ART availability and Fertility Desire: Evidence from a population-based cohort in Rakai, Uganda from 2001-2011

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Abstract

Background: Sub-Saharan Africa is simultaneously dealing with generalized HIV epidemics, high fertility, and low contraceptive use, and is an important context to examine fertility desire. We examined the desire for children among women using historical data from a population-based cohort survey in rural Uganda. Specifically, we assessed if ART rollout had an impact on the fertility desires of HIV-positive and HIV-negative women.

Methods: The Rakai Community Cohort Survey (RCCS) is an open cohort in fifty three communities the District of Rakai in southwest Uganda. We used data from women ages 15-49 years who were part of the RCCS from 2001-2011, resulting a total of 42,195 person-round observations. Fertility desires included currently wanting a first child or wanting another child. We used bivariate and multivariate longitudinal generalized linear mixed models to assess the effects of HIV status and treatment phases (pre and post ART) while adjusting for the other controlling variables including age, marital status, educational attainment, and individual history.

Results: Fertility desire was high among women in Rakai, ranging from 49 to 53 percent. In bivariate analyses, age, HIV status, parity, marital status, educational attainment, recent sexual activity, self-assessment of HIV risk, and socio-economic status were significantly associated with fertility desire. Fertility desires increased after ART became available in 2004 (OR 1.60, 95% CI: 1.50 – 1.72), adjusting for socio-demographic and HIV-related factors; Fertility desires rose significantly among both HIV-positive (OR: 1.39 [95% CI: 1.18-1.63]) and HIV-negative (OR: 1.60 [95% CI: 1.50-1.70]) women.

Conclusion: HIV treatment availability may increase fertility desire among women. HIV-positive and HIV-negative women need appropriate reproductive counseling to fulfill fertility desires and avoid HIV risk.

Introduction

Widespread availability of anti-retroviral therapies and the resultant improvement in the longevity and quality of life of people affected by HIV and AIDS has brought attention to the reproductive health needs of people living with HIV or AIDS. Fertility preferences within the context of HIV and AIDS have received particular consideration from research and program perspectives in conjunction with calls for more comprehensive reproductive health services for people affected by HIV or AIDS.[1] Many sub-Saharan African countries are simultaneously dealing with generalized HIV epidemics, high fertility rates, and low contraceptive use; these provide an important impetus to examine fertility desire.

Review of literature exploring fertility desires and intentions within the context of HIV and HIV treatments reveals a profusion of studies on fertility desire in recent years. These studies however, find mixed impact of HIV treatment on fertility desires.[2] For instance, a study in Nigeria highlighted the importance of childbearing and strong fertility aspirations among people living with HIV.[3] A study is South Africa found that men and women on HIV treatment wanted to have children in the future, and for women this was associated with the duration of time they had been on treatment.[4] Another study in Uganda also showed that HIV treatment use was associated with increased fertility desire among HIV-positive women.[5] On the other hand, a slew of studies with HIV-positive women [6] and among HIV clinic patients on anti-retroviral therapies (ART) [7-9] found reduced fertility desire. In part, the mixed results may stem from methodological and sampling constraints. Many studies rely on cross-sectional survey data, thus limiting their ability to examine change in desires over time. Some quantitative studies estimate pregnancy intentions indirectly by examining change in factors like contraceptive use. Many studies have been limited to examining the pregnancy intentions of HIV positive women, and have not included an HIV negative reference group. A further limitation of recent studies has been the recruitment of respondents from clinic settings, whereby limiting generalizability of the findings to populations at large or even populations outside of the clinic setting.[10] In this analysis we attempted to fill these gaps in the literature. We examined the desire for children among women using historical data from a community-based cohort survey in rural Uganda. Specifically, we assessed if ART rollout was associated with a change in the fertility desires of HIV-positive and HIV-negative women.

