Couple-level Age and Educational Asymmetries and HIV Risk in Kenya

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Abstract

Age and economic-asymmetries, and concomitant power imbalances between men and women in sexual relationships, are commonly cited as reasons for young women's disproportionate vulnerability to HIV in sub-Saharan Africa. Though they are suggested to be common, little is known about the actual prevalence of age and economically-asymmetric relationships in Africa, nor their association with women's HIV risk. Using couples data from Kenya's 2003 and 2008 Demographic and Health Survey with HIV biomarkers, this study aimed to assess the prevalence of age and educational asymmetries among couples in Kenya, and to evaluate if these predictors are associated with increased risk of HIV infection in women adjusting for covariates. Age and educationally asymmetric relationships were relatively common (21 & 30% respectively). Age asymmetries (where the man was >=10 years older) was associated with higher HIV risk for women, but educational asymmetries were not associated with an increased risk of HIV for women.

Word Count: 150

Introduction

Nearly twice as many women in sub-Saharan Africa (SSA) are infected with HIV compared with men (UNAIDS 2009). Generally men are infected later and women earlier (Ott et al, 2011), but young women, age 15-24 continue to experience the highest overall HIV infection rates with 3 to 4 times the HIV prevalence of men (Gouws et al, 2008). In explaining variation in HIV infection rates between the sexes, researchers have pointed to the existence of age and economic asymmetries, and concomitant power imbalances between men and women in sexual relationships, as potential reasons for young women's disproportionate vulnerability to HIV (Luke, 2003). Poor women are believed to be at higher risk of contracting HIV due to pressures to engage in exchange sex to meet basic survival needs (Heise & Elias 1995; WHO 2000; Gilbert & Walker 2002). In an urban context, young women with aspirations for upward mobility have been observed to exchange sex with wealthy male "sugar-daddies" for luxury items (Luke, 2005; Leclerc Madlala 2008; Wojicki 2002). Together, these studies have led to an image of wealthy, older men but poor, young women as being most vulnerable to HIV infection.

In spite of this commonly held characterization, much of the research on age and economic asymmetries in Africa remains impressionistic, derived from qualitative studies or non-random samples.[1] Though they are suggested to be common, little is known about the actual prevalence of age and economically asymmetric relationships in Africa, nor their direct association with women's HIV risk. A few studies have tried to ascertain the prevalence of intergenerational, "sugar-daddy" style relationships using questions asking whether girls have ever exchanged sex for money or favors with estimates ranging from ranging from 12-25% across various studies for age asymmetries and 5-80% for transactional sex (see Luke et al, 2005 for a systematic review of the literature). Studies have linked intergenerational relationships with HIV risk factors including reduced condom use and lower room for sexual negotiation on the female's part with studies finding the greater the asymmetry in partner age and wealth, the lower women's power (Longfield et al, 2004; Glynn et al, 2001; Chatterji et al, 2005; Bearinger et al, 2007; Kelly et al 2003; Gregson et al, 2002).

Other studies have focused on either age or economic asymmetries or both and their relationship with HIV risk factors, particularly non-condom use in relationships, though some studies also directly correlate asymmetrical relationships with HIV infection (Kelly et al 2012; Gregson et al, 2002). Kelly et al. (2003) identified large age differences in sexual relationships as a contributing factor to HIV prevalence. A study of adolescent girls age 15–24 in rural Zimbabwe concluded that each one-year increase in age difference between partners was associated with a 4 percent increase in HIV risk (Gregson et al, 2002).

Previous studies have largely focused on asymmetric, casual relationships, while few studies examine the risk posed by asymmetries in marital or cohabitating

[1] See Leclerc-Madlala S. Age-disparate and intergenerational sex in southern Africa: the dynamics of hypervulnerability. AIDS. 2008;22 Suppl 4:S17-25 for a thorough review of the qualitative and ethnographic literature.

relationships. Many studies of exchange sex focus exclusively on a definition of economic asymmetry as transactions between sexual partners (Luke et al, 2003), and exclude the relative difference in incomes or economic status between partners.[2] Much qualitative research has focused on better defining the reasons girls enter and sustain transactional relationships and the nature of the exchange (see Leclerc-Madlala 2008 for review). Although a focus on explicit transactions likely captures a broad range of behaviors that can be loosely thought of as exchange sex, this type of measure lacks specificity and details about the length of the relationship, frequency of contact and importantly whether the relationship was actually asymmetric with respect to age and/or socio-economic status. Older male partners are likely to be ubiquitously better off than adolescent girls and any relationship where a man works outside the home and the woman does not, or where the man has relatively higher earning power, are by nature transactional at a certain level. If the relevant hypothesized mechanism making relationships premised on exchange riskier for young girls is the power differential in relationships reducing opportunities for sexual negotiation, then any relationship premised on an economic imbalance between partners should in theory heighten HIV risk.

However, one area that remains murky is the hypothesized mechanism leading from power imbalances in relationships to HIV risk. Reduced ability to negotiate sexual behaviors, particularly condom use, in relationships due to unbalanced relationship power is the most often advanced explanation for heightened HIV risk, though condom use remains quite low in SSA and may not be the most relevant HIV prevention mechanism (Halperin et al). The literature has tended to portray young girls as at elevated HIV risk, yet risk presumably cuts both ways, as increasing research is beginning to highlight. Men may also be put at risk through exposure to infected female partners. Indeed, if young girls have the highest HIV infection rates of any demographic group, they must have been exposed through some biologically plausible pathway. Some mechanisms hypothesized to increase HIV risk in young girls (and their male partners) include the following (see Figure 1 for conceptual model):

- ***Heightened biological susceptibility***- In age discordant relationships, if the girl is very young, her immature reproductive tract may heighten the risk of contracting HIV if her partner is already positive. Prospective studies of serodiscordant couples and of men's contacts with female sex workers have demonstrated that women have upward of twice the probability of infection if exposed to HIV (Padian et al, 1991; Nicolosi, et al, 1994; Royce et al, 1997; Mastro et al, 1998) and the risk to young girls is thought to be higher due to their greater likelihood to have cervical ectopy (Higgins, Hoffman, Dworkin, 2009). A portion of serodiscordance between men and women is believed to be driven by this difference in biological vulnerability.
- ***External exposure through male partner***- Asymmetric relationships may be less likely to be monogamous due to unequal power relations, which also make it more difficult for young girls to negotiate safer sex. One expression of male

[2] For instance, Luke (2005) exclusively defines "economic asymmetry" as a "transaction between sexual partners, not the relative difference in incomes or economic status between partners".

