

BMJ Open Cross-sectional study on the prevalence and predictors of pregnancy among women living in HIV discordant relationships in a rural Rakai cohort, Uganda

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ABSTRACT

Objectives This study examines the prevalence of pregnancy in serodiscordant couples and identifies predictors associated with pregnancy in rural Rakai, Uganda.

Study design A population-based cross-sectional study that used data from the Rakai Community Cohort Study (RCCS).

Setting and participants We used data from the RCCS survey round 17 (2015–2016), which included 488 women in serodiscordant relationships. This study was conducted in Rakai district, located in south-western Uganda.

Primary outcomes Pregnancy status.

Statistical analysis Multivariable modified Poisson regression using stepwise selection was used to determine characteristics and behaviours associated with pregnancy status.

Results The prevalence of pregnancy was 12% in women among serodiscordant couples. HIV-negative women in serodiscordant couples had a slightly higher pregnancy prevalence rate (13.6%) compared with HIV-positive women in serodiscordant couples (11%). Factors significantly associated with higher prevalence of pregnancy were; younger age 15–24 years (prevalence risk ratio (PRR)=4.04; 95% CI 1.72 to 9.50), middle age 25–34 years (PRR=2.49; 95% CI 1.05 to 5.89), Christian religion (PRR=2.26; 95% CI 1.41 to 3.63) and inconsistent condom use in the last 12 months (PRR=4.38, 95% CI 1.09 to 17.53). Neither HIV status nor HIV status disclosure was significantly associated with risk of getting pregnant.

Conclusion Nearly 12% of women in serodiscordant relationships were pregnant, highlighting the need for integrated services to prevent unintended pregnancies and reduce conception related risks for those choosing to conceive. Association with younger age and inconsistent condom use suggests a role for early and continued couple-based conception counselling.

INTRODUCTION

As the HIV epidemic intensifies in sub-Saharan Africa, the prevalence of HIV infection among women of childbearing age is increasing.^{1–3} In sub-Saharan Africa, 59% of

Strengths and limitations of this study

- This study was conducted within a large longitudinal cohort that had a high level of retention and quality assurance.
- However, as most data was based on self-reported measures, there could be a potential for recall bias.
- This was a cross-sectional study, which means that causal and temporal relationships are difficult to establish.
- Reporting condom use during the last 12 months may not always accurately characterise a person's overall condom use over a longer period. The frequency of condom use as well as sexual encounters might affect people's ability to accurately remember and report details of sexual encounters.

adults living with HIV are women, the vast majority of whom are of reproductive age.⁴ Uganda has 1.5 million people living with HIV, of whom 57% are women.⁵ Sexual relationships where one partner is HIV positive and the other sexual partner is HIV negative (serodiscordancy) are common in Africa with almost 5%–31% who are married or cohabiting living in these relationships.^{6–9} In Uganda, incidence modelling revealed that 43% of all new HIV infections were adults living in HIV discordant monogamous relationships.¹⁰

The majority of the women in discordant relationships face numerous challenges, including desire and commitment to have children,¹¹ disclosing their HIV status, as well as the effects of pregnancy on their own health.¹² Many women, whether HIV positive or negative, view reproduction as a social and psychological obligation to their partners,¹² which could be a reason why discordant couples continue to have unprotected sex in order to conceive.¹³ Furthermore, traditional gender

roles, interpersonal motivation,¹⁴ societal expectations, partner's influences and HIV stigma are additional factors that might explain why serodiscordant couples practice unprotected sex in order to have children.¹⁵ Such findings have significant implications since the desire for pregnancy among discordant couples can lead to an increase in high-risk sexual behaviour,¹⁶ with an attendant risk of HIV transmission to the uninfected partner.^{17 18}

On the other hand, different options exist for HIV-positive people in discordant relationships to have children including timed intercourse to reduce frequency of intercourse, self-insemination¹⁹ and improved access to ART²⁰ as the rate of transmission of HIV in serodiscordant couples under conditions of excellent adherence, consistent undetectable blood viral load and continued administration of pre-exposure prophylaxis is very low. However, some of the advanced and efficient reproduction strategies and technologies such as sperm washing and alternative artificial intrauterine insemination that can reduce the risk of horizontal HIV transmission²¹ among discordant couples are either non-affordable or not common in low-income countries.^{21–23}

