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Safer Conception Methods and Counseling: Psychometric Evaluation of New Measures of Attitudes and Beliefs Among HIV Clients and Providers

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Abstract

With data from 400 HIV clients with fertility intentions and 57 HIV providers in Uganda, we evaluated the psychometrics of new client and provider scales measuring constructs related to safer conception methods (SCM) and safer conception counselling (SCC). Several forms of validity (i.e., content, face, and construct validity) were examined using standard methods including exploratory and confirmatory factor analysis. Internal consistency was established using Cronbach's alpha correlation coefficient. The final scales consisted of measures of attitudes towards use of SCM and delivery of SCC, including measures of self-efficacy and motivation to use SCM, and perceived community stigma towards child-bearing. Most client and all provider measures had moderate to high internal consistency (alphas 0.60–0.94), most had convergent validity (associations with other SCM or SCC-related measures), and client measures had divergent validity (poor associations with depression). These findings establish preliminary psychometric properties of these scales and should facilitate future studies of SCM and SCC.

Keywords

HIV; Uganda; Safer conception methods; Safer conception counseling; Psychometric evaluation

Introduction

It is estimated that 20–59 % of persons living with HIV (PLWHIV) in Uganda desire to have children [1–3]. Between October 2012 and September 2013, over 120,000 pregnant Ugandan women attending antenatal care and enrolled in Prevention of Mother to Child Transmission (PMTCT) services were HIV positive [4]. Conception among HIV-affected couples involves risks of HIV transmission not only to the fetus, but to uninfected partners as well. This is of high concern in Uganda where approximately 40 % of cohabiting couples have an HIV negative partner [5], underscoring the need for promoting methods to reduce sexual transmission of HIV during the preconception period.

Current reproductive health services for PLWHIV focus solely on preventing unplanned pregnancies and provision of prophylactic antiretroviral therapy (ART) to prevent mother-to-child transmission among those who become pregnant [6], with little to no support given to safer conception practices among clients who want to have a child. While effective use of ART and corresponding viral suppression greatly diminish the risks of horizontal transmission [7, 8], most low-resource settings do not have the resources to conduct routine viral load testing [9]. Moreover, not all PLWHIV are on ART and not everyone has adequate ART adherence in order to achieve viral suppression [10]—all of which highlight the need to promote the use of safer conception methods (SCM) among PLWHIV to reduce the risk of HIV transmission to uninfected partners during attempts to conceive [11]. Along with effective ART adherence, SCM can play a significant role as part of a combination of safer conception specific and non-specific approaches to reducing horizontal transmission [11, 12].

Inexpensive SCM include timed unprotected intercourse (TUI) that is limited to the female's monthly fertile period, which is the preferred method when the male is HIV positive. TUI can also be used when the female partner is HIV positive, but manual self-insemination (MSI) with partner's sperm is the preferred course of action when the male partner is HIV negative. Both of these methods have been demonstrated to reduce risk of HIV transmission [13, 14], and in fact there is no risk associated with MSI. Other more complicated, costly and technology-dependent SCM, such as sperm washing plus insemination or in vitro fertilization [15], are not yet realistic options for most couples in resource-constrained settings. Aside from ART, other methods for reducing horizontal transmission that are not specific to the context of conception include male circumcision, which can lower the acquisition risk for uninfected men by 50–60 % [16, 17], and pre-exposure antiretroviral prophylaxis (PrEP) for the uninfected partner [18]; however, the efficacy of the latter is not yet established in the context of trying to conceive nor is it easily accessible in low-resource settings such as Uganda.

Despite these options for reducing risk, many PLWHIV who want to have a child do not use SCM [19]. Consistent with an ecological adaptation of the Information, Motivation and Behavioral skills (eIMB) model of health behavior [20], studies have identified several client and provider-level barriers that reflect knowledge, attitudes and behavioral control beliefs related to the use of SCM and provision of safer conception counseling (SCC) [21–23]. Client-level factors include knowledge about TUI and MSI, negative attitudes (e.g.,

perceiving SCM as “unnatural”), self-efficacy (e.g., to negotiate with partners, to identify fertile periods, to limit unprotected sex to only fertile days), perceived partner willingness to use SCM, and motivation to use SCM, as well as personal and perceived social stigma regarding childbearing among PLWHIV [21]. HIV providers can play a key role in whether or not their clients use SCM, as it is likely providers who will need to teach clients about SCM and instill confidence in the value of their use. Unfortunately, research has identified several provider level factors that reduce the likelihood of SCM use including lack of provider-client communication about childbearing desires that encourages clients to seek information and support, low perceived value in providing SCC (e.g., believe preventing new infections is more important; do not believe clients will adhere to condom use), low self-efficacy with regards to providing SCC [21, 24], and judgmental provider attitudes that increase stigmatization of childbearing among PLWHIV [22, 25].

