(Extended Abstract)

Does Schooling Reduce the Risk of Sexually Transmitted Infection? The Association between Herpes Simplex Type 2, Educational Attainment, School Status and Learning Outcomes among Adolescents in Rural Malawi

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Introduction

Demographers have long observed that the better educated are healthier than their less educated counterparts;[7, 10, 13] an extensive literature has documented a strong association between educational attainment and fertility,[7] child mortality,[4] and health.[11] Time spent in school has been hypothesized to develop cognitive skills, and transmit knowledge, in particular knowledge about behaviors that can promote health. Education is thought to further enhance health by increasing the utilization of medical services, improving interactions with medical professionals, and enhancing compliance to treatment regimens. By extrapolation, these same mechanisms should lead to lower rates of sexually transmitted infection (STI) among more educated individuals. Microeconomic theory posits that individuals who have invested in their education have more of an incentive to protect their health because of greater expected returns in the future.[5, 17] Furthermore, micro-sociological theory suggests that the social networks of more educated individuals may provide better health information and outcomes than those of less educated individuals. [37]

This paper uses data from a longitudinal survey of adolescents in rural areas in the Southern region of Malawi that tested blood samples from respondents for HIV and herpes simplex virus 2 (HSV-2) — commonly referred to as genital herpes —to investigate the association between STI infection and education. Although our interest is in the association between HIV infection and educational attainment, HIV prevalence among our respondents, who were aged 14-16 when first interviewed in 2007, may be too low to provide sufficient power for estimating associations reliably and, thus, HSV-2 status, which is strongly associated with HIV status,[25]is used as an indicator of HIV risk.[50]

Literature Review

Beginning in the early 1990s, research on the link between educational attainment and HIV in sub-Saharan Africa indicated that HIV prevalence was higher among the wealthier and among those who have acquired more years of schooling.[16, 22, 27, 29, 33, 41, 48] These studies found that those with more schooling were more likely to live in urban areas, were more mobile, and had greater disposable income. These socio-economic characteristics were associated with risk behaviors such as having more (and more heterogeneous) sexual partners, extramarital relationships, and delayed marriage. Although both educational attainment and HIV prevalence are higher in urban areas, the positive association between educational attainment and HIV prevalence was found to be stronger in rural areas. Hargreaves and Glynn[29] suggested that highly educated individuals from rural areas may have gone to urban areas for their schooling, or may have greater geographic mobility than their less educated rural peers, facilitating their exposure to the risk of infection.

As the epidemic has matured, evidence that HIV is more common among the better educated has become less conclusive. Repeated cross-sectional surveys in rural Tanzania,[36] Uganda,[18] and Zambia,[34] found that after 2000 the positive association between educational attainment and HIV prevalence, observed previously, had either disappeared or reversed. A negative association between educational attainment

and HIV prevalence was also found in cross-sectional studies among voluntary counseling and testing (VCT) clients in Ethiopia[9] and antenatal clinic attendees in Malawi.[15] A study of four African cities[24] found no association between education and HIV prevalence in two cities (in Kenya and Zambia), but a negative gradient for women in Cameroon and men in Benin. In one of the only studies to examine the relationship between educational attainment and HIV incidence (as opposed to prevalence), Barnighausen et al.[3] found in KwaZulu-Natal, South Africa that each additional year of schooling reduced the likelihood of becoming infected by seven percent. In a study of risk factors for HIV infection among a nationally representative sample of young women aged 15-24 in South Africa, Pettifor et al.[42] found that those who had not completed high school were more likely to be infected than high school graduates, although they could not identify behavioral factors associated with higher risk. Other studies, however, continued to find a positive education gradient. Boerma et al.[8] compared findings from Manicaland, Zimbabwe, and Kisumu, Kenya and found a positive education gradient in Kisumu, whereas a weaker education gradient existed in Manicaland, even after controlling for risk behavior and other characteristics. A recent meta-analysis of the education effect concludes that while most studies prior to 1996 found a positive association between educational attainment and HIV prevalence, those since 1996 have generally found no association or a negative gradient.[28]

