Education, HIV and Early Fertility: Experimental Evidence from Kenya*

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Abstract

We provide experimental evidence on the relationships between education, HIV/AIDS education, risky behavior and early fertility in Kenya. We exploit randomly assigned variation in the cost of schooling and in exposure to the national HIV/AIDS prevention curriculum for a cohort of over 19,000 adolescents in Western Kenya, originally aged 13.5 on average. We collected data on the schooling, marriage, and fertility outcomes of these students over 7 years, and tested them for HIV and Herpes (HSV2) after 7 years. We find that subsidizing education at the upper primary level reduces the dropout rate by about 18 percent. For girls, the education subsidy also leads to a significant reduction in teen pregnancy and teen marriage, but does not reduce the risk of sexually transmitted infection (STI). In contrast, bundling the education subsidy with the delivery of the HIV curriculum (with its abstinence-until-marriage message) leads to a lower STI risk for girls, but to a smaller decrease in early fertility than the subsidy alone. Finally, the HIV curriculum by itself has no impact on STI rates or on early pregnancy, although it reduces the number of unwed teenage pregnancies. These results are consistent with a model of sexual behavior and schooling decisions where girls choose whether to have casual or committed relationships, and teenage pregnancy may be a comparably desirable outcome for girls who cannot continue their education.

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1 Introduction

Early fertility and sexually transmitted infections (chief among them, HIV) are arguably the two biggest health risks facing teenage girls in sub-Saharan Africa.[1] In 2003, 24% of girls aged 15 to 19 in Kenya had started childbearing. The HIV infection rate among them was 3% at the time, and it had reached 7% by 2009 (Central Bureau of Statistics, 2004 and 2010).

This paper provides experimental evidence on how these two risks are affected by education subsidies and HIV risk information, and by their interaction. Between 2003 and 2006, we conducted a large randomized trial with 328 schools in Western Kenya to compare the effectiveness of two programs conducted either in isolation or combined: 1) providing free school uniforms to reduce the cost of education among upper primary school students; and 2) government-provided training of three teachers per primary school to help them deliver the national HIV/AIDS curriculum, which focuses on abstinence until marriage as the way to prevent infection. We assess the long-term impact of these two programs, in isolation and combined, on sexual behavior, fertility, and transmission of HIV and another sexually transmitted infection (STI), Herpes Simplex Virus type 2 (HSV-2), using a panel dataset that covers a cohort of over 19,000 youths, half of them girls, over 7 years. Both HIV and HSV2 prevalence at a point in time are indicators of the total number of people who were ever infected by those diseases. It is evident with HIV, which at the moment cannot be cured. In the case of HSV2, the antibodies remain in the blood, even when the person is asymptomatic.

At the onset of our study, these youths were 13.5 years old on average, and constituted the entire universe of sixth graders in the 328 schools enrolled in the study. At endline, these youths were 20.5 years old on average, and the majority was out of school. Despite the gap between the onset of the study and the endline data collection, we achieved a very high follow-up rate overall. During a first wave of endline surveying, 54% of the study youths could be interviewed and almost all of them agreed to be tested for HIV and HSV2. A subsample of 29% of the remainder was then selected for intensive tracking, and 81% of them could be found and surveyed, for an effective follow-up rate at endline of 91%. In other words, for 91% of the youths in our initial sample, we have either personal survey

[1]Pregnancy in adolescence is associated with greater risks for the mother as well as the child, including premature delivery (Trussell and Pebley, 1984). While part of this association reflects the fact that teenage pregnancy is more common among those socially and economically disadvantaged, there is a clear direct causal impact of biologic immaturity (Fraser et al., 2005).

information, or survey information for a "representative" youth. The resulting data set is unique due to the combination of its size (12,310 observations), the length of the follow up (7 years), the successful tracking rate, the availability of biomarkers for HSV2 and HIV, and the facts that it is the follow-up of a large scale randomized trial involving over 300 schools.

While the ultimate goal of both programs was to reduce risky sexual behavior, the two programs differed in their intended pathway. Specifically, the intermediate goal of the education subsidy was to enable adolescents to stay in school longer; while the intermediate goal of the teacher training program was to affect the content of education.

We first show that both programs achieved these respective intermediate goals. Training teachers on how to deliver the HIV curriculum increased the likelihood that teachers discuss HIV in the classroom and increased students' scores on HIV knowledge questions. Subsidizing education through the provision of two school uniforms over three years was effective at increasing educational attainment: the program reduced primary school dropout rates by 18% for both boys and girls. This is not surprising as school uniforms are the only remaining cost of attending primary school in Kenya, and at $6 a piece, uniforms were a significant expense for poor Kenyan families at the time of our program (per capita GDP was only US$360 in 2003). Surprisingly, however, we find that the two programs impacted each other. Specifically, the impact of the uniform distribution on schooling was muted in the schools where teachers were trained on delivering the HIV curriculum.