Unfortunately, to our knowledge, there are no reliable and validated quantitative measures of these clients and provider constructs in the published literature—as studies to date on client and provider attitudes and beliefs regarding SCM and SCC have been almost entirely qualitative. Establishing valid measures of these constructs is critical to advancing the field's understanding of these constructs, their influence on client and provider behavior, and the identification of targets for intervention development to improve adoption of safer conception practices.

To address this gap, we developed client and provider measures of these constructs for use in a quantitative, longitudinal examination of knowledge, attitudes and practices related to SCM and SCC among a cohort of 400 HIV clients with intentions to conceive, and a cohort of 57 HIV providers. In this paper we report the findings from the psychometric evaluation of these measures using baseline data from these two cohorts.

Methods

Study Setting

This study was conducted at The AIDS Support Organization (TASO) HIV primary care clinics in Kampala and Jinja, Uganda. TASO, a non-governmental organization founded in 1987, provides care and support for HIV/AIDS infected and affected people in Uganda. The Kampala site is located next to the Mulago National Referral Hospital and has over 6700 active clients. The Jinja site is located within the Jinja Regional Referral Hospital campus and provides HIV care to over 8000 clients. In addition to providing HIV treatment and counselling services, TASO has family planning and contraception services at its clinics, but has not integrated the provision of safer conception services.

Participants

Participants were recruited between May and October of 2013. Clients from the two clinics were eligible for the study if they were (1) at least 18 years old, (2) married or in a committed heterosexual relationship, and (3) had intentions to have a child with their partner within the next 24 months. Clients in seroconcordant or serodiscordant relationships were eligible to participate; while risks of conception and having condomless sex are greatest in

serodiscordant couples due to the risk of horizontal transmission, concordant couples are at risk for superinfection (i.e., acquiring drug resistant strains of HIV from their partner), and all couples risk acquiring sexually transmitted diseases. In Uganda, HIV care providers emphasize the need to use condoms even with seroconcordant partners to protect against superinfection, and concerns about these risks were raised in relationship to conception in our qualitative research with this population [21]. In order to ensure participants were independent of each other, only one member of a couple was allowed to take part in the study. Recruitment of clients took place primarily during the triage phase of registering their attendance at clinic visits. A brief screening was conducted with adult clients by the triage personnel. Those who were likely to be eligible were referred to the research coordinator for a more thorough screening. At each site, all medical or clinical officers and a randomly selected sample of nurses and counselors were approached by the study coordinator and asked to participate in the study as well.

Procedures

Consent procedures were implemented with confirmed eligible client and provider participants, and after providing written informed consent, trained and experienced Ugandan interviewers administered the baseline survey. Clients and providers were offered the choice of English or Luganda versions of the surveys, with all clients preferring the Luganda version and nearly all providers choosing English. It took an average of 30 min to complete the survey. Although only baseline data were used for the analysis reported in this paper, follow-up surveys were scheduled at 6-month intervals for 24 months or until the client (or their partner) become pregnant in which case their participation would end after a post-delivery survey was completed. Clients received 15,000 Ush (\$6 USD) after completing each survey, while providers received 20,000 Ush (\$8 USD). Client participants were encouraged to consult with their medical providers if they had any questions about the SCM or other inquiries related to their fertility intentions and/or health care. The study protocol was reviewed and approved by Institutional Review Boards at Makerere University School of Biomedical Sciences and RAND Corporation, as well as the Uganda National Council for Science and Technology.

Item Development

Guided by the eIMB model of health behavior, we explored knowledge, attitudes, and control beliefs of clients and providers through focus groups and semi-structured interviews with 48 clients and 33 providers [21, 24]. Drawing on our findings, the published literature and existing measures of similar constructs used in other contexts, we followed standard scale development guidelines [26] to draft either original or adapted items to assess the constructs that emerged as listed below. A panel of six senior investigators on the project, each with expertise in the area of fertility in HIV, and two of whom are native Ugandans, participated in an iterative survey development process of review, revision, and piloting that resulted in the final versions used in this study. Items were developed in English and then submitted to appropriate cultural and language translation methods [27] including forward and backward translation, piloting, cognitive debriefing, and revision. The scales are described below and the wording of each individual item is listed in Tables 2 and 5.

Client Measures

Self-efficacy for Using Safer Conception Methods: We adapted items from a self-efficacy measure developed by Johnson et al. [28] to create seven items (A1–A7) to assess clients' level of confidence to negotiate and utilize SCC and SCM with their provider and partner, respectively. Respondents rated their level of confidence on a scale of 1 'can't do at all' to 10 'certain I can do'.

Motivation to Use Safer Conception Methods: We adapted items from the Brief Motivation Scale [29] to create six items (B1–B6) to assess level of commitment and readiness to engage in SCC and use SCM. Respondents rated their level of agreement with each statement on a scale of 1 'strongly agree' to 10 'strongly disagree'.

Perceived Partner's Willingness to Use Safer Conception Methods: We developed five items (C1–C5) to assess the respondents' perception of their partner's willingness to attend SCC and use SCM. Respondents were asked to rate their confidence from 1 'no confidence' to 5 'high confidence'.