power and patriarchy is the double standard that culturally sanctions multiple partners for men, but stigmatizes the same behavior for women, including harsh punishments for sexual transgressions by women. Consequently, research on gender and HIV in sub-Saharan Africa has suggested that women are often put at risk of HIV by promiscuous male partners (e.g., Heise & Elias 1995; Gilbert & Walker 2002). Women, who may themselves be monogamous, may be put at risk for HIV through their partners' behaviors (Fox, 2014). Studies have found that older partners of young women and girls frequently sustain multiple and concurrent partnerships, not only with other casual partners but also with a main 'long-term' partner (Hargreaves et al, 2009). Further, age mixing in sexual relationships may increase young women's vulnerability to HIV because older men, who have longer sexual histories, are more likely to have already been exposed to HIV. As the main partner of these men is usually older than their casual partners (Chopra et al, 2009), these men are believed to act as a bridging population, allowing HIV to spread indirectly from older age groups with a higher burden of HIV infections to younger age groups. Wealthier or more educated men may also constitute high risk "central nodes," as their deeper pockets makes them more attractive to multiple female partners. On the other hand, poorer men may have more difficulty affording wives and instead may be forced into informal sexual relationships. Inflation in the cost of the bridewealth has been identified as a barrier to poorer men marrying and may encourage more casual partnerships (Murray, 1977).

- ***Selection***- Young girls, or girls who have previously engaged in exchange sex, may come into relationships infected and subsequently infect their male partner or may themselves engage in external sexual relationships. Analysis of sero-discordant couples in several sub-Saharan African countries has shown that the likelihood that HIV was introduced into the relationship by the woman is much higher than has previously been assumed: in 30% to 40% of couples married for over 10 years, the woman was positive and the man negative, even though relatively few women reported having outside partners (Mishra, 2007). Studies of sero-discordance in couples in high migration settings have found that the direction of spread of the epidemic is likely not primarily from returning migrant men to their rural partners, but also from women to their migrant partners, based on high degrees of serodiscordance among female partners in relationships with migrants (Lurie et al., 2003).

To evaluate these different mechanisms and their impact on HIV risk in men and women, we used couples data from Kenya's 2003 and 2008 Demographic and Health Surveys with linked HIV biomarkers. Although a previous study examined age and educational relationship asymmetries in urban Kenya and found them to be relatively common (Luke, 2003), this study did not draw on a nationally representative sample, and did not have access to HIV biomarkers. The present study aimed to assess the prevalence of age and socio-economic asymmetries among couples in Kenya, and to evaluate if these predictors were associated with increased rates of HIV infection and to explore potential explanatory mechanisms.

Methods

Sample

Couples data from Kenya's 2003 and 2008 Demographic and Health Surveys (DHS) with linked individual HIV test results were combined to assess the prevalence of age and economically asymmetric relationships and the association between being in an asymmetric relationship and women and men's HIV risk. The couples data recode file provides a flat dataset with joined men's and women's data on the same row. Couples are cohabitating men and women sampled from the same household that report being in a relationship. Most, but not all couples, report being married.

The data were combined to increase the overall sample size of couples and because differences in the samples over time were not found to be substantial (see Table 2). In keeping with findings from other studies (Hallet et al, 2006), HIV prevalence rates have reduced in Kenya between 2003 and 2008 though the prevalence of asymmetric relationships has not significantly changed between the two time periods. The combined couples data yielded 2,343 couples with available HIV data. Analyses were run separately for each year (2003 and 2008) and with data combined. Final results are shown only for combined data.

Measures

Dependent variable. The principal dependent variable for this study, an individual's serostatus, is measured as the test result from the DHS rapid HIV test. Dried blood spots were collected from willing and informed participants to test for HIV using two Enzyme-Linked Immunosorbent Assay (ELISA) tests that would also allow for sero-typing (Mishra et al, 2006). Men ages 15-59 and women ages 15-49 were eligible to be tested for HIV. For the purpose of the present analysis, we were interested primarily in women's HIV status as an outcome, but secondarily in men's HIV risk.

Independent Variables

Age Asymmetry. An age asymmetric relationship was measured as a relationship where the man was at least 10 years older than his female partner. Intergenerational relationships where one partner is 10 or more years older such as these have been hypothesized to contribute to the age discordance in HIV infection rates between men and women in SSA. In keeping with previous literature, we also examined relationships in which the man was 5+ years older, which sometimes defines age asymmetry this way, as well as coding relationships as same age, 1-4 years older, 5-9 years older and 10 years+.

Socio-Economic Asymmetry. A relationship was considered socio-economically asymmetric if the male partner's educational attainment was higher than the female partner's. Educational attainment is measured as having no education, primary school, secondary school and tertiary school. For instance, if a man had completed secondary school, but his partner had only completed primary or had no education, the relationship was coded as being economically asymmetric. Education was used rather than wealth since wealth is measured at a household level and therefore does not vary between men

and women within couples on the DHS. A combined measure of both age and educational asymmetries was also composed by interacting the two variables to determine whether this combination had a compounding effect on women's HIV risk.

A single question on the DHS included on the 2003 survey asks female respondents if they have ever given or received money, a gift or a favor in exchange for sex. We examined this variable as a potential alternative measure to our measure of socio-economic asymmetry in relationships, but only 1.4% of respondents replied affirmatively to this question.

We did not anticipate finding many relationships where the female partner was substantially older than her male partner or where the female had higher education than the male. Where we did find these relationships, rather than excluding them and reducing sample size, we coded them as symmetrical, hypothesizing that women in these relationships will have relatively higher or more equal power to their male partners since the asymmetry is working to their advantage.[3]

Mechanism and Control Variables

External Sexual Partners. A primary mechanism hypothesized to explain why a woman in an asymmetric relationship should be at higher risk of HIV infection is that her male partner may be more likely to have additional partners outside the relationship. It is also possible that women in asymmetric relationships may also be more likely to have additional partners. To test this assumption, a measure of non-marital sexual partners was constructed from a question on the DHS that asks about the number of sexual partners other than one's spouse/partner that an individual had sex with in the past year. This question, was recoded into a dichotomous variable of whether or not someone reported having at least one sexual partner other than his/her spouse/partner in the past year. Men and women with one or more sexual partners other than his/her spouse/partner were coded as having an external sexual partner. We included both men's and women's self-reported external partners, as either could be a source of the introduction of HIV into the couple, though literature has shown that women tend to substantially underreport external partners (Nnko, 2004; Helleringer, 2007; Hewett, 2004; Gersovitz, 1998).

Polygamous Union. Though data in the couples sample is not collected on all wives in a polygamous union, men and women are asked their number of wives/co-wives. Being in a polygamous union has been found to be associated with higher HIV risk relative to being in a monogamous union, but to be associated with lower risk than having an extramarital partner (Fox, 2014). Being in a polygamous union increases the possible entry points through which a polygamous household may be exposed to HIV. We coded couples as either being in a polygamous or monogamous union and enter this primarily as a control variable.