We then turn to analyzing whether and how the two programs affected teenage fertility and the risk of sexually transmitted infection. Since the HIV infection rate is extremely low in our cohort (less than 1%), we focus on HSV2 as the primary measure of risky sexual behavior. We find a nuanced set of results:

1. When implemented alone, the uniform program significantly reduced pregnancy rates among girls by 17% in the first three years (from 16% to 13%). After 7 years, girls who had benefited from uniforms were still 7% less likely to have started childbearing than their counterparts in the control group (49% versus 46%). They were not less likely to be infected with HSV2, however.

2. When implemented alone, the teacher training program did not have a significant impact on either the teenage fertility rate or the risk of HSV2 infection. However, it reduced the likelihood that teenage pregnancy is out of wedlock. It also decreased maternal age at first pregnancy for those who did get pregnant.

3. When the two programs were implemented jointly, the reduction in fertility was lower than when uniforms were provided without HIV risk education, but the effect on STI was higher. Specifically, we find that girls that benefited from both programs were

significantly less likely to be infected with HSV2 at the long-term follow-up, 7 years later. They were not significantly different from girls in the control group in terms of early fertility, however.

These results are consistent with a model we develop in the last section of the paper. The first important feature of the model is that schooling and pregnancy are incompatible. This is a reasonable feature since, in many settings, including ours, pregnant girls typically have to leave school.[2] This makes the opportunity cost of being pregnant high for girls financially able and willing to go to school. In contrast, when girls have already dropped out, being pregnant does not entail this cost. The other main ingredients of the model are the following: girls derive utility from sex but sex entails a risk of STI as well as a risk of pregnancy. Protection against these risks is available, but costly. Girls can chose whether to have a committed relationship (marriage, or relationship leading to marriage in case of pregnancy), or to have casual sex partners. Pregnancy provides benefits that are higher within marriage than outside marriage. For a given level of protection, girls perceive the risk of getting infected with an STI to be higher when having casual sex than in a committed relationship. Given this, the girls in our model decide how much education to get, how much sex to have and of which type (married sex or casual sex), and how much protection to use. At any point, they engage in only one type of sex. Since the benefit of pregnancy is higher, and the risk of STIs is lower, in a committed relationship, girls will have more sex and use less protection in committed relationships than when they choose casual sex.

This model generates the three comparative statics we observe in our data. First, when the cost of education decreases (as through our uniforms program), girls invest more in their education. This leads them to use more protection, and have less sex (to avoid pregnancy), conditional on choosing either married or casual sex. The gain in utility of a drop in the cost of education are higher within casual sex than committed relationships (since the value of pregnancy is higher for committed relationships), and this will therefore, other things equal, lead to a shift from married to casual sex. Thus all the forces lead in the direction of a reduction in teenage pregnancies when uniforms are provided.

Second, when girls receive an HIV education message that insists on the risk of getting HIV if having sex outside marriage (as does Kenya's national HIV/AIDS curriculum for primary school, in which the recommended behavior is abstinence till marriage), the perceived risk of getting an STI in a casual relationship increases. This leads to a reduction in sex and an increase in protection within casual relationships for those who choose casual relationships (hence a decrease in unwed pregnancies). But it also leads to a tendency to

[2]See Baird, McIntosh and Ozler (2011) for evidence that marriage/fertility and schooling are mutually exclusive in Malawi, and Ozier (2011) for additional evidence from Kenya.

shift from casual sex to committed relationships. Because sex is higher and protection is lower within committed relationships than within casual sex, this second effect leads to more pregnancies within marriage. Overall, the total effect on teenage pregnancies, and on STIs, is ambiguous. However, we should see a reduction in the number of unwed pregnancies.

Finally, when both programs are combined, girls want to avoid getting pregnant to stay in school, but they also think that casual sex is risky. They may then be less likely to shift from committed relationships to casual sex, but, whatever they choose, they will be having less sex, and use more protection. This should lead to a reduction of both STIs and pregnancies relative to the control group. The effects may be lower or higher than under the uniforms program, however, depending on the true risk of STI infection in casual relationships, as well as the benefit of pregnancies within committed relationships. The pattern of results we find, with more pregnancies but fewer STIs under the joint programs than under the uniforms program only, seems quite plausible.

While the model helps interpreting our results, it also helps highlighting the type of HIV risk information that is most likely to have unambiguous impacts on STI rates. In particular, in our model, an information campaign that would increase people's beliefs about the risk of HIV associated with all types of unprotected sex (both married and casual) would unambiguously reduce STI risk, and also increase educational attainment. Another important result of the model (and the data) is that a message that insists on the difference between sex within and outside marriage may have the (possibly unwanted) effect of increasing to occurrence of very early marriages, and compensating a decline in pregnancies out of wedlock by an increase in early pregnancy within marriage.

