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## Abstract

We investigate the relationship between intimate partner violence (IPV) and HIV among married women using Demographic and Health Survey data from ten sub-Saharan African countries, and find a strong association. The association is due to higher HIV risk among violent men; neither women's decreased ability to protect themselves from HIV transmission within marriage, nor their risky sexual behavior, explains the link. Thus, it is not violence per se that drives the spread of HIV, but the fact that violent men are more likely to become HIV positive and then infect their wives. Programs that aim at reducing HIV by eliminating IPV should therefore also focus on men's risky sexual behavior.

**Keywords:** AIDS, domestic violence, gender inequality, HIV, intimate partner violence, sub-Saharan Africa

**JEL**: I14, I15, J12

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## 1. Introduction

In 2012, there were roughly 2.3 million new human immunodeficiency virus (HIV) infections and 1.6 million deaths from acquired immunodeficiency syndrome (AIDS) worldwide (UNAIDS, 2013). Of these, 1.4 million new infections and 1.2 million deaths occurred in sub-Saharan Africa, where one in 20 adults is HIV positive. HIV/AIDS thus continues to be a major threat to social and economic development in many African countries.

Many factors drive the spread of HIV: the economics literature has dealt with mobile populations (Corno and de Walque, 2012; Oster, 2012), competing health risks (Oster, 2005), economic shocks (Robinson and Yeh, 2011; Wilson, 2012), and economic inequality (Durevall and Lindskog, 2012). In other fields and in policy discussions, gender based violence is considered one of the key factors (Dunkle et al., 2004; UNAIDS, 2012, WHO, 2013). According to UNAIDS (2011 p. 17), one in seven new HIV infections could have been avoided by preventing intimate partner violence (IPV). This statement is based on Jewkes et al. (2010), who analyzed longitudinal data on young women from Eastern Cape Province in South Africa. Prevention programs focusing on IPV are thus expected to reduce HIV rates substantially. However, a recent multi-country study with nationally representative data not only questions whether IPV causes HIV, but even suggests that there is no association between them (Harling et al., 2010).

Using twelve Demographic and Health Surveys (DHSs) from ten countries, we first evaluate whether there is an association between IPV and HIV among married women[1] in sub-Saharan Africa. Because we find an association (in contrast to Harling et al. (2010)), we then evaluate the main suggested links between IPV and HIV. First, IPV might reduce women's ability to protect themselves from infection within marriage because of sexual violence and increased infectivity or inability to demand safe or no sex. Second, IPV might increase the probability that women will contract HIV outside marriage due to risky sex. Third, women's risky sexual behavior or HIV-

[1] We use the terms married, husband, and wife for simplicity, although the data includes both married women and those living with a man, i.e., all women who are in a union.

positive status might trigger violence. Finally, violent men might be more likely to get infected outside marriage than other men, i.e., women are infected not because of IPV but because their husbands are HIV positive (Anderson et al., 2008; Jewkes, 2010).

In the ten countries studied, 20% to 50% of married women report IPV in their current union. IPV is thus common enough to play an important role in explaining the spread of HIV.[2] Furthermore, several studies have found a strong positive association between IPV and HIV infection (WHO, 2013), and a causal effect has been suggested (Andersson, et al. 2008; Jewkes, 2010; Silverman et al. 2010). Yet, most studies use small, non-random, cross-section samples, such as women visiting health clinics. There are prospective (follow-up) studies establishing a causal link between rape and HIV infection, but rape is hardly the major cause of the HIV epidemic (Dude, 2011). Other studies use indirect evidence, such as the connection between childhood sexual abuse and HIV infection later in life (Anderson et al., 2008). Three studies use panel data from sub-Saharan countries: Jewkes et al.'s (2010) study, mentioned above, and called a landmark study by UNAIDS (2011:17); Were et al. (2011), who fail to find that IPV increases the risk of infection in a sample of HIV discordant couples in Eastern and Southern Africa, though already infected women were more likely to report IPV; and Kouyoumdjian et al. (2013), who report that women exposed to IPV in a sample from rural Uganda are 55% more likely than other women to get infected within a year.

Three studies analyze nationally representative data, including sub-Saharan African countries. Dude (2011) and Kayibanda et al. (2012), using the Rwanda 2005 DHS, find an impact of IPV on HIV: exposed women are roughly two to three times more likely to be HIV positive than others. The most comprehensive study, Harling et al. (2010), finds no statistically significant positive effects in six DHSs from sub-Saharan Africa and three from other less developed countries.

Jewkes et al. (2010) and Kouyoumdjian et al. (2013) also address the issue of causal mechanisms, but the paucity of information on men in their samples is a limiting factor. Jewkes et al.'s (2010) claim that IPV causes HIV is thus questioned by Castor et al. (2010) and Epstein (2010), who note

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[2] See Devries et al. (2013) for data on IPV across the world.

that HIV acquisition outside the marital relationship, with reverse causality due to infidelity by either partner, could be the main reason for the association.

We use all sub-Saharan DHSs that have HIV testing and a complete module on domestic violence available as of mid-2013. The data are from countries with generalized HIV epidemics, i.e., where at least 1% of the adult population is HIV positive. Three of them – Malawi, Zambia, and Zimbabwe – have very high prevalence rates (over 10%), while Côte d'Ivoire, Gabon, Kenya, and Rwanda are lower (about 5%), and Burkina Faso, Mali and Liberia are still lower (somewhat over 1%). There are two DHSs for Malawi and Zimbabwe.

Our main analysis is based on logit regressions on samples of married women, but we also estimate linear probability models and nonparametric nearest-neighbor matching models with bias-correction (Abadie and Imbens, 2011) as robustness checks. The data is pruned to avoid extrapolation, i.e., to improve overlap between women exposed to and not exposed to IPV (Crump et al., 2009). We also restrict the sample to within-country regions with at least a 1% HIV prevalence rate, since the power of the test is small when there are very few HIV-positive individuals. To analyze potential links, we use information about the husband's HIV status. Women with HIV-positive husbands are analyzed separately to investigate the hypothesis that IPV increases the transmission from husband to wife; women with HIV-negative husbands are analyzed separately to investigate the hypothesis that IPV is triggered by, or increases, women's sexual risk-taking. Then, to investigate the hypothesis that violent men are more likely to become infected with HIV, both women with HIV-positive husbands and women with HIV-negative husbands are analyzed together.

We find that IPV is associated with an increased probability of HIV infection. A woman subject to IPV is 15%-20% more likely to be HIV positive than other married women, which is close to Jewkes et al.'s (2010) one in seven (≈14%). The association is related to physical and emotional violence, not to sexual violence.

When we use samples conditional on the husband being either HIV positive or negative, there is no significant difference in HIV status between women subject to IPV and those who are not. Thus neither women's decreased ability to protect themselves from HIV transmission within marriage, nor their risky sexual behavior outside marriage, seems to be the major reason for the association.

But when both women with HIV-positive husbands and women with HIV-negative husbands are included, we find significant differences. This suggests that IPV is primarily associated with HIV infection among women because violent men are more likely to be HIV positive and thus infect their wives, not because of a causal impact of IPV. This conclusion is supported by a strong association between IPV and men's HIV risk in a sample of men whose wives are HIV negative.

One conclusion is, thus, that we cannot expect HIV prevention programs focusing on IPV to automatically reduce HIV incidence unless they also aim at, and succeed in, reducing risky sexual behavior. Some programs deal with gender norms, but there seems to be too little, if any, emphasis on men's risk behavior, as is evident from WHO (2010) and the review by Heise (2012).

The next section elaborates on potential links between IPV and HIV infection and describes our empirical strategy to investigate them. Section 3 describes the data, Section 4 outlines the econometric model, and Section 5 reports the main results as well as results of the robustness checks. Section 6 summarizes the findings and draws conclusions.

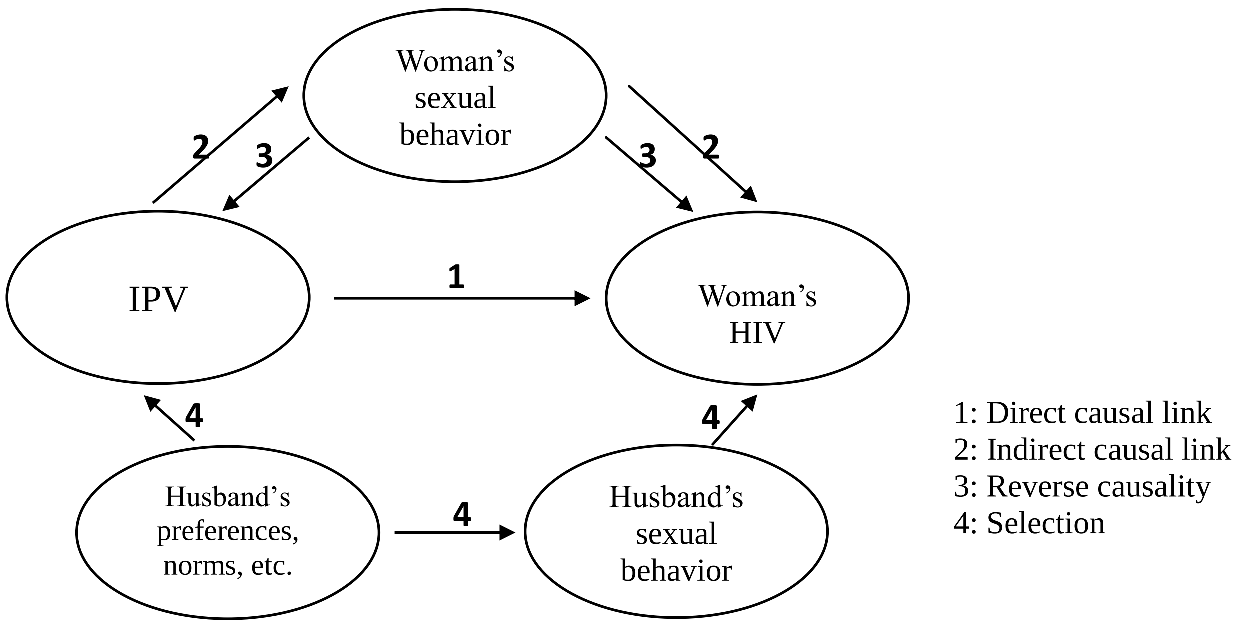
## 2. Intimate partner violence and HIV infection among women

### *2.1 The theoretical links*

In economics, IPV is modeled either as a source of utility, perhaps because it releases frustration (Farmer and Tiefenthaler, 1997; Card and Dahl, 2011), or as an instrument to control women, in order to align household bargaining outcomes with those of the husband, or even to extract resources from the wife's family (Tauchen et al., 1991; Bloch and Rao, 2002). IPV also depends on women's out-of-marriage options, since it increases the likelihood of separation. Thus, IPV decreases both when divorce becomes more feasible (Stevenson and Wolfers, 2006) and when women's out-of-marriage economic prospects improve (Aizer, 2010). The focus on women's out-of-marriage options seems to be specific to economics, while less attention is paid to norms and childhood experiences than in other disciplines. Heise (2012) provides a good overview of theories on IPV in different disciplines.