Nationally representative data on HIV prevalence collected by the Demographic and Health Surveys (DHS) have not resolved the matter. An analysis of the 2004 Lesotho DHS found that men who had attended primary school were significantly less likely to be HIV-positive than those who had never attended school.[14] Having attended secondary school was not significant, nor was any educational level for women, although the coefficients suggested a negative relationship. Two studies that examined data from five countries—Burkina Faso, Cameroon, Ghana, Kenya, and Tanzania — have found no association between educational attainment and HIV prevalence when education was measured linearly in single grades completed.[19] While higher educational attainment was associated with protective behaviors such as condom use, getting tested for HIV, knowledge of HIV transmission and prevention, and discussion of HIV risk among spouses, it was also associated with risk behaviors such as infidelity and a lower level of abstinence. Together these effects cancelled each other. Also using the DHS data, Fortson[21] found that when the association between education and HIV prevalence was measured non-linearly, a positive relationship emerged in all countries except Burkina Faso suggesting that some aspect of education itself, or some attribute of those who are educated, may lead to increased risk. She noted that educational attainment was associated with both the delayed onset of sexual initiation — a protective factor — and the greater likelihood of having premarital sex — a risk factor — but hypothesized that the risk effect proved stronger.

Complicating the interpretation of the education gradient in the HIV epidemic is the fact that educational attainment is often considered a proxy for socioeconomic status. Yet years of schooling and household wealth may have opposite effects on HIV infection within the same study.[53] To the extent that epidemiological studies include any socio-economic variable in addition to educational attainment, the one most commonly used is occupation. None of these studies, however, suggests how occupation influences the risk of HIV infection. More direct measures of household wealth, such as an index of asset ownership or per capita expenditures, are easier to understand in relation to HIV risk, but, given their data requirements, are less commonly used. While greater household asset ownership is significantly associated with having multiple sexual partners, a greater likelihood of sex with nonregular partners, and a greater likelihood of concurrent partners,[35, 47] critics have noted that what is driving risk behavior may not be wealth as such but rather participation in the wage economy. Gillespie et al.[23] point out that in the countries surveyed by the DHS only the highest one or two asset quintiles include the nonpoor, suggesting that asset indices of “wealth” in sub-Saharan Africa really measure the degree of household poverty. Bingenheimer[6] notes that asset ownership may more closely approximate participation in the wage economy than represent actual wealth and that many of those who earn cash and can buy consumer goods may be more vulnerable than those who engage in subsistence agriculture because of the

uncertainty of employment.

While a considerable body of research exists on the association between educational attainment and HIV among adults, few studies of adolescents have investigated the associations among school attendance, educational attainment, and HIV. Indeed, to the best of our knowledge, no panel studies of adolescents have examined the timing of HIV/HSV-2 acquisition relative to school attendance and learning outcomes, and only one other panel study[17] has investigated the association between HIV and educational attainment.

Study Aims

Using data from a longitudinal survey of adolescents in rural Malawi first interviewed in 2007, combined with HIV and HSV-2 results from the 4th and 5th rounds of fieldwork in 2010 and 2011, the goals of this paper are: 1) to estimate the associations between HSV-2, educational attainment, and learning outcomes; and 2) to estimate the association between HSV-2 seroconversion and current school status. In developing these analyses we will first investigate the degree to which respondents refused STI testing and assess whether those unwilling to be tested are selective of certain characteristics, since refusal potentially biases estimates of disease prevalence.[40, 46] Therefore, we will use a Heckman two-stage selection procedure to correct for testing refusal bias. Before exploring these associations among our sample, we provide some background information on the study setting including the prevalence of HIV and HSV-2, and the educational system.

HIV and HSV-2 Prevalence in Malawi

Malawi is among the 10 poorest countries in the world with a gross national income per capita (GNI-PPP) of $667 in 2007.[54] Further, 85 percent of the population live in rural areas without access to proper sanitation, potable water, electricity, and all-weather roads. Age at marriage among women is early, with nearly half of girls marrying before the age of 18. Moreover marriage in Malawi is quite "fragile," with high rates of separation and divorce,[44, 45] which may be both a cause and consequence of HIV.