Uganda offers a unique setting for such a study – a mature generalized HIV epidemic coupled with a high fertility context. In 2011, HIV prevalence was 8.2 percent among women.[11] Uptake of treatment for the prevention of mother to child transmission (PMTCT) among HIV-positive women was estimated at 48 percent in 2010 [12] and approximately half of all eligible HIV-positive people in 2011 were receiving ART in Uganda.[11] Uganda also has one of the highest total fertility rates in the world at 6.2 births per woman.[13] Contraceptive use is low among all women aged 15-49 years (at 24%).[13]

Previous work in the southwestern Rakai district of Uganda has shown that HIV treatment use was associated with increased pregnancy rates among HIV-positive women.[14] In this analysis we examine change in fertility desire at the community level using data from a population-based longitudinal cohort. With this analysis we hope to extend current knowledge and

provide information on how HIV treatment and prevention programs impact the reproductive aspirations of HIV-positive and HIV-negative community members, particularly in settings where fertility and childbearing are highly valued.

Data and Methods

The data for this analysis are from the Rakai Community Cohort Survey (RCCS). The RCCS is a population-based, open cohort of consenting adults resident in fifty three communities of the District of Rakai in southwest Uganda. Surveys were initially repeated on an annual basis; more recent survey periods have been as long as two years. All eligible participants between the ages of 15-49 years are administered a questionnaire at enrollment and at each follow up visit. The individual interview collects detailed demographic and household level data; information on individual characteristics, sexual behaviors, pregnancy history, fertility desires, and health status; and biological samples for a variety of biological endpoints, including HIV status, STI co-infection, and viral load determination on select sub-samples.

The main outcome of interest for this analysis was fertility desire, defined as the desire to have a first child or another child among female RCCS participants of reproductive age (15-49 years) between 2001 and 2011. The two main predictor variables for this analysis will be time (survey round) and HIV status. Additionally, we used two broad set of predictor variables. The first set included socio-demographic variables, such as schooling attainment, pregnancy experiences, and marital status. The second set of variables dealt with perceptions of HIV risk and knowledge about HIV treatments.

We conducted initial exploratory analysis to compare key variables pre and post ART rollout. We used t-test and Mantel-Haenszel Chi-square tests to determine the significance of the disparities. Building on the initial analysis, we ran bivariate and multivariate longitudinal generalized linear mixed models with adjustments for repeat observations to assess the effects of HIV status and treatment phases (pre and post ART) while adjusting for the other controlling variables including age, marital status, educational attainment, and individual history. We also tested for the interaction of age and HIV status over time using Wald-type chi-square test.

Results

We used data from women ages 15-49 years who were part of the RCCS from 2001-2011, resulting a total of 42,195 person-round observations. Table 1 presents descriptive information on women before and after the rollout of HIV treatment programs in the community (in 2004). The median age of the respondents was 27 years. Most women in the sample were married, had 3 children (range 0-15), had received some primary schooling, and lived in rural areas. After 2004, more women came from households with higher socio-economic status.

Fertility desire increased from 49 percent to 53 percent after ART availability ($p < 0.0001$). Women presented similar characteristics before and after ART availability in terms of their desired spacing for subsequent children and the average number of children. Significantly more women reported using modern contraceptive methods after 2004 (39%) than before (31%). Our sample included more HIV-positive women after 2004 (15%) than before (11%).

More women considered themselves at medium or high risk of acquiring HIV after 2004. While data was not collected before 2004, after 2004, almost all women (90%) percent knew about medication to prevent mother to child HIV transmission, and 31 percent had heard of someone using ARTs. Forty one percent of HIV-positive women were receiving some type of HIV treatment – either medication to boost their immune system or ARTs.

Table 2 presents bivariate regression analyses to predict desire for children among women. Age was a strong predictor of fertility desire. Older women were less likely to want a, or another, child compared to teen women in our sample. When we adjusted for age, we found that fertility desire increased among women in each subsequent survey round, with a perceptible leap in odds of increased fertility desire between survey rounds 10 and 11, OR_{adj} 1.34 to OR_{adj} 1.63. ART was rolled out in Rakai as a treatment program between rounds 10 and 11. The age-adjusted bivariate regressions also highlighted other significant predictors of fertility desire among women in the Rakai community, including HIV status (OR_{adj} 0.40), parity, marital status, educational attainment, recent sexual activity, self-assessment of HIV risk, and socio-economic status. Tribal and religious affiliations for the most part did not significantly predict desire for a/another child and are dropped from subsequent models. Respondents with Saved or Pentecostal Christian affiliation had a higher desire for children compared to respondents with Catholic affiliation.