In countries with inadequate health systems such as Uganda with retention levels on ART for women who initiate treatment during pregnancy are progressively declining over time, and only 38% of infants among those HIV exposed receiving antiretroviral therapy (ARV) for elimination of mother to child transmission (eMTCT),⁵ serodiscordant couples face the risk of possible horizontal and vertical HIV transmission. Therefore, identifying factors associated with pregnancy in discordant couples is relevant, both for gaining insights into HIV transmission dynamics and for designing interventions that meet pregnancy desires and protect reproductive rights while reducing the risk of HIV-1 transmission. In this study, we assessed the prevalence rates of pregnancy in discordant relationships in Rakai, Uganda and identified predictors associated with pregnancy.

METHODS

Study population

This cross-sectional study was conducted among serodiscordant couples in Rakai, a rural district located in south-western Uganda with a population of 518 008.²⁴ The data for this study was extracted from the Rakai Community Cohort Study (RCCS). RCCS is an open prospective cohort that has been described previously.^{25 26} It has approximately 15 000 consenting participants aged 15–49 years who are interviewed in surveys conducted every 12–20 months since 1994, and the overall adult HIV prevalence is 13%. Structured interviews are administered by same sex interviewers, and participants provide interview information and blood samples for HIV serology. Interviews establish information on sociodemographic characteristics, sexual behaviours, health and contextual characteristics. We used data from the survey round 17 (2015–2016).

Eligibility criteria

Married participants were identified and retrospectively linked to their spouses, including those in polygamous unions. Couples' HIV status was then determined at each visit, and couples were defined as HIV discordant if one member was initially HIV infected and the other uninfected. Those confirmed as discordant and eligible for this study must have reported sex at least once a month and were married or cohabiting at the time of the study. Pregnancy was detected through self-report and a human chorionic gonadotropin urine test for those uncertain about their pregnancy status or whose last menstruation was more than 30 days prior to the interview.

Definition of key variables

Prevalent pregnancy was the outcome variable and was defined as the proportion of those women in discordant relationships detected as pregnant during the time of the study. Variables that were expected to correlate with pregnancy among discordant couples in the current study were based on previous findings concerning pregnancy predictors among HIV-positive individuals.^{27–30}

The variables included were grouped as follows: education level was dichotomised as primary school level/did not attend school and secondary level or higher. Age was grouped into three categories: 18–24 years, 25–34 years and 35–49 years. Religion was dichotomised as Christian and non-Christian. The HIV status of the woman was dichotomised as HIV-1 uninfected and HIV-1 infected. Inconsistent/no condom use was defined on the basis of responses to a question about frequency of condom use during the last 12 months. The response alternatives were dichotomised as consistent condom use for 'always' and inconsistent/no condom use for those who responded that they 'sometimes' or 'never' used condoms. Alcohol use at last sex was dichotomised as 'yes' and 'no'. HIV status disclosure was dichotomised as 'yes' and 'no'. (See [table 1](#) for further details.)

Patient and public involvement

The RCCS works with the participants within the survey research area to design research questions, ethical guidelines, compensatory time and venues for interviews. Beyond this, there was no further patient and public involvement for this study.

Statistical methods

The prevalence of pregnancy was determined as the number of women pregnant irrespective of HIV status at the time of study divided by the total number of women in discordant relationships of childbearing age; 15–49 years. Contingency tables were used for bivariate analyses to examine associations between the outcome variable (pregnancy) and the covariates, and X^2 tests used for statistical inference. Prevalence risk ratios (PRR) and 95% CIs were estimated using generalised linear models with family of binomial and log link. Multivariable modified Poisson regression^{31 32} using stepwise selection was

Table 1 Summary of key variables in this study

Variable	Categorisation	Description/composition
Age in years	18–24	
	25–34	
	35–49	
Level of education	Primary	≤7 years of formal education or no education
	Secondary	>7 years of formal education
Religion	Christians	Catholics, Protestants, Pentecostals
	Non-Christians	Moslems and others
HIV status	HIV infected	Woman who tested HIV positive
	HIV negative	Women who tested HIV negative
Pregnancy status	Pregnant	Self-reported as pregnant or tested positive after the HCG urine test
	Not pregnant	Self-reported as not pregnant or tested negative after the HCG urine test
Frequency of condom use in the last 12 months	Consistent	Always
	Inconsistent	Sometimes, never
Alcohol use before sex	Yes/no	Using alcohol at last sex (yes/no)
Disclosure of HIV status	Yes	Marriage partner aware of the HIV status
	No	Marriage partner not aware of HIV status