The HIV prevalence rate in Malawi is currently estimated to be between 12 and 14 percent,[a] with substantial variability across the country; the rate in the South, the region where our longitudinal survey is situated, is estimated at nearly 18 percent.[38] As is the case elsewhere in sub-Saharan Africa, young Malawian women are disproportionately affected by the epidemic.[32] Moreover, the gender difference in prevalence is much greater among young people, with women under age 30 considerably more likely to be infected than their male peers. Indeed, among those aged 15-21 residing in rural areas in the Southern region, the prevalence rate is reported to be about 11 percent for women and two percent for men.[b] Notably, DHS data indicate that years of schooling and HIV prevalence are unrelated among women, but men who have attended secondary school are more likely to be infected than their less educated peers.[31, 38] On the other hand, incidence data from urban Malawi indicate a positive association between educational attainment and HIV among women.[31] DHS data indicate that prevalence is associated with wealth quintile for both men and women; those in a position of relative affluence are more likely to be infected.[38] Considerable variability in prevalence is also observed among ethnic groups. The Yao, who live primarily in the South, are predominantly Muslim and practice male circumcision (which is demonstrated to have a protective effect [2, 26]), have one of the highest rates of HIV. Researchers have speculated that the Yao are more likely to engage in sexual practices that elevate risk.[43]

Less is known about the prevalence of HSV-2 in Malawi than about the prevalence of HIV because testing is not common. An HSV-2 prevalence study in rural, northern Malawi based on stored sera collected between 1988 and 2005 from a random sample of the general population who were case-

[a] The 2004 DHS reported an HIV rate in Malawi of 12 percent; in 2008, UNAIDS reported a rate of 14 percent.[38, 51]
[b] Investigators' tabulations from 2004 Malawi DHS.

controls for mycobacterial disease studies and from women attending antenatal clinics, found high rates of prevalence that increased for the initial 10 year period.[25] Age-standardized rates for the period from 1988-90 were 30 percent for men and 48 percent for women aged 15-44, and increased to 36 percent for men and 58 percent for women in the period between 1998 and 2001, and were then statistically similar for the following four year period. The sample of 15-19 year olds in the most recent period is too small to allow confident assertions about current prevalence for adolescents. However, the prevalence estimate for those under age 25 was between 22 and 24 percent for the entire study period, which the authors did not separate by sex because of the small sample.

Education in Malawi

While Malawi still ranks on the low end among African countries in grade attainment, there has been substantial progress in recent years. In 2004, 64 percent of young men aged 20–24 and 51 percent of young women had completed 6 or more years of schooling (DHS). In the case of young women, this is a doubling relative to 20 years ago while for young men the increase was only from 57 to 64 percent. Primary completion rates among young people are much lower, however, because primary school in Malawi extends through 8 grades (known as standards). For example 45 percent of young men aged 20–24 completed primary compared to only 26 percent of young women, suggesting substantial attrition in the later years of primary school particularly among girls.[c]

Since the elimination of all primary school fees in 1994, Malawi has achieved nearly universal access to primary school. Although this policy has been effective in increasing access, it is thought to have had little positive impact on other critical schooling outcomes, namely retention, grade repetition, attainment, and skill acquisition.[d] In fact, according to the results of numeracy tests administered in Standard 6 in Malawi, no students scored in the "competent" range or above.[52] Indeed, Malawi had the lowest numeracy scoring of 14 countries in the Southern and Eastern African Consortium for Monitoring Educational Quality (SACMEQ). Furthermore, although policies and interventions to encourage girls' school enrollment have contributed to near gender parity in primary school entry,[1, 12] girls are still more likely to leave school than are boys and do so at a younger age.[39] Moreover, due to late entry, repetition, and temporary withdrawal, adolescents of the same age are distributed across a wide range of standards.