Our multivariate model (Table 3) confirmed that in a community-based population cohort, fertility desire increases after the availability of ARTs, OR 1.60 (95% CI: 1.50 – 1.72), when adjusting for HIV status, age, parity, marital status, recent sexual activity, self-assessment of HIV risk, and SES. Notably, factors unrelated to HIV treatment availability also continued to influence fertility desire for women in Rakai. Being HIV-positive, being older, having more children, being previously married currently separated or widowed), and considering yourself to be at medium or high risk of HIV decreased women's desire for children. On the other hand being currently married and being currently sexually active increased desire for children. We also tested the interaction of time and HIV status, and found that interaction to be not significant (results not shown).

Finally, we examined if ART availability had the same impact on the fertility desire among HIV-positive and HIV-negative women. Stratified multivariate regressions reveal that fertility desire was significantly higher among both HIV-positive (OR: 1.39 [95% CI: 1.18-1.63]) and HIV-negative (OR: 1.60 [95% CI: 1.50-1.70]) women after 2004 in this community-based population cohort, when controlling for age, parity, marital status, and recent sexual activity. The only notable difference in the predictors of fertility desire between HIV-positive and HIV-negative women was current marital status: for HIV-positive women being currently married was no longer a significant predictor of fertility desire, unlike their HIV-negative counterparts.

Discussion

Communities like Rakai have been living with the persistent peril of HIV for over two decades and have witnessed the extremes of the epidemic – rapid wasting and death of a vast number of community members to longer and healthier life due to HIV treatment availability. How

people conceptualize risk from HIV in light of these changing dynamics is likely to moderate their reproductive desires. Although a large number of studies have explored fertility desires and outcomes within the context of HIV and AIDS, there remains a lack of consensus on how HIV treatment availability influences fertility desires. Our study adds insight to this growing body of literature by examining HIV-positive and HIV-negative women's fertility desire before and after HIV treatment program availability.

Studies on fertility desires have often focused solely on the perspectives of HIV-positive women, relied largely on cross-sectional data, or used a clinic-based sample. Use a population-based cohort sample, our study is able to examine the longitudinal impact of ART availability on fertility desire. We found significantly increased fertility desire among all women in Rakai after ART roll-out. While factors unrelated to HIV treatment availability (e.g. age of the respondent) continued to impact fertility desire, treatment availability had a strong and significant impact on all women in Rakai.

Previous research in Rakai has shown that desire for children among HIV-positive women in conjunction with good immunologic response to HIV treatment and higher CD4 counts was associated with increased pregnancy incidence [14]. Our data extends this analysis and suggests the potential for convergence in the fertility desires of HIV-positive and HIV-negative women over time in Rakai. In our stratified analyses we find increased fertility desires among both HIV-positive and HIV-negative women in Rakai after the implementation of HIV treatment programs. The upswing in fertility desires might be a reflection of greater community-level optimism about life with HIV, particularly in communities where fertility is highly valued.

A limitation is that our study did not have access to data on men's fertility desires. Men's fertility desires and their influence on women's fertility desires are an important aspect of reproductive decision-making [15]. Also, the high ART coverage in the Rakai community may not be typical of other sub-Saharan African settings. The level of ART coverage might be an important in influencing fertility desire.

Implications

As HIV treatments expand their outreach, these findings lend important insights for policy and program efforts aimed at reaching women with appropriate family planning counseling and services within the context of generalized HIV epidemics. Programs need to highlight the benefits of ART and PMTCT services to help women and men achieve their reproductive goals – to have children free from the threat of HIV transmission. This study also lends support to the need for strengthened family planning counseling and services with HIV services, so that women and men can make informed decisions about when to have children and how to space them. HIV treatment and prevention programs do impact the reproductive aspirations of the community-at-large, where fertility and childbearing are highly valued.