Whether the violence is a direct source of utility or is an instrument to obtain utility, the violence itself, with the exception of sexual violence, cannot spread HIV. So what could be the reason behind an association? There are four links between IPV and sexual transmission of HIV, which is by far the most common mode of transmission among adults in sub-Saharan Africa. These links are illustrated in Figure 1.

**Figure 1: Potential links between IPV and a woman's HIV infection among couples**




First, there could be a direct causal link between IPV and HIV. Most obviously, HIV can be directly transmitted during forced sex, both due to a higher frequency of sexual acts and to increased risk of transmission per act. Even without explicitly forced sex, women subject to physical or emotional violence might be less able to demand safe sex or abstain from sex when their partner is known to be, or suspected of being, HIV positive (Anderson et al., 2008; Jewkes, 2010). The term choice disability has sometimes been used to describe this link. Violence thus works as a bargaining instrument that shifts household outcomes towards those preferred by the violent husband (where he is assumed to want more unprotected sex).

Second, there might be an indirect causal link, where IPV could either increase or decrease a woman's sexual risk-taking outside of marriage. If violence is used as an instrument to control women, one might suspect a decrease. However, in sub-Saharan Africa, there is evidence that IPV is associated with increased risky sexual behavior on part of the woman, such as transactional sex, sex work, having more partners, having sex while intoxicated, etc. (Andersson et al., 2008). This could be understood as a way to search for outside options or as a consequence of depression and reduced self-esteem. IPV could also lead to separation, which is likely to increase the number of new sexual partners of the woman.

Third, there could be reverse causality, with women's high-risk behavior causing IPV. For example, HIV-infected women could be subject to violence because of their HIV status (Were et al, 2011; Kayibanda et al., 2012). Although HIV testing was not widespread until recently in most of SSA, and most people were unaware of their HIV status, risky behavior itself could trigger violence, either in an attempt to control the woman's behavior or as a consequence of anger and frustration.

Fourth, the association between IPV and HIV could depend on selection, i.e., violent men also have risky sexual behavior. For example, some norms of masculinity could encourage both men's sexual risk-taking and their use of violence to control women (Harrison et al., 2006; Silverman et al., 2007; Jewkes 2010). Low attachment and high aggression could also increase both partner violence and sexual risk-taking, where the low attachment and high aggression could be either genetic personality traits among some men, as claimed by some evolutionary psychologists (Paulhus and Williams, 2002), or the outcome of traumatic childhood experiences, as claimed by some developmental psychologists (Ehrensaft and Cohen, 2003). Furthermore, both violence and risky sex could be related to lack of self-control.

### *2.2 How to identify links*

If IPV and HIV are associated, policy implications depend on the link. Our strategy to disentangle potential links is to condition samples of women on the HIV status of the husband.

When women subject to IPV are unable to protect themselves from unwanted sex within the marriage (the direct causal link), we would expect IPV to be positively associated with HIV among women whose husbands are HIV positive, since a violent HIV-infected husband is more likely to transmit the virus to his wife.

On the other hand, when IPV increases women's sexual risk-taking outside of marriage (the indirect causal link), or when HIV or risky behavior triggers violence (reverse causality), we would expect

IPV to be associated with HIV among women whose husbands are HIV negative. We are not able to separate the indirect causal link from reverse causality using this strategy.

When violent men also tend to take sexual risks outside of marriage (selection), we would expect IPV to be associated with an increased risk of having a HIV-positive husband. Hence, IPV would be associated with HIV in samples that include both women whose husbands are HIV positive and women whose husbands are HIV negative. But we would not expect IPV to be associated with HIV in samples of women that are conditional on the HIV status of the husband. In the robustness analysis, we also analyze the HIV status of men with HIV-negative wives in light of men's reported sexual behavior.[3]

When using the sample of women with HIV-positive husbands, we do not estimate the probability of transmission from husband to wife, since women who infected their husbands will also be in the sample. Still, given the large number of discordant couples, a higher transmission rate from husband to wife due to violence should show up in this sample. Relatedly, when using the sample of women with HIV-negative husbands, we do not estimate the probability of women getting infected by someone other their husband, since the women who have already infected their husbands are excluded. Again, considering the large number of discordant couples, higher out-of-marriage infection rates of women exposed to violence should be observable in our sample.

## 3. Data

We use twelve DHSs from ten countries:[4] Burkina Faso, Côte d´Ivoire, Gabon, Kenya, Liberia, Malawi (2), Mali, Rwanda, Zambia, and Zimbabwe (2). The DHSs are nationally representative.

[3] Instead of dividing up the samples, we could have used interaction terms. However, our approach provides a more intuitive interpretation of the results.

[4] There is data on HIV status and intimate partner violence in Kenya for 2003, Rwanda for 2010 and Cameroon for 2013. However, the first two lack information about violence among the parents of the women, an important control variable; Rwanda 2010 does not have a module on emotional violence; and Cameroon 2013 does not have information on HIV status and IPV from the same women. We exclude these surveys from the analysis, even though the results are similar when Kenya 2003 and Rwanda 2010 are included.

Detailed information is available at ORC Macro (2012). All women aged 15-49, and men aged 15-54 (sometimes 15-59), either in all households or in subsamples, were eligible for interviews. HIV testing was carried out voluntarily in those households where men were eligible for interviews. Information was also collected about a range of family and individual factors, sexual behavior, and IPV. The IPV questions were, however, asked only of one eligible woman in each household, with no one else aware of the questions. Currently-married women were asked about IPV in their current union; formerly-married women were asked about their last union.

Questions about violence are classified as physical, emotional, or sexual. The actual questions are specific, such as "does/did your husband slap you, punch you with his fist, twist your arm, etc.?", making the results less culturally bound than would general questions about violence. Multiple questions also give multiple openings to report violence (Kishor and Johnson, 2004). Nevertheless, there could still be underreporting. Sexual violence might be the most challenging to measure accurately due to stigma and shame. Sexual violence questions could also be more open to interpretation than physical violence questions, since it might not always be clear whether the sexual act was forced in cases without explicit physical violence. Relatedly, physical and emotional violence might make sexual violence redundant.

Our main sample consists of almost 26,000 women with both HIV and IPV data. It is restricted to married women (in union) because we lack information about the spouse when the woman is widowed or separated. As a robustness check, we use two alternative samples: all women who have ever been married ('ever-married women') and women in their first marriage who report no premarital sex and no extramarital sex during 12 months prior to the interview. The samples are limited to regions with a generalized epidemic (HIV rate above 1.0%), since it is very unlikely that a relationship between IPV and HIV can be detected when there is almost no HIV. When an association is due to differences in sexual behavior, those differences are of course more likely to result in differences in HIV status if there is more HIV in the region. We also estimated models with women from high HIV prevalence regions only (HIV rate above 7%, which is the sample mean).

Table 1 reports country/survey level data on HIV prevalence rates for married women, married men, and couples divided up into the following three groups: 'both spouses are infected', 'only the woman is infected', and 'only the man is infected'. Note that men in polygamous marriages can be part of more than one couple.

HIV prevalence rates among married women and men range from 1.2% and 1%, respectively, in Burkina Faso in 2010 to 19.1% and 22.1% in Zimbabwe in 2005/06. Differences between married women and men within countries tend to be small. A comparison of couples shows that discordant couples are common, which is good for our empirical strategy to investigate links.

**Table 1: HIV prevalence rates (%) for married women and men**

| | Married women HIV+ | Married men HIV+ | Both spouses HIV+ | Only the wife is HIV+ | Only the husband is HIV+ |
|---|---|---|---|---|---|
| Burkina Faso, 2010 | 1.2 | 1.0 | 0.2 | 0.7 | 0.6 |
| Côte d´Ivoire 2011/12 | 4.6 | 4.3 | 1.8 | 2.7 | 2.4 |
| Gabon 2011 | 6.0 | 4.4 | 1.3 | 4.6 | 2.6 |
| Kenya, 2008 | 7.1 | 6.9 | 3.6 | 3.3 | 3.1 |
| Liberia, 2006 | 1.8 | 1.5 | 3.5 | 1.3 | 0.9 |
| Mali, 2007 | 1.5 | 1.0 | 0.3 | 0.9 | 0.4 |
| Malawi, 2004 | 13.9 | 14.0 | 7.6 | 4.5 | 5.3 |
| Malawi, 2010 | 10.5 | 11.0 | 6.5 | 3.3 | 4.8 |
| Rwanda, 2005 | 2.8 | 3.3 | 1.9 | 0.9 | 1.5 |
| Zambia, 2007 | 15.0 | 16.0 | 8.6 | 4.7 | 6.8 |
| Zimbabwe, 2005/06 | 19.1 | 22.1 | 14.2 | 5.0 | 7.3 |
| Zimbabwe, 2010/11 | 16.6 | 18.5 | 10.8 | 4.9 | 7.2 |

Notes: Columns 1 and 2 show the shares of all married women and men, irrespective of whether we have information about their spouses' HIV status. Columns 3, 4, and 5 show shares of all married couples.