Internalized Stigma Towards Childbearing Among PLWHIV: We developed four items (D1–D4) to measure the respondent's internalized childbearing stigma and personal attitudes about childbearing among PLWHIV. Respondents were asked to indicate their level of agreement with statements about feelings of shame, guilt, and HIV affected couples' ability to be good parents. Response options ranged from 1 'disagree strongly' to 5 'agree strongly'.

Perceived Community Stigma Towards Childbearing Among PLWHIV: We developed three items (E1–E3) to measure the respondent's perception of community stigma surrounding pregnancy and childbearing in HIV-affected couples. Each item is a statement and assesses respondents' perceptions of communities' opinions on childbearing among PLWHIV. Response options ranged from 1 'disagree strongly' to 5 'agree strongly'.

Provider Measures

Provider Stigma of Childbearing Among PLWHIV: We constructed five items (F1–F5) to gauge providers' views about PLWHIV having children, available options to lower risk during conception, and their role in providing SCC. Response options ranged from 1 'strongly disagree' to 4 'strongly agree.'

Interest in Providing Safer Conception Counseling: We constructed nine items (G1–G9) to measure providers' interest in providing specific aspects of SCC. Items assessed interest in providing SCC to different types of couples (e.g., female HIV-infected client with uninfected partner; male HIV-infected client with uninfected partner; client with no committed partner; clients who have not disclosed to their partner; clients/couples who already have children), and counseling clients on the use of specific SCM (e.g., TUI; MSI). Providers rated their level of interest on a scale of 1 'low' to 10 'high'.

Perceived Value of Providing Safer Conception Counseling: We developed six items (H1–H6) to assess providers' views of the value of providing SCC to their HIV clients. Items asked providers to rate their level of agreement with statements that the provision of SCC is 'a waste of time' because of perceived client nonadherence to specific safer conception instructions, and limited available resources for offering SCC. Response options ranged from 1 'strongly disagree' to 4 'strongly agree'. All items were reversed scored.

Self-efficacy for Providing Safer Conception Counseling: We adapted a self-efficacy measure developed by Johnson et al. [28] to create eight items (I1–I8) that assess a provider's level of confidence to discuss childbearing and provide SCC to different types of clients/couples (e.g., serodiscordant couples; clients with no committed partners; clients who have not disclosed to their partners). Respondents rated their level of confidence on a scale of 1 'low' to 10 'high'.

For all scale measures we computed the mean item score. Higher scores represent a greater experience of the target construct.

Data Analysis

Validity—Content validity was established prior to data collection during the iterative item development process conducted with six experts. Face validity was explored during cognitive debriefing conducted during pilot testing with volunteers who met study eligibility criteria. Construct validity was evaluated through exploring divergent validity for the client scales, but could not be evaluated in the provider scales due to the lack of a validated comparison measure. Divergent (or discriminant) validity examines the degree to which measures of constructs that theoretically should not be related, do in fact evidence little shared variance. Pearson's correlation coefficients with a measure of depression (9-item Patient Health Questionnaire; PHQ-9) [31] were calculated. Consistent with standard psychometric evaluation procedures [30] the pattern of shared variance was inspected with low correlation coefficients considered evidence of divergent validity (<0.30). Neither the client nor provider batteries included additional validated measures to formally examine convergent validity of the newly developed scales. Nevertheless, in an attempt to further explore construct validity, we made a priori predictions of how the new scales would interact based on our eIMB informed conceptual model and conducted exploratory analyses using Pearson's correlations.

Factor Analysis—We used factor analysis methods to examine the number of latent constructs measured by the client and provider items and to match items to factors (scales). The analysis began with all 25-items and 28-items from the client and provider surveys, respectively. Missing data for the client and provider scale items were less than 1 %.

Client Data Analysis—For cross-validation purposes, we randomly split the client data ($N = 400$) into a training set ($N = 200$) and test set ($N = 200$). We fit several exploratory factor analysis (EFA) models to the training data, varying the number of factors and the items included in each model. Items were allowed to load freely on factors, regardless of the scale to which they were intended to belong. Models were compared by examining scree

plots and proportion of variance accounted for, individual residual correlations and their root mean square, loading patterns (after varimax rotation), and communalities. Candidate models were compared further based on their fit in confirmatory factor analyses (CFAs), also fit to the training data. Due to the non-normality of the data, EFA models were estimated using ordinary (unweighted) least squares in the FACTOR Procedure in SAS 9.4, and CFA models were estimated using maximum likelihood with robust standard errors in the lavaan package in R [32]. We dropped several items that did not load strongly on any factor, loaded on more than one factor, or yielded inadmissible CFA estimates (e.g., zero unique variance). After selecting two models with acceptable fit to the client training data, CFA models were fit to the client test data for validation. For all the remaining analyses, the full sample ($N = 400$) was used.