Our paper contributes to, and brings together, three distinct strands of literature. First, we contribute to the literature on the link between education and fertility behavior. While empirically there is a strong positive correlation between education and delay in the onset of fertility, and a strong negative correlation between education and the number of children (see Strauss and Thomas (1995) for a review of the literature), this may not indicate a causal relationship running from education to fertility, both due to the potential for reverse causality, and to possible omitted variables. Studies that have managed to overcome this identification issue have yielded mixed findings, however. Exploiting school expansion as a source of exogenous drop in the cost of schooling in Indonesia and in Nigeria, respectively, Breierova and Duflo (2002) and Osilii and Long (2008) find a causal effect of education on the onset of fertility. This echoes the findings of two studies that have exploited changes in compulsory schooling laws in developed countries (Black, Devereux, and Salvanes (2004) in the US and Norway; and Monstad, Propper and Salvanes (2008) in Norway). More recently, Lavy and Zablotsky (2011), exploiting the abrupt end of the military rule which greatly restricted the mobility of Arabs in Israel until the mid-1960's, also find a strong causal impact of schooling on fertility. In contrast, McCrary and Royer (2011), using exact cutoff dates for school entry in two US States, find no effect of education on maternal age at first birth. The two sets of results correspond to different conceptual experiments, however. McCrary and Royer (2011) identify the effect of more years of education obtained in early childhood, for people who drop out of school around the same age (for example 16, when they are allowed to). This is different from asking girls (or giving them the opportunity) to stay one more year in school, say, from age 16 to age 17, as our uniform provision or the school construction programs did. The two sets of results can be reconciled if what affects the probability of teenage pregnancy is the fact of being in school during teenage years, rather than the content being taught.

Second, we contribute to the literature on what works (and what does not) in the prevention of sexually transmitted infections among African youths. Whether HIV prevention information alone can make a difference, and what the content of this information should be, remains a source of debate among practitioners. Most national HIV prevention programs are difficult to evaluate since they are typically rolled out at once (Pettifor et al, 2007). Localized or targeted information campaigns are easier to evaluate, but there are surprisingly few rigorous studies with objective biomarker outcome data on this issue (see MacCoy et al, 2010, for a review). A randomized community trial in rural Tanzania, which examined both behavioral and biological outcomes, found that a multi-component adolescent sexual health program had a significant impact on HIV knowledge and attitudes, as well as some behaviors, but did not have a consistent impact on STI outcomes in either the short- or the long-run (Ross et al, 2007; Doyle et al. 2010). The study was somewhat underpowered, however: the intervention was randomized across only 20 communities, and was powered to detect a minimum difference in HIV incidence of 50%. In the same setting as ours, Dupas (2011) uses pregnancy as a biomarker and shows that HIV risk reduction messages (in her case, focusing on partner choice) are more effective at changing youth behavior than the risk avoidance message, focusing on abstinence-until-marriage, that constitutes the HIV prevention curriculum for primary school in Kenya, as in many other African countries. Our results, on a much larger cohort of students and over a much longer period of time, confirm, using STI biomarkers, that Kenya's HIV curriculum as it stands is overall ineffective at reducing the risk of sexually transmitted infections among youths, although combined with a reason to stay in school, it has a positive effect. This is an important result, because similar HIV curricula are rolled out by the government of several East-African countries. There is also relatively little evidence on the impact of financial resources on HIV risk. Our results suggest that in-kind subsidies in the form of free school uniforms are not enough, by themselves, to reduce STI risk over the long-run, even though they can reduce the risk of pregnancy. In a recent study in Malawi, Baird, McIntosh and Ozler (2011) find that cash transfers (whether conditional on school participation or unconditional) to the families of out-of-school girls can lead to significant reductions in infections rates after 18 months. Given our long-term results, a key question is whether the very short-run effects of the Malawi cash transfer program will persist.

Third, we contribute to the literature on the link between education and health behavior. Evidence from both developed countries (see Cutler and Lleras-Muney, 2009, for a review) and developing countries (Thomas, Strauss and Henriques, 1991) suggest that the cognitive gains associated with more years of education positively affect health behavior, in particular avoidance of risky behavior. For example, Ahituv, Hotz and Philipson (1996) find higher rates of condom use among young american adults with higher educational attainment. The evidence to date on the relationship between educational attainment and HIV status in Sub-Saharan Africa is mixed, however. Using nationally representative DHS surveys, Fortson (2008) finds evidence that education is positively correlated with HIV infection while De Walque (2009) does not. Iorio and Santaeulalia-Llopis (2011) use DHS data from 18 countries to test whether the relationship between education and HIV status varies as the HIV epidemic progresses, and find evidence of nonstationarity, with the relationship being positive at both the early and very late stages of the epidemic, and negative at intermediate stages. Looking specifically at how responsiveness to HIV risk information varies by education status, De Walque (2007) finds that, in Uganda, the more educated were quicker and more prone to change their behavior in response to the national HIV risk information campaign than those with less education. Our results offer a more nuanced view. While we find that only those exposed to an education subsidy responded to the HIV information in a way that reduced their risk of STI infection, we find this effect only for girls, not for boys. Furthermore, for girls at the margin of dropping out of school, we find that an exogenous increase in educational attainment alone is not sufficient to reduce exposure to STIs, including HIV, suggesting that the general content of education did not make a difference for these girls. This is consistent with a recent paper by Jensen and Lleras-Muney (2011), which finds that a randomized intervention that increased schooling among men in the Dominican Republic reduced the incidence of risky behavior (such as heavy drinking and smoking), not by changing these youths preferences towards risk or knowledge of risk, but by changing their environment (those in school have less money to buy cigarettes and drinks and are less exposed to peers who smoke and drink than those working).