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Table 1. Sample Characteristics

	Before 2004	After 2004	
Number of respondent person-rounds	17,459	24,736	
Age of Respondent (years)			
Median	28	30	
Fertility Desire	**pct**	**pct**	**P-value**
No	51%	47%	<0.0001
Yes	49%	53%	
Marital Status			
never married	14%	14%	0.6512
previously married	18%	18%	
current married	68%	67%	
Number of Children			
Median (range)			
Sexually active, last 12 months			
No	15%	14%	0.0757
Yes	85%	86%	
Level of Schooling			
No schooling	9%	7%	<0.0001
Some Primary schooling	65%	61%	
Some Secondary schooling	24%	28%	
Some Tertiary schooling	2%	2%	
Missing	<1%	1%	
Residential Area			
Rural	82%	82%	0.2072
Trading village	18%	18%	
Socio-economic Status			
Low	34%	45%	<0.0001
Middle	29%	31%	
High	37%	24%	
HIV status			
Negative	71%	82%	<0.0001
Positive	11%	15%	
Missing	18%	4%	
Heard of someone using ARTs			
No	NA	69%	NA
Yes	NA	31%	
Knowledge of PMTCT			
Yes	NA	90%	NA
No	NA	10%	
Currently using HIV treatment			
No	NA	2%	NA
Yes	NA	6%	
Missing	NA	92%	
Assessment of own HIV risk			
not at all	5%	7%	<0.0001
low	55%	30%	
median	29%	36%	
high	4%	26%	
don't know	7%	0%	

Table 2. Predictors of Fertility Desire, Bivariate Associations

	Bivariate Associations			
Predictors of Fertility Desire	**OR**	**95% Lower**	**95% Upper**	**P-value**
Age at interview				
15-19	-	-	-	-
20-24	0.29	0.25	0.34	<0.0001
25-29	0.11	0.10	0.13	<0.0001
30-39	0.04	0.03	0.04	<0.0001
40-49	0.01	0.01	0.01	<0.0001
	Age-adjusted			
	OR_{adj}	**95% Lower**	**95% Upper**	**P-value**
Visit round				
2001-2002 (ref)	-	-	-	-
2002-2003	1.23	1.14	1.32	<0.0001
2003-2004	1.34	1.24	1.45	<0.0001
2005-2006	1.63	1.51	1.77	<0.0001
2006-2008	1.99	1.84	2.15	<0.0001
2008-2009	1.83	1.68	1.98	<0.0001
2010-2011	1.96	1.81	2.13	<0.0001
Number of children				
0 (ref)	-	-	-	-
1	0.45	0.39	0.52	<0.0001
2	0.25	0.22	0.29	<0.0001
3	0.19	0.16	0.22	<0.0001
4	0.13	0.11	0.15	<0.0001
5	0.10	0.87	0.12	<0.0001
6+	0.06	0.05	0.07	<0.0001
Marital Status				
never married (ref)	-	-	-	-
previously married	0.34	0.30	0.38	<0.0001
current married	0.74	0.68	0.89	<0.0001
Sexually active, last 12 months				
No (ref)	-	-	-	-
Yes	1.74	1.60	1.89	<0.0001
Education Level				
Never go schooling (ref)	-	-	-	-
Primary schooling	1.01	0.91	1.12	0.8888
Secondary schooling	1.60	1.43	1.80	<0.0001
Tertiary schooling	2.97	2.35	3.74	<0.0001
Residential area				
Rural	-	-	-	-
Trading village	0.96	0.90	1.03	0.3783
Socio-economic Status				
Low	-	-	-	-
Middle	0.81	0.76	0.85	<0.0001
High	0.69	0.65	0.74	<0.0001
HIV status				
Negative	-	-	-	-
Positive	0.43	0.40	0.46	<0.0001
Heard of someone using ARTs				
No	-	-	-	-
Yes	1.05	0.98	1.12	0.1570
Knowledge of PMTCT				
No	-	-	-	-
Yes	1.03	0.93	1.15	0.5701
Currently using HIV treatment*				
No	-	-	-	-
Yes	-	-	-	-
Assessment of own HIV risk				
not at all	-	-	-	-
low	0.99	0.89	1.08	0.7526
median	0.88	0.80	0.97	0.0087
high	0.78	0.70	0.87	<0.0001
don't know	0.77	0.66	0.89	0.0004

