Polygyny and HIV in sub-Saharan Africa

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Abstract

In most African countries with generalized epidemics, HIV infection is more common in men and women in polygynous unions than in monogamous unions. Using DHS data for twelve African countries and longitudinal survey data from Malawi, we study adverse selection into polygynous unions as one of the factors that explain cross-sectional differences in HIV prevalence. The survey data from Malawi allow us to evaluate selection into polygynous unions based on characteristics that correlate with HIV status (widowhood and marriage order). From the DHS surveys with linked seroprevalence data, we select women who married in a three month interval prior to the survey. This guarantees that their HIV infection predates the marriage, and assess the recruitment into monogamous and polygynous unions using their HIV status as the main predictor of interest. We conclude with reflections on the possible implication of these selection processes on population-level trends in HIV prevalence.

Extended abstract

1. Objectives

We study the relationship between polygyny and HIV infection in sub-Saharan Africa and test the mechanisms that could lead different infections rates in individuals in both types of unions. In most African countries, particularly in those where the HIV epidemic has struck hard, prevalence is higher in women who are in polygynous compared to monogamous unions (Table 1). With this in mind, we investigate whether women who are recruited into a polygynous union are more likely to be HIV positive than those who marry a monogamous husband. As alternative explanations for higher HIV prevalence rates in polygynous unions, we also consider the possibility that partners in polygynous more often engage in extra-marital or risky sexual behavior, as well a polygyny or concurrency effect.

This extended abstract is mainly based on exploratory analyses using data from the Malawi Diffusion and Ideational Change Project (MDICP). In the paper that we wish to present at PAA annual conference, we will mainly draw our analysis from a pooled dataset from twelve African Demographic and Health Surveys.

2. Polygyny and STI's: the prior evidence

It is not uncommon for polygyny to be listed among a set of cultural practices that fuel the HIV/AIDS epidemic (Gausset 2001). Even though this assertion is not often empirically verified, there are several plausible reasons for considering polygyny a risk factor for HIV infection. First, polygynous marriages involve multiple partners, each of whom might introduce HIV in the household. Once one of the spouses is or becomes HIV positive, the others are exposed to HIV as well. Second, the concurrency of sexual partnerships in polygynous unions might have an independent effect on the spread of the virus: under serial monogamy earlier partners are not at risk of being infected by later partners; in concurrent relationships, the protective effect of the sequence is lost (Morris and Kretzschmar 1997). Particularly for diseases such as HIV/AIDS that have an early peak in infectivity, concurrency could be an important independent risk factor in the spread of the virus (Morris and Kretzschmar 1997; Wawer et al. 2005).

Though a concurrency effect on the spread of HIV and other STD's is a theoretically sound idea, the empirical evidence is mixed.[1] Thirdly, men in societies where polygyny is practiced tend to marry at a later age and more often have casual sexual partnerships in early adulthood (Caldwell et al. 1993; Philipson and Posner 1995). Fourth, the institution of polygyny presumably endorses the belief that men require more than one woman for sexual satisfaction (Caldwell et al. 1993). Lastly, polygynous societies are often also characterized by high rates of marital dissolution and the easy remarriage of widows and divorcees. This could lead to an increase in the total number of sexual partners over a woman's lifetime (Halton et al. 2003; Pison 1986; van de Walle 1990).

On the other hand, it is sometimes argued that polygyny contains –the connectedness and density of– sexual networks because it reduces the incidence of casual or extra-marital sex and, therefore, that polygyny reduces the transmission of HIV (Caldwell et al. 1993; Carael, Ali and Cleland 2001; Mitsunaga et al. 2005)[2]. The empirical evidence for that is –again– not conclusive. Two studies that gathered at least partial evidence that men (and women) in polygynous unions have more extra-marital affairs than their counterparts in monogamous marriages (Carael et al. 2001; Mitsunaga et al. 2005). A study in Tanzania suggests that non-marital partnerships are less common in polygynous men and more frequent among women in polygynous unions (Nnko et al. 2004).

This short review illustrates that barely a handful of studies have addressed the relationship between polygyny and HIV using empirical evidence. HIV status-based selection into polygynous unions has never been the subject of a thorough analysis. Adverse selection into partnerships, which, in turn may expose

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[1] In a study on the spread of Herpes Simplex, Halton and colleagues found that the risk of infection was as high in women whose husband was polygynous as in those whose husband had a prior marriage (Halton et al. 2003). This suggests that it is the number of partners one has had, and not necessarily the concurrency of these relationship that affects the spread of STD's. This was also suggested by Lagarde and colleagues who were not able to identify that concurrency of sexual partnerships facilitates the spread of HIV (Lagarde et al. 2001). Convincing evidence for a concurrency effect on HIV incidence and prevalence in the Rakai district in rural Uganda could not be found either (Kelly 2001). In a study on Chlamydia transmission in Colorado, however, concurrency was identified as the most powerful predictor of transmission (Potterat et al. 1999).