The paper proceeds as follows. Section 2 describes the Kenyan context and program design. Section 3 presents the data. Sections 4 and 5 present the short- and long-run results, respectively. Section 6 presents the model. Section 7 concludes.

2 Background: Context and Study Design

2.1 Background on Education and HIV Prevention in Kenya

2.1.1 Education in Kenya

Primary school in Kenya consists of grades 1 through 8. Grade repetition is common, and as a result many students are 15, 16, or even older, by the time they reach eighth grade (if they do). In 2003, the newly elected government abolished school fees and provided schools with a grant for teaching materials, with the explicit objective of achieving universal primary education. Since then, schools are not allowed to charge any fees. They are also not supposed to refuse entry into the classroom to students without a uniform, but this part of the policy is not always enforced on the ground, and students often face strong social pressure to wear a uniform. As a result, it is very unusual to see a Kenyan student not wearing a uniform. The cost of a uniform was about $6 in 2003, in a country where the GDP per capita was $360 at the time. Uniforms are the only remaining direct cost of education in public primary schools. Dropping out before completing eighth grade is common, especially for girls. Our data shows that, absent any education subsidy, about 30% of girls and 21% of boys who reach sixth grade dropout before completing eighth grade.

2.1.2 HIV prevention and Sex Education in Kenya

In 1999, the Kenyan government established a national curriculum on HIV/AIDS education to reach children in primary school. The national HIV curriculum was developed with the assistance of UNICEF, and was the outcome of an extensive consultation process within the Kenyan society that included many stakeholders, including religious groups. The primary school HIV/AIDS curriculum teaches basic medical facts about AIDS, HIV transmission, prevention, and care for people living with AIDS. It stresses abstinence as the most effective way to prevent pregnancies and infection with sexually transmitted diseases, followed by faithfulness. Contraceptive methods are not mentioned in the official children textbook. Condoms can be discussed in class at the teacher's discretion or in response to questions, but the curriculum recommends against promoting condoms to primary school children.

2.2 Study Design

We exploit two programs implemented in partnership with the non-profit organization ICS Africa. The first program consisted in reducing the cost of education by providing free school uniforms. The second program consisted in training teachers on how to deliver the national HIV/AIDS prevention curriculum to primary school students. Before we describe the two programs in detail below, we start by describing the sampling frame.

2.2.1 Sampling Frame

The study took place in two districts of Western Kenya: Butere-Mumias and Bungoma districts.[3] A total of 7 divisions were sampled from those two districts. All public primary schools in those 7 divisions, amounting to 328 schools total, were sampled for the study. None of these schools had participated in any randomized experiment prior to this one. All the schools that were selected to participate in the study agreed to participate. Schools in the sample have, on average, two other primary schools within a 2 kilometer radius. The 328 schools sampled for the study were randomly assigned to one of four arms using a random number generator. The four arms were as follows:

Summary of Experimental Design

	# of schools (Total=328)	Uniforms Distribution	Teacher Training
C: Control (C)	82		
U: Uniforms	83	Yes	
H: Teacher Training on HIV curriculum	80		Yes
UH: Both Programs	83	Yes	Yes

Block randomization (stratification) was used. The following variables were used to create the strata: the administrative division the school is in, the quartile in which the school performance fell at the 2002 national examination, and whether the school's gender ratio among upper primary pupils was above or below the median in 2002. This led to a total of 82 strata. 76 of the strata had exactly 4 schools in them, and those four schools were randomly assign to a different experimental arm using a random number generator. In the three strata that had 3 schools, the experimental arm that was dropped was randomized. Likewise, in the three strata that had 5 schools, the experimental arm that was included twice was randomized.

[3]These districts have recently been split into multiple districts. We use the 2003 names.

Table 1 presents summary statistics on the 328 schools in our sample, by treatment group. For each characteristic, we also present the p-values of the test that the difference between each treatment arm and the control arm is zero. Only three of the 45 p-values we computed are smaller than 0.10, suggesting that the randomization was effective at creating balance between the groups.

2.2.2 Uniforms Program

Between January and July 2003, ICS Africa distributed a free school uniform to around 5,000 girls and 5,000 boys enrolled in grade 6 at the onset of the school year (January 2003) in the schools sampled for the uniforms program. Baseline enrollment data was collected from all the schools before announcing the program in order to avoid creating incentives for transfers across schools. Only children enrolled at the time of the baseline were eligible to receive free uniforms. Local tailors visited the schools to take children's measurements and made the uniforms. ICS subsequently delivered them to the children through a school visit.

In the Fall 2004, ICS distributed a second uniform to the same set of students, conditional on them being still enrolled in the same school. (For logistical reasons, it was not possible to track individual students to their new school to provide them with a uniform in case of a transfer). In order to provide incentives to the students to remain in school, it was announced at the onset of the program that students still enrolled in the same school would be eligible for a second uniform (no matter what grade they were in). Students who had lost or damaged their uniform in-between the two rounds of distribution did not receive a replacement uniform.