[3] We recognize, however, that the opposite could be the case: women with higher degrees or who are older than her partner may still feel at a power disadvantage since a double standard may render higher age and education as disempowering to women.

Time between age at first sex at age at first marriage. Girls with a younger age at first sex or a longer time between age at first sex and age at first marriage are believed to be at higher risk via the selection mechanism- a longer period of potential exposure to HIV. Men also may be at higher risk the longer they have spent sexually active prior to marriage. We generated a measure of the number of years spent sexually active before marriage by subtracting the age at first sex from the age at first marriage. We recoded this into individuals who had sex for the first time at or after their first marriage, 1-5 years before marriage, 5-9 years before marriage and 10+ years before marriage. We believe this is a better measure than age at first sex since many girls in sub-Saharan Africa may be married quite young and it allows us to separate individuals who reported having their first sex at marriage from those reporting being sexually active prior to marriage.

Age and education. Absolute age and not just the relative age difference between partners may be associated with HIV risk- particularly older age for men and younger age for women/girls. Thus, we enter age in five year increments to separate out the effect of age difference between partners from age per se. Male and female educational attainment were also entered to separate absolute from relative differences.

Gender and Relationship Power. Given that differences in power relations is a primary reason advanced for why asymmetric relationships are riskier than homophilous relationships, we examine two measures of gender/relationship power. First through a series of questions that ask who has the final say on a variety of different tasks. Three questions were asked of both men and women and in both waves- who has the final say on large household purchases, everyday household purchases and visits to friends and family. Women were asked two additional questions about who has the final say in health care and preparing daily meals. We decided to use the five questions posed to women to measure perceived relationship power among women. Women who responded either that the woman had the final decision or that the partners jointly decided were coded as 1 and otherwise as 0 where the man had the ultimate say. The responses to these questions were summed and a 0 was assigned where the woman perceived that she never or rarely had the final say, 1 to sometimes, and 2 to almost always having final decision making power or sharing that power jointly.

A second scale asked of both men and women ascertains attitudes towards domestic violence, specifically, the circumstances under which wife beating is justifiable (i.e., if she burns the food, etc.).[4] For this measure we use only men's responses averring that what is most important for relationship power is the man perceiving that wife beating is justifiable, whether the woman in the relationship agrees or not. Men were coded as believing that wife beating is often(2), seldom(1) or never(0) justified.

Regional Prevalence of Male Circumcision and External Partners. As HIV is an infectious disease spread through networks of individuals, the prevalence of HIV risk factors, particularly the percent of relationships in a geographic area that are not

[4] Specific question wording was as follows: Wife beating is justified if she… goes out without telling him,; neglects the children; argues with him; refuses to have sex with him; burns the food. Responses options were yes, no, don't know.

monogamous is important to the contextual risks of others in the area. Likewise, the degree to which others in networks are circumcised or not is likely to be of consequence. HIV should move more slowly through networks where most men are circumcised since male circumcision has been found in clinical trials to reduce HIV risk by up to 60% for men. Following other studies (Fox 2014), we include the percent of individuals in a region that report having an external partner and the percent of men that report being circumcised as additional control/predictor variables.

Control variables. Other control variables related to sexual behavior were also entered as controls including having had symptoms of an STD in the past year. Couple level wealth and place of residence (urban-rural) were entered as additional demographic controls. Men's and women's age and educational attainment was entered to separate the absolute impact of age and education apart from their relative difference within the couple.

Analysis. Data were analyzed using Stata version 12 (StataCorp; College Station, TX, USA). Multivariate relationships between the outcome measures (women's HIV serostatus; men's HIV serostatus) and age and economic asymmetries were assessed in a stepwise fashion- first entering just the variables representing asymmetries, then adding demographic controls, power measures and finally adjusting for behavioral explanatory variables. All models were run as two level models accounting for the adjusting for household and region using the xtlogit command in Stata.

Results

Age and economic asymmetric relationships were relatively common- approximately 22% of relationships were asymmetric in relation to age and 30% with respect to education (see Table 1).

Being in an age asymmetric relationship (where the man was at least 10 years older than the woman) was associated with higher HIV risk for women (OR=1.59, $p<0.01$), but being in an educationally asymmetric relationship was only marginally associated with an increased risk of HIV for women after the inclusion of explanatory variables ($p<0.1$) (see Tables 5 & 6). After accounting for various demographic factors, the relationship between age asymmetries and female HIV status remained robust though diminished. Adding additional behavioral explanatory variables did not further reduce the magnitude of the effect. Neither men nor women reporting that they had other non-marital sexual partners in the past year was associated with increased HIV risk for women. Women who had spent 6 or more years sexually active before marriage had a higher HIV risk. Both male and female circumcision were associated with lower odds of HIV infection and women reporting having had a genital sore in the past year, but not men. Demographic risk factors for HIV remained robust even with the addition of behavioral mechanisms.

Power measures were not significantly associated with women and or men's HIV status nor did their inclusion in the model dramatically reduce the significance of being in

an intergenerational relationship. Analysis (not shown) did not find any significant association between power measures and the likelihood of being in an age or educationally asymmetrical relationship. Nor was being in an asymmetrical relationship associated with a man having an extramarital partner. Thus, the mechanisms through which asymmetrical relationships are believed to confer heightened HIV risk to women were not significant in this instance.

Neither age nor educational asymmetries in relationships was associated with an elevated HIV risk for men. Factors associated with elevated HIV risk in men were similar to those associated with increased HIV risk in women (see Tables 7 & 8).

Discussion

The relatively high prevalence of age and socio-economically discordant partnerships found in the study (22% and 30% respectively) are in line with estimates from other studies. The review of the transactional sex literature by Luke (2005) found several studies that report that between 12 and 25 percent of women/girl's partners are more than ten years older (Laga et al. 2001; Gregson et al. 2002; Kelly et al. 2003; Lydie et al. forthcoming). Several studies that have examined age asymmetries have found that few girls appear to have partners of the same age and very few have ones who are younger (Calves and Meekers 1997; Konde-Lule et al. 1997; Kelly et al. 2003). On the other hand, the single item measure of exchange sex asked to women in 2003 revealed very few women (only 1.4% of the sample) that reported ever having exchange sex for money, gifts or favors, suggesting this more explicit version of exchange may be relatively less common than previously believed.