[2] A greater permissiveness of extra-marital sex is sometimes associated with the practice of prolonged post-partum abstinence (Cleland, Ali and Capo-Chichi 1999; Orubuloye, Caldwell and Caldwell 1997). Men in polygynous unions could change partners within marriage, and thus have less of an incentive to engage in non-marital sex than monogamous men (Cleland et al. 1999; van de Walle 1990).

individuals to a greater risk of infection is closely related to the idea of assortative mating or homogamy. Assortative mating is well documented in the social science and public health literature (Jacobs and Furstenberg 1986; Kalmijn 1994; Mare 1991; Mathews and Reus 2001; Salces, Rebato and Susanne 2004). HIV status homogamy may well offer the key to further our understanding about the leveling of population-level HIV incidence and prevalence rates, which is observed in several African countries today.

3. Data and methods

The preliminary analyses that we present here are mainly based on data from the Malawi Diffusion and Ideational Change project (MDICP)[3]. These are longitudinal survey data collected in the rural areas of three districts with approximately 1,500 ever-married women and their husbands who have been interviewed in 1998 (MDICP1), in 2001 (MDICP2) and 2004 (MDICP3). The sample is ethnically and religiously heterogeneous. The Rumphi district in the north is characterized by a predominantly patrilineal system of descent with patrilocal residence after marriage. The ethnic groups in Balaka in the south follow a matrilineal system of filiation and residence after marriage is most often matrilocal. In Mchinji, in the center of the country, descent is less rigidly matrilineal and residence may be either matrilocal or patrilocal. The southern district is predominantly Muslim; Christians are in the majority in the other two areas. The Tumbuka are the main ethnic group in Rumphi, the Chewa in Mchinji and the Yao in Balaka. Because of this cultural heterogeneity, we control for district in most of our statistical models.

In 2004 respondents were counseled and tested for HIV.[4] HIV prevalence in the sample is 9.3 percent for women (95%-CI: 7.6-11.3) and 6.4 percent for men (95%-CI: 4.6-8.7). Unless stated otherwise, we rely for most analyses on retrospectively reported marriage histories collected as part of MDICP2. For each respondent, these histories contain information on the present (or most recent if not currently married), previous and first marriage. For each marriage that is

[3] A description of the project, survey instruments and data is available at http://www.malawi.pop.upenn.edu and in a special collection of Demographic Research (Watkins et al. 2003). More detail about the MDICP marriage data is provided in Reniers (2003) and Reniers (forthcoming).

[4] The testing protocol is summarized in Bignami et al. (2004).

included in the histories, information is available on the start, duration and outcome of the marriage, as well as on a number of marriage characteristics such as the residence pattern during marriage, the age difference between the spouses, whether or not the husband is/was polygynous, and whether there was any suspicion of spousal adultery.[5] From these histories, we created a dataset of marriages that will be used for studying spousal recruitment based on characteristics that are correlated with HIV status. Ideally selection should be studied using HIV status as the predictor of interest, but because the sample size and number of HIV positive cases in the sample is too small to permit such an analysis, we focus instead on two risk factors of HIV, namely widowhood and marriage order. Both multiple marriages and widowhood are considered risk factors for being HIV positive; an assumption for which we will provide some evidence as well.

For the second part of our analysis, we use a pooled dataset from twelve African Demographic and Health Surveys with linked HIV serostatus data. To reassure that the HIV status measured at the time of the interview predates the marriage, we only select women who married three months prior to the survey (seroconversion occurs three months after infection). We use that dataset to test whether HIV positive women are more likely to be recruited into marriages with polygynous partners.

4. Preliminary results: covariates of HIV

In Table 1, we present statistics of HIV prevalence by union status from a number of DHS in Africa. Particularly in countries where the HIV epidemic is most severe (Zimbabwe, Malawi, Tanzania and Kenya), HIV prevalence is higher among women in polygynous compared to monogamous unions. The relationship is not as clear in places where prevalence rates are lower, but in these cases the HIV epidemic is a predominantly urban phenomenon whereas polygyny is more

[5] Marriage outcome (if ended) is defined as either divorced or widowed. Separation is very rare and combined with the category 'divorced'. The measure of polygyny used in this paper is based on two questions: 1) whether or not the husband (or respondent if male) had any other wives at the time of marriage, and 2) whether the husband (or respondent) married an additional wife(ves) during the marriage under consideration. A marriage is considered polygynous if any of those two questions was answered affirmatively. The measure of suspected adultery is clarified in section 4.

common in rural areas. Place of residence, in other words, is likely to suppress the relationship between polygyny and HIV in these areas. This assertion will be further investigated in the paper.