2.2.3 Teacher Training Program

By early 2000s, many Kenyan teachers reported not feeling comfortable teaching the official HIV/AIDS curriculum without having been trained. Starting in 2002 the government engaged in a large scale effort to train teachers. ICS Africa teamed up with the government in 2003 and helped implement the national training program for 184 primary schools in 2003 by providing logistical and financial support. Schools sampled for the Teacher Training were asked to send three upper primary teachers to participate in a 5-day training program.

The training sessions were conducted jointly by one facilitator from the AIDS Control Unit of the Ministry of Education, Science and Technology (MoEST), two facilitators from the Kenya Institute of Education (KIE), and one trained staff member from ICS. The teacher training covered a wide range of topics, including basic facts on HIV/AIDS, condom demonstration, information on Voluntary Counseling and Testing, and AIDS education methodology. The fact that the training was mainly led by MOEST and KIE teams ensured that teachers were trained like any other in Kenya, and in particular that they were trained to deliver the officially approved curriculum.

In addition to delivering HIV information in the classroom, trained teachers were advised to set up health clubs to deliver HIV information outside of the classroom. A year after the training, 86% of the schools whose teachers had been trained had established health clubs.

3 Data and Estimation Strategy

The sample is made of the cohort of students who were enrolled in Grade 6 at the onset of the study, i.e. January 2003, in one of the 328 primary study schools. In total, this cohort includes 19,289 students (9,487 girls and 9,802 boys), with an average of 29 girls and 30 boys per school. We collected data for this cohort of students on a regular basis between 2003 and 2010.

3.1 The Data

Two types of data were collected. To look at short-run effects, we collected regular updates on school enrollment, school attendance, marital status and childbearing status through school visits between 2003 and 2007. To look at longer-run effects on health outcomes, as well as collect information on the pathways through which those outcomes were affected, we conducted a long-run follow-up survey with study participants in 2009-2010.

3.1.1 Short- and Medium-Run Outcomes: "Roll Call" Data

To get regular status updates on the youths in the study sample, we conducted 7 unannounced school visits over the course of 5 years. At each visit, the list of all those in our baseline sample was read aloud to upper-grade students present at the time of the visit, and for each name on the list, the following questions were asked: Is X still in school? If yes, in what grade? If no, does she still live in the area? Is she married? Does she have any children? If so, how many? How old is her first born? Is she currently pregnant?

We use this roll call data to create dummy variables for "dropout", "ever married", and "ever pregnant". We also collected data on attendance on the day of the roll call visit, which gives us a measure of the intensive margin of school participation for those reported as being still enrolled in school.

To check whether this roll call method generates accurate data on childbearing and marital outcomes, a random subsample of 1,420 girls were sampled to be "tracked" at home and interviewed about their fertility history in 2006. Girls reported as having started childbearing were oversampled. Of the 1,420 girls sampled for this exercise, about 44% could be interviewed in person within 4 months of the roll call, and for the rest information could be gathered from a relative, in most cases the mother.

Appendix Table A1 presents the rates of consistency between the roll call data and the data collected through the quality control exercise, as well as how they vary across treatment groups. We find that 79% of those who were reported as having started childbearing by their former schoolmates had indeed started childbearing, and 83% of those who were reported as not having started childbearing had indeed not started. The longer the gap between the roll call and the home visit, the lower the consistency rate, unsurprisingly. The consistency level is greater when we look at the "ever had a child" outcome (rather than ever started childbearing, which includes current pregnancies). Overall, the roll call method appears to provide remarkably accurate information (if we take the information obtained through home visits as "true"). Most importantly, the level of consistency between the two sources does not appear to vary across treatment groups.

3.1.2 Long-Run Outcomes: The Long-run Biomarkers Follow-Up Survey

A long-run follow-up was conducted in 2009-2010, more than six years after the two programs had taken place. To test the impacts of the two programs on transmission of STIs among study participants, the follow-up study included the measurement of two biomarkers: HSV-2 (Herpes Simplex Virus Type 2) and HIV.

HSV-2 was selected as the primary endpoint for several reasons. First, HSV-2 is an infection that is almost exclusively sexually transmitted. It leads to the lifelong presence of antibodies against HSV-2 in the blood, thereby providing a permanent marker of having ever been infected with HSV2, and thus an objective proxy for relatively risky sexual behavior (Obasi, 1999). Second, a pilot study conducted in 2007 found prevalence of HSV-2 in a similarly aged cohort to be greater than 10%, but prevalence of other sexually transmitted infections, including HIV, to be significantly lower (Chlamydia, Gonorrhea, Trichomonas Vaginalis and HIV were all less than 5%). Thus, given the observed prevalence, the power to detect changes in HSV-2 infections within the selected cohort was high. However, the very low prevalence of the other STIs, including HIV, in our age group and region would have ensured insufficient power to detect any changes in the prevalence levels of those infections, even with a much larger sample. For this reason, other STIs (except HIV) were not measured as part of the long-term follow-up.

The follow-up survey was administered either at the respondent's home, or at a central location that the respondent had been invited to (through letters distributed by local chiefs).