Data

The Malawi Schooling and Adolescent Survey is a longitudinal study of 2,650 adolescents resident in two contiguous rural districts in the southern region of the country, who were aged 14-16 at the start of 2007. The initial 2007 sample consisted of 1,764 students (875 girls and 889 boys) who were randomly selected from the enrollment rosters at 59 randomly selected primary schools in Machinga and Balaka districts. The probability of a particular school being included was proportional to its enrollment in 2006. At each school approximately 30 students stratified by gender and age who were enrolled in standards 4-8, the last four years of primary school, were interviewed. An additional sample of 886 adolescents (463 girls and 423 boys) who were not enrolled in school was drawn from the communities surrounding the selected primary schools. These respondents, referred to as the "out-of-school sample" because of their status when first interviewed, were identified through key informants located at the school or resident in the randomly selected school catchment villages. The study's ratio of 14-16 year olds attending standards 4-8 relative to those out-of-school was dictated by the proportion observed in the most recent DHS for Malawi.[e] Follow-up interviews have been conducted annually since 2007; the most recent round of data was collected in 2011. The study successfully re-interviewed 91%, 90%, 88% and 88% of the original sample in 2008, 2009, 2010, and 2011, respectively.

[c] Investigators' tabulations from 2004 Malawi DHS.

[d] For a discussion of the effect of free primary education on school quality and community-state relations, see Kendall, 2007.[30]

[e] The 2004 Malawi DHS indicated that 77% of 14-16 year olds attending school were in standards 4-8; 6% were in standards 1-3 and 17% were in secondary school. Approximately 25% of 14-16 year olds were not in school. Thus the ratio of 14-16 year olds in standards 4-8 relative to those out of school based on the DHS was 70:30, whereas the MSAS ratio is 67:33.

STI Testing Procedures

Beginning in 2010 (Round 4), respondents were tested for HIV and HSV-2. HIV testing was conducted at the household and followed the Ministry of Health's guidelines for voluntary counseling and testing. After completing the main survey, the interviewer obtained consent for testing. For those respondents giving consent, HIV status was determined via whole blood obtained from finger pricks using EDTA capillary tubes. A serial algorithm of HIV testing was used: if respondents tested positive for Determine, they were retested using Uni-Gold™ Recombigen®.™ Both tests have a very high sensitivity (100%) and specificity (>99%) in clinic evaluations, including a controlled laboratory setting in rural Kenya.[20] BIOLINE HIV 1/2 3.0, was used as a tiebreaker in cases in which Determine and Unigold tests gave contradictory results.

The HSV-2 specimen was also collected at the household via finger prick. A sample of whole blood was collected and stored in microtainers. HSV-2 specimens were transported to the College of Medicine-Johns Hopkins Research Project Laboratory at Queen Elizabeth Central Hospital in Blantrye for testing. The Kalon ELISA antibody test was used, for which the sensitivity and specificity have been found to be high (100%) in clinical evaluations when compared to Western Blot. In view of the small number of samples for which Kalon did not produce a definitive result (1.6% of those tested in 2010), indeterminate results were not retested. After specimen collection, all participants were provided information about HSV-2 detection, symptoms, safe sex practices and treatment options. An external validation of the testing procedure was successfully carried out in 2010 by Contract Laboratory Services in Johannesburg. HSV-2 test results were made available to study participants at centralized health centers proximate to Balaka and Machinga districts. Respondents were provided vouchers with identification numbers to receive their test results and reimbursement for travel to the site.

Preliminary Results

Table 1 indicates the percentage of respondents who refused to be tested for HSV-2 for each round. Slightly over 10% of respondents were unwilling to be tested in Round 4 and nearly 16% were unwilling in Round 5 with no significant difference in refusals by sex. Refusal was inversely related to years of school completed. Refusal rates were also considerably higher for the currently married and for Muslims, especially in Round 4. Note that 8.7% of the sample refused to be tested for HIV in Round 4 and 14.5% refused in Round 5, with patterns similar to those for HSV-2; little difference was observed by sex, but significant differences were seen by education and marital status for females, and religion for both males and females, especially in Round 4 (results not shown).