The study found that women in age asymmetric relationships were 1.59 times more likely to be infected with HIV than women in age homophilous relationships. These results suggest that age asymmetries are an important predictor of female HIV risk, though it is not exactly clear why. None of the behavioral variables that might explain this relationship were significant predictors of HIV, nor did their inclusion in the model reduce the significance of age asymmetry on HIV risk. Although certain risk cofactors were found to significantly predict HIV infection, such as male and female circumcision and the presence of an STD, these heightened vulnerabilities alone cannot explain HIV risk without a plausible exposure mechanism. Power measures were also not associated with HIV risk, nor did they diminish the influence of age asymmetries on HIV risk. Separate analysis of age asymmetries as a predictor of relationship power did not show that being in an asymmetrical relationship was associated with lower relationship power. Neither were external partners for either men or women associated with HIV infection, although being in polygamous union was associated with elevated HIV risk. As HIV must enter the relationship through some biologically plausible mechanism, the lack of significance of external partners could be an artifact of the social desirability bias that is pervasive in self-reported sexual behavior questions, especially in women (Gersovitz et al 1998; Hewett 1004; Nnko 2004).

Examining more closely the mechanisms that might explain this relationship, this study appears to support a more nuanced picture of female HIV risk vis-à-vis male power. Age asymmetries are indeed associated with higher HIV risk in women, but the association with a larger time between age at first sex and age at first marriage in women suggests that a selection mechanism may be at play- women may be introducing HIV into relationships, either by already being HIV infected upon entry in the relationship, or subsequently contracting HIV. Furthermore, though serodiscordance was not explicitly examined in this analysis, women in couples had higher rates of HIV infection, so it is clear that there are some couples in which the woman is positive and the man is negative. While a "female vulnerability" paradigm has served as a corrective to earlier literature that either ignored women's HIV risk or portrayed women (especially sex workers) as disease vectors, recent literature has increasingly problematized this paradigm, with mounting evidence that HIV risk cuts both ways and increasing attention to how masculinities and the intersection of various structural forces shape heterosexual men's HIV risk (Higgins, Hoffman, Dworkin, 2010). As Higgins, Hoffman and Dworkin (2010) point out, "especially in more generalized epidemics, women and men may be infecting each other in far more balanced numbers than previously believed" [p. 441].

Overall, men married later and spent more time sexually active before marriage, however, this was not associated with HIV risk in their female partners or for the men themselves. Men also were not more likely than women to endorse attitudes favoring male power. For instance, nearly 50% of men compared with 38% of women reported that wife beating was not justified in any of the circumstances asked about in the survey.

A key limitation to this study is that, due to the sampling procedures, it is only generalizable to married or otherwise cohabitating couples. We do not have information on the partners of individuals in couples. Another limitation are the sexual behavior measures, which ask only about non-marital sexual partners in the past year and the number of lifetime partners is only ascertained in 2008 and not 2003. The limitations of self-reported measures of sexual behavior and women's tendency to underreport other partners is well known (Higgins, Hoffman, Dworkin, 2010). Underreporting of sexual behaviors among women has been suggested to be a potential explanation for null findings in studies of age and economic asymmetries and HIV risk. The fact that educational asymmetries became significant with the inclusion of covariates suggests possible unaccounted for collinearity. Cohort studies are needed to parse out different mechanisms.

Conclusions

Age and educational asymmetries were found to be relatively common. While age asymmetries are associated with a higher HIV risk for women, economic asymmetries are not, and the exact mechanisms explaining the association with women's heightened HIV risk in these relationship is not entirely clear since men having other partners, a biologically plausible mechanism for HIV to be introduced into a relationship, is not associated with women's HIV risk, or the reverse (women having multiple partners).

This suggests potential limitations to sexual behavior questions including the fact that it only captures other partners in the past year and relies on participant self-report.