Table 2 reports the share of married women who have experienced IPV, grouped according to type of violence: physical, emotional, and sexual. In most countries, about one-third of the married women report having been subject to physical violence from their husbands. The exceptions are Burkina Faso (10.7%), Mali (17.7%), Zambia (46%) and Rwanda 2010 (56%). Emotional violence ranges from 9.3% in Burkina Faso to 36% in Liberia. Sexual violence is less common, varying between 1.3% in Burkina Faso and 17.6% in Rwanda 2010.

**Table 2: Percentages of married women who have experienced IPV**

| | Physical | Emotional | Sexual |
|---|---|---|---|
| Burkina Faso, 2010 | 10.7 | 9.3 | 1.3 |
| Côte d´Ivoire 2011/12 | 24.5 | 17.5 | 4.8 |
| Gabon 2011 | 46.4 | 33.8 | 14.1 |
| Kenya, 2008 | 36.4 | 28.5 | 14.1 |
| Liberia, 2006 | 36.7 | 36.5 | 9.4 |
| Mali, 2007 | 17.7 | 10.3 | 3.7 |
| Malawi, 2004 | 20.2 | 12.5 | 13.3 |
| Malawi, 2010 | 21.6 | 25.8 | 16.6 |
| Rwanda, 2005 | 34.2 | 12.8 | 14.0 |
| Zambia, 2007 | 46.0 | 25.0 | 16.6 |
| Zimbabwe, 2005/06 | 30.3 | 31.0 | 13.8 |
| Zimbabwe, 2010/11 | 28.4 | 25.3 | 14.7 |

The overall response rates in the DHSs are very good, usually over 95%. But not everyone eligible for HIV testing and the domestic violence module could or wanted to participate. Appendix 1 presents an analysis of missing data. It is hard to draw any firm conclusions about potential biases resulting from missing data, but the analysis suggest that an under-estimation of the IPV-HIV association is more likely than an over-estimation.

## 4. Econometric Models

In our main analysis, we use logit regression and pruning to reduce the risk of extrapolation. The idea behind pruning is to remove from the sample women who are either very unlikely or very likely to be subject to IPV. When values are extrapolated, results become sensitive to functional form, an argument made in favor of matching over regression (Stuart, 2010). However, pruning can be combined with regression (Angrist and Pischke, 2009, pp. 86-91). We thus estimate logit regressions of the probability of IPV before each HIV regression, and women who have a probability of IPV below 0.05 and over 0.95 are removed from the estimation sample. As mentioned, linear probability models and matching on covariates with regression adjustment (Abadie and Imbens, 2011) are estimated as robustness checks.

Most of our control variables are standard, such as age, education, household relative wealth, ethnicity, religion, region, and urban residence. In addition, we control for husband's age and education and for three childhood-family background variables: the number of siblings; mortality before age 15 among siblings; and father-beat-mother.

Household wealth is measured by the within-survey wealth quintiles provided in the data, i.e., it is a measure of relative wealth rather than absolute wealth. The wealth quintiles are based on an index created using information on housing characteristics and a wide range of physical assets. The weights attached to each item in the index are the 'coefficients' of the first principal component in a principal components analysis.

Religion and ethnicity capture differences in norms and traditions that might matter for both IPV and the spread of HIV. For example, studies regularly find that countries with many Muslims have lower HIV rates (Sawers and Stillwaggon. 2008). Ethnicity might also affect infection rates via cultural traditions about sexual behavior and reproductive health (Bryceson et al., 2006; Wadesango et al., 2011).

We use dummies for within-country regions and urban residence, as HIV rates vary greatly geographically. Because the HIV environment changes over time, the region dummies are survey specific; for example, there are separate dummies for Central Malawi in 2004 and in 2010. We use three variables related to the woman's family of origin: the number of siblings, mortality among siblings, and violence among the woman's parents, called "father-beat-mother" and measured with a binary indicator. The variables are meant to capture childhood environment and socioeconomic status.

## 5. Results

### 5.1 The association between IPV and HIV among married women

Table 3 shows that physical and emotional violence are associated with higher HIV rates for exposed women, both in the sample of all regions with a generalized epidemic (HIV>1.0%) and in the sample restricted to high-prevalence regions (HIV>7.0%), with p-values < 0.01. The marginal effect is clearly higher in high-prevalence regions (0.023 compared to 0.015 for physical violence, and 0.033 compared to 0.019 for emotional violence), and emotional violence has a stronger association than physical violence. Physical violence is associated with a 15% increase, and emotional violence with a 20% increase, in the probability that a woman is HIV positive, both in regions with generalized epidemics and in high HIV prevalence regions.[5] Sexual violence is not statistically significant and the estimated marginal effects are close to zero. This could be because there is no effect or because of large underreporting of sexual violence.

The results also show that the probability of HIV infection for married women increases with years of schooling, age of partner, urban residence, and wealth, though not for the wealthiest. These results are consistent with earlier findings (Harling et al. 2010). Several of the other control variables are strongly correlated with the probability of IPV, as Table A5 in Appendix II shows. Most notably, the childhood variables all increase the risk of IPV, while education reduces it.

To investigate the links at work, we estimate models with three different samples: women whose husbands were HIV tested in the survey, which is a sub-sample of the one used in Table 3; women with HIV-positive husbands; and women with HIV-negative husbands. Note that the first sample is the second plus the third. We focus on physical and emotional violence only, since sexual violence does not seem to be associated with HIV status among married women in our data. Table 4 presents results for regions with generalized epidemics, and Table 5 for high HIV prevalence regions.

[5] In regions with a generalized epidemic, the HIV rate among women in our sample is about 10%. In high HIV prevalence regions, it is about 16%.

**Table 3: IPV and HIV among married women - logit marginal effects.**

| | Regions with generalized epidemics | | | High HIV prevalence regions | | |
|---|---|---|---|---|---|---|
| | Physical violence | Emotional violence | Sexual violence | Physical violence | Emotional violence | Sexual violence |
| Physical violence | 0.015*** | | | 0.023*** | | |
| | (0.004) | | | (0.007) | | |
| Emotional violence | | 0.019*** | | | 0.033*** | |
| | | (0.004) | | | (0.007) | |
| Sexual violence | | | 0.007 | | | 0.004 |
| | | | (0.006) | | | (0.009) |
| Age | 0.000 | 0.000 | 0.000 | 0.001 | 0.001 | 0.001 |
| | (0.000) | (0.000) | (0.000) | (0.001) | (0.001) | (0.001) |
| Education in years | 0.002** | 0.002** | 0.002** | 0.004*** | 0.004*** | 0.005*** |
| | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) |
| Number of siblings | -0.000 | -0.000 | -0.000 | -0.001 | -0.002 | -0.001 |
| | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) |
| Sibling child mortality | -0.007 | -0.008 | -0.007 | -0.005 | -0.009 | -0.002 |
| | (0.012) | (0.012) | (0.012) | (0.020) | (0.020) | (0.020) |
| Father beat mother | 0.003 | 0.003 | 0.003* | 0.003 | 0.003 | 0.004 |
| | (0.002) | (0.002) | (0.002) | (0.003) | (0.003) | (0.003) |
| Husband's age | 0.002*** | 0.002*** | 0.002*** | 0.002*** | 0.002*** | 0.002*** |
| | (0.000) | (0.000) | (0.000) | (0.001) | (0.001) | (0.001) |
| Husband's education | 0.000 | 0.000 | 0.000 | -0.000 | -0.000 | -0.001 |
| | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) |
| Urban | 0.052*** | 0.052*** | 0.053*** | 0.078*** | 0.079*** | 0.082*** |
| | (0.006) | (0.006) | (0.006) | (0.011) | (0.011) | (0.011) |
| 2nd relative wealth quintile | 0.004 | 0.003 | 0.004 | 0.004 | 0.006 | 0.004 |
| | (0.007) | (0.007) | (0.007) | (0.011) | (0.011) | (0.011) |
| 3rd relative wealth quintile | 0.012* | 0.012* | 0.013* | 0.017 | 0.019* | 0.015 |
| | (0.007) | (0.007) | (0.007) | (0.011) | (0.011) | (0.011) |
| 4th relative wealth quintile | 0.020*** | 0.020*** | 0.020*** | 0.023** | 0.024** | 0.019* |
| | (0.007) | (0.007) | (0.007) | (0.011) | (0.012) | (0.012) |
| 5th relative wealth quintile | 0.014 | 0.014 | 0.014 | 0.003 | 0.002 | -0.002 |
| | (0.009) | (0.009) | (0.009) | (0.015) | (0.015) | (0.015) |
| *N* | 25,647 | 25,827 | 24,746 | 13,782 | 13,666 | 13,225 |

Note: HIV prevalence is at least 1% in generalized epidemics regions and 7% in high prevalence regions.
All estimations also include region * survey dummies, ethnicity dummies, religion dummies and a constant (not reported), although, as expected, many were statistically significant.
Significance levels are indicated as * p<0.1; ** p<0.05; *** p<0.01.
Clustered (at the survey cluster level) standard errors in parentheses.

