HIV Risk and Adolescent Behaviors in Africa*

Anne Case
Christina Paxson

More than 23 million people are estimated to be living with HIV in Sub-Saharan Africa, concentrated primarily in East and Southern Africa (UNAIDS 2012). There are a number of non-competing explanations for the crisis along the "AIDS Belt," which runs from Kenya south through to Lesotho, Swaziland and South Africa. These include the behaviors of drivers moving goods (Oster 2012); behaviors of migrant workers who keep households in both urban and rural areas (Corno and de Walque 2012); and transactional sex among young adults (Epstein 2007). All of these behaviors generally lead to overlapping sexual partnerships, which may influence the speed with which HIV is spread (Epstein and Morris 2011).

In this paper, we add to what is known about the origins and geographic concentration of the pandemic by examining the role played by education in East and Southern Africa in the 1960s and 1970s. Using data from 45 Demographic and Health Surveys carried out in 18 countries in sub-Saharan Africa, we show that areas in which HIV rates grew most quickly in the 1980's and 1990's tended to have increases in female education and non-marital sexual activity during the decades *before* the AIDS crisis was recognized.

A large literature indicates that education protects individuals against health risks—but only when education aids in the understanding of risks and the behaviors that reduce risk. If the causes of health risks are not well-understood, education may not be protective. Preston (1996),

* Forthcoming *American Economic Review Papers and Proceedings 2013*. Anne Case: Professor of Economics and Public Affairs, Princeton University, Princeton NJ 08544, accase@princeton.edu. Christina Paxson: President, Brown University, Providence RI 02912, Christina_Paxson@brown.edu. We acknowledge support from The Demography of Aging Center at Princeton University, funded under the National Institute of Aging grant P30 AG024361.

for example, notes that in 1900, the mortality risk for a school teacher's child in the US was no better than that of the average child. However, by 1925, once the germ theory of disease was well accepted, teachers' children's survival rates were dramatically better than those for other children. Feldman et al. (1989) document that in 1960 there was little difference in middle-age and old-age mortality rates for men by educational attainment. Twenty years later, once the risks associated with smoking were understood, better-educated men's mortality risks were substantially lower than those of less-well-educated men.

Early in the HIV crisis, some researchers theorized that education would protect women from HIV (Summers 1994). However, others argued that education would put women's health at risk through its effect on partnership patterns. Bledsoe (1990) noted that a woman's education reduces her pool of potential marriage partners. This, together with economic opportunities that accompany education, might lead young women to forgo participation in polygamous marriages, and instead take on the role of "outside wife" or mistress. Singh and Samara (1996) argued that the effect of education in extending the time from menarche to marriage—due to the time cost of attaining education and the limiting effects education has on acceptable marriage partners—would put women at risk for sexually transmitted diseases, including HIV, through its anticipated impact on premarital sex. Increased rates of premarital sex among educated women may have led to higher rates of sexually transmitted infections, an important risk factor for HIV (Oster 2005).

As data became available with which to examine the associations between education and HIV risk in sub-Saharan Africa, it became clear that education was positively correlated with HIV (Gregson et al. 2001, Hargreaves and Glynn 2002). Fortson (2008), using data from several Demographic and Health Surveys (DHS) conducted in sub-Saharan Africa after 2000, found a robust positive association between education and HIV infection. In exploring mechanisms that

may explain this correlation, she found that education was positively and significantly associated with premarital sex.

Empirical analysis of the spread of HIV is complicated by the fact that not only are choices about sexual behaviors influenced by HIV risk, but they also influence HIV risk. Dynamic feedback effects from behaviors, to HIV prevalence, and back to behaviors make it difficult to interpret associations between behaviors and HIV prevalence that are observed in the data. For example, Bongaarts (2007) finds that, across 33 African countries, later marriage is associated with higher HIV prevalence. These results may obtain because earlier marriage is protective against HIV. However, age at marriage may itself be influenced by HIV prevalence in a region. If so, regressions of the HIV prevalence on the age at marriage may not provide unbiased estimates of the effects of marriage on HIV risk. Similar issues confound the study of the relationship between HIV and education: education may influence HIV risk, but the likelihood that a child eventually contracts HIV may affect decisions to invest in her education.

We investigate the relationship between education and HIV, marriage and non-marital sexual activity, with a focus on adolescent behaviors that dates from the time before the HIV crisis began. We make use of the fact that older women in our sample were adolescents during the early 1980's, when HIV had started to spread through Africa but the cause of HIV was still unknown. Decisions regarding education, sexual behavior, and teen marriage of these women could not have been influenced by any knowledge of HIV risk. An investigation of how adolescent decisions made during this period are related to current HIV prevalence in their regions of residence provides information on the riskiness of different activities, and contributes to our understanding of the spatial patterns of HIV that have developed.