TABLES AND FIGURES

Figure 1: Conceptual Model

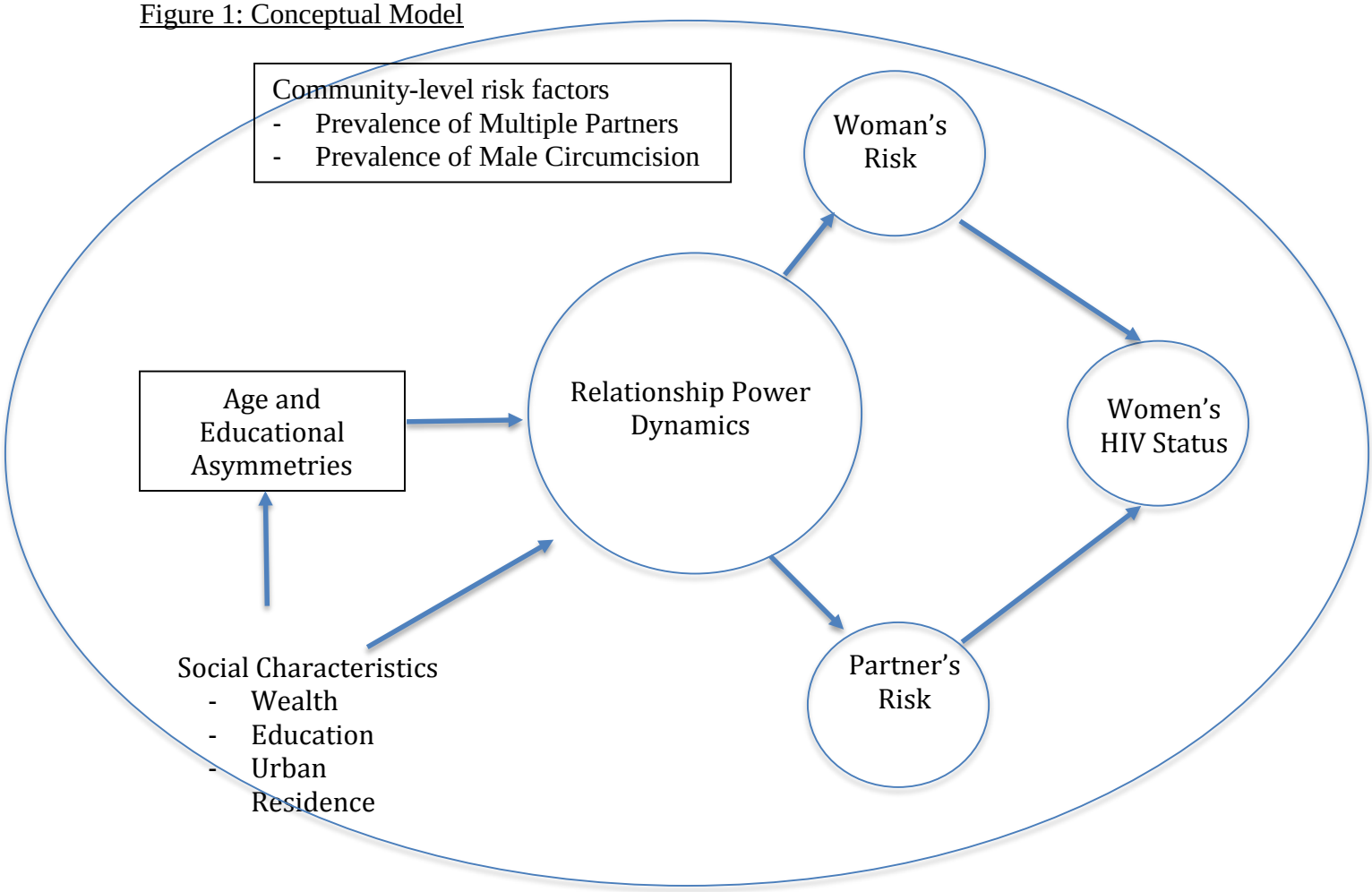

Table 1: Couple, Male and Female Descriptive Characteristics of Sample

	Women (%)	*Men (%)*	*Couple (%)*
HIV+	7.48	6.47	
Age Asymm Relationship			21.9
Edu Asymm Relationship			29.12
External Partner	1.13	7.64	
Decision making power (woman little to no control of decisions)	17.87		
Wife beating justified (never justified)	38.45	49.25	
Age btw first sex & first marriage (median)	1	6	
Polygamous Union			10.76
STD (sore) past 12m	2.82	1.92	
Education (median yrs)	5.44	5.20	
Age (median)	29	36	
Circumcision (female, male)	36.31	86.98	

Table 2: Differences between 2003 and 2008 chi square tests unless otherwise specified

	DHS 2003 n= 1116 (weighted)	*DHS 2008 n= 1294 (weighted)*	*P value*
Female age (median, IQR)	29 (12)	29 (12)	1.0
Male age (median, IQR)	36 (13)	35 (14)	0.82
HIV prevalence females (N, %)	92 (8.2 %)	81 (6.3%)	0.07
HIV prevalence males (N, %)	72 (6.5%)	75 (5.8%)	0.51
Intergenerational Relationship (N, %)	252.3 (21%)	248.0 (19%)	0.25

Table 3: Demographic factor differences in prevalence of HIV positive females

	HIV positive female n=173 (weighted)	*HIV negative female n=2237 (weighted)*	*OR (CI)*	*P value*
Age median (IQR)	27.0 (10)	29. 0 (12)	**0.9 (0.9-1.0)**	**<0.01**
Basic literacy	148 (85.4%)	1772 (79.2%)	**1.3 (1.0-1.9)**	**0.05**
Religion				0.683
Catholic	43 (25.0%)	531 (23.7%)	1.0 (0.7-1.5)	
Protestant	121 (70.0%)	1504 (67.2%)	ref	
Muslim	6 (3.4%)	150 (6.7%)	0.4 (0.2-1.1)	
Other	3 (1.6%)	53 (2.4%)	0.6 (0.2-1.9)	
*Urban residence**	58 (33.8%)	531 (23.8%)	**2.0 (1.5-2.7)**	**<0.01**
Household wealth				**<0.01**
Poorest	23 (13.3%)	422 (18.9%)	1.1 (0.6-1.9)	
Poor	34 (19.6%)	409 (18.3%)	1.6 (0.9-2.8)	
Middle	21 (12.2%)	415 (18.6%)	ref	
Richer	33 (19.2%)	441 (19.7%)	1.5 (0.8-2.6)	

Richest	62 (35.7%)	549 (24.6%)	**2.2 (1.3-3.6)**	
Education				**0.01**
None	8 (4.4)	247 (11.1%)	**0.3 (0.2-0.7)**	
Primary	119 (69.2%)	1344 (60.1%)	Ref	
Secondary	39 (22.5%)	512 (22.9%)	0.9 (0.6-1.2)	
Tertiary	6.7 (3.9%)	134 (6.0%)	0.6 (0.3-1.1)	

*vs rural

Table 4: Behavioral factor differences in prevalence of HIV positive females

	HIV positive female (n=173)	*HIV negative female (n=2237)*	*OR (CI)*	*P value*
Age discordant couple	51 (29.2%)	435 (19.5%)	**1.7 (1.2-2.4)**	**<0.01**
Educational discordant couple	52 (30.4%)	636 (28.4%)	1.1 (0.8-1.5)	0.86
Extramarital partner				
Male	17 (9.9%)	150 (6.7%)	1.5 (0.9-2.6)	0.11
Female	3 (1.8%)	23 (1.0%)	1.8 (0.5-5.9)	0.33
Polygamous union	41 (23.6%)	251 (11.2%)	**2.4 (1.7-3.6)**	**<0.01**
Age first sex (female)				**<0.01**
<15	85 (49.0%)	575 (25.7%)	**2.5 (1.80-3.5)**	
16-20	68 (39.4%)	1129 (50.4%)	ref	
>21	21 (11.7%)	534 (23.9%)	0.8 (0.5-1.4)	
STD sx last year				
Male	5 (2.7%)	50 (2.2%)	1.2 (0.5-3.2)	0.83
Female	10 (5.9%)	63 (2.8%)	**2.2 (1.1-4.3)**	**0.05**
*Paid for sex (male)**	0 (0%)	11 (0.5%)	NC	0.34