Table 2 provides data on HSV-2 prevalence by Round 5. As expected females are significantly more likely to test positive as are those who are older and currently or previously married. Among males, the percent testing positive for HSV-2 antibodies is not significantly related to education. In contrast, for females there is a substantial and significant gradient by educational attainment with those who completed only 0-4 years of primary nearly two times more likely to test positive than those who completed primary or some secondary. Note that education retains its effect, albeit reduced, within marital status categories. Unmarried females who have not completed primary school have a prevalence of 30% compared to 16% for those who have completed at least primary (p=.04). The comparable percentages for the currently married are 29% for those who haven't completed primary versus 21% for those who completed (p=.09) and, for the formerly married 51% versus 25% (p=.03). Consistent with the aggregate data on prevalence by educational attainment, among females, HSV-2 prevalence is lower for those who are literate in Chichewa and English and show greater proficiency in math. For males, the bivariate associations of HSV2 with English literacy and numeracy are either weak or nonexistent.

Given the pattern of refusals shown in Table 1 with those with lower educational attainment and females currently married more apt to decline to be tested, HSV-2 prevalence is likely somewhat higher in this population, particularly among females, than is indicated by the data collected.

As expected, HIV prevalence is relatively low in this sample among males, with 1.1% of males testing positive; prevalence among females is considerably higher with 4.9% testing positive (data not shown). While prevalence of HIV increases considerably with age among females, with 3.4 % of young women aged18 or younger testing positive compared with 8.7% of those aged 22 or older[f], prevalence does not increase much with age among males, which is consistent with the age pattern of HIV by sex in sub-Saharan Africa where men's risk typically does not rise substantially until their mid twenties. As is the case for HSV-2, there is no association between educational attainment and HIV for males, but there is a significant negative association for females, albeit not entirely smooth, reflecting the small number of infections. Note, also, that of the 11 males who tested positive for HIV by Round 5, six were also positive for HSV-2. Of the 51 females who tested positive for HIV, 36 or 71% also tested positive for HSV-2.

The longitudinal nature of the data allows us to broaden our examination to include seroconversion between Rounds 4 and 5 by current school attendance in Round 4 (see Table 3). The bivariate association between seroconversion and Round 4 school status is weak and not significant for either males or females.

Proposed Analysis

These preliminary descriptive data raise a number of questions about the effect of schooling on the likelihood of infection that will be addressed in the paper:

1. Why are educational attainment, literacy and numeracy inversely associated with HSV-2 for females and either not associated (educational attainment, numeracy) or weakly associated (literacy in Chichewa and English) among males?
    a. Is the increase in knowledge presumably acquired in school counterbalanced by the fact that young men with more education and likely higher income can attract more sexual partners?
    b. Is the inverse educational gradient in HSV-2 infection for females associated with the prevalence and duration of marriage among women with low levels of educational attainment?
2. Why is current school status not particularly predictive of HSV-2 seroconversion for females while educational attainment, literacy, and numeracy are associated with reduced prevalence?
3. What is the association of HSV-2 with other educational outcomes, including being behind grade for age, and grade repetition, both of which are quite common in Malawi?

We will use logistic regression models to estimate the effect of various risk factors for HSV-2 status. Although our focus is on the role of education, we will control for potentially confounding variables including, age, marital status, ethnicity, religion, parental education, household assets, living arrangements, and mobility. In the first part of our analysis, we will use a Heckman two stage regression model to control for testing refusal on the estimation of HSV-2 prevalence in Round 5. In the second part of our analysis, we will capitalize on the longitudinal nature of the data and use individual fixed effects to examine HSV-2 seroconversion between Rounds 4 and 5 as a function of change in school enrollment status during that period. Fixed effect models will control for constant, unobserved individual and

[f] Age reporting is inconsistent across rounds; thus we have women who report that they are age 22 and older in 2011 although they indicated they were no more than age 16 in 2007.