* Estimates were not estimable after adjusting for age due to sparse sample size

Table 3. Multivariate Regression Predicting Fertility Desire among Women

Predictors of Fertility Desire	N	OR	95% Lower	95% Upper	P-value
Period					
Before 2004	17459	-	-	-	-
After 2004	24736	1.60	1.50	1.72	<0.0001
HIV status					
Negative	32679	-	-	-	-
Positive	5469	0.40	0.35	0.46	<0.0001
Age at interview					
15-19 (ref)	3709	-	-	-	-
20-24	8601	0.60	0.50	0.72	<0.0001
25-29	9706	0.39	0.33	0.48	<0.0001
30-39	12976	0.22	0.18	0.27	<0.0001
40-49	7014	0.04	0.03	0.05	<0.0001
Number of children					
0 (ref)	4047	-	-	-	-
1	5123	0.35	0.30	0.42	<0.0001
2	5966	0.18	0.15	0.21	<0.0001
3	5579	0.12	0.10	0.14	<0.0001
4	4805	0.07	0.06	0.09	<0.0001
5	3768	0.05	0.04	0.06	<0.0001
6+	7675	0.03	0.02	0.03	<0.0001
Marital Status					
Never married (ref)	6061	-	-	-	-
Previously married	7644	0.64	0.56	0.73	<0.0001
Current married	28490	1.51	1.34	1.70	<0.0001
Sexually active, last 12 months					
No (ref)	6151	-	-	-	-
Yes	36044	1.94	1.72	2.19	<0.0001
Assessment of own HIV risk					
Not at all	2614	-	-	-	-
Low	17216	1.14	1.01	1.30	0.0362
Median	13865	0.93	0.82	1.06	0.2380
High	7141	0.78	0.68	0.90	0.0003
Don't know	1345	1.00	0.82	1.22	0.9797

Table 4. Multivariate Regression Predicting Fertility Desire Stratified by HIV-status of the Respondents

HIV status	HIV negative					HIV positive				
Predictors of Fertility Desire	N	OR	95% Lower	95% Upper	P-value	N	OR	95% Lower	95% Upper	P-value
Age at interview*	32679	0.88	0.87	0.88	<0.0001	5469	0.88	0.86	0.89	<0.0001
Period										
Before 2004	12483	-	-	-	-	1837	-	-	-	-
After 2004	20196	1.60	1.50	1.70	<0.0001	3632	1.39	1.18	1.63	0.0002
Number of children										
0 (ref)	3260	-	-	-	-	354	-	-	-	-
1	3992	0.36	0.30	0.44	<0.0001	675	0.35	0.24	0.51	<0.0001
2	4485	0.19	0.16	0.23	<0.0001	899	0.15	0.10	0.21	<0.0001
3	4213	0.14	0.11	0.16	<0.0001	816	0.13	0.09	0.18	<0.0001
4	3613	0.09	0.07	0.11	<0.0001	686	0.09	0.06	0.13	<0.0001
5	2875	0.07	0.05	0.08	<0.0001	500	0.05	0.03	0.09	<0.0001
6+	6109	0.04	0.03	0.04	<0.0001	753	0.05	0.03	0.09	<0.0001
Marital Status										
Never married (ref)	4907	-	-	-	-	589	-	-	-	-
Previously married	4764	0.74	0.64	0.85	0.0007	2229	0.55	0.41	0.73	<0.0001
Current married	23008	1.67	1.47	1.91	<0.0001	2651	1.07	0.82	0.14	0.5722
Sexually active, last 12 months										
No (ref)	4318	-	-	-	-	1114	-	-	-	-
Yes	28361	1.72	1.50	1.96	<0.0001	4355	2.05	1.55	2.73	<0.0001

*We used the continuous measure of age to ensure that the regression model could be compiled for HIV-positive women due to the sparseness of the data.