**Table 4: IPV and HIV for married women conditional on husband's HIV status in regions with generalized epidemics - logit marginal effects.**

| | Physical violence | | | Emotional violence | | |
|---|---|---|---|---|---|---|
| | Husband's HIV status known | Husband HIV positive | Husband HIV negative | Husband's HIV status known | Husband HIV positive | Husband HIV negative |
| Physical violence | 0.012** | -0.010 | 0.006 | | | |
| | (0.005) | (0.028) | (0.004) | | | |
| Emotional violence | | | | 0.011** | -0.037 | 0.004 |
| | | | | (0.005) | (0.029) | (0.004) |
| Age | 0.000 | 0.002 | -0.000 | 0.000 | 0.003 | -0.000 |
| | (0.001) | (0.003) | (0.000) | (0.001) | (0.003) | (0.000) |
| Education in years | 0.002** | 0.004 | 0.000 | 0.002** | 0.002 | 0.001 |
| | (0.001) | (0.005) | (0.001) | (0.001) | (0.005) | (0.001) |
| Number of siblings | 0.001 | -0.000 | 0.000 | 0.001 | -0.003 | 0.000 |
| | (0.001) | (0.005) | (0.000) | (0.001) | (0.005) | (0.000) |
| Sibling child mortality | -0.021 | -0.019 | -0.019* | -0.024* | -0.041 | -0.022** |
| | (0.014) | (0.080) | (0.011) | (0.014) | (0.081) | (0.011) |
| Father beat mother | 0.002 | 0.001 | 0.001 | 0.002 | 0.002 | 0.001 |
| | (0.002) | (0.011) | (0.002) | (0.002) | (0.011) | (0.002) |
| Husband's age | 0.002*** | -0.001 | 0.001* | 0.002*** | -0.002 | 0.001 |
| | (0.000) | (0.003) | (0.000) | (0.000) | (0.003) | (0.000) |
| Husband's education | -0.001 | -0.003 | -0.000 | -0.001 | -0.002 | -0.000 |
| | (0.001) | (0.005) | (0.001) | (0.001) | (0.005) | (0.001) |
| Urban | 0.044*** | 0.115*** | 0.015*** | 0.043*** | 0.106** | 0.016*** |
| | (0.007) | (0.041) | (0.005) | (0.007) | (0.042) | (0.005) |
| 2nd relative wealth quintile | 0.006 | -0.025 | 0.008 | 0.006 | -0.020 | 0.008 |
| | (0.008) | (0.046) | (0.007) | (0.008) | (0.047) | (0.007) |
| 3rd relative wealth quintile | 0.021** | 0.025 | 0.013* | 0.019** | 0.036 | 0.013* |
| | (0.008) | (0.044) | (0.007) | (0.008) | (0.045) | (0.007) |
| 4th relative wealth quintile | 0.024*** | 0.009 | 0.018*** | 0.024*** | 0.013 | 0.017** |
| | (0.008) | (0.048) | (0.007) | (0.008) | (0.049) | (0.007) |
| 5th relative wealth quintile | 0.014 | -0.063 | 0.014 | 0.011 | -0.063 | 0.011 |
| | (0.011) | (0.058) | (0.008) | (0.011) | (0.060) | (0.009) |
| N | 15,735 | 1,405 | 13,253 | 15,633 | 1,354 | 13,001 |

Note: HIV prevalence is at least 1% in generalized epidemics regions.
All estimations also include region * survey dummies, ethnicity dummies, religion dummies and a constant (not reported), although, as expected, many were statistically significant.
Significance levels are indicated as * p<0.1; ** p<0.05; *** p<0.01.
Clustered (at the survey cluster level) standard errors in parentheses.

**Table 5: IPV and HIV for married women conditional on husband's HIV status in high prevalence regions - logit marginal effects.**

| | Physical violence | | | Emotional violence | | |
|---|---|---|---|---|---|---|
| | Husband's HIV status known | Husband HIV positive | Husband HIV negative | Husband's HIV status known | Husband HIV positive | Husband HIV negative |
| Physical violence | 0.023*** | 0.004 | 0.006 | | | |
| | (0.008) | (0.030) | (0.006) | | | |
| Emotional violence | | | | 0.026*** | -0.004 | 0.010 |
| | | | | (0.009) | (0.031) | (0.006) |
| Age | 0.000 | 0.002 | 0.000 | 0.001 | 0.003 | 0.000 |
| | (0.001) | (0.003) | (0.001) | (0.001) | (0.003) | (0.001) |
| Education in years | 0.005*** | 0.007 | 0.002 | 0.006*** | 0.004 | 0.003** |
| | (0.002) | (0.006) | (0.001) | (0.002) | (0.006) | (0.001) |
| Number of siblings | 0.000 | -0.001 | -0.001 | -0.000 | -0.003 | -0.001 |
| | (0.001) | (0.005) | (0.001) | (0.001) | (0.005) | (0.001) |
| Sibling child mortality | -0.020 | -0.024 | -0.008 | -0.025 | -0.063 | -0.011 |
| | (0.024) | (0.087) | (0.016) | (0.024) | (0.092) | (0.016) |
| Father beat mother | 0.003 | -0.005 | 0.002 | 0.003 | -0.006 | 0.002 |
| | (0.003) | (0.012) | (0.002) | (0.003) | (0.012) | (0.002) |
| Husband's age | 0.003*** | -0.002 | 0.001 | 0.003*** | -0.002 | 0.001 |
| | (0.001) | (0.003) | (0.001) | (0.001) | (0.003) | (0.001) |
| Husband's education | -0.002 | -0.006 | -0.001 | -0.002 | -0.006 | -0.001 |
| | (0.001) | (0.005) | (0.001) | (0.001) | (0.005) | (0.001) |
| Urban | 0.070*** | 0.145*** | 0.024*** | 0.071*** | 0.133*** | 0.027*** |
| | (0.013) | (0.046) | (0.009) | (0.013) | (0.047) | (0.009) |
| 2nd relative wealth quintile | -0.001 | -0.046 | 0.007 | 0.002 | -0.054 | 0.009 |
| | (0.014) | (0.049) | (0.010) | (0.014) | (0.050) | (0.010) |
| 3rd relative wealth quintile | 0.025* | 0.001 | 0.014 | 0.026* | 0.002 | 0.015 |
| | (0.013) | (0.046) | (0.010) | (0.013) | (0.047) | (0.010) |
| 4th relative wealth quintile | 0.025* | -0.014 | 0.016 | 0.025* | -0.009 | 0.014 |
| | (0.014) | (0.051) | (0.010) | (0.014) | (0.052) | (0.011) |
| 5th relative wealth quintile | -0.004 | -0.105* | 0.005 | -0.008 | -0.098 | 0.003 |
| | (0.019) | (0.062) | (0.013) | (0.019) | (0.064) | (0.014) |
| N | 8,116 | 1,255 | 6,782 | 7,977 | 1,185 | 6,623 |

Note: HIV prevalence is at least 7% in high prevalence regions.
All estimations also include region * survey dummies, ethnicity dummies, religion dummies and a constant (not reported), although, as expected, many were statistically significant.
Significance levels are indicated as * p<0.1; ** p<0.05; *** p<0.01.
Clustered (at the survey cluster level) standard errors in parentheses.

In the sample that includes both women with HIV-positive and HIV-negative husbands, there are statistically significant marginal effects: 0.012 and 0.023 for physical violence and 0.011 and 0.026 for emotional violence. When conditioning on either HIV-positive or HIV-negative husbands, the estimated marginal effects are small and statistically insignificant. Hence, neither increased transmission due to lack of decision power nor risky female sexual behavior (as a cause or a consequence of IPV) appears to be a key link between IPV and HIV.

### 5.2 HIV and the sexual behavior of men

The finding that IPV seems to be related to HIV only when both women with HIV-positive and HIV-negative husbands are included in the sample suggests that violent men are HIV infected more often than other men, due to riskier sexual behavior. This has testable implications for HIV risk and sexual behavior among IPV perpetrators. Husbands were not asked about violent behavior, but we can use the information provided by their wives.

Table 6 evaluates the hypothesis that men whose wives reported IPV have a higher HIV risk. We use a sample of men with HIV-negative wives, so that the wife cannot have infected the husband. Perpetrators of physical and emotional violence have a significantly higher probability of being HIV positive; the marginal effects are 0.007 and 0.013 for physical violence, and 0.012 and 0.018 for emotional violence, while there is no effect of sexual violence.

We would also expect IPV to be related to risky sexual behavior among men. As Table 7 shows, IPV perpetrators have an earlier sexual debut than other men, marry at a younger age, have more premarital and extramarital sex and a higher number of lifetime sexual partners, have paid for sex more often, and are more likely to have had an HIV test.

**Table 6: IPV and HIV among married men with HIV-negative wives – logit marginal effects**

| Men | Regions with generalized epidemics | | | High HIV prevalence regions | | |
|---|---|---|---|---|---|---|
| | Physical violence | Emotional violence | Sexual violence | Physical violence | Emotional violence | Sexual violence |
| Physical violence | 0.007** | | | 0.013** | | |
| | (0.004) | | | (0.006) | | |
| Emotional violence | | 0.012*** | | | 0.018** | |
| | | (0.004) | | | (0.007) | |
| Sexual violence | | | 0.003 | | | -0.000 |
| | | | (0.005) | | | (0.008) |
| Age | 0.002*** | 0.002*** | 0.002*** | 0.003*** | 0.003*** | 0.002*** |
| | (0.000) | (0.000) | (0.000) | (0.001) | (0.001) | (0.001) |
| Education in years | 0.001** | 0.001* | 0.002** | 0.002** | 0.002 | 0.002* |
| | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) |
| Wife's age | 0.000 | 0.001 | 0.000 | 0.001 | 0.001 | 0.001 |
| | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) |
| Wife's education | -0.000 | -0.000 | -0.000 | -0.001 | -0.001 | -0.000 |
| | (0.000) | (0.000) | (0.001) | (0.001) | (0.001) | (0.001) |
| Urban | 0.016*** | 0.017*** | 0.020*** | 0.018* | 0.020* | 0.024** |
| | (0.005) | (0.006) | (0.006) | (0.011) | (0.011) | (0.011) |
| 2nd relative wealth quintile | 0.005 | 0.006 | 0.006 | 0.011 | 0.013 | 0.011 |
| | (0.006) | (0.006) | (0.007) | (0.010) | (0.010) | (0.011) |
| 3rd relative wealth quintile | 0.010* | 0.010 | 0.012* | 0.020* | 0.020* | 0.019* |
| | (0.006) | (0.006) | (0.007) | (0.011) | (0.011) | (0.011) |
| 4th relative wealth quintile | 0.010 | 0.009 | 0.010 | 0.016 | 0.013 | 0.014 |
| | (0.007) | (0.007) | (0.008) | (0.012) | (0.012) | (0.012) |
| 5th relative wealth quintile | 0.015* | 0.014* | 0.016* | 0.023* | 0.019 | 0.017 |
| | (0.008) | (0.008) | (0.009) | (0.014) | (0.014) | (0.014) |
| N | 15,500 | 14,968 | 12,403 | 7,582 | 7,426 | 7,190 |

Note: HIV prevalence is at least 1% in generalized epidemics regions and 7% in high prevalence regions.
All estimations also include region * survey dummies, ethnicity dummies, religion dummies and a constant (not reported), although, as expected, many were statistically significant.
Significance levels are indicated as * p<0.1; ** p<0.05; *** p<0.01.
Clustered (at the survey cluster level) standard errors in parentheses.