Provider Data Analysis—Given the small sample of providers ($N = 57$), the provider data was not split into training and test subsamples, and only exploratory (not confirmatory) factor analysis was conducted. As with the client data, we carried out the factor analysis using ordinary least squares estimation in SAS 9.4. The number of final factors was determined by examining scree plots and considering the number of factors with eigenvalues greater than 1. Scale composition was determined by examining the pattern of factor loadings (after varimax rotation). Items that loaded on more than one factor were generally retained on the factor where they evidenced the highest loading. However, conceptual fit with the other items loading on a factor was also considered in making these determinations. Subscale names were developed by examining the themes that best described the items comprising the factor.

Internal Consistency—The internal consistency of all scales was examined with Cronbach's alpha; alphas in the range of 0.90 and above, 0.70–0.89, 0.50–0.69, and <0.50 have been demonstrated to represent excellent, high, moderate, and low levels of internal consistency, respectively [33].

Results

Participant Characteristics

The client sample included a total of 400 participants (207 from Kampala and 193 from Jinja). With the exception of five who refused, those who were screened and were eligible decided to participate. The provider sample included 57 providers (29 from Kampala and 28 from Jinja), including 10 medical/clinical officers, 13 nurses, and 34 counselors, and no refusals. The characteristics of both samples are listed in Table 1, including demographics, client health characteristics and reproductive history, and provider features. All providers agreed to participate.

Client Measures

The iterative factor analysis process yielded two models—one with three factors and another with four factors—with acceptable fit to the training data, which were then fit to the test data for cross-validation. The final loadings (> 0.3) and scale compositions for the four-factor model are presented in Table 2. Satorra–Bentler chi square values and fit statistics for the

two models can be found in Table 3. Although the chi square values are reported, they were not considered in determining model fit, as large samples can result in significant chi square p values simply due to sample size; thus, we report alternative goodness-of-fit indices [34]. The comparative fit index (CFI) can range from 0.0 to 1.0, with values closer to 1.0 indicating a better model fit, while values less than 0.08 for the standardized root mean square residual (SRMR) and the root mean square residual (RMSEA) indicate a good model fit. These indicators supported the four-factor model as the best fit to the client data (CFI = 0.969, SRMR = 0.047, and RMSEA = 0.052).

The four-factor model for the client items revealed a large primary factor, Eigenvalue = 3.38 (PCS), explaining 44 % of the common variance. The next three factors had Eigenvalues of 2.38 (M), 1.27 (PPW), and 0.74 ($SE-SCM$) and explained an additional 30, 16 and 9 % of the variance, respectively.

Names for the four factors were selected to be descriptive of the questions' content and are as follows: Factor 1: *Perceived community stigma towards childbearing among PLWHIV* (items E1–E3); Factor 2: *Motivation to use SCM* (items B1, B3, B6); Factor 3: *Perceived partner's willingness to use SCM* (items C1–C3); and Factor 4: *Self-efficacy for using SCM* (items A3–A5).

Mean scores and standard deviations for each of the four final client measures are shown in Table 4, reported for the full sample as well as separately by gender, educational attainment, and whether or not the participant was on antiretroviral drugs (ARVs). The results suggest that men have a higher self-efficacy for using SCM and perceived partner's willingness to use SCM. In addition, those currently taking ARVs seem to have a higher self-efficacy for using SCM.

Internal Consistency—Cronbach's α for the 3-item *Self-efficacy for using SCM* measure was 0.50, demonstrating moderate internal consistency. The 3-item scales for *Motivation to use SCM* and *Perceived partner's willingness to use SCM* demonstrated high internal consistency with Cronbach's alphas of 0.88 and 0.85, respectively. The Cronbach's alpha for the 3-item scale for *Perceived community stigma* was 0.94, indicating excellent internal consistency.

Validity

Divergent Validity: All of the measures demonstrated evidence of divergent validity with low correlation coefficients indicating little shared variance with the depression measures. The *Motivation to use SCM* and *Perceived partner's willingness to use SCM* scales did not evidence any shared variance with the depression measure ($r = -0.055$, $p = 0.270$; $r = -0.076$, $p = 0.132$ respectively). The self-efficacy and perceived community stigma scales were correlated with depression ($r = -0.186$, $p = 0.002$; $r = 0.102$, $p = 0.040$), but the magnitude of the correlation coefficients indicated very little shared variance.

Exploratory Analyses: Unless noted, all correlation coefficients were in the expected direction and indicated shared variance. As expected, the *Motivation to use SCM* scale was positively correlated with *Self-efficacy for using SCM* ($r = 0.244$, $p < 0.0001$), and

Perceived partner's willingness to use SCM ($r = 0.213, p < 0.0001$), while the *Self-efficacy for using SCM measure* was associated with the scale for *Perceived partner's willingness to use SCM* ($r = 0.371, p < 0.0001$). Unexpectedly, the *Motivation to use SCM scale* and *Perceived community stigma towards childbearing among PLWHIV* scales did not evidence shared variance ($r = 0.012, p = 0.806$). In addition, *Perceived community stigma towards childbearing among PLWHIV* was associated with neither the *Self-efficacy to use SCM* ($r = -0.028, p = 0.572$) nor *Perceived partner's willingness to use SCM* ($r = -0.092, p = 0.066$) scales.