We also examine how adolescent behaviors are related to the spread of HIV over time. If

non-marital sexual activity in adolescence is riskier than teen marriage, then regions in Africa that had higher rates of teen non-marital sexual activity relative to adolescent marriage at the beginning of the AIDS crisis should have experienced a more rapid spread of the disease. We find that regions in which, in the early 1980's, non-marital adolescent sexual activity were more prevalent and adolescent marriage was less prevalent—which coincide with regions that had higher rates of female education—have higher HIV rates today.

Data

Demographic and Health Surveys are large, nationally representative household-based surveys that collect information on population, health and nutrition. DHS surveys have been conducted in low-income and middle-income countries since 1986 and, once started in a country, are generally repeated at five year intervals. The standard DHS questionnaire collects information from women between the ages of 15 and 49, covering topics such as age at first marriage, age at sexual debut, and educational attainment. Recent surveys have tested respondents for HIV, making it possible to measure HIV prevalence within countries and, using information on the region within countries in which respondents live, regional HIV prevalence.

We use data from DHS surveys conducted between 1988 and 2006 in eighteen countries in sub-Saharan Africa, listed in Table 1. [Table 1 about here.]

We use the region of residence information provided by the DHS to define regions that are consistently identified over time within countries. In some countries, we must aggregate sub-regions up into larger regions in order to obtain regional definitions that are consistent across survey waves. In Ghana and Tanzania, the regional definitions changed so much that we must exclude their two earliest surveys—the 1988 survey for Ghana and the 1991-92 survey for Tanzania—from our analysis. Table 1 shows the survey waves we use and the number of regions

for each country, ordered by the countries' HIV prevalence rates. The number of regions varies considerably across countries: Malawi and Cameroon have only three regions, whereas Tanzania has 20. On average, there are 2,394 women between the ages of 15 and 49 per region.

Regional HIV prevalence rates are calculated using HIV testing data for men and women ages 15-49, using the relevant sampling weights provided by the surveys. Earlier research on a subset of countries we use concludes that response rates for HIV testing are high, and that bias from non-response and the exclusion of non-household population groups is small (Mishra et al. 2008). Table 1 provides statistics on HIV prevalence for each country overall, and the minimum and maximum regional prevalence. The statistics show the familiar pattern of low HIV rates in West Africa and high HIV rates in East and Southern Africa, with considerable variation across regions within countries.

We focus on marriage and sexual activity prior to the age of 20, using a sample of women who were born between 1958 and 1965, who were ages 20 and older at the time of the survey. Women born before the mid-1960's were making decisions about teen marriage and sexual activity outside of marriage before it was understood how HIV was transmitted. The beginning of the AIDS epidemic in Africa is generally dated at 1981, but at that time the causes of HIV transmission were not well understood. When the HIV virus was isolated, in 1984, there was uncertainty even in the scientific community as to whether HIV could be spread by heterosexual contact. One of the earliest studies of HIV/AIDS in a sub-Saharan African country (then Zaire), published in 1984, states that patients in Zaire appear to differ from those of European and American origin in that equal numbers of men and women had the disease. The study found that, in two married couples observed, both partners were HIV positive. On the basis of this evidence, the authors stated that there was a "strong indication" of heterosexual transmission, and

recommended that additional studies be conducted, "further clarifying this new epidemiological pattern" (Piot et al. 1984). Clarification, at least in the scientific community, came quickly. Another article, published in *Science* four years later, reviewed a number of then-recent studies that led to the confident assertion that HIV-1 infection in Africa is "mainly heterosexually acquired" (Piot et al. 1988). Knowledge about HIV transmission and prevention began to spread in African communities in the late 1980s and early 1990s. The women we focus on here turned 20 in 1985 or earlier, when the epidemic was young and before it was widely known that HIV could be spread through heterosexual activity.