The survey included questions on sexual behavior, past and current sexual partners, marriage, and fertility, as well as educational attainment. At the end of the follow-up survey, respondents were given a voucher for a free HSV-2 test to be performed at a mobile clinic located near their homes or at the central location where the survey had been administered. To collect data on HIV serostatus, all respondents who attended the mobile clinic were also asked to participate in anonymous linked HIV testing. In accordance with internationally accepted ethical standards and UNAIDS/WHO guidelines, the anonymous HIV test was performed only for respondents who provided informed consent for this specific procedure, and strict procedures to protect the identity of respondents were followed. The results were fully anonymized and could not be provided to participants. In addition, a randomly selected subsample of the respondents was offered voluntary counseling and testing, by trained field officers, at home.

Conditional on being successfully tracked for the follow-up survey, compliance with biomarker testing (HSV-2 and anonymous linked HIV testing) was remarkably high, at 97% on average, and comparable across groups.

Given the very high compliance rate with both the survey and the blood draws, the main challenge for the study was not in convincing respondents to provide us with information, but rather in physically locating the study participants so as to be able to ask them for information, seven years after the initial study started. This challenge cannot be underestimated, since the population under study was extremely mobile – at the time of this long-run follow-up, the youths in our sample had transitioned out of school and many of them had married outside their initial villages.

The long-run biomarker follow-up survey started in March 2009. By August 2010, 10,651 youths (55% of the 19,289 youths in the study cohort) had been successfully tracked. This is a remarkably high tracking rate given the challenges discussed above. Of those tracked, 97.5% had been interviewed, 2% had been identified as dead, and less than 1% had refused to be interviewed or were deemed mentally unfit for the interview. The tracking rate was higher among boys (59%) than girls (51%), due to a combination of factors. First, boys were more likely to still live at home with their parents, and tracking those who haven't left their home was much easier than tracking those who had moved. Second, conditional on having moved to another location within the study area, boys were easier to track than girls.

In August 2010, 29% of the 8,657 respondents left to track were randomly sampled for "intensive tracking." Between September 2010 and March 2011, teams of field officers and lab technicians were sent to various locations (including those outside of our initial study area, e.g. Nairobi, Mombasa, or even nearby Uganda) in order to individually track the sampled respondents at their current homes. 77.5% of girls and 84% of boys sampled for intensive tracking could be successfully tracked and surveyed. This brings our effective tracking rate (in the terminology of Orr et al., 2003 and Baird et al., 2011) to 0.51 + (0.49) * (0.775) = 89% for girls, and to 0.59 + (0.41)*(0.84) = 93% for boys. In other words, for 89% of the girls and 93% of the boys in our initial sample (91% overall), we have either personal survey information, or survey information for a "representative" youth.

Our effective tracking rate of 91% percent after 7 years compares favorably with already highly successful panel data collection efforts conducted in the same area of Western Kenya. Following up on 7,500 children sampled in 1998, Baird et al. (2011) achieved an effective tracking rate of 85% after 6 years, and 83% after 10 years. Following up on around 3,000 adolescent girls sampled in 2001, Friedman et al. (2011) achieved an effective tracking rate of 80% after 4 years.

3.2 Attrition

Despite the fact that, as we will see below, both sources of data (the roll call data and the individual follow-up survey data) yield very consistent results, an important question is whether differential attrition could be driving some of our results. To test for this, we run regressions to test whether attrition in our two datasets (roll-call data and long-run survey) was differential across treatment groups. Appendix Table A2 studies attrition in the roll call data. We find no evidence of differential attrition for any outcomes, except for dropout rates at the 5 year mark.

Appendix Table A3 studies attrition in the long-term follow-up data. While death rates were comparable across groups (at 1.3% among girls and 1.6% among boys), survey rates during the first phase of tracking (the regular tracking phase) were significantly higher in the treatment groups than in the control group (especially among girls). To remedy this, and as discussed above, we implemented an intensive tracking phase (following Orr et al., 2003 and Baird et al., 2010). Based on the information we had gathered (from relatives or neighbors) about respondents that we could not survey, we sorted these respondents left to track into 6 groups based on their initial district of origin (Butere/Mumias or Bungoma), as well as their current location (at their parent's home, in a new home within their initial district, in a new district). We then randomly sampled a subset of students in each of these subgroups (1/3rd of those still in their district of origin and 1/5th of those outside their home district, since those were more expensive to track). Column 3 of Table A3 regresses the share of those sampled for intensive tracking (IT) among those not found during regular tracking on the treatment indicators. Column 4 presents estimates of the survey rates among them. It shows that the intensive tracking was somewhat more successful among those exposed to either program than in the control group, and significantly higher when both programs implemented jointly than in the control group. All in all, Column 5 shows that the sample that could be followed-up after 7 years over-represents those that received uniforms, whether by themselves or in conjunction with the teacher training program. Controlling for sampling weights (column 6) does not solve this problem fully for girls that received both programs, since the intensive tracking success rate was higher among those in schools where both programs were implemented jointly .