Provider Measures

Results of the exploratory factor analysis and final loading for the 28 provider items are displayed in Table 5. A large primary factor (Eigenvalue = 5.76) explaining 27.9 % of the common variance (*SE-SCC*) was revealed. The next 5 factors had Eigenvalues of 3.78 (*I-RF*), 2.39 (*I-SCM*), 2.02 (*PS*), 1.52 (*PV*), and 1.27 (*I-SC*), and explained a cumulative 53.2 % of the common variance. All other Eigenvalues were less than 1 and explained only small amounts of additional variance. This resulted in a six-factor solution that explained 81 % of the common variance. The final six provider scales are: Factor 1: *Self-efficacy for providing SCC* (items I1–I8). Although three items from this scale (I6, I7 and I8) had higher loadings on other factors, we chose to include them in the self-efficacy scale based on face validity. Factor 2: *Interest in providing SCC in the context of relational factors* (items G6–G9); Factor 3: *Interest in providing SCC regarding specific SCM* (items G3–G5, and H4–H6); Factor 4: *Provider stigma of childbearing among PLWHIV* (items F1–F5); Factor 5: *Perceived value of providing SCC* (items H1–H3); and Factor 6: *Interest in providing SCC to serodiscordant couples* (items G1 and G2).

Internal Consistency—Cronbach's alpha for the 5-item *Provider stigma of childbearing among PLWHIV* scale was 0.61 indicating moderate internal consistency. Cronbach's alpha for the 2-item scale for *Interest in providing SCC to serodiscordant couples* was 0.91 (excellent internal consistency); $\alpha = 0.68$ for the 6-item *Interest in providing SCC regarding specific SCM* scale (moderate); and 0.83 for the 4-item *Interest in providing SCC in the context of relational factors scale* (high). The three interest scales help to distinguish between different facets of interest in providing SCC, but the use of the total mean score likely also has utility given the high internal reliability of the 12-item scale ($\alpha = 0.80$). Both the 3-item scale for *Perceived value of providing SCC* ($\alpha = 0.73$) and the 8-item scale for *Self-efficacy for providing SCC* ($\alpha = 0.87$) evidenced high internal consistency.

Exploratory Analyses—Unless noted, all correlation coefficients were in the expected direction and indicated shared variance. As predicted, the *Self-efficacy for providing SCC* scale was negatively associated and shared variance with the *Provider stigma of childbearing among PLWHIV* scale ($r = -0.284, p = 0.032$), and positively correlated and shared variance with the *Interest in providing SCC to serodiscordant couples* measure (*I-SC* $r = 0.319, p = 0.016$). While not statistically significant, the *Self-efficacy* scale also evidenced non-trivial shared variance with the *Interest in providing SCC in the context of relational factors* (*I-RF*: $r = 0.237, p = 0.076$). However, contrary to our prediction, the *Self-efficacy scale* was not associated with the *Interest in providing SCC regarding specific SCM* (*I-SCM*: $r = 0.088, p$

= 0.516). Consistent with our prediction, the three measures of *Interest in providing SCC* (*I-SC*, *I-SCM*, and *I-RF*) were positively associated and shared variance with each other (*I-SC* & *I-SCM*: $r = 0.32$, $p = 0.015$; *I-SC* & *I-RF*: $r = 0.392$, $p = 0.003$; *I-SCM* & *I-RF*: $r = 0.372$, $p = 0.004$).

Discussion

This article describes the psychometric assessment of original and adapted items used to evaluate Ugandan clients' and providers' attitudes (including perceived and internalized stigma), motivation, and beliefs (including self-efficacy) related to SCM and SCC. We examined psychometric properties of five client measures (*Self-efficacy for using SCM*, *Motivation to use SCM*, *Perceived partner's willingness to use SCM*, *Internalized stigma towards childbearing among PLWHIV*, and *Perceived community stigma towards childbearing among PLWHIV*) and four provider scales (*Provider stigma of childbearing among PLWHIV*, *Interest in providing SCC*, *Perceived value of providing SCC*, and *Self-efficacy for providing SCC*). We present preliminary evidence that supports both the internal consistency as well as the preliminary validity of the final measures.

The client measures resulted in four final scales: *Perceived community stigma towards childbearing among PLWHIV*, *Motivation to use SCM*, *Perceived partner's willingness to use SCM*, and *Self-efficacy for using SCM*. These scales are consistent with several of the major themes that have been repeatedly found in prior qualitative studies [21, 24]. While not the most robust measure of construct validity, the observed intercorrelations among the newly developed scales in the exploratory analyses make sense and are consistent with our eIMB informed conceptual model. Nevertheless, not all client items proved to be useful, with 13 out of 25 being dropped due to poor fit during the exploratory and/or confirmatory procedures. For instance, the internalized stigma items (D1 and D2), both of which had limited variability (>80 % of clients choosing the same response), yielded inadmissible CFA estimates (zero unique variance). It is possible that these or other dropped items were poorly worded, failed to communicate complicated concepts in language that was matched to clients' health literacy levels, or that meaningful content was lost in the translation process to the local language. However, we presented all of the items in this paper in the hopes that they might be useful for descriptive purposes in future studies, and what we hope will be additional measurement development efforts.