*did not have female variable

Table 5: Women's HIV Status by Age Asymmetry in Relationship

VARIABLES	1 OR(CI)	2 OR(CI)	3 OR(CI)	4 OR(CI)	5 OR(CI)	6 OR(CI)
Age Assymetric Relationship	1.59*** (1.12 - 2.24)	1.90** (1.13 - 3.17)	1.90** (1.13 - 3.17)	1.84** (1.08 - 3.13)	1.83** (1.04 - 3.21)	1.81** (1.03 - 3.18)
Urban residence		1.56 (0.89 - 2.70)	1.56 (0.89 - 2.70)	1.72** (1.00 - 2.96)	1.73* (0.98 - 3.05)	1.76* (1.00 - 3.10)
Wealth						
Quinitile 1 (ref)						
Quinitile 2		1.60 (0.88 - 2.90)	1.60 (0.88 - 2.90)	1.84** (1.00 - 3.36)	2.11** (1.12 - 3.93)	2.05** (1.09 - 3.82)
Quinitile 3		1.26 (0.66 - 2.41)	1.26 (0.66 - 2.41)	1.39 (0.72 - 2.69)	1.58 (0.80 - 3.10)	1.61 (0.81 - 3.16)
Quinitile 4		1.86* (0.98 - 3.51)	1.86* (0.98 - 3.51)	1.99** (1.03 - 3.81)	2.08** (1.05 - 4.10)	2.20** (1.11 - 4.33)
Quinitile 5		2.28** (1.07 - 4.84)	2.28** (1.07 - 4.84)	2.26** (1.05 - 4.84)	2.00* (0.90 - 4.44)	2.24** (1.01 - 4.92)
Education level (female)						
None						
Primary		2.02* (0.92 - 4.42)	2.01* (0.91 - 4.42)	1.95* (0.88 - 4.31)	1.52 (0.68 - 3.38)	1.33 (0.60 - 2.93)
Secondary		1.35 (0.56 - 3.24)	1.35 (0.56 - 3.24)	1.37 (0.56 - 3.30)	1.08 (0.43 - 2.65)	0.93 (0.38 - 2.27)
Tertiary		0.76 (0.24 - 2.41)	0.76 (0.23 - 2.42)	0.67 (0.20 - 2.20)	0.54 (0.16 - 1.81)	0.48 (0.14 - 1.59)
Education level (male)						
None						
Primary		1.19 (0.47 - 2.99)	1.20 (0.47 - 3.01)	1.49 (0.58 - 3.82)	1.13 (0.44 - 2.89)	1.02 (0.39 - 2.59)
Secondary		0.88 (0.33 - 2.32)	0.88 (0.33 - 2.33)	1.19 (0.44 - 3.22)	0.88 (0.32 - 2.41)	0.79 (0.29 - 2.15)
Tertiary		0.98 (0.33 - 2.86)	0.99 (0.33 - 2.89)	1.45 (0.48 - 4.36)	1.11 (0.36 - 3.41)	0.98 (0.32 - 3.01)
Wife beating justified scale (men)			1.01 (0.78 - 1.30)	0.99 (0.76 - 1.29)	1.00 (0.75 - 1.30)	1.00 (0.75 - 1.31)
Final decision making scale (female)			1.02 (0.81 - 1.26)	1.04 (0.83 - 1.30)	1.02 (0.81 - 1.28)	1.03 (0.82 - 1.29)
Polygamous Union				1.88*** (1.16 - 3.02)	1.72** (1.03 - 2.86)	1.66* (0.99 - 2.75)
1+ other sexual partner past year (women)					0.39 (0.07 - 1.96)	0.39 (0.07 - 1.93)
1+ other sexual partner past year (men)				1.04	1.00	0.99

				(0.60 - 1.79)	(0.57 - 1.76)	(0.56 - 1.73)
Years btw first sex & first marriage (female)						
None				0	0	0
1 to 5					1.18 (0.79 - 1.76)	1.17 (0.78 - 1.73)
6+					2.93*** (1.75 - 4.88)	2.90*** (1.73 - 4.84)
Years btw first sex & first marriage (male)						
None				0	0	0
1 to 5				1.53 (0.80 - 2.89)	1.55 (0.80 - 2.97)	1.51 (0.78 - 2.89)
6+				1.41 (0.76 - 2.59)	1.27 (0.68 - 2.38)	1.25 (0.67 - 2.33)
STD symptoms (sore) past year (female)					2.38** (1.14 - 4.93)	2.35** (1.13 - 4.87)
STD symptoms (sore) past year (male)				1.14 (0.45 - 2.84)	1.29 (0.51 - 3.28)	1.21 (0.47 - 3.06)
Circumcised (female)					0.51*** (0.31 - 0.84)	0.50*** (0.30 - 0.83)
Circumcised (male)				0.27*** (0.17 - 0.41)	0.31*** (0.18 - 0.51)	0.38*** (0.23 - 0.61)
% Non-marital partner past yr, region						1.00 (0.90 - 1.11)
% Men circumcised, region						0.98*** (0.96 - 0.99)
Constant	0.05*** (0.03 - 0.09)	0.02*** (0.00 - 0.08)	0.02*** (0.00 - 0.09)	0.02*** (0.00 - 0.11)	0.03*** (0.00 - 0.19)	0.19 (0.01 - 2.34)
Observations	2,434	2,424	2,424	2,401	2,246	2,246

*** p<0.01, ** p<0.05, * p<0.1

Age included but not shown

Table 6: Women's HIV Status by Educational Asymmetry in Relationship

	1	2	3	4	5	6
VARIABLES	Women's HIV, OR(CI)	Women's HIV, OR(CI)	Women's HIV, OR(CI)	Women's HIV, OR(CI)	Women's HIV, OR(CI)	Women's HIV, OR(CI)
Education Asymmetry	1.09	2.16**	2.16**	2.17**	2.08*	2.06*
	(0.780 - 1.530)	(1.049 - 4.435)	(1.049 - 4.437)	(1.033 - 4.558)	(0.949 - 4.559)	(0.940 - 4.507)
Urban residence		1.63*	1.63*	1.82**	1.83**	1.88**
		(0.942 - 2.831)	(0.943 - 2.835)	(1.058 - 3.140)	(1.037 - 3.246)	(1.062 - 3.322)
Wealth						
Quinitile 1 (ref)						
Quinitile 2		1.55	1.55	1.78*	2.08**	2.02**
		(0.855 - 2.810)	(0.855 - 2.811)	(0.973 - 3.255)	(1.114 - 3.872)	(1.082 - 3.767)
Quinitile 3		1.22	1.21	1.32	1.50	1.52
		(0.637 - 2.322)	(0.636 - 2.320)	(0.686 - 2.556)	(0.761 - 2.942)	(0.776 - 2.997)
Quinitile 4		1.83*	1.83*	1.94**	2.07**	2.18**
		(0.969 - 3.468)	(0.968 - 3.470)	(1.012 - 3.735)	(1.049 - 4.068)	(1.104 - 4.284)
Quinitile 5		2.16**	2.15**	2.11*	1.89	2.09*
		(1.018 - 4.564)	(1.014 - 4.562)	(0.984 - 4.526)	(0.852 - 4.188)	(0.951 - 4.604)
Education level (female)						
None						
Primary		3.08**	3.07**	2.99**	2.30*	2.02
		(1.273 - 7.468)	(1.267 - 7.454)	(1.215 - 7.351)	(0.905 - 5.860)	(0.799 - 5.122)
Secondary		2.69*	2.68*	2.77*	2.12	1.83
		(0.895 - 8.102)	(0.890 - 8.097)	(0.900 - 8.545)	(0.652 - 6.906)	(0.565 - 5.926)
Tertiary		2.43	2.41	2.26	1.74	1.51
		(0.484 - 12.225)	(0.477 - 12.192)	(0.420 - 12.108)	(0.294 - 10.286)	(0.258 - 8.874)
Education level (male)						
None						
Primary		0.88	0.88	1.10	0.87	0.79
		(0.346 - 2.236)	(0.344 - 2.245)	(0.418 - 2.884)	(0.329 - 2.289)	(0.299 - 2.069)
Secondary		0.38	0.38	0.50	0.40	0.36
		(0.111 - 1.294)	(0.110 - 1.302)	(0.140 - 1.819)	(0.107 - 1.486)	(0.099 - 1.342)
Tertiary		0.32	0.32	0.45	0.38	0.34
		(0.073 - 1.392)	(0.072 - 1.405)	(0.097 - 2.126)	(0.075 - 1.871)	(0.069 - 1.677)
Wife beating justified scale (men)			1.01	0.98	0.99	0.98
			(0.778 - 1.300)	(0.752 - 1.273)	(0.748 - 1.297)	(0.748 - 1.297)
Final decision making scale (female)			1.02	1.04	1.02	1.03
			(0.816 - 1.267)	(0.831 - 1.301)	(0.810 - 1.285)	(0.819 - 1.297)
Polygamous Union				1.95***	1.77**	1.71**
				(1.207 - 3.137)	(1.062 - 2.942)	(1.027 - 2.836)
Years btw first sex & first marriage (female)						
None						
1 to 5					1.15	1.13
					(0.774 - 1.706)	(0.763 - 1.682)
6+					2.93***	2.90***
					(1.757 - 4.876)	(1.739 - 4.836)
Years btw first sex & first marriage (male)						
None						
1 to 5				1.48	1.50	1.46
				(0.781 - 2.790)	(0.779 - 2.870)	(0.760 - 2.797)