Table 1: HIV prevalence (in %) by union status in selected African countries (women, aged 15-49)

	not in union	Polygynous	monogamous
Ethiopia (2005)	2.4	1.5	1.5
Guinea (2005)	2.8	1.3	1.8
Burkina (2003)	2.6	1.2	2.0
Rwanda (2005)	4.3	4.7	2.5
Ghana (2003)	2.4	3.3	2.8
Ivory Coast (2005)	6.8	6.4	5.7
Cameroon (2004)	7.5	5.5	6.6
Tanzania (2004-5)	9.1	9.9	6.6
Kenya (2003)	9.8	11.4	7.2
Malawi (2004)	15.5	16.4	11.6
Zimbabwe (2004-5)	22.3	24.3	19.3

Source: Demographic and Health Surveys & AIDS Indicator Surveys (http://www. measuredhs.com)

Within Malawi, there are quite important regional differences in the prevalence of polygyny (Table 2). It is most common in the north and least common in the southern region. Note that the prevalence of polygyny in the MDICP sample is higher than the levels reported in the 2004 Demographic and Health Survey (DHS), but that is in large part due to differences in the definition and classification of polygynous and monogamous unions in both studies.[6] In

[6] Levels of reported polygyny between the MDICP and DHS data are different for several reasons. First, the MDICP sample is drawn from exclusively rural settings where levels of polygyny are generally higher. Secondly, in MDCIP1 the sampling frame consisted of ever-married women and their husbands. In MDICP2 other and new spouses of already sampled men and women were also interviewed, thereby increasing the share of women married to a polygynous husband. Thirdly, the measure of polygyny in the DHS reflects current status, whereas the definition used here categorizes a marriage as polygynous when the husband had another wife at any time during the marriage under consideration (see also footnote 5). Lastly, the MDICP data pertain to all (i.e. current, previous and first) marriages of men and women in the sample, which means that the marriages may have been initiated any time between the 1940s and the time of the survey. Considering that the prevalence of polygamy in Malawi has decreased over time (see table 1), that is another reason why the measure used here differs from the values reported in the DHS. Rather

terms of HIV prevalence, the levels in the DHS sample are higher than in the MDICP. One of the reasons is that the latter pertain to an exclusively rural population. The exception is the central region, and this is possibly due to the uncharacteristically high refusal rates in the central region in the DHS survey (particularly in Lilongwe where less than 40 percent of the respondents were tested). Noteworthy is that polygyny is most prevalent in the district (Rumphi) where HIV infection rates are lowest. In Balaka, where HIV prevalence is highest, polygyny is least common. At the aggregate level polygyny thus negatively correlates with HIV prevalence across the MDICP study regions. This is not the case, however, at the individual level where the association is positive: the odds for being HIV positive are 2.58 times (95%-CI: 1.34 - 4.94) higher among men who have ever been in a polygynous household than among men who have not had any concurrent spouses. The corresponding value for women is 2.00 (95%-CI: 1.30 - 3.08).[7]

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than a nuisance, however, the over-representation of polygynous marriages in our sample is a convenient statistical feature because it increases the power of statistical tests.

[7] These associations are also reproduced for each of the three districts separately. For men the relationship is only significant for Mchinji. There are, however, only 40 HIV positive men in the sample and that contributes to the low statistical power of the tests. In the MDHS, the odds that a polygynous man (current status) tested positive are lower than those for a monogamous man, but these values are not significant (OR: 0.65, 95%-CI: 0.39 - 1.14). For women, the value is closer to what we find in the MDICP sample and is significant (OR: 1.49, 95%-CI: 1.08 - 2.06) (NSO and ORC Macro 2005).

Table 2: prevalence of polygyny and HIV in the three regions of the DHS survey and sample districts of the MDICP (in percent)

	DHS[a]		
	South	Central	North
Fraction of currently married women with one or more co-wives			
1992	17.2	22.7	28.3
2004	12.8	15.5	25.9
Fraction of currently married men with more than one spouse			
1992	4.7	12.6	14.9
2004	6.1	11.3	20.7
HIV prevalence (both sexes), 2004	17.6	6.5	8.1

	MDICP		
	Balaka	Mchinji	Rumphi
Fraction of marriages in which the respondent (women's reports) had one or more co-wives at any time during her marriage	31.7	36.9	50.7
Fraction of marriages in which the respondent (men's reports) had more than one wife at any time during his marriage	23.8	29.4	45.0
HIV prevalence (both sexes)	10.6	9.1	5.7

Notes:
[a] Sources: NSO and ORC Macro (1994; 2005)

These differences persist after controlling for district and age (Table 3, model 1). Again, this is particularly so for polygynous men, for whom prevalence is more than three times as high compared to monogamously married men. The odds for being HIV positive among women who have been –or still are– married to a polygynous husband are twice those of women who have always been married to a monogamous husband.