The final scales had moderate to high internal consistency. There was also preliminary evidence of construct validity. Given the focus of our study, the survey instrument contained very few measures that were not conceptually related to SCM or SCC, which made it difficult to identify appropriate measures other than depression for evaluating divergent validity and none for convergent validity. Future research will be able to further examine the validity of these measures.

The provider measures resulted in six scales: *Self-efficacy for providing SCC*, three measures of *Interest in providing SCC* (to serodiscordant couples; regarding specific SCM; and in the context of relational factors), *Provider stigma of childbearing among PLWHIV*, and *Perceived value of providing SCC*. The provider measures had moderate to high internal

consistency and intercorrelations that suggest construct validity that make sense and are consistent with our eIMB informed contextual model. While the literature on provider barriers for providing SCC is still emerging, the content represented in these scales is also consistent with the findings of earlier studies [24, 25].

Although this study provides valuable information and is to our knowledge the first to attempt to provide reliability and preliminary validity data on measures for assessing attitudes and beliefs regarding SCM and SCC, it is not without its limitations. The same sample of providers was used to establish the factor structure, reliability and construct validity, and the small sample size prevented us from performing a confirmatory analysis. Additional studies are therefore needed to further evaluate the provider scales' reliability and validity in larger independent samples. Furthermore, with SCC not being readily available in the study setting, the study population was relatively unfamiliar with SCM and the goals of SCC, which makes it challenging to examine the constructs measured by the client scales, and further research will need to examine how the scales perform psychometrically when SCC becomes more accessible and PLWHIV in Uganda become more familiar with and start to use SCM more often. Nonetheless, the current perspective of clients towards SCM is valuable for informing the development of effective SCC programs to promote SCM use. Also, once SCC becomes more available and client use of SCM increased, studies will be able to assess whether these measures can demonstrate change in these attitudes and beliefs that correspond to changes in SCM and SCC behaviors.

In closing, these findings provide initial evidence of the reliability and validity of new measures of client and provider attitudes and beliefs related to SCM and SCC. While further research with these measures are needed to replicate our findings and perhaps refine the composition of the scales, it is our hope that these measures will serve to facilitate the emergence of quantitative research related to safer conception knowledge, attitudes and practices among HIV clients and providers. To date, research in this field has been almost solely qualitative in nature, but quantitative studies including intervention evaluations need to be forthcoming to advance the provision of quality safer conception services for PLWHIV. The presence of validated measures with strong psychometric properties is central to this effort. While the primary outcomes of most studies in this field will focus on the behavioral use of SCM and provision of quality SCC, these measures of attitudes and beliefs related to SCM and SCC can serve to improve our understanding of the mechanisms that influence these behavioral outcomes and thus serve to inform the design of safer conception interventions.

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Table 1
Characteristics of the client ($N = 400$) and provider ($N = 57$) samples

Variable	Mean/frequency (SD or %)	
	Client	Provider
<i>Demographics</i>		
Female	299 (74.8 %)	33 (57.9 %)
Mean age (years)	33.8 (7.5)	35 (5.4)
At least some secondary education	179 (47.2 %)	
<i>Client health characteristics</i>		
Mean years since HIV diagnosis	5.5 (4.7)	
On HIV antiretroviral therapy	242 (60.7 %)	
<i>Client reproductive health history</i>		
Have had children	354 (88.5 %)	
Mean number of children	3.2 (2.3)	
Have had a child with current partner	195 (48.8 %)	
Had pregnancy since knowing HIV status	110 (38.7 %)	
<i>Client relationship status</i>		
Married	175 (44 %)	
In a committed relationship	225 (56.3 %)	
In a polygamous relationship	121 (30.3 %)	
<i>Status of partner with whom trying to conceive</i>		
Partner is HIV positive	156 (39 %)	
Partner is HIV negative	122 (30.5 %)	
Partner HIV status is not known	122 (30.5 %)	
Partner knows respondent's HIV status	317 (79.3 %)	
<i>Provider characteristics</i>		
Medical/clinical officer		10 (17.5 %)
Nurses		13 (22.8 %)
Counselors		34 (59.7 %)
Years of experience working with HIV+ patients		7.5 (3.9)

Table 2
Complete items, factor loadings, and final scales for the 12-items measuring client beliefs related to safer conception methods