That women born in countries that now have high HIV rates were changing their behaviors prior to an understanding of HIV can be seen in Figure 1, where literacy rates and teen marriage rates are presented, by birth year, for countries in which HIV prevalence from the most recent survey is above 4 percent. [Figure 1 about here. TITLE: "TABLE 1. MARRIAGE AND LITERACY AMONG WOMEN IN HIGH HIV COUNTRIES"; LABELS: x-axis "Year of Birth" y-axis "Percentage rate"]

These are the countries from Cote d'Ivoire to Swaziland, shown in Table 1. The most dramatic increase in literacy occurred for women born between 1958 and 1965, when the literacy rate rose by more than 10 percentage points. Concurrently, the rate of teen marriage fell for this same cohort of women by more than 10 percentage points. We find a similar inverse pattern in low HIV countries, but literacy rates remained very low (between 15 and 20 percent), teen marriage rates remained very high (between 80 and 75 percent) for women born between 1958 and 1985 in the now low-HIV countries. (Estimation not shown.)

Adolescent behaviors and the spread of HIV

The patterns of marriage and sexual activity in place just prior to the introduction of HIV in sub-Saharan Africa may have played a critical role in determining where HIV would spread most rapidly. Table 2 presents the associations between current country-level HIV prevalence and teen marriage, sexual activity and educational attainment for the cohort of women born between 1958 and 1965. [Table 2 about here.]

The first column repeats the information on HIV prevalence from the most recent survey for each country shown in Table 1. The next three columns show country-level averages for years spent as a virgin, years sexually active and unmarried, and years married between the ages of 10 and 20. In general, teen marriage was less prevalent in countries with currently high HIV rates: the Pearson correlation coefficient between the country-level HIV rate and average years of teen marriage rate is –0.587. This correlation is driven in part by the exceptionally high level of teen marriage in Niger (5.19 years), which has the second-lowest HIV rate, and the exceptionally low level of teen marriage in Swaziland (1.08 years), which has the highest HIV rate. However, the Spearman rank correlation coefficient, which is robust to outliers, is also high (–0.608). The reverse pattern is seen for non-marital sexual activity among teens, with larger spells of non-marital sexual activity more common in currently high-HIV countries. It is interesting to note that, in countries that have higher HIV rates today, women in the 1958-65 cohort also had (on average) longer spells of virginity in adolescence. This counterintuitive finding can be explained by the fact that later marriage is associated with a longer period of virginity, which confers almost no HIV risk, and a longer period of non-marital sexual activity which confers much higher HIV risk.

Countries that had more teen marriage, less virginity and less teen non-marital sexual activity, in the 1958-1965 cohort, had larger fractions of women who never attended school. The

correlation between education among girls born in this period and the rate of HIV today is striking. Among the six highest-HIV countries, in all countries but Malawi the fraction of girls with at least some education exceeded 80 percent, whereas in eight of the ten lowest-HIV countries had rates of "any education" of less than 33 percent.

The last two rows of Table 2 show similar patterns for the correlation coefficients between the country-region level HIV rate and the country-region measures of teen marriage, teen sexual activity, virginity and education: in country-regions with currently higher HIV rates, women in this cohort spent less time in marriage as teenagers, more time in non-marital teen sexual activity and virginity, and were more likely to have attended school.

The reasons for the decline in marriage among teens in the currently high-HIV regions cannot be established conclusively given the data we have available. However, the fact that the decline in marriage coincides with an increase in girls' schooling suggests that, ironically, improvements in investments in girls born in the late 1950's and early 1960's that resulted in greater education and delayed marriage, which happened to coincide with the onset of the HIV epidemic, may have made some regions more vulnerable to the spread of HIV.

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Table 1—-Descriptive Statistics for Countries

Country	Survey years	Number of regions	Sample HIV rate (percent)	Lowest regional HIV rate (percent)	Highest regional HIV rate (percent)
Senegal	1992-93, 1997, 2005	4	0.70	0.49	2.06
Niger	1992, 1998, 2006	6	0.73	0.34	1.30
Dem. Rep. of Congo	2007	11	1.30	0.20	3.72
Mali	1995-96, 2001, 2006	9	1.33	0.63	2.09
Ethiopia	2000, 2005	11	1.47	0.31	5.84
Guinea	1999, 2005	5	1.55	0.94	2.40
Liberia	2006-07	7	1.60	0.13	2.45
Burkina Faso	1992-93, 1998-99, 2003	13	1.84	0.13	4.02
Ghana	1993-94. 1998-99, 2003	10	2.17	0.95	3.72
Cote d'Ivoire	1994, 1998-99, 2005	9	4.72	1.71	5.84
Cameroon	1991, 1998, 2004	3	5.50	2.64	8.39
Tanzania	1999, 2004-05, 2007-08	20	5.73	1.63	16.39
Kenya	1993, 1998, 2003	7	6.76	4.21	14.99
Malawi	1992, 2000, 2004-05	3	11.79	6.44	17.56
Zambia	1992, 1997-98, 2001-02, 2007	9	14.27	6.79	20.75
Zimbabwe	1994, 1999, 2005-06	10	18.12	15.15	20.78
Lesotho	2004-05	10	25.35	17.93	29.70
Swaziland	2006-07	4	25.95	23.15	28.82

Notes: HIV rates are based on the most recent year of survey data for each country, for all men and women.