Table 3: Risk factors of HIV+ status (odds ratios), MDICP

	Women		Men	
	Model 1	Model 2	Model 1	Model 2‡
District (vs Balaka)				
Mchinji	0.773	0.955	1.196	2.882**
	(1.01)	(0.17)	(0.46)	(2.13)
Rumphi	0.495***	0.743	0.460*	1.422
	(2.58)	(1.01)	(1.74)	(0.65)
Age	1.230*	1.172	1.410**	1.455*
	(1.91)	(1.45)	(2.02)	(1.72)
Age^2	0.997**	0.997*	0.996**	0.995*
	(2.25)	(1.93)	(2.11)	(1.87)
Ever polygynous	2.301***	1.670**	3.142***	1.568
	(3.63)	(2.10)	(3.26)	(1.07)
Marriage order (vs 1st marriage)				
Second		2.258***		ref‡
		(3.08)		
> Second		4.292***		1.895
		(4.24)		(1.51)
N (respondents)	1043	1043	621	306
LL	-306.69	-296.85	-137.83	-90.09
Df	5	7	5	6
Pseudo R^2	0.05	0.08	0.07	0.08

Absolute value of z statistics in parentheses
* Significant at 10%; ** significant at 5%; *** significant at 1%
‡ Analysis pertains to higher order marriage only. The second marriage is the reference category.

One of the mechanisms that could produce a difference in HIV prevalence rates in polygynous and monogamous unions is a difference in the number of marriages. To test whether this has an effect on HIV status and to verify whether it absorbs some of the variance in HIV prevalence attributed to polygyny, we introduce marriage order as an additional explanatory variable in the analyses. For women, having been married more than once correlates significantly with HIV status and reduces the effect of having ever been in a polygynous marriage. Nonetheless, the latter, remains significant, implying that alternative explanations for the variance in prevalence rates by polygyny status cannot be excluded. For men the test is less straightforward as polygyny implies multiple partners by definition. In their case, we compare prevalence rates for those who have been in precisely two formal unions and those who were in at least three marriages. The

effects are of a similar order of magnitude as for women, but not statistically significant; perhaps because the small sample size limits statistical power.

So far, we have presented some evidence that HIV prevalence rates are higher in polygynous unions, but this does not seem to be a simple function of the respondent's number of formal unions. In what follows, we investigate the selection of HIV positive women into polygynous households.

5. Preliminary results: selection of HIV positive women into polygynous unions

A direct assessment of the selection of HIV positive women into polygynous unions requires a measure of HIV status for all women at the time of marriage. Unfortunately, these data are not available. Instead, we examine selection processes with respect to characteristics that are measurable and that correlate with HIV status. One of them is widowhood, and we therefore compare the likelihood that widows and divorcees become part of a polygynous household. The odds for being HIV positive are about 78 percent higher (p=.12) for a widow [8] than for a divorcee, controlling for district and age. Adding an additional control for having been in a polygynous household barely changes that relationship. For adverse selection into polygynous marriages to account for (part of) the difference in HIV prevalence rates between polygynous and monogamous households, women whose previous husband(s) died should be disproportionately found in marriages with a polygynous husband[9].

The other outcome that we consider is marriage order. Here we postulate that marriage order correlates with HIV status (see Table 3), and that women at higher order marriages are more frequently selected into marriages with polygynous men. In these analyses we define a polygynous husband as someone who had at least one other spouse at the time of marriage. The tests for both of these selection processes are carried out using a binary logistic regression model

[8] In the 2004 Malawi DHS, HIV prevalence among the widowed (current status) was 35.5% (N=103) and 23.3% among the divorced and separated (N=272) (NSO and ORC Macro 2005).

[9] In a different study, remarriage rates of widows were found to be lower than those of divorcees (particularly in the 1990s); most likely because a fair share of the widows have become the surviving spouses of AIDS victims and therefore not very attractive marriage partners (Lesthaeghe et al. 1989; UNAIDS 2006). In this paper, we are merely interested in explaining differences in HIV prevalence between men and women in polygynous and monogamous marriages. The analysis therefore conditions on remarriage.

whereby the marriage type is the outcome of interest and widowhood (versus divorced status, table 5, model 1) and marriage order (table 5, model 2) are the main predictors of interest.