**Table 7: Indicators of husband's sexual behavior**

| | Wife does not report IPV | | Wife reports IPV | | Difference | | |
|---|---|---|---|---|---|---|---|
| | Mean | Std. Err. | Mean | Std. Err. | Mean | Std. Err. | t-stat |
| Age at first marriage | 23.67 | 0.055 | 23.23 | 0.089 | 0.469*** | 0.104 | 4.51 |
| Age at first intercourse | 19.43 | 0.046 | 18.30 | 0.066 | 1.13*** | 0.084 | 13.46 |
| Premarital sex | 0.728 | 0.005 | 0.785 | 0.007 | -0.057*** | 0.009 | -6.21 |
| Extramarital sex | 0.096 | 0.003 | 0.172 | 0.006 | -0.076*** | 0.006 | -11.63 |
| Lifetime no. of sex partners[1] | 3.77 | 0.099 | 4.22 | 0.162 | -0.449 ** | 0.182 | -2.46 |
| Ever had an HIV test | 0.349 | 0.005 | 0.423 | 0.008 | -0.074*** | 0.010 | -7.60 |
| Paid for sex | 0.088 | 0.003 | 0.124 | 0.003 | -0.036*** | 0.006 | -5.91 |

[1]Information on lifetime number of sex partners was not collected for Malawi in 2004, hence men from this survey are not included in this computation.

### 5.3 Alternative samples of women

Our samples of married women could be either too exclusive or too inclusive. If violent men are more often HIV infected, there could be mortality bias: some IPV perpetrators who infected their wives might have died, leaving their wives widowed. Moreover, IPV could lead to separation and divorce (Were et al. 2011). Separation and a subsequent increase in sex partners is one possible link between IPV and HIV. We could also underestimate the relationship between IPV and HIV if the woman was infected by a violent man who is not her current husband (or, in the case of ever-married women, her last husband).

We therefore checked the robustness of our results in samples of ever-married women and women in their first union who reported no premarital sex and no extramarital sex during the last 12 months (Table A6 and A7 in Appendix II). In the ever-married sample, we cannot include husband's age and education as control variables, and we cannot condition the sample depending on husband's HIV status. To a great extent, using the sample of women in their first union limits the route of transmission to husband-to-wife, but underreporting of sexual contacts makes the limitation less than perfect.

For ever-married women, physical, emotional and sexual violence are all strongly associated with an increased HIV risk. The earlier finding of a lack of association between sexual violence and HIV might thus be specific to currently married women. Possible reasons for this could be that sexual violence often leads to separation, women are more prone to admit sexual violence after they have left their partner, or sexual violence is related to riskier sexual behavior after separation. The results for the sample of women in their first union are similar to the ones obtained with married women; physical and emotional violence are significant and sexual violence is insignificant.

### 5.4 Individual surveys

Testing individual surveys (Table A8 in Appendix II) gives a mixed result; several of the estimates are not significant. However, some individual surveys have statistically significant positive marginal effects: the two Zimbabwean surveys for both physical and emotional violence, Kenya for physical violence, and Zambia for emotional violence. It is noteworthy that surveys with statistically significant marginal effects tend to be from high prevalence countries.

### 5.5 Alternative econometric models

Results can be sensitive to the choice of model and functional form. We therefore re-estimated our models using the linear probability model and various matching procedures. In Table A9-A12 in Appendix II, results from the linear probability model and from matching on covariates with regression adjustment are presented. The ones obtained with the linear probability model are very similar to those of the logit model, both in terms of size and statistical significance.

In the matching model reported, each woman who has been subject to IPV is matched with the four most similar women who have not been subject to IPV, using the Mahalanobis distance measure to choose the most similar women in terms of covariates. The unobserved potential outcome is thus imputed, using the average outcome of the best matches. We use the variance estimator of Abadie and Imbens (2011) to compute consistent, but not fully efficient, standard errors.

Matching estimators with a finite number of matches induces a conditional bias term that grows with the number of continuous regressors, and reciprocally with the number of matches (Abadie and Imbens, 2006). Regression adjustment removes this bias and makes the results double robust, i.e., as long as either the matching algorithm or the regression adjustment model is correctly specified, the other one does not have to be so (Stuart, 2010).

Matching gives similar results for emotional violence in terms of significance and size of effects, while the results for physical violence results are a bit weaker. In regions with generalized epidemics, physical violence is associated with a positive and statistically significant increase in the probability of HIV infection in the sample of all married women, but not in the sample of women whose husband's HIV status is known. It is the other way around in high prevalence regions: physical violence is associated with an increased HIV risk in the sample of women whose husband's HIV status is known, but not in the sample of all married women. However, the standard errors tend to be too large using this approach (Abadie and Imbens, 2011).

## 6. Summary and Conclusions

HIV/AIDS in many sub-Saharan African countries continues to be a key challenge for policymakers and the international community. Although the spread of HIV can be facilitated in many ways, gender inequality is often considered a main cause (Dunkle et al., 2004; Gillespie. et al., 2007; UNAIDS, 2012). And, according to a recent UNAIDS report (2011:17), one in seven HIV infections might be prevented if intimate partner violence (IPV), a key component of gender inequality, was eradicated, a claim based on a longitudinal study of women in the Eastern Cape of South Africa (Jewkes et al., 2010). However, the only existing multi-country study with nationally representative data from sub-Saharan African countries fails to find an association between IPV and HIV (Harling et al., 2010).

We analyze the relationship between IPV and HIV using twelve Demographic and Health Surveys (DHSs) from ten sub-Saharan African countries. Physical and emotional violence increase the probability that a woman is HIV positive by about 15% and 20% respectively, very close to Jewkes et al.'s (2010) one in seven (≈14%). Sexual violence is reported less often and is not associated with increased HIV risk among married women in our data. But when divorced and widowed women are included in the sample, there is an association.

Marginal effects are generally larger when the sample is limited to high prevalence regions, and the individual surveys with statistically significant marginal effects are from high HIV prevalence countries. Thus, the association between IPV and HIV is clearly stronger in high HIV prevalence surroundings. This could be due to too-small samples and lack of power of our tests, but it is more likely a consequence of how HIV is linked to IPV.

We investigate potential links behind the IPV-HIV association using information on the HIV status of the husband. IPV does not increase HIV risk among women with HIV-positive husbands, so the husband's HIV is not transmitted more often to the wife in couples where there is IPV. Similarly, IPV was not associated with higher HIV rates among women with HIV-negative husbands. Thus, neither IPV-induced risky female sexual behavior, nor IPV triggered by the woman's HIV infection or her sexual behavior, appears to be a central link between IPV and higher female HIV risk. However, when the sample of women whose husbands are known to be HIV positive is combined with the sample whose husbands are known to be HIV negative, there is a significant effect. This means that the main reason behind the association between IPV and HIV infection is that violent men are more likely to be HIV positive, and therefore infect their wives. Hence, we find no evidence of a causal link from IPV to HIV. This conclusion is supported by a higher HIV risk among IPV perpetrators than among other men. It is also supported by the fact that IPV perpetrators report more risky sex.

Programs that combat IPV and HIV could be designed in many ways: improving laws and law enforcement; encouraging reporting of IPV offences; and empowering women economically or psychologically. All of these have the potential to improve the lives of many women. However, our results suggest that we should not expect substantial additional effects on women's risk of HIV infection unless men's sexual behavior also changes. Some widely used prevention programs – such as *Stepping Stones* and *SASA!* – include men. But many others – such as microfinance with gender-equality training to empower women – do not (WHO, 2010). And it is not clear how much emphasis is put on men's sexual risk behavior when programs are implemented: evaluations of two programs failed to find an impact on HIV transmission, even though IPV might have declined (Pronyk et al., 2006; Jewkes et al., 2008). One explanation for these results is that it is not violence per se that drives the HIV epidemic, but the fact that violent men are more likely to become HIV positive, and then to spread the infection.

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**Appendix 1: Missing Data Analysis**

Naturally, not everyone eligible for HIV testing and the domestic violence module could or wanted to participate. Table A1 reports missing observations for HIV testing, IPV and both, as a percentage of the total sample of eligible women. Some were absent and some refused to provide a blood sample for HIV testing. Malawi 2004 has the largest share of missing HIV observations, 21.67%, while Zambia 2007 and the two Zimbabwean surveys have over 10% missing observations. Rwanda has the lowest share, 0.64%. Missing IPV observations range from 10.04% in Malawi 2004 to 37.04% in Rwanda 2005.

**Table A1: Missing observations as percent of total sample**

| | HIV | IPV | Both |
|---|---|---|---|
| Burkina Faso, 2010 | 1.50 | 11.46 | 0.34 |
| Côte d´Ivoire 2011/12 | 7.16 | 19.81 | 2.50 |
| Gabon 2011 | 2.07 | 25.07 | 0.82 |
| Kenya, 2008 | 7.28 | 19.68 | 2.47 |
| Liberia, 2006 | 6.09 | 19.76 | 2.06 |
| Mali, 2007 | 3.51 | 13.60 | 0.73 |
| Malawi, 2004 | 21.67 | 10.04 | 4.36 |
| Malawi, 2010 | 5.36 | 13.63 | 1.05 |
| Rwanda, 2005 | 0.64 | 37.04 | 0.47 |
| Zambia, 2007 | 15.80 | 15.29 | 4.30 |
| Zimbabwe, 2005/06 | 12.36 | 18.12 | 3.70 |
| Zimbabwe, 2010/11 | 10.28 | 17.33 | 3.79 |

Notes: No weights are used

Fortunately, few respondents lack both HIV and IPV data. In an attempt to evaluate the potential bias from the exclusion of women with missing data, we check how HIV prevalence differs among women with and without IPV data, and how exposure to IPV differs among women with and without HIV data (Table A2).