6+				1.40	1.26	1.24
				(0.759 - 2.568)	(0.675 - 2.353)	(0.664 - 2.304)
1+ other sexual partner past year (women)					0.43	0.43
					(0.087 - 2.136)	(0.087 - 2.097)
1+ other sexual partner past year (men)				1.09	1.05	1.03
				(0.635 - 1.866)	(0.597 - 1.839)	(0.590 - 1.811)
STD symptoms (sore) past year (female)					2.46**	2.45**
					(1.187 - 5.094)	(1.185 - 5.057)
STD symptoms (sore) past year (male)				1.16	1.33	1.25
				(0.464 - 2.904)	(0.529 - 3.364)	(0.498 - 3.159)
Circumcised (female)					0.52***	0.50***
					(0.314 - 0.848)	(0.305 - 0.832)
Circumcised (male)				0.27***	0.31***	0.38***
				(0.171 - 0.418)	(0.187 - 0.511)	(0.234 - 0.612)
% Non-marital partner past yr, region						1.00
						(0.902 - 1.107)
% Men circumcised, region						0.98***
						(0.966 - 0.993)
Constant	0.06***	0.04***	0.04***	0.05***	0.07***	0.44
	(0.035 - 0.103)	(0.011 - 0.169)	(0.010 - 0.174)	(0.010 - 0.208)	(0.014 - 0.343)	(0.042 - 4.535)
Observations	2,434	2,424	2,424	2,401	2,246	2,246

*** p<0.01, ** p<0.05, * p<0.1
Age included but not shown

Table 7: Men's HIV Status by Age Assymetry in Relationship

VARIABLES	1 Male HIV, OR(CI)	2 Male HIV, OR(CI)	3 Male HIV, OR(CI)	4 Male HIV, OR(CI)	5 Male HIV, OR(CI)
Age Assymetric Relationship	1.37	1.57	1.29	1.24	1.23
	(0.932 - 2.023)	(0.895 - 2.760)	(0.703 - 2.375)	(0.662 - 2.310)	(0.655 - 2.295)
Urban residence		0.76	0.86	0.96	0.98
		(0.415 - 1.406)	(0.452 - 1.655)	(0.504 - 1.828)	(0.521 - 1.842)
Wealth					
Quinitile 1 (ref)		0	0	0	0
Quinitile 2		1.71*	2.05**	2.53***	2.48***
		(0.912 - 3.223)	(1.067 - 3.946)	(1.290 - 4.971)	(1.261 - 4.864)
Quinitile 3		1.64	1.87*	2.07**	2.07**
		(0.836 - 3.217)	(0.928 - 3.759)	(1.009 - 4.259)	(1.009 - 4.264)
Quinitile 4		2.59***	2.37**	2.75***	2.82***
		(1.314 - 5.087)	(1.157 - 4.869)	(1.314 - 5.768)	(1.347 - 5.904)
Quinitile 5		3.67***	2.97**	3.05**	3.25***
		(1.633 - 8.246)	(1.257 - 7.032)	(1.267 - 7.338)	(1.365 - 7.753)
Education level (female)					
None					
Primary		0.88	0.72	0.87	0.81
		(0.431 - 1.812)	(0.343 - 1.497)	(0.405 - 1.879)	(0.379 - 1.720)
Secondary		0.81	0.69	0.92	0.85
		(0.356 - 1.826)	(0.300 - 1.605)	(0.385 - 2.184)	(0.362 - 2.002)
Tertiary		0.40	0.28*	0.37	0.35
		(0.117 - 1.383)	(0.080 - 1.013)	(0.101 - 1.380)	(0.096 - 1.291)
Education level (male)					
None					
Primary		1.74	1.45	2.04	1.79
		(0.604 - 5.037)	(0.503 - 4.198)	(0.679 - 6.114)	(0.597 - 5.343)
Secondary		1.47	1.19	1.97	1.72
		(0.485 - 4.446)	(0.389 - 3.662)	(0.616 - 6.275)	(0.542 - 5.487)
Tertiary		1.06	0.98	1.61	1.41
		(0.304 - 3.689)	(0.275 - 3.489)	(0.432 - 6.010)	(0.380 - 5.248)
Wife beating justified scale (men)					
Never Justified		0	0	0	0
Sometimes justified		0.98	1.17	1.14	1.14
		(0.678 - 1.419)	(0.791 - 1.724)	(0.763 - 1.705)	(0.760 - 1.700)
Often/always justified		0.86	1.07	0.96	0.95
		(0.438 - 1.697)	(0.526 - 2.157)	(0.466 - 1.968)	(0.463 - 1.953)
Final decision making scale (female)					
Respondent little to no control		0	0	0	0
Respondent some control		0.66	0.66	0.70	0.72
		(0.394 - 1.114)	(0.385 - 1.136)	(0.404 - 1.222)	(0.412 - 1.243)
Respondent in control or joint most of the time		0.82	0.77	0.79	0.80
		(0.511 - 1.320)	(0.466 - 1.261)	(0.473 - 1.307)	(0.483 - 1.329)
Polygamous Union				1.45	1.40
				(0.833 - 2.516)	(0.805 - 2.426)
1+ other sexual partner past year (women)			2.09	1.88	1.90
			(0.646 - 6.741)	(0.548 - 6.474)	(0.555 - 6.486)
1+ other sexual partner past year (men)				1.48	1.47
				(0.822 - 2.650)	(0.818 - 2.635)
Years btw first sex & first marriage (female)					
None					