To test whether attrition in the long-run follow-up survey was differential in terms of underlying, unobserved characteristics, we estimate the treatment effects observed in the roll call data on the follow-up subsample. We perform this analysis in Table A4 for one outcome (having ever started childbearing). We find that the estimates of the short- and medium-run treatment effects on childbearing measured through the roll call method are very much comparable when estimated on the full sample for which roll call data is available (columns 1 and 4), or on the subsample for which long-run data could be collected after 7 years (columns 2 and 5). Not surprisingly given the fact that the estimates are virtually identical in the full sample and the sample with attrition, the sampling weights correction, while decreasing the precision, does not affect the estimates much (columns 3 and 6). If any thing, the specification with sampling weights has a lower point estimate for the effect of the interaction between the two program than either the full sample or the unweighted estimates. This may be due to the fact that girls who benefited from both programs were more likely to be found during intensive tracking period. But the important take away from this table is that the results in the full sample and the tracked sample are virtually identical, even without using the sampling weights. This is encouraging and suggests that attrition does not bias the results below.

3.3 Estimation Strategy

Since the Uniform Distribution Program and the Teacher Training Program were randomly assigned to schools, schools should be similar in expectation across groups, along both observable and unobservable dimensions. Baseline statistics, presented in Table 1, confirm that there was no significant difference in observable school characteristics across groups at the start of the program. Thus the effectiveness of the two programs, and of their interaction, can be evaluated by simple comparison of the outcomes across groups. In practice, this is implemented in a simple regression framework. For each individual-level outcome, the estimation equation is:

$$O_{is} = \alpha + \beta U_s + \gamma T_s + \delta U_s \times T_s + X_s' \mu + \varepsilon_{is} \tag{1}$$

where O_{is} is the outcome for student i enrolled in school s at baseline. U_s is an indicator variable equal to 1 if the school was sampled for the Uniforms program and T_s is an indicator variable equal to 1 if the school was sampled for Teacher Training on HIV education. Error terms are assumed to be independent across schools, but are allowed to be correlated across observations in the same school (the standards errors are adjusted using the cluster command in stata). Given the attrition results discussed earlier, we present results with and without sampling weights: the sampling weights ensure that our final follow-up database is representative of (almost) the entire initial study population, but they reduce precision. We present test of equality between the two sets of estimates.

In equation 1, estimates of the coefficient β will measure the effect of the uniforms distribution on the outcome of interest, absent any other program. The effect of the Teacher Training program will be captured by γ. Finally, the effect of both programs conducted in conjunction will be capture by the sum $\beta + \gamma + \delta$.

In all tables that follow, we present estimates of equation 1 for a series of outcomes. In each table, Panel A presents the estimates for girls and Panel B presents the estimates for boys. At the bottom of each panel, we show the mean of the dependent variable for the control group, the effect of the two programs implemented jointly, and we present the p-value for the test that the effect of the joint programs is zero ($\beta + \gamma + \delta = 0$). Regressions were run both with and without school-level controls. Not surprisingly given the random assignment of schools to the programs and the very large sample size, the results are essentially identical, so the tables report only the results without these control variables. The results we show control for one individual control variable (year of birth) as well as randomization strata dummies. The results are essentially unchanged if we do not control for those, however. Finally, while all tables below present results of linear probability models, we have run the regressions with probit or logit specifications and found that the results are qualitatively unchanged (results available upon request).

4 Short- and Medium Run Results: the Roll Call Data

4.1 Impacts of the Education Subsidy

Table 2 present the results of OLS estimates of the effects observed within the first 3 or 5 academic years after the onset of the study. The first column in Table 2 suggests that the uniforms program helped marginal students remain in school. Girls in schools where free uniforms were provided were 3.2 percentage points less likely to have dropped out within the three academic years over which the program ran. The effect for boys was a 2.4 percentage point decrease in dropout rates. Given that dropouts are less common for boys than for girls to start with, however, the magnitude of the effect for boys and girls is about the same in percentage terms: a 17% decrease for girls and a 19% decrease for boys. This result confirms that the cost of the uniform remains an important barrier to access to education in Kenya.

While we see a large impact of the uniforms program on the extensive margin of education, we do not see any impact on the intensive margin. Column 2 of Table 2 shows that school attendance (conditional on being enrolled in school) did not change in schools where the uniforms program was implemented. The fact that we see no decrease in average attendance, despite the fact that the composition of students enrolled in school was affected by the program, suggests that students who avoided dropping out thanks to the free uniforms were able to attend school as regularly as other students.

We now turn to whether the program reduced the incidence of teenage pregnancy and marriage. This analysis is presented in columns 3-6 of Table 2. We find relatively large impacts for girls. While 16 percent of girls in the control group had ever been pregnant within 3 years, this share was 2.7 percentage points (17%) lower in Uniforms schools. Girls were also 2.6 percentage points (20%) less likely to be married.

After two more years, despite the end of the program and the fact that many girls had completed primary school by then, the gap between the two groups had increased in absolute value: girls in uniform schools were by then 4.4 percentage points less likely to have started childbearing (Table 2, column 9). This implies a lower percentage reduction, since within 5 years, 33% of girls in the control group had started childbearing. But this suggests that girls in the Uniforms group did not "catch up" as soon as the education subsidy ended, implying that the effect of the education subsidy on teen fertility was not simply due to the fact that the time spent in class reduced the time available to find sexual partners – the "incarceration effect", in the terminology of Black, Devereux and Salvanes (2004).