**Table A2: Differences in HIV and IPV rates among married women with present and missing data**

| | HIV rates | | | IPV rates | | |
|---|---|---|---|---|---|---|
| | Non-missing IPV | Missing IPV | t-stat of diff | Non-missing HIV | Missing HIV | t-stat of diff |
| Burkina Faso, 2010 | 0.013 | 0.002 | 2.61*** | 0.170 | 0.141 | 0.70 |
| Côte d´Ivoire 2011/12 | 0.048 | 0.028 | 2.20** | 0.294 | 0.336 | -1.33 |
| Gabon 2011 | 0.072 | 0.040 | 3.43*** | 0.549 | 0.523 | 0.64 |
| Kenya, 2008 | 0.101 | 0.043 | 4.46*** | 0.442 | 0.295 | 4.26*** |
| Liberia, 2006 | 0.024 | 0.017 | 1.34 | 0.477 | 0.418 | 1.99** |
| Mali, 2007 | 0.016 | 0.011 | 0.86 | 0.201 | 0.217 | -0.41 |
| Malawi, 2004 | 0.157 | 0.155 | 0.072 | 0.263 | 0.213 | 2.70*** |
| Malawi, 2010 | 0.137 | 0.037 | 8.29*** | 0.340 | 0.258 | 3.09*** |
| Rwanda, 2005 | 0.033 | 0.052 | -3.11*** | 0.359 | 0.269 | 0.95 |
| Zambia, 2007 | 0.180 | 0.118 | 4.19*** | 0.520 | 0.466 | 2.82*** |
| Zimbabwe, 2005/2006 | 0.249 | 0.111 | 10.12*** | 0.452 | 0.354 | 5.09*** |
| Zimbabwe, 2010/2011 | 0.224 | 0.101 | 9.47*** | 0.394 | 0.317 | 3.87*** |

Note: No weights are used. *** =p<0.01. ** =p<0.05. *= p<0.1

HIV rates tend to be higher among women with IPV data; the exception is Rwanda. Because we cannot know if IPV rates are higher or lower among women with missing data, bias in estimation of the relationship between IPV and HIV could go either way. One likely reason for missing IPV is that privacy could not be secured. If missing IPV is due to some extent to reluctance to admit IPV, we might overestimate the true association between IPV and HIV, since HIV is less common among those without IPV data. However, we do not think there is any reason to expect women who are subject to IPV, and who do not want to admit it, to have lower HIV rates than others, when women subject to IPV, who do admit it, have higher HIV rates than others. One way to investigate whether IPV rates differ for women who do and do not have IPV data is to compare strong predictors of IPV. As can be seen in Table A5 in Appendix II, the strongest predictors of IPV are father-beat-mother, number of siblings, child mortality among siblings, and husband's education. In Table A3, we report regressions of these IPV risk predictors on a missing/non-missing IPV dummy and region/survey dummies. We used the pooled sample of married women. Women with missing IPV do not differ from women with IPV in terms of these predictors of IPV.

**Table A3: Comparing married women with missing and non-missing IPV (Coefficient of non-missing IPV dummy)**

| | | Coef. | Std Err | z-stat |
|---|---|---|---|---|
| Father-beat-mother | Logit | 0.080 | 0.272 | 0.30 |
| Number of siblings | Ordered logit | 0.081 | 0.060 | 1.35 |
| Sibling's child mortality | OLS | 0.005 | 0.006 | 0.79 [a)] |
| Husband's years of education | Ordered logit | 0.008 | 0.007 | 1.14 |

Notes: a) t-statistic.
*** =p<0.01. ** =p<0.05. *= p<0.1.
All estimations also include region*survey dummies.
Information on "trips away last 12 months" and "long time spent away" was not collected for Kenya 2008, and lifetime number of partners was not collected for Malawi 2004.

In most surveys, IPV rates are higher among women with HIV data (Table A2). Again, since we do not know the HIV rates among women with missing HIV data, bias could go either way. If refusal to provide a blood test is related to reluctance to admit HIV, we might overestimate the relationship between IPV and HIV. To investigate the potential relationship between missing HIV data and HIV risk, and hence the impact of these missing women on the estimated results, we followed a similar strategy as that used to investigate IPV risk among women with missing IPV. We ran a number of regressions of various HIV-risk factors on a non-missing HIV status dummy and region/survey dummies. We used the pooled sample of married women (Table A4).

**Table A4: Comparing married women with missing and non-missing HIV status (Coefficient of non-missing HIV status)**

| | | Coef. | Std Err | z-stat |
|---|---|---|---|---|
| Extramarital | Logit | -0.044 | 0.107 | -0.41 |
| Premarital | Logit | 0.009 | 0.034 | 0.26 |
| Lifetime number of partners | Ordered logit | 0.186*** | 0.038 | 4.85 |
| Age at 1st sex | OLS | -0.199*** | 0.042 | -4.71 [a)] |
| Trips away last 12 months | Ordered logit | 0.112*** | 0.040 | 2.82 |
| Spent long time away | Logit | 0.058 | 0.061 | 0.96 |
| Age | OLS | 0.116 | 0.133 | 0.87 [a)] |
| Age difference with spouse | OLS | -0.041 | 0.112 | -0.37 [a)] |

Notes: a) t-statistic.
*** =p<0.01. ** =p<0.05. *= p<0.1.
All estimations also include region*survey dummies.
Information on "trips away last 12 months" and "long time spent away" was not collected for Kenya 2008, and lifetime number of partners was not collected for Malawi 2004.

Women with HIV data had more lifetime sexual partners, an earlier sexual debut, and had made more trips away from home during the last 12 months. More lifetime sexual partners, an earlier sexual debut, and more trips away from home would be expected to increase HIV risk. Hence, we suspect that HIV rates actually are lower among those without HIV data. Because IPV rates are lower among those without HIV data than those with HIV data, the estimated relationship between IPV and HIV could be biased downward.

## Appendix II: Additional Tables

**Table A5: Logit models of physical, emotional and sexual violence - marginal effects**

| | Regions with generalized epidemics | | | High prevalence regions | | |
|---|---|---|---|---|---|---|
| | Physical violence | Emotional violence | Sexual violence | Physical violence | Emotional violence | Sexual violence |
| Age | 0.001 | 0.000 | -0.000 | 0.001 | 0.000 | -0.000 |
| | (0.001) | (0.001) | (0.000) | (0.001) | (0.001) | (0.001) |
| Education in years | -0.005*** | -0.000 | 0.001 | -0.006*** | -0.000 | 0.000 |
| | (0.001) | (0.001) | (0.001) | (0.002) | (0.001) | (0.001) |
| Number of siblings | 0.004*** | 0.005*** | 0.002*** | 0.003** | 0.005*** | 0.004*** |
| | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) |
| Sibling child mortality | 0.071*** | 0.088*** | 0.038*** | 0.072*** | 0.088*** | 0.042** |
| | (0.016) | (0.015) | (0.011) | (0.024) | (0.015) | (0.018) |
| Father beat mother | 0.028*** | 0.018*** | 0.011*** | 0.020*** | 0.018*** | 0.011*** |
| | (0.003) | (0.002) | (0.002) | (0.003) | (0.002) | (0.002) |
| Husban's age | -0.003*** | -0.000 | -0.001** | -0.004*** | -0.000 | -0.001* |
| | (0.000) | (0.000) | (0.000) | (0.001) | (0.000) | (0.001) |
| Husband's education | -0.004*** | -0.003*** | -0.002*** | -0.005*** | -0.003*** | -0.002* |
| | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) |
| Urban | 0.037*** | 0.020** | 0.006 | 0.035** | 0.020** | -0.000 |
| | (0.009) | (0.009) | (0.007) | (0.014) | (0.009) | (0.011) |
| 2nd relative wealth quintile | 0.003 | 0.005 | 0.001 | 0.008 | 0.005 | -0.000 |
| | (0.009) | (0.009) | (0.007) | (0.012) | (0.009) | (0.009) |
| 3rd relative wealth quintile | -0.012 | -0.014 | 0.001 | -0.012 | -0.014 | -0.006 |
| | (0.010) | (0.009) | (0.007) | (0.013) | (0.009) | (0.010) |
| 4th relative wealth quintile | -0.013 | -0.005 | -0.005 | -0.009 | -0.005 | -0.008 |
| | (0.011) | (0.010) | (0.008) | (0.014) | (0.010) | (0.011) |
| 5th relative wealth quintile | -0.049*** | -0.013 | -0.016* | -0.043** | -0.013 | -0.032** |
| | (0.013) | (0.012) | (0.009) | (0.018) | (0.012) | (0.014) |
| N | 26,164 | 26,181 | 25,713 | 13,818 | 26,181 | 13,782 |

Note: HIV prevalence is at least 1% in generalized epidemics regions and 7% in high prevalence regions.
All estimations also include region * survey dummies, ethnicity dummies, religion dummies and a constant (not reported), although, as expected, many were statistically significant.
Significance levels are indicated as * p<0.1; ** p<0.05; *** p<0.01.
Clustered (at the survey cluster level) standard errors in parentheses.