HCG, human chorionic gonadotropin.

used while assessing the impact of each variable on the model, using the log likelihood ratio test to estimate adjusted PRRs of characteristics and behaviours associated with pregnancy status. Only variables with $p < 0.05$ in the univariate analyses were included in the multivariate model. Aggregated analyses of all discordant couples were performed irrespective of the HIV status of the women. A further stratified analyses was done with HIV-positive women (whose male sexual partner is negative) and HIV-negative women (whose male partner is positive). All tests of statistical significance were two sided with $p < 0.05\%$ and 95% CIs. We used STATA V.13.0 (StataCorp, College Station, Texas, USA) for statistical analyses.

RESULTS

Table 2 describes the background characteristics of the women in discordant relationships. The median age of participants was 31 years (IQR 26–38 years). The majority of participants were aged 25–34 years (46.5%), had primary or no education (92.6%) and 74.2% were non-Christians. Depo Provera was the most commonly reported pregnancy prevention medication, used by 20.3%. Almost 86.7% were either using condoms inconsistently or not at all in the last 12 months, 48% had not disclosed their HIV status to their partners and 29.9% drank alcohol at last sex.

Table 3 shows the prevalence and PRRs of pregnancy among women in discordant relationships. The overall prevalence of pregnancy was 12% (59/488). HIV-negative women in discordant relationships had a slightly higher

pregnancy prevalence rate (13.6%) compared with HIV-positive women (11%). Factors significantly associated with higher prevalence of pregnancy were younger age 15–24 years (PRR=4.04; 95% CI 1.72 to 9.50), middle age 25–34 years (PRR=2.49; 95% CI 1.05 to 5.89), Christian religion (PRR=2.26; 95% CI 1.41 to 3.63) and inconsistent condom use in the last 12 months (PRR=4.38, 95% CI 1.09 to 17.53). Neither HIV status nor HIV status disclosure was significantly associated with risk of getting pregnant.

Table 4 shows the association between pregnancy status and predictors of pregnancy among women living in discordant relationships obtained through stepwise Poisson regression analyses. In the fully adjusted model (model 3), Christian religion remained a significant predictor of pregnancy (PRR=1.71; 95% CI 1.05 to 2.70), whereas middle age (25–34 years; PRR=2.10, 95% CI 0.88 to 4.99) and inconsistent condom use in the last 12 months (PRR=3.17, 95% CI 0.78 to 12.81) were no longer significant predictors.

Multivariate stepwise Poisson regression models stratified by the HIV status of the women were then used to further examine factors that had significantly predicted pregnancy in the unadjusted analyses (see **table 3**). The stratified results showed that HIV status was an effect modifier with regard to factors that predicted pregnancy among discordant couples (see **tables 5 and 6**).

In the final model (**table 6**) for HIV-positive women, both younger age (PRR=3.68, 95% CI 1.0 to 12.97) and Christian religion (PRR=2.64, 95% CI 1.39 to 4.99) were

Table 2 Baseline characteristics of women in discordant relationships enrolled in a prospective cohort in rural Rakai, Uganda (n=488)

Characteristic	Frequency (n)	Proportion (%)
Overall	488	100.0
HIV status		
Positive	282	57.8
Negative	206	42.2
Age		
15–24	135	27.7
25–34	227	46.5
35–49	126	25.8
Level of education		
Primary level or lower	452	92.6
Secondary level or upper	36	7.4
Religion		
Christian	126	25.8
Non-Christian	362	74.2
Number of sexual partners		
1	417	85.5
≥2	71	14.5
Condom use in the last 12 months		
Inconsistent	423	86.7
Consistent	65	13.3
HIV status disclosure		
Yes	254	52.0
No	234	48.0
Alcohol use at last sex		
Yes	147	29.9
No	341	69.9
Most common methods to prevent pregnancy		
Pills	9	1.8
Condoms	49	10.0
Depo Provera	99	20.3
Implant/Norplant	30	6.1
Calendar	11	2.3
Others or none	290	59.5

significant, whereas for HIV-negative women (table 5), none of the variables remained significant in the final model.