Items	Factor loadings			
	<i>PCS</i>	<i>M</i>	<i>PPW</i>	<i>SE-SCM</i>
A1 I can discuss safer conception options with my partner				
A2 I can ask a provider for help in planning a pregnancy				
A3 I can follow advice about postponing attempts to conceive until any sexually transmitted infections are treated (<i>SE-SCM</i>)				0.479
A4 I can follow advice about limiting unprotected sex to only 2–3 specific days per month (<i>SE-SCM</i>)				0.558
A5 I/my partner can learn how to track the most fertile days in a woman's cycle (<i>SE-SCM</i>)				0.719
A6 My partner will ejaculate into a container or a condom during sex and then inject the semen into my vagina if necessary to reduce the risk of transmission to my partner				
A7 My partner will take HIV medications every day during the months we try to conceive if it reduces his/her risk of getting infected with HIV				
B1 It is important to me to work with a health care provider to plan a pregnancy (<i>M</i>)		0.734		
B2 I want to discuss conception options with my partner before we try to have a child				
B3 I'm confident a health care provider can be helpful to me and my partner in trying to have a child safely (<i>M</i>)		0.722		
B4 I feel it is important to include my partner in this discussion about safer childbearing				
B5 I am willing to go about conception in a non-traditional manner if it will reduce the risk of transmission to an uninfected partner				
B6 I am ready to temporarily delay getting pregnant if it helps me to have a child more safely *(<i>M</i>)		0.898		
C1 Your partner would attend a doctor visit with you to learn about safer ways to conceive a child (<i>PPW</i>)			0.827	
C2 Your partner would be open to trying methods to reduce risk during conception (<i>PPW</i>)			0.867	
C3 Your partner would be willing to wait to have unprotected or “live” sex until your/both of your CD4 counts are at a high level (<i>PPW</i>)			0.610	
C4 Your partner would cooperate with advice to only have unprotected sex during 2–3 peak fertility days per month				
C5 Your partner would cooperate with advice to have sex with a condom so that his semen could be contained and then injected into your vagina in order to reduce the risk associated with trying to conceive a child				
D1 I feel ashamed for wanting to have a child				
D2 I feel selfish for wanting to have a child				
D3 HIV+ persons who want to have a child should feel embarrassed to tell their HIV provider				
D4 People living with HIV can be good parents				
E1 People in the community look down on HIV+ individuals who want to have a child (<i>PCS</i>)	0.980			
E2 An HIV? man who gets his partner pregnant is looked down upon (<i>PCS</i>)	0.900			
E3 An HIV? woman who gets pregnant is looked down upon (<i>PCS</i>)	0.864			

PCS perceived community stigma towards childbearing among PLWHIV, *M* motivation to use SCM, *PPW* perceived partner's willingness to use SCM, *SE-SCM* self-efficacy for using SCM

* Respondents were instructed to consider the pregnancy, whether it was themselves or their partner who would be pregnant

Table 3
Summary of the fit indices for the final three- and four-factor models of client beliefs

Model	Satorra-Bentler χ^2	df	χ^2/df	CFI	SRMR	RMSEA
3-Factor	102.864 ^{**}	51	2.017	0.933	0.046	0.077
4-Factor	70.085 [*]	48	1.460	0.969	0.047	0.052

CFI comparative fit index, SRMR standardized room mean square residual, RMSEA root mean square error of approximation

^{**} $p < 0.001$;
^{*} $p < 0.05$

Table 4
Means (standard deviations) and *t* test *p* values for the final client scales by key demographic and health characteristics

Scale (possible range)	Full sample (N = 400)	Women (N = 299)	Men (N = 101)	Some secondary education	No secondary education	Currently taking antiretrovirals (ARVs)	Not taking ARVs
<i>PCS</i> (1–5)	4.024 (1.02)	4.079 (1.04)	3.859 (0.97) <i>p</i> = 0.063	4.113 (0.98)	3.984 (1.03) <i>p</i> = 0.216	3.970 (1.06)	4.113 (0.97) <i>p</i> = 0.176
<i>M</i> (1–10)	9.056 (1.58)	9.019 (1.53)	9.165 (1.73) <i>p</i> = 0.420	9.185 (1.41)	8.936 (1.77) <i>p</i> = 0.135	9.127 (1.53)	8.944 (1.67) <i>p</i> = 0.262
<i>PPW</i> (1–5)	3.988 (1.08)	3.747 (1.12)	4.703 (0.45) <i>p</i> < 0.0001	4.009 (1.14)	3.997 (1.02) <i>p</i> = 0.909	4.025 (1.12)	3.939 (1.01) <i>p</i> = 0.438
<i>SE-SCM</i> (1–10)	8.626 (1.42)	8.502 (1.47)	8.987 (1.21) <i>p</i> = 0.003	8.629 (1.42)	8.623 (1.43) <i>p</i> = 0.967	8.786 (1.32)	8.380 (1.55) <i>p</i> = 0.006

p values are for two-sided *t* tests for differences between sexes, educational attainment, and ARV statuses. All means represent the mean item score for the scale

PCS perceived community stigma towards childbearing among PLWHIV, *M* motivation to use SCM, *PPW* perceived partner's willingness to use SCM, *SE-SCM* self-efficacy for using SCM

Table 5
Complete items, factor loadings, and final scales for the 28-items measuring provider beliefs related to safer conception counseling