household-level factors that may simultaneously be related to both our predictors and outcomes. To the extent that data on sexual behavior shed light on the association between education and infection status, we will incorporate them in our analyses. Note, however, that although the sexual behavior data were collected with audio computer-assisted self-interviewing (ACASI), which provides greater confidentiality and privacy than conventional face-to-face interviews, previous analyses have found them to suffer from serious measurement problems.[49]

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Table 1. Refused Testing for HSV-2 by Round, Sex, and Demographic Characteristics (percent)

	Round 4 All respondents offered testing (N=2078; 1005 males, 1073 females)			Round 5 All respondents offered testing (N=2094; 1037 males, 1057 females)		
Refused HSV-2 testing	Males	Females	Total	Males	Females	Total
Sex	10.3	10.8	10.5	15.3	16.5	15.9
Educational attainment						
0-4 Years primary	13.2	16.8***	15.1***	19.1*	21.3*	20.3***
5-7 Years primary	11.8	12.0	12.0	18.6	18.8	18.7
Completed primary	7.0	10.7	9.2	9.9	15.9	13.1
Some secondary	8.4	5.7	7.2	13.4	11.7	12.7
Marital status (females only)						
Never married		5.6***			9.4***	
Current married		14.8			19.7	
Previously married		1.8			16.7	
Religion						
Muslim	13.7**	14.8***	14.3***	17.2	17.3	17.2†
Christian	7.3	7.0	7.1	14.1	16.2	15.1
Other/none	0	20.0	8.3	0	0	0

*p<0.05, **p<0.01, ***p<0.001, †p<0.10

For this analysis, the sample includes all respondents who were offered HIV testing. This *excludes*:

- respondents who refused participation in FTF survey
- respondents who were incapacitated or in any other way unable to give blood
- respondents whose blood was not collected due to long distance
- respondents who were approached before IRB clearance had been obtained (R4)
- respondents (R5) who had tested positive in 2010, with the exception of the few respondents who were offered repeat testing

Table 2. Tested Positive for HSV-2 Antibodies by Round 5 by Sex, Demographic Characteristics, Literacy and Numeracy (percent)

	Males (N=959)	Females (N=1022)	Total (N=1981)
Sex	17.8	25.2***	21.6
Age reported (R5)			
18 or younger	15.5	21.4†	18.1**
19	18.2	20.1	19.1
20	16.0	27.6	22.0
21	19.3	25.8	23.0
22 or older	26.9	33.3	30.9
Marital status (R5)			
Never married		17.8***	
Currently married		25.4	
Previously married		43.8	
Educational attainment (R5)			
0-4 years primary	20.0	36.0***	28.7***
5-7 years primary	19.6	29.2	25.1
Completed primary	15.9	18.4	17.2
Some secondary	16.5	18.4	17.4
Chichewa literacy (R5)[1]			
Cannot read 2 sentences	25.5**	35.2**	30.7***
Can read 2 sentences	16.3	23.1	19.8
English literacy (R5)[1]			
Cannot read 2 sentences	19.0	32.9***	26.8***
Can read 2 sentences	17.2	20.2	18.7
Math proficiency (R5)[1]			
Answered 0 questions correctly	25.4	38.0**	32.7**
Answered 1-12 questions correctly	17.2	28.5	23.3
Answered 13-17 questions correctly	15.8	21.4	18.7
Answered 18-22 questions correctly	21.2	13.0	18.2

*p<0.05, **p<0.01, ***p<0.001, †p<0.10

[1] Due to missing Literacy/Math data, N=956 for males and N=1019 for females

Table 3. HSV-2 Seroconversion between Rounds 4 and 5 by Sex and Current School Attendance in Round 4 (percent)

	Males (N=627)	Females (N=670)	Total (N=1297)
Sex	6.9	8.5	7.7
Current school attendance			
Not attending	7.6	8.7	8.3
Attending primary	7.6	9.8	8.3
Attending secondary	5.2	7.0	5.9