DISCUSSION

This study found that pregnancy was common among women in discordant relationships with a rate of 12% and we identified younger age (15–24), middle age (25–34),

Christian religion and inconsistent condom use in the last 12 months as significant predictors of pregnancy among women living in discordant relationships. The pregnancy rate in this cohort is consistent with pregnancy rates in discordant couples in Kenya at 10%,²⁷ in Uganda at 12%^{30 33} and in South Africa and Zimbabwe at 13.2%.³⁴ Pregnancy is an indicator of unsafe sex, which means women in discordant relationships are at a higher risk of acquiring or transmitting HIV.

Age was a significant predictor of pregnancy in this study, with women at a younger age at increased risk of becoming pregnant compared with older women. Previously, younger age has been correlated with pregnancy after HIV diagnosis,^{13 35 36} and thus a woman's age would significantly influence her choice to become pregnant. The results of this study emphasise the importance of quick, accurate information about pregnancy and neonatal transmission among younger women in discordant relationships.

The role of the intimate partners in these relationships should not be underestimated. ART programmes should fully engage and involve partners in the reproductive health decisions especially regarding choice of contraception, desire for another child or any potential consequences that may occur due to unsafe sex. There is a need for an integration of reproductive health services into HIV care programming, and health-related decisions should be made as a couple. Thus, more couple counselling would be recommended.

Consistent condom use in combination with ART, when documentation of viral suppression is not possible, is critical in reducing HIV transmission among heterosexual serodiscordant couples.³⁷ Effectiveness of HIV prevention can be increased if ART is given in combination with consistent condom use, as shown in China.³⁸ Estimates of the level of protection against HIV transmission from consistent and correct condom use have ranged from 60% to 96%, making it one of the effective ways of reducing transmissions among discordants.³⁹ However, in this study, we observed inconsistent condom use among women in discordant relationships. A possible explanation could be that female partners may not be empowered to advocate for condom use for every sexual act, which is similar to previous studies about condom negotiation.⁴⁰ This finding is consistent with previous studies that have shown low condom use among discordant couples.^{13 20 41} Also, the desire for children correlates with low levels of protected sex among HIV-positive persons.⁴² The high rates of inconsistent condom use may indicate the need for additional sexual health education and counselling including condom negotiation skills among female partners in discordant relationships.

The proportion of HIV-positive women in heterosexual serodiscordant relationships in this study was 57%, which shows that women are likely to be the index partner in a discordant couple relationship. These results are consistent with previous studies from five different countries that showed women represented an average 30%–50% of

Table 3 Prevalence of pregnancy and correlates of pregnancy in a rural cohort in Rakai, Uganda (n=488)

Characteristic	Overall	Pregnant (%)	Not pregnant (%)	P values	Unadjusted PRR (95% CI)
HIV status					
Negative	206	28 (13.6)	178 (86.4)	0.385	0.81 (0.50 to 1.30)
Positive	282	31 (11.0)	251 (89.0)		Ref
Age in years					
15–24	135	26 (19.3)	109 (80.7)	0.001	4.04 (1.72 to 9.50)
25–34	227	27 (11.9)	200 (88.1)	0.037	2.49 (1.05 to 5.89)
35–49	126	6 (4.8)	120 (95.2)		Ref
Educational level					
Primary level or lower	452	53 (11.7)	399 (88.3)	0.373	0.70 (0.32 to 1.52)
Secondary level or upper	36	6 (4.8)	30 (83.3)		Ref
Religion					
Christian	126	26 (20.6)	100 (79.4)	0.001	2.26 (1.41 to 3.63)
Non-Christian	362	33 (9.1)	329 (90.9)		Ref
Number of sexual partners					
≥2	71	8 (11.3)	63 (88.7)	0.819	0.92 (0.45 to 1.85)
1	417	51 (12.2)	366 (87.8)		Ref
Condom use in the last 12 months					
Inconsistent	423	57 (13.5)	366 (86.5)	0.037	4.38 (1.09 to 17.53)
Consistent	65	2 (3.1)	63 (96.6)		Ref
HIV status disclosure					
Yes	254	30 (11.8)	224 (88.2)	0.844	0.95 (0.59 to 1.53)
No	234	29 (12.4)	205 (87.6)		Ref