Table 2—Marital Status, Teen Sexual Behavior and Education. Women born from 1958-1965

Country	Current HIV rate (%)	Years between ages 10 and 20 spent: As virgin	Unmarried & sexually active	Married	Has any education (%)
Senegal	0.70	6.54	0.25	3.22	0.28
Niger	0.73	4.71	0.10	5.19	0.09
Dem. Rep. of Congo	1.30	6.11	1.47	2.42	0.67
Mali	1.33	5.69	0.62	3.69	0.16
Ethiopia	1.47	5.14	0.28	4.57	0.11
Guinea	1.55	5.72	0.55	3.73	0.14
Liberia	1.60	5.63	1.78	2.58	0.29
Burkina Faso	1.84	6.72	0.44	2.84	0.11
Ghana	2.17	6.72	1.23	2.06	0.63
Cote d'Ivoire	4.72	5.55	1.81	2.64	0.33
Cameroon	5.50	5.51	1.18	3.30	0.65
Tanzania	5.73	6.29	1.22	2.49	0.62
Kenya	6.76	6.07	1.78	2.16	0.82
Malawi	11.79	6.18	0.94	2.88	0.57
Zambia	14.27	5.93	1.09	2.98	0.84
Zimbabwe	18.12	6.95	0.83	2.22	0.82
Lesotho	25.35	7.33	0.45	2.22	0.96
Swaziland	25.95	6.62	2.29	1.08	0.82
Pearson's ρ with HIV rate, country level		0.572	0.288	–0.587	0.754
Spearman's ρ with HIV rate, country level		0.480	0.422	–0.608	0.773
Pearson's ρ with HIV rate, country-region level		0.374	0.138	–0.394	0.665
Spearman's ρ with HIV rate, country-region level		0.296	0.299	–0.377	0.716

Notes: Marriage, sexual activity and literacy are measured using a sample of women ages 20 to 49 who were born between 1958 and 1965. The relevant sample weights are used for all calculations. HIV rates are based on the most recent year of survey data for each country, for all men and women.

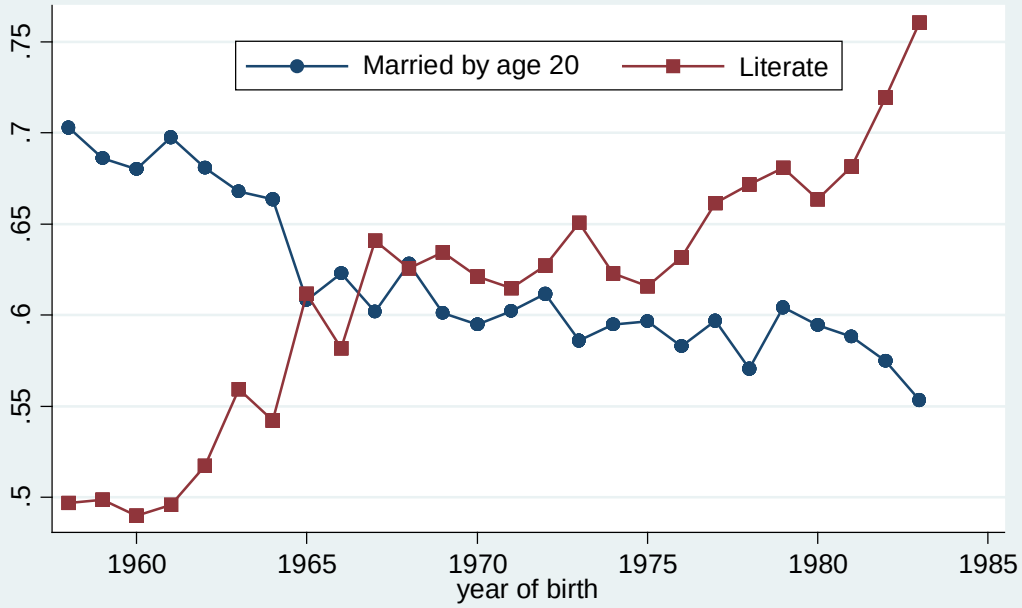

Figure 1. Marriage and literacy among women in high HIV countries