Items	Factor loadings					
	SE-SCC	I-RF	I-SCM	PS	PV	I-SC
F1 Children born to an HIV+ parent face more challenges than are necessary (<i>PS</i>)				0.371		
F2 HIV+ people often lack all that they need to bring a child into the world (<i>PS</i>)				0.601		
F3 HIV+ people who want to have children are being selfish (<i>PS</i>)				0.608	-0.316	
F4 Helping HIV+ people have children is a distraction from more important issues that we need to address as providers (<i>PS</i>)				0.485		
F5 Ensuring patients are always having safe protected sex is more important than helping HIV+ people to have Children (<i>PS</i>)				0.480		
G1 How interested are you in providing guidance on how to conceive safely to a couple where the woman is HIV+ and the man is not? (<i>I-SC</i>)						0.825
G2 How interested are you in providing guidance on how to conceive safely to a couple where the man is HIV+ and the woman is not? (<i>I-SC</i>)						0.770
G3 How interested are you in providing guidance to mixed status couples about the use of unprotected or “live” sex only during the few days a month when the woman is most fertile? (<i>I-SCM</i>)			0.503		-0.413	
G4 How interested are you in providing guidance to mixed status couples (where the woman is HIV+) about how to collect the man's semen and inject it into the woman's vagina? (<i>I-SCM</i>)			0.491			
G5 If ARVs were approved for such use in Uganda, how interested would you be in providing guidance to uninfected partners of your HIV+ patients about taking ARVs daily during the months they attempt conception via unprotected sex? (<i>I-SCM</i>)			0.598			
G6 How interested are you in providing guidance to an HIV-infected woman who wants to conceive, but does not have a committed partner? (<i>I-RF</i>)	0.900					
G7 How interested are you in providing guidance to an HIV-infected man who wants to conceive, but does not have a committed partner? (<i>I-RF</i>)		0.876				
G8 How interested are you in providing guidance about HIV disclosure to an HIV-infected client who wants to have a child with an HIV-negative partner, to whom they have not disclosed their HIV status? (<i>I-RF</i>)		0.546				0.301
G9 How interested are you in providing guidance to HIV-affected couples who want to conceive if they already have children? (<i>I-RF</i>)		0.516				
H1 Providing guidance on safer conception to a female client is a waste of time as they won't be able to get their man to agree to modify their sexual practices (<i>PV</i>)					0.732	
H2 Providing guidance on safer conception to a female client is a waste of time as their man will demand live sex (<i>PV</i>)					0.799	
H3 Clients who are counseled to have unprotected or “live” sex during a few days a month when the woman is most fertile will not want to resume using condoms afterward (<i>PV</i>)					0.385	
H4 Most clients will not follow the advice we give regarding how to increase the safety of conception (<i>I-SCM</i>)			0.625	0.337		
H5 Most uninfected partners will not take HIV medications daily during the conception period (<i>I-SCM</i>)			0.393	0.395		
H6 It is not a good use of resources to recommend that uninfected partners take HIV medications daily during the conception period (<i>I-SCM</i>)			0.758			
I1 Using a scale of 1 to 10, with 1 = not confident at all and 10 = extremely confident, how confident do you feel in your ability to ask clients about their future childbearing goals? (<i>SE-SCC</i>)	0.629					

Items	Factor loadings					
	<i>SE-SCC</i>	<i>I-RF</i>	<i>I-SCM</i>	<i>PS</i>	<i>PV</i>	<i>I-SC</i>
I2 How confident do you feel in your ability to provide safer conception guidance to a couple in which the woman is HIV-infected and the man is not? (<i>SE-SCC</i>)	0.889					
I3 How confident do you feel in your ability to provide safer conception guidance to a couple in which the man is HIV-infected and the woman is not? (<i>SE-SCC</i>)	0.787					
I4 If ART initiation was not restricted by CD4 count, how confident are you that you could provide guidance for early initiation of ART among HIV+ patients with uninfected partners who want to conceive? (<i>SE-SCC</i>)	0.619			-0.342		
I5 If pre-exposure prophylaxis was readily available in Uganda, how confident are you that you could provide guidance to uninfected partners of your HIV+ patients on taking ARV's daily during the months they attempted conception via unprotected sex? (<i>SE-SCC</i>)	0.470		0.435			
I6 How confident do you feel in your ability to provide guidance to an HIV-infected woman who wants to conceive, but does not have a committed partner? (<i>SE-SCC</i>)	0.611	0.665				
I7 How confident do you feel in your ability to provide guidance to an HIV-infected man who wants to have a child, but does not have a committed partner? (<i>SE-SCC</i>)	0.614	0.648				
I8 How confident do you feel in your ability to provide guidance about HIV disclosure to an HIV-infected client who wants to have a child with an HIV-negative partner, to whom they have not disclosed their HIV status? (<i>SE-SCC</i>)	0.461			-0.477		

SE-SCC self-efficacy for providing *SCC*, *I-RF* interest in providing *SCC* in the context of relational factors, *I-SCM* interest in providing *SCC* regarding specific *SCM*, *PS* provider stigma of childbearing among PLWHIV, *PV* perceived value of providing *SCC*, *I-SC* interest in providing *SCC* to serodiscordant couples