PRR, prevalence risk ratio.

all discordant couple index cases.⁴⁰ This is at odds with a common assumption that men are the main link to the high-risk groups.¹³ This finding could be explained by some studies in Uganda that have reported similar rates

for male to female (12.0 per 100 person-years) and female to male transmission (11.6 per 100 person-years)^{20 41} and that women are more susceptible biologically to becoming infected than men. In addition, the practice of concurrent

Table 4 Association (adjusted prevalence risk ratios, 95% CI) between pregnancy status and predictors of pregnancy among 488 women living in discordant relationships in Rakai, Uganda

	Model 1* PRR (95% CI)	Model 2† PRR (95% CI)	Model 3‡ PRR (95% CI)
Age in years			
15–24	4.04 (1.72 to 9.50)	3.24 (1.3 to 7.79)	2.94 (1.20 to 7.19)
25–34	2.49 (1.05 to 5.89)	2.28 (0.96 to 5.40)	2.10 (0.88 to 4.99)
35–49	Ref	Ref	Ref
Religion			
Christian	2.26 (1.41 to 3.63)	1.82 (1.11 to 2.97)	1.71 (1.05 to 2.7)
Non-Christian	Ref	Ref	Ref
Condom use in the last 12 months			
Inconsistent	4.38 (1.09 to 17.53)		3.17 (0.78 to 12.81)
Consistent	Ref		Ref

*Model 1: unadjusted model.

†Model 2: adjusted for age and religion.

‡Model 3: adjusted for age, religion and condom use in the last 12 months.

PRR, prevalence risk ratio.

Table 5 Multivariate regression analysis of factors associated with pregnancy in discordant couples in which the woman is the HIV-1 negative partner (n=206) in rural Rakai, Uganda

Predictors	Model 1* PRR (95% CI)	Model 2† PRR (95% CI)	Model 3‡ PRR (95% CI)
Age in years			
15–24	2.91 (0.85 to 9.94)	2.68 (0.72 to 9.90)	2.24 (0.62 to 8.03)
25–34	2.99 (0.90 to 9.98)	2.96 (0.88 to 9.87)	2.71 (0.82 to 8.92)
35–49	Ref	Ref	Ref
Religion			
Christian	1.38 (0.67 to 2.82)	1.24 (0.56 to 2.75)	1.14 (0.53 to 2.46)
Non-Christian	Ref	Ref	Ref
Condom use in the last 12 months			
Inconsistent	1.85 (1.31 to 2.59)		1.48 (0.92 to 2.35)
Consistent	Ref		Ref

*Model 1: unadjusted model.

†Model 2: adjusted for age and religion.

‡Model 3: adjusted for age, religion and condom use in the last 12 months.
PRR, prevalence risk ratio.

sexual partnerships, which is common practice in Uganda, is considered to be a critical driver of the AIDS epidemic.⁴² Polygamy, a form of concurrent partnership where a man has multiple wives, is a common cultural practice and thus polygamous couples are exposed to a larger sexual network which may be one of the reasons for more women being HIV positive in discordant relationships. This study demonstrates continued gendered risks for women in HIV serodiscordant relationships in sub-Saharan Africa. In particular, men with two or more wives are more likely to make decisions about when to have sex or when to use a condom.

Religion was another predictor of pregnancy in HIV-positive women. This is similar to studies done

worldwide.^{43,44} A study in the USA about sexual behaviour attitudes found that women who reported a religious affiliation were less likely to use contraception than non-religious women,⁴⁵ and in a study conducted in a sub-Saharan setting, the importance of religion in the lives of women was a stronger predictor of pregnancy than any other social-cultural factors.⁴⁶ Fears of infection from sexual partners, prevention of unintended pregnancy, risks of potential HIV transmission and abortions may be particular concerns for women in discordant relationships, especially in relation to their religious beliefs. Therefore, healthcare workers should provide appropriate spiritual counselling and support when they encounter such women in their care.