**Table A6: IPV and HIV among ever-married women – logit marginal effects.**

| | Regions with generalized epidemics | | | High HIV prevalence regions | | |
|---|---|---|---|---|---|---|
| | Physical violence | Emotional violence | Sexual violence | Physical violence | Emotional violence | Sexual violence |
| Physical violence | 0.020*** | | | 0.029*** | | |
| | (0.004) | | | (0.007) | | |
| Emotional violence | | 0.021*** | | | 0.034*** | |
| | | (0.004) | | | (0.007) | |
| Sexual violence | | | 0.020*** | | | 0.024*** |
| | | | (0.006) | | | (0.008) |
| Age | 0.003*** | 0.003*** | 0.004*** | 0.005*** | 0.005*** | 0.006*** |
| | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| Education in years | 0.002*** | 0.002*** | 0.003*** | 0.005*** | 0.005*** | 0.005*** |
| | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) |
| Number of siblings | -0.001 | -0.001 | -0.001 | -0.002* | -0.002* | -0.002* |
| | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) |
| Sibling child mortality | -0.007 | -0.006 | -0.003 | -0.005 | -0.005 | -0.000 |
| | (0.012) | (0.012) | (0.013) | (0.020) | (0.021) | (0.020) |
| Father beat mother | 0.002 | 0.003 | 0.003* | 0.004 | 0.004 | 0.004 |
| | (0.002) | (0.002) | (0.002) | (0.003) | (0.003) | (0.003) |
| Urban | 0.060*** | 0.062*** | 0.068*** | 0.089*** | 0.090*** | 0.090*** |
| | (0.006) | (0.006) | (0.007) | (0.010) | (0.010) | (0.010) |
| 2nd relative wealth quintile | 0.008 | 0.008 | 0.010 | 0.010 | 0.010 | 0.010 |
| | (0.006) | (0.007) | (0.007) | (0.010) | (0.010) | (0.010) |
| 3rd relative wealth quintile | 0.020*** | 0.020*** | 0.022*** | 0.030*** | 0.029*** | 0.028*** |
| | (0.007) | (0.007) | (0.008) | (0.011) | (0.011) | (0.011) |
| 4th relative wealth quintile | 0.025*** | 0.025*** | 0.027*** | 0.033*** | 0.032*** | 0.031*** |
| | (0.007) | (0.007) | (0.008) | (0.011) | (0.011) | (0.011) |
| 5th relative wealth quintile | 0.012 | 0.011 | 0.013 | 0.002 | -0.000 | -0.000 |
| | (0.009) | (0.009) | (0.010) | (0.014) | (0.014) | (0.014) |
| *N* | 30,861 | 30,219 | 26,007 | 16,750 | 16,717 | 16,408 |

Note: HIV prevalence is at least 1% in generalized epidemics regions and 7% in high prevalence regions.
All estimations also include region * survey dummies, ethnicity dummies, religion dummies and a constant (not reported), although, as expected, many were statistically significant.
Significance levels are indicated as * p<0.1; ** p<0.05; *** p<0.01.
Clustered (at the survey cluster level) standard errors in parentheses.

**TableA7: IPV and HIV among women in their first union who do not report pre- or extramarital sex – logit marginal effects.**

| | Regions with generalized epidemics | | | High HIV prevalence regions | | |
|---|---|---|---|---|---|---|
| | Physical violence | Emotional violence | Sexual violence | Physical violence | Emotional violence | Sexual violence |
| Physical violence | 0.020*** | | | 0.025*** | | |
| | (0.005) | | | (0.008) | | |
| Emotional violence | | 0.013** | | | 0.018** | |
| | | (0.005) | | | (0.008) | |
| Sexual violence | | | 0.004 | | | -0.001 |
| | | | (0.007) | | | (0.011) |
| Age | -0.001** | -0.001* | -0.001** | -0.001 | -0.001 | -0.001 |
| | (0.000) | (0.000) | (0.000) | (0.001) | (0.001) | (0.001) |
| Education in years | 0.002* | 0.002 | 0.002** | 0.005*** | 0.004** | 0.005*** |
| | (0.001) | (0.001) | (0.001) | (0.002) | (0.002) | (0.002) |
| Number of siblings | -0.000 | -0.000 | -0.001 | -0.002 | -0.002 | -0.002 |
| | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) |
| Sibling child mortality | -0.005 | -0.005 | -0.004 | 0.009 | 0.010 | 0.012 |
| | (0.015) | (0.015) | (0.015) | (0.024) | (0.025) | (0.025) |
| Father beat mother | 0.003 | 0.003 | 0.003 | 0.003 | 0.003 | 0.004 |
| | (0.002) | (0.002) | (0.002) | (0.004) | (0.004) | (0.004) |
| Urban | 0.038*** | 0.037*** | 0.035*** | 0.048*** | 0.047*** | 0.044*** |
| | (0.008) | (0.008) | (0.008) | (0.012) | (0.012) | (0.012) |
| 2nd relative wealth quintile | 0.012 | 0.014* | 0.016* | 0.014 | 0.019 | 0.021 |
| | (0.008) | (0.008) | (0.008) | (0.013) | (0.013) | (0.013) |
| 3rd relative wealth quintile | 0.013 | 0.014 | 0.013 | 0.018 | 0.021 | 0.019 |
| | (0.009) | (0.009) | (0.009) | (0.013) | (0.014) | (0.014) |
| 4th relative wealth quintile | 0.018* | 0.020** | 0.020** | 0.023 | 0.029* | 0.028* |
| | (0.009) | (0.009) | (0.009) | (0.015) | (0.015) | (0.015) |
| 5th relative wealth quintile | 0.015 | 0.018* | 0.019* | 0.013 | 0.018 | 0.017 |
| | (0.011) | (0.011) | (0.011) | (0.017) | (0.018) | (0.018) |
| *N* | 12,283 | 12,202 | 11,879 | 7,073 | 6,960 | 6,718 |

Note: HIV prevalence is at least 1% in generalized epidemics regions and 7% in high prevalence regions.
All estimations also include region * survey dummies, ethnicity dummies, religion dummies and a constant (not reported), although, as expected, many were statistically significant.
Significance levels are indicated as * $p<0.1$; ** $p<0.05$; *** $p<0.01$.
Clustered (at the survey cluster level) standard errors in parentheses.

**Table A8: The marginal effect of physical and emotional violence on the probability of HIV infection among married women in each separate survey – in regions with generalized epidemics.**

| | Physical violence | | | Emotional violence | | |
|---|---|---|---|---|---|---|
| | Marginal effect | Standard error | Observations | Marginal effect | Standard error | Observations |
| Burkina Faso | -0.004 | (0.008) | 1,421 | 0.006 | (0.009) | 1,269 |
| Côte d´Ivoire | -0.001 | (0.012) | 1,672 | -0.002 | (0.013) | 1,615 |
| Gabon | -0.008 | (0.012) | 1,647 | -0.014 | (0.013) | 1,648 |
| Kenya | 0.035** | (0.016) | 1,507 | 0.007 | (0.016) | 1,539 |
| Liberia | -0.002 | (0.008) | 1,763 | 0.004 | (0.007) | 1,768 |
| Mali | 0.001 | (0.01) | 867 | -0.016 | (0.023) | 604 |
| Malawi 2004 | 0.018 | (0.021) | 1,641 | 0.016 | (0.026) | 1,455 |
| Malawi 2010 | 0.007 | (0.011) | 4,064 | 0.002 | (0.011) | 4,069 |
| Rwanda | 0.006 | (0.008) | 1,915 | 0.013 | (0.01) | 1,850 |
| Zambia | 0.001 | (0.013) | 2,465 | 0.027* | (0.015) | 2,460 |
| Zimbabwe5 | 0.028* | (0.016) | 2,965 | 0.054*** | (0.016) | 2,967 |
| Zimbabwe6 | 0.041*** | (0.0149 | 3,226 | 0.035** | (0.016) | 3,232 |

*=p<0.1, **=p<0,05, ***=p<0,01. Marginal effects are estimated after logit regressions. All regressions also include age, years of education, number of siblings, child mortality among siblings, father-beat-mother, partner's age and years of education, urban, within-survey wealth quintiles, religion dummies, ethnicity dummies and region dummies. Standard errors are clustered at the survey cluster level.

**Table A9: IPV and HIV among married women – OLS coefficients.**

| | Regions with generalized epidemics | | | High HIV prevalence regions | | |
|---|---|---|---|---|---|---|
| | Physical violence | Emotional violence | Physical violence | Emotional violence | Physical violence | Emotional violence |
| Physical violence | 0.014*** | | | 0.023*** | | |
| | (0.004) | | | (0.007) | | |
| Emotional violence | | 0.034*** | | | 0.034*** | |
| | | (0.008) | | | (0.008) | |
| Sexual violence | | | 0.006 | | | 0.005 |
| | | | (0.006) | | | (0.009) |
| Age | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.001 |
| | (0.000) | (0.001) | (0.000) | (0.001) | (0.001) | (0.001) |
| Education in years | 0.002** | 0.004*** | 0.002*** | 0.004*** | 0.004*** | 0.004*** |
| | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) |
| Number of siblings | -0.000 | -0.001 | -0.000 | -0.001 | -0.001 | -0.001 |
| | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) |
| Sibling child mortality | -0.007 | -0.009 | -0.004 | -0.005 | -0.009 | -0.002 |
| | (0.010) | (0.018) | (0.012) | (0.018) | (0.018) | (0.018) |
| Father beat mother | 0.003 | 0.003 | 0.004 | 0.003 | 0.003 | 0.003 |
| | (0.002) | (0.003) | (0.002) | (0.003) | (0.003) | (0.003) |
| Husband's age | 0.002*** | 0.002*** | 0.002*** | 0.002*** | 0.002*** | 0.002*** |
| | (0.000) | (0.001) | (0.000) | (0.001) | (0.001) | (0.001) |
| Husband's education | -0.000 | -0.001 | -0.000 | -0.000 | -0.001 | -0.001 |
| | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) |
| Urban | 0.052*** | 0.088*** | 0.066*** | 0.087*** | 0.088*** | 0.091*** |
| | (0.006) | (0.012) | (0.008) | (0.012) | (0.012) | (0.012) |
| 2nd relative wealth quintile | 0.003 | 0.006 | 0.004 | 0.003 | 0.006 | 0.003 |
| | (0.006) | (0.009) | (0.007) | (0.009) | (0.009) | (0.009) |
| 3rd relative wealth quintile | 0.013* | 0.016 | 0.012 | 0.015 | 0.016 | 0.012 |
| | (0.007) | (0.010) | (0.007) | (0.010) | (0.010) | (0.010) |
| 4th relative wealth quintile | 0.030*** | 0.024** | 0.025*** | 0.023** | 0.024** | 0.019* |
| | (0.007) | (0.011) | (0.008) | (0.011) | (0.011) | (0.011) |
| 5th relative wealth quintile | 0.030*** | 0.003 | 0.023** | 0.004 | 0.003 | -0.001 |
| | (0.009) | (0.015) | (0.010) | (0.014) | (0.015) | (0.015) |
| *N* | 25,998 | 13,702 | 21,050 | 13,818 | 13,702 | 13,259 |

Note: HIV prevalence is at least 1% in generalized epidemics regions and 7% in high prevalence regions.
All estimations also include region * survey dummies, ethnicity dummies, religion dummies and a constant (not reported), although, as expected, many were statistically significant.
Significance levels are indicated as * p<0.1; ** p<0.05; *** p<0.01.
Clustered (at the survey cluster level) standard errors in parentheses.