1 to 5			1.03	1.02	1.00
			(0.676 - 1.567)	(0.660 - 1.562)	(0.647 - 1.537)
6+			2.00**	2.05**	2.03**
			(1.144 - 3.485)	(1.162 - 3.625)	(1.149 - 3.595)
Years btw first sex & first marriage (male)					
None					
1 to 5				0.96	0.96
				(0.502 - 1.840)	(0.500 - 1.831)
6+				0.67	0.67
				(0.359 - 1.251)	(0.361 - 1.252)
STD symptoms (sore) past year (female)			1.77	1.78	1.75
			(0.787 - 3.992)	(0.774 - 4.089)	(0.761 - 4.046)
STD symptoms (sore) past year (male)				1.32	1.26
				(0.490 - 3.563)	(0.469 - 3.388)
Circumcised (female)			0.25***	0.48***	0.45***
			(0.146 - 0.413)	(0.271 - 0.836)	(0.254 - 0.797)
Circumcised (male)				0.23***	0.28***
				(0.138 - 0.400)	(0.168 - 0.472)
% Non-marital partner past yr, region					0.98
					(0.868 - 1.101)
% Men circumcised, region					0.97***
					(0.956 - 0.986)
Constant	0.04***	0.01***	0.03***	0.04***	0.70
	(0.023 - 0.078)	(0.002 - 0.093)	(0.004 - 0.213)	(0.006 - 0.344)	(0.044 - 11.244)
Observations	2,397	2,387	2,229	2,211	2,211

*** p<0.01, ** p<0.05, * p<0.1

Age included but not shown

Table 8: Men's HIV Status by Education Assymetry in Relationship

VARIABLES	1 Male HIV, OR(CI)	2 Male HIV, OR(CI)	3 Male HIV, OR(CI)	4 Male HIV, OR(CI)	5 Male HIV, OR(CI)
Education Assymetry	1.18	1.68	1.62	1.63	1.58
	(0.823 - 1.706)	(0.789 - 3.569)	(0.727 - 3.618)	(0.717 - 3.692)	(0.695 - 3.576)
Urban residence		0.79	0.89	0.99	1.02
		(0.429 - 1.457)	(0.461 - 1.698)	(0.520 - 1.896)	(0.538 - 1.917)
Wealth					
Quinitile 1 (ref)					
Quinitile 2		1.67	2.02**	2.51***	2.45***
		(0.889 - 3.135)	(1.048 - 3.881)	(1.278 - 4.928)	(1.250 - 4.820)
Quinitile 3		1.59	1.80*	2.01*	2.01*
		(0.811 - 3.110)	(0.894 - 3.630)	(0.977 - 4.140)	(0.977 - 4.143)
Quinitile 4		2.57***	2.32**	2.73***	2.79***
		(1.305 - 5.044)	(1.128 - 4.766)	(1.302 - 5.720)	(1.331 - 5.841)
Quinitile 5		3.50***	2.79**	2.95**	3.14**
		(1.556 - 7.860)	(1.177 - 6.624)	(1.223 - 7.112)	(1.314 - 7.502)
Education level (female)					
None					
Primary		1.23	0.97	1.21	1.10
		(0.505 - 3.001)	(0.386 - 2.448)	(0.466 - 3.123)	(0.426 - 2.816)
Secondary		1.37	1.13	1.55	1.39
		(0.429 - 4.406)	(0.335 - 3.800)	(0.445 - 5.409)	(0.403 - 4.830)
Tertiary		0.92	0.61	0.88	0.78
		(0.158 - 5.382)	(0.092 - 4.009)	(0.126 - 6.113)	(0.113 - 5.444)
Education level (male)					
None					
Primary		1.33	1.18	1.60	1.43
		(0.437 - 4.024)	(0.386 - 3.609)	(0.502 - 5.079)	(0.451 - 4.529)
Secondary		0.79	0.72	1.11	1.02
		(0.193 - 3.231)	(0.171 - 3.035)	(0.250 - 4.935)	(0.231 - 4.478)
Tertiary		0.46	0.45	0.72	0.67
		(0.081 - 2.556)	(0.075 - 2.750)	(0.111 - 4.637)	(0.104 - 4.266)
Wife beating justified scale (men)					
Never Justified					
Sometimes justified		0.97	1.15	1.14	1.13
		(0.669 - 1.401)	(0.777 - 1.707)	(0.760 - 1.700)	(0.757 - 1.695)
Often/always justified		0.87	1.09	0.97	0.96
		(0.441 - 1.706)	(0.534 - 2.215)	(0.470 - 1.985)	(0.465 - 1.962)
Final decision making scale (female)					
Respondent little to no control					
Respondent some control		0.65	0.63	0.69	0.71
		(0.387 - 1.097)	(0.366 - 1.100)	(0.397 - 1.204)	(0.406 - 1.228)
Respondent in control or joint most of the time		0.82	0.73	0.78	0.79
		(0.508 - 1.314)	(0.435 - 1.216)	(0.468 - 1.295)	(0.478 - 1.318)
Polygamous Union				1.48	1.43
				(0.855 - 2.572)	(0.827 - 2.481)
1+ other sexual partner past year (women)			2.21	1.96	1.97
			(0.700 - 7.005)	(0.577 - 6.663)	(0.583 - 6.666)
1+ other sexual partner past year (men)				1.50	1.49
				(0.836 - 2.697)	(0.831 - 2.679)
Years btw first sex & first marriage (female)					
None					

1 to 5			1.01	1.01	0.99
			(0.666 - 1.546)	(0.657 - 1.557)	(0.645 - 1.532)
6+			2.00**	2.07**	2.05**
			(1.146 - 3.495)	(1.173 - 3.655)	(1.158 - 3.621)
Years btw first sex & first marriage (male)					
None					
1 to 5				0.94	0.93
				(0.489 - 1.795)	(0.488 - 1.791)
6+				0.66	0.66
				(0.354 - 1.233)	(0.357 - 1.237)
STD symptoms (sore) past year (female)			1.86	1.82	1.80
			(0.826 - 4.172)	(0.797 - 4.153)	(0.784 - 4.113)
STD symptoms (sore) past year (male)				1.36	1.29
				(0.502 - 3.662)	(0.480 - 3.482)
Circumcised (female)			0.25***	0.48***	0.45***
			(0.148 - 0.419)	(0.271 - 0.834)	(0.254 - 0.795)
Circumcised (male)				0.24***	0.28***
				(0.138 - 0.401)	(0.168 - 0.472)
% Non-marital partner past yr, region					0.97
					(0.866 - 1.098)
% Men circumcised, region					0.97***
					(0.956 - 0.986)
Constant	0.04***	0.03***	0.03***	0.05***	0.88
	(0.024 - 0.080)	(0.005 - 0.138)	(0.006 - 0.196)	(0.009 - 0.330)	(0.064 - 12.027)
Observations	2,397	2,387	2,229	2,211	2,211

Age included but not shown

*** p<0.01, ** p<0.05, * p<0.1

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