Table 6 Multivariate regression analysis of factors associated with pregnancy in discordant couples in which the woman is the HIV-1 positive partner (n=282) in rural Rakai, Uganda

Predictors	Model 1* PRR (95% CI)	Model 2† PRR (95% CI)	Model 3‡ PRR (95% CI)
Age in years			
15–24	5.37 (1.62 to 17.77)	3.75 (1.13 to 12.47)	3.68 (1.0 to 12.97)
25–34	2.18 (0.64 to 7.42)	1.74 (0.51 to 5.96)	1.71 (0.48 to 6.0)
35–49	ref	ref	ref
Religion			
Christian	3.42 (1.78 to 6.55)	2.69 (1.42 to 5.0)	2.64 (1.39 to 4.99)
Non-Christian	ref	1ref	ref
Condom use in the last 12 months			
Inconsistent	1.98 (0.49 to 7.97)		1.19 (0.29 to 4.86)
Consistent	ref	ref	ref

*Model 1: unadjusted model.

†Model 2: adjusted for age and religion.

‡Model 3: adjusted for age, religion and condom use in the last 12 months.
PRR, prevalence risk ratio.

We observed that about 48% of women in discordant relationships had not disclosed their HIV status to their partners, and in addition, 12.4% of the women who were pregnant had not disclosed their HIV status to their sexual partners. In a Ugandan context, reproductive issues such as childbearing have a central role in women's social identity. Interviews conducted among HIV-positive pregnant mothers in Uganda highlighted the importance of HIV status disclosure in pregnancy decisions.⁴⁷ Positive women who disclose have been found to encounter reduced pressure to conceive from both their sexual partners and community members.⁴⁸ This study recommends a more prominent role of safe conception in the counselling of discordant couples and more emphasis on the importance of disclosure in discordant relationships. Such a strategy could increase care seeking, improve communication and offer motivation to have better family planning for the future.

In this study, hormonal contraception (oral contraception pill and Depo Provera injection) was more popular (20.3%) than barrier contraceptives like condoms and implants. This is similar to a study done in Zambia where discordant couples preferred hormonal contraception.⁴⁹ Despite a continued call worldwide about the importance of family planning in discordancy, concerns continue to arise about hormonal contraception increasing a woman's risk to HIV infection or her transmission to her sexual partner.⁵⁰ However, the need clearly exists to make contraception accessible and available to serodiscordant couples who face a dilemma of achieving their fertility desires and managing their risk of HIV infection. This study recommends the need to involve men in family planning decisions, involve them in family planning education and increase family planning counselling, and especially making the discussions between contraceptive use and the HIV infection central.

The major strength of this study was the large longitudinal cohort in which the data were derived that had a high level of retention and quality assurance. Some of the limitations of this study include: the use of cross-sectional data, which limits our ability to derive causal inferences. Second, most data were based on self-reported measures, which are subject to social desirability and recall bias. Third, reporting condom use during the last 12 months may not always accurately characterise a person's overall condom use over a long period. The frequency of condom use as well as recalling sexual encounters might affect people's ability to accurately answer and remember details of sexual encounters.

CONCLUSION

We found a 12% pregnancy rate among women in HIV discordant relationships and identified key predictors of pregnancy, thus highlighting the need to develop strategies for making conception safer in discordant relationships. Such studies will require integrated reproductive counselling about reproductive choices and provision of

services that reduce unintended pregnancies or conception-related risks especially for women who choose to conceive and, also the need to incorporate fertility-related counselling into HIV treatment services offered at different points.

Contributors LJN conceptualised the study, and designed, analysed and drafted the first version of the manuscript. BOA and AA were involved in the analysis, interpretation and critical review of the manuscript. AA, BOA and LJN were involved in revising the article critically for important intellectual content and approved the final version to be published.

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Competing interests None declared.

Patient consent Not required.

Ethics approval The Rakai Community Cohort Study (RCCS) was approved by the Research and Ethics Committee of the Uganda Virus Research Institute, the Uganda National Council of Science and Technology and US-based Western Institutional Review Board.

Provenance and peer review Not commissioned; externally peer reviewed.

Data sharing statement The data sets used for this study are available on request from the Rakai Community Cohort Study database at Rakai Health Sciences Program (www.rhsp.org).

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