**Table A10: IPV and HIV among married women in regions with a generalized epidemic – OLS coefficients.**

| | Physical violence | | | Emotional violence | | |
|---|---|---|---|---|---|---|
| | Husband's HIV status known | Husband HIV positive | Husband's HIV status known | Husband HIV positive | Husband's HIV status known | Husband HIV positive |
| Physical violence | 0.011** | -0.010 | 0.005 | | | |
| | (0.005) | (0.029) | (0.004) | | | |
| Emotional violence | | | | 0.011* | -0.036 | 0.004 |
| | | | | (0.006) | (0.030) | (0.004) |
| Age | 0.000 | 0.002 | -0.000 | 0.000 | 0.002 | -0.000 |
| | (0.001) | (0.003) | (0.000) | (0.001) | (0.003) | (0.000) |
| Education in years | 0.002** | 0.004 | 0.001 | 0.002** | 0.005 | 0.000 |
| | (0.001) | (0.005) | (0.001) | (0.001) | (0.005) | (0.001) |
| Number of siblings | 0.001 | -0.000 | 0.000 | 0.001 | -0.002 | 0.000 |
| | (0.001) | (0.005) | (0.001) | (0.001) | (0.005) | (0.001) |
| Sibling child mortality | -0.018 | -0.015 | -0.015** | -0.019* | -0.023 | -0.015** |
| | (0.011) | (0.084) | (0.007) | (0.011) | (0.085) | (0.007) |
| Father beat mother | 0.003 | 0.002 | 0.002 | 0.003 | 0.003 | 0.002 |
| | (0.003) | (0.012) | (0.002) | (0.003) | (0.012) | (0.002) |
| Husband's age | 0.002*** | -0.001 | 0.001* | 0.002*** | -0.002 | 0.001* |
| | (0.000) | (0.003) | (0.000) | (0.000) | (0.003) | (0.000) |
| Husband's education | -0.001 | -0.003 | -0.000 | -0.001 | -0.003 | -0.000 |
| | (0.001) | (0.005) | (0.001) | (0.001) | (0.005) | (0.001) |
| Urban | 0.044*** | 0.110*** | 0.015*** | 0.044*** | 0.101** | 0.016*** |
| | (0.007) | (0.041) | (0.005) | (0.007) | (0.043) | (0.005) |
| 2nd relative wealth quintile | 0.005 | -0.029 | 0.005 | 0.005 | -0.032 | 0.005 |
| | (0.008) | (0.049) | (0.005) | (0.008) | (0.049) | (0.005) |
| 3rd relative wealth quintile | 0.021*** | 0.019 | 0.010* | 0.021*** | 0.017 | 0.010* |
| | (0.008) | (0.046) | (0.005) | (0.008) | (0.045) | (0.005) |
| 4th relative wealth quintile | 0.032*** | 0.006 | 0.017*** | 0.032*** | 0.004 | 0.017*** |
| | (0.008) | (0.050) | (0.006) | (0.008) | (0.050) | (0.006) |
| 5th relative wealth quintile | 0.024** | -0.065 | 0.012 | 0.023** | -0.063 | 0.011 |
| | (0.011) | (0.060) | (0.007) | (0.011) | (0.060) | (0.007) |
| *N* | 16,488 | 1,427 | 14,967 | 16,472 | 1,402 | 14,950 |

Note: HIV prevalence is at least 1% in generalized epidemics regions.
All estimations also include region * survey dummies, ethnicity dummies, religion dummies and a constant (not reported), although, as expected, many were statistically significant.
Significance levels are indicated as * p<0.1; ** p<0.05; *** p<0.01.
Clustered (at the survey cluster level) standard errors in parentheses.

**Table A11: IPV and HIV among married women in high prevalence regions – OLS coefficients.**

| Married women | Physical violence | | | Emotional violence | | |
|---|---|---|---|---|---|---|
| | Husband's HIV status known | Husband HIV positive | Husband's HIV status known | Husband HIV positive | Husband's HIV status known | Husband HIV positive |
| Physical violence | 0.022** | 0.002 | 0.005 | | | |
| | (0.009) | (0.030) | (0.006) | | | |
| Emotional violence | | | | 0.027*** | -0.003 | 0.010 |
| | | | | (0.010) | (0.032) | (0.007) |
| Age | 0.000 | 0.002 | 0.000 | 0.000 | 0.002 | 0.000 |
| | (0.001) | (0.003) | (0.001) | (0.001) | (0.003) | (0.001) |
| Education in years | 0.005*** | 0.005 | 0.002* | 0.005*** | 0.003 | 0.002* |
| | (0.002) | (0.006) | (0.001) | (0.002) | (0.006) | (0.001) |
| Number of siblings | 0.000 | -0.001 | -0.001 | -0.000 | -0.003 | -0.001 |
| | (0.001) | (0.005) | (0.001) | (0.001) | (0.006) | (0.001) |
| Sibling child mortality | -0.020 | -0.046 | -0.008 | -0.035 | -0.069 | -0.017 |
| | (0.021) | (0.093) | (0.014) | (0.021) | (0.097) | (0.014) |
| Father beat mother | 0.002 | -0.007 | 0.003 | 0.002 | -0.007 | 0.002 |
| | (0.003) | (0.013) | (0.002) | (0.003) | (0.014) | (0.002) |
| Husband's age | 0.003*** | -0.002 | 0.001 | 0.003*** | -0.002 | 0.001 |
| | (0.001) | (0.003) | (0.001) | (0.001) | (0.003) | (0.001) |
| Husband's education | -0.002 | -0.007 | -0.001 | -0.002 | -0.005 | -0.001 |
| | (0.001) | (0.005) | (0.001) | (0.001) | (0.006) | (0.001) |
| Urban | 0.080*** | 0.146*** | 0.030*** | 0.079*** | 0.125*** | 0.031*** |
| | (0.015) | (0.046) | (0.010) | (0.015) | (0.047) | (0.011) |
| 2nd relative wealth quintile | -0.001 | -0.046 | 0.006 | 0.001 | -0.046 | 0.008 |
| | (0.012) | (0.051) | (0.008) | (0.012) | (0.053) | (0.008) |
| 3rd relative wealth quintile | 0.023* | -0.001 | 0.012 | 0.023* | 0.015 | 0.012 |
| | (0.013) | (0.047) | (0.009) | (0.013) | (0.049) | (0.009) |
| 4th relative wealth quintile | 0.025* | -0.022 | 0.014 | 0.024* | 0.003 | 0.014 |
| | (0.014) | (0.053) | (0.010) | (0.014) | (0.054) | (0.010) |
| 5th relative wealth quintile | -0.005 | -0.108* | 0.002 | -0.009 | -0.079 | 0.002 |
| | (0.019) | (0.064) | (0.013) | (0.019) | (0.066) | (0.013) |
| *N* | 8,131 | 1,238 | 6,843 | 7,867 | 1,176 | 6,471 |

Note: HIV prevalence is at least 7% in high prevalence regions.
All estimations also include region * survey dummies, ethnicity dummies, religion dummies and a constant (not reported), although, as expected, many were statistically significant.
Significance levels are indicated as * p<0.1; ** p<0.05; *** p<0.01.
Clustered (at the survey cluster level) standard errors in parentheses.

**Table A12: IPV and HIV – average treatment effects on the treated from non-parametric covariate matching with regression adjustment.**

| Sample of women | Type of violence | Generalized epidemic Coef. | Generalized epidemic Std. Err. | High HIV prevalence Coef. | High HIV prevalence Std. Err. |
|---|---|---|---|---|---|
| All married | Physical | 0.009* | (0.005) | 0.012 | [0.008) |
| All married | Emotional | 0.016*** | (0.005) | 0.026*** | (0.009) |
| All married | Sexual | 0.002 | (0.007) | 0.004 | (0.009) |
| Husband's HIV status known | Physical | 0.008 | (0.006) | 0.018* | (0.010) |
| Husband's HIV status missing | Physical | 0.019** | (0.009) | 0.016 | (0.014) |
| Husband HIV positive | Physical | -0.039 | (0.031) | -0.033 | (0.033) |
| Husband HIV negative | Physical | 0.004 | (0.004) | 0.007 | (0.007) |
| Husband's HIV status known | Emotional | 0.011* | (0.006) | 0.024** | (0.011) |
| Husband's HIV status missing | Emotional | 0.037*** | (0.009) | 0.044*** | (0.014) |
| Husband HIV positive | Emotional | -0.052 | (0.032) | -0.023 | (0.034) |
| Husband HIV negative | Emotional | 0.003 | (0.005) | 0.010 | (0.008) |

Notes: Each woman subject to IPV is matched with the four (five in case of ties) most similar women who are not subject to IPV. Similarity is evaluated based on Mahalanobis distance. The covariates are age, education, household wealth quintile, siblings, sibling child mortality, husband's age and education, religion, ethnicity, urban residence and region*survey dummies. Robust standard errors proposed in Abadie and Imbens (2006, 2011) are used.