Table 5: characteristics affecting marriage to a polygynous husband (women only, odds)

	Model 1‡	Model 2
District (vs Balaka)		
Mchinji	1.179	1.460***
	(0.90)	(2.67)
Rumphi	3.101***	2.826***
	(5.42)	(7.38)
Age at marriage	1.259***	1.244***
	(3.18)	(4.11)
Age at marriage2	0.997***	0.997***
	(2.75)	(3.41)
Widow (vs divorcee)	1.21	
	(0.88)	
Marriage order (vs 1st marriage)		
Second		2.781***
		(6.36)
> Second		3.500***
		(5.16)
N (marriages)	705	2232
LL	-449.83	-1037.08
df	5	6
Pseudo R2	0.06	0.13

Notes:
Robust z statistics in parentheses (adjusted for clustering on respondent)
* Significant at 10%; ** significant at 5%; *** significant at 1%
‡ Analysis pertains to higher order marriages only
Variable definitions: *Age at marriage*: age at marriage of the respondent (i.e., the wife); *widow:* whether the woman's previous marriage ended in widowhood or divorce/separation; *Marriage order*: 1st marriage (reference category), 2nd marriage, or higher order marriage of the wife.
Models selection: The interaction between marriage period and outcome of the previous marriage is not significant (indicating no change in the selection of widows into polygynous unions over time). The interaction effect between marriage period and marriage order seems to suggest that women in their third marriage or above are selected into polygynous households more often in the 1990s than was the case before that period. This effect, however, does not reach statistical significance either (z=1.04). Both interactions were omitted from the final model.

In addition to our earlier finding that the prevalence of polygyny varies by district, we learn from Table 5 that the frequency of polygynous marriages increases with women's age at marriage: the older a woman, the more likely she is to marry a polygynist. The quadratic effect for age at marriage indicates that the

odds of marrying a polygynous husband follow a curvilinear pattern with an inflection point around age 36. Widows are, as expected, more likely to remarry a polygynous husband, but the effect is relatively small and not significant[10].

The effect of marriage order is much stronger and highly significant: the odds that a woman will marry a polygynous husband are about three times higher in a second marriage than in a first marriage, and the association gains strength with marriage order. Interestingly, marriage order is also a better predictor of HIV status than widowhood (when compared to divorced women). In these analyses, we thus find support for the proposition that HIV positive women are selected into polygynous marriages.

6. Discussion of preliminary findings

We began with the observation that HIV prevalence rates are higher in polygynous compared to monogamous unions; particularly in countries with a widespread epidemic. For Malawi, this association is related to, but cannot be fully explained by the number of formal unions one has been in, suggesting that other factors contribute to the higher prevalence rates in polygynous unions. Selection is one of the possible mechanisms that produces higher HIV prevalence rates in polygynous unions. Although our evidence is indirect, women who are at higher risk of infection (i.e. those who are at higher marriage orders and those who are widowed compared to divorced), are more likely to join polygynous unions. Using Demographic and Health Surveys, we will extend these analyses for other countries and using observed HIV status at the time of marriage as the main predictor of interest.

An interesting feature of the MDICP study sites is that the highest HIV prevalence rates are found in the district where polygyny is least common (and vice versa). Using the evidence at hand, it is not possible to explain the difference in individual and aggregate-level correlations between polygyny and HIV[11].

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[10] The lack of a strong effect is also an indication that levirate or widow inheritance is probably not very important in Malawi (at least not to the extent that it would lead to noticeable differences between widows and divorcees in their likelihood of remarrying a polygynous husband). Because levirate is uncommon in ethnic groups with matrilineal descent systems, we also tested an interaction between widowed and district, but that was not significant either.

[11] Incidentally, HIV prevalence is also much lower in western Africa where polygyny rates are usually much higher than in the eastern and southeastern Africa. A similar observation has been made by Frank (1992).

Unobserved heterogeneity is a likely candidate, but a more intriguing hypothesis is one that implies a strong selection of HIV positive individuals into polygynous households. As we have observed, this could lead to a positive individual-level correlation between polygyny and HIV. However, if the selection is strong and the sexual networks of men and women who are in polygynous unions are sufficiently distinct from those who are in monogamous unions, they could have the potential to contain aggregate HIV prevalence rates in societies where polygyny is practiced compared to those that are more exclusively monogamous. This argument brings us back to the more general issue of assortative mating on HIV status, and we hope to shed further light on that with the analyses based on the pooled DHS datasets.

7. References

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