of (case 1) best-worst scaling in marketing research. Int J Res Mark. 2013;30(3):292–303.
26. Flynn TN. Valuing citizen and patient preferences in health: recent developments in three types of best-worst scaling. Expert Rev Pharmacoeconomics Outcomes Res. 2010;10(3):259–67.
27. Marley AAJ, Louviere JJ. Some probabilistic models of best, worst, and best–worst choices. J Math Psychol. 2005;49(6):464–80.
28. Janssen EM, Segal JB, Bridges JF. A framework for instrument development of a choice experiment: an application to type 2 diabetes. Patient. 2016;9(5):465–79.
29. Janssen EM, Marshall DA, Hauber AB, Bridges JF. Improving the quality of discrete-choice experiments in health: how can we assess validity and reliability? Expert Rev Pharmacoeconomics Outcomes Res. 2017;17(6):531–42.
30. Getahun H, Granich R, Sculier D, Gunneberg C, Blanc L, Nunn P, et al. The impact of antiretroviral therapy and isoniazid preventive therapy on tuberculosis incidence and mortality among HIV-infected women and their infants in Pune, India, 2002-2005. Clin Infect Dis. 2007;45:241–9.
31. Department of Health Republic of South Africa. National consolidated guidelines for the prevention of mother-to-child transmission of HIV (PMTCT) and the management of HIV in children, adolescents and adults. Pretoria, South Africa; 2014.
32. Golub JE, Saraceni V, Cavalcante SC, Pacheco AG, Moulton LH, King BS, et al. The impact of antiretroviral therapy and isoniazid preventive therapy on tuberculosis incidence in HIV-infected patients in Rio de Janeiro, Brazil. AIDS. 2007;21(11):1441–8.
33. Akolo C, Adetifa I, Shepperd S, Volmink J. Treatment of latent tuberculosis infection in HIV infected persons. Cochrane Database Syst Rev. 2010;1:CD000171.
34. UNAIDS. Get on the fast-track: the life-cycle approach to HIV. Switzerland; 2016.
35. Clouse K, Pettifor A, Shearer K, Maskew M, Basset J, Larson B, et al. Loss to follow-up before and after delivery among women testing HIV positive during pregnancy in Johannesburg, South Africa. Trop Med Int Heal. 2013;18(4):451–60.
36. Martinson NA, McLeod KE, Milovanovic M, Msandiwa R, Lebina L. Implementation of isoniazid preventive therapy for HIV-infected adults: overstatement of district reports. Int J Tuberc Lung Dis. 2014;18(8):1005.
37. Clouse K, Schwartz S, Van Rie A, Basset J, Yende N, Pettifor A. What they wanted was to give birth; nothing else. J Acquir Immune Defic Syndr. 2014;67 (1):e12–8.
50. Katirayi L, Namadingo H, Phiri M, Bobrow EA, Berhan AY, et al. HIV-positive pregnant and postpartum women: a qualitative study. Int AIDS Soc. 2016;19(1):1–8.

51. Pelzer K, Ramlagan S. Perceived stigma among patients receiving antiretroviral therapy: a prospective study in KwaZulu-Natal, South Africa. AIDS Care. 2011;23(11):60–8.

52. Kohler PK, Okanda J, Kinuthia J, Mills LA, Ollio G, Odhiambo F, et al. Community-based evaluation of PMTCT uptake in Nyanza Province, Kenya. PLoS ONE. 2014;9(10):e110110.

53. Chakrapani V, Newman PA, Shunmugam M, Kurian AK, Dubrow R. Barriers to free antiretroviral treatment access for female sex workers in Chennai, India. AIDS Patient Care STDS. 2009;23(11):973–80.

54. Ngarina M, Poponeo R, Kilewo C, Biberfeld G, Ekstrom AM. Reasons for poor adherence to antiretroviral therapy postnatally in HIV-infected women treated for their own health: experiences from the Mitha Plus study in Tanzania. BMC Public Health. 2015;13:450.

55. Tian A, Machekano R, Gounder CR, Maama-maïme LB, Ntene-sealiete K, Sahu M, et al. Preventing tuberculosis among HIV-infected pregnant women in Lesotho: the case for rolling out active case finding and isoniazid preventive therapy. J Acquir Immune Defic Syndr. 2014;67(1):e5–11.

56. Health Information Systems Program, District Health Information System [Internet]. Eastern Cape, South Africa: 2015.

SUPPORTING INFORMATION

Additional Supporting Information may be found in the online version of this article:

Figure S1. Flow chart for study participants at six weeks, 14 week and later than 14 weeks post-partum visits.

Table S1. Participants’ characteristics by the timing of postpartum visits included in the main analysis (N = 154)

Table S2. Aggregate BWS scores in the antepartum versus postpartum periods by the timing of postpartum visits (N = 154)

Table S3.1. Individual best–worst scaling scores for 11 statements in the antepartum versus postpartum periods among participants who completed the survey at six weeks postpartum visits and were included in the main analysis (N = 33)

Table S3.2. Individual best–worst scaling scores for 11 statements in the antepartum versus postpartum periods among all participants who completed the survey at 6 weeks postpartum visits (N = 93)

Table S3.3. Individual best–worst scaling scores for 11 statements in the antepartum versus postpartum periods among participants who completed the survey at 14 weeks postpartum visits included in the main analysis (N = 77)

Table S3.4. Individual best–worst scaling scores for 11 statements in the antepartum versus postpartum periods among participants who completed the survey at >14 weeks postpartum visits and were included in the main analysis (N = 44)

Figure S2. Changes in individual best–worst scaling (BWS) scores for 11 statements related to preventive therapies among HIV-positive pregnant women in the postpartum versus antepartum periods.

Figure S3. Full list of 11 questions included in the questionnaire.