Panel B examines program impacts on boys. Both marriage and (observed) paternity are very low among boys even by the end of our sample period, but we still see decreases among boys in schools where uniforms were provided. This could come from the fact that their female classmates were less available to engage in sexual activity, or from a direct effect of the program on boys. Our guess is that the former was probably at play.

For girls, the effects on fertility are surprisingly large by comparison to the effect on education: within either three or five academic years, the program-induced reduction in the fraction of girls who started childbearing was almost as large as the reduction in school dropout. It would seem tempting to use columns 1 and 4 of table 2, respectively, (or columns 7 and 9), as the first stage and the reduced form of an instrumental variable strategy of the effect of education on early fertility. However, this is probably not legitimate: this instrumental strategy would be valid only under the assumption that the uniforms had no direct effect on the pregnancy status of girls. There are several reasons why this identification restriction may not hold. First, the availability of the uniform decreases the cost of education, even for girls who would not have dropped out. In our model, it will induce some girls who would not have dropped out to delay sexual activity (or use contraception) to avoid becoming pregnant. Second, a new, clean uniform may make the girls more proud, or reinforce their identity as "school girls", and thus gives them more confidence to say no to sex or marriage. Third, not having to pay for the uniform may reduce the temptation to engage in a relationship with a "sugar daddy", who can provide for the cost of the uniform. All of these suggest that an instrumental variable estimate of the impact of education on early fertility using our experiment would be biased upwards. Nevertheless, the fact that the two reduced form estimates of the effect of the programs on averted dropout and averted fertility are approximately the same size suggest a very large impact of the ability to stay in school on adolescent behavior, and especially on the delay of fertility, in Kenya.

Another way to think about the margin that was affected by the uniforms program is to combine our data on marriage with our data on pregnancy to check whether the pregnancies that were averted by the uniforms program would have been within or outside marriage. The evidence in columns 5 and 6 of Table 3 suggests that the program exclusively reduced within-marriage pregnancy. This result suggests that the pregnancies averted were primarily among girls who, had it not been for the education subsidy, would have dropped out of school and be more likely to get married and start a family. We will come back to this result when we discuss the model in section 6.

4.2 Impacts of the HIV prevention curriculum

To measure the extent to which HIV/AIDS education was delivered in schools, focus group discussions were held with students enrolled in grades 6 and 7 in early 2004, that is 12 to 18 months after the teacher training took place. The focus group discussions were conducted separately with 5 boys and 5 girls randomly chosen among students present in class during an unannounced visit. Overall, these discussions showed that the teacher training was effective at increasing the likelihood that teachers talked about HIV in the classroom. In particular, students in schools where teachers had been trained were 50% more likely to report that at least one teacher had mentioned HIV/AIDS in the previous week.

A self-administered survey, distributed among students enrolled in grade 8 in 2005, confirm these results. While the students who (anonymously) filled out this data do not necessarily correspond to the students in our study cohort (since we know from our roll call data that only about 32% of those in our study cohort had reached grade 8 in 2005), looking at this data can still be informative. Appendix Table A5 shows the results of OLS regressions on these data. We find that the teacher training increased the likelihood that students report that teachers mentioned HIV. It also somewhat affected the student's knowledge set about HIV, albeit moderately so. Male students in schools where the teachers were trained were more likely to mention abstinence as a means to prevent HIV infection, and both boys and girls were more likely to mention faithfulness, something we will return to below.

While the teacher training affected the content of education received by students, it did not affect the amount of schooling received. Table 2 shows that the coefficient estimates of the impact of the training on schooling outcomes (dropout and attendance) are very small and insignificant. This is not surprising since we did not anticipate the teacher training to have a direct effect on schooling.

A more surprising (and discouraging) result is that the teacher training had no significant impact on teen marriage, and it decreased teen childbearing only slightly (and insignificantly). However, it significantly decreased the number of out of wedlock pregnancies.

4.3 Impacts of the two programs implemented jointly

Arguably the most surprising result in the roll call data, at least at first glance, is that the teacher training on the HIV curriculum appears to have had the perverse effect of reducing the impact of the uniforms program both on schooling and on fertility. Indeed, the combined effect of both programs (shown at the bottom of each panel as "Total Effect U + H + U x H", with its p-value underneath) on dropout is only half that of the uniforms program alone, and not quite significant at conventional levels (the p-value is 0.17). The effect of the two programs together is lower than half that of the uniforms program alone when it comes to pregnancy risk. Again, that total effect is not significant, with the p-value at 0.29 (column 4). Two years later, that effect had diminished even further compared to that of the uniforms (col. 9). Finally, when it comes to marriage, the point estimate suggests that girls who received a uniform and whose teachers were trained were actually as likely to be married as girls who received neither program (col. 3). When combined, the data on marriage and pregnancy suggests that the small decrease in teen pregnancy observed when both programs are combined is concentrated among outside-marriage pregnancies, and overall the effect of the two programs combined is just exactly the same as the effect of the teacher training program alone.

These results are troubling, as they suggest that the HIV curriculum may play a counterproductive role on education and teenage pregnancy in an environment where barriers to education are reduced. Because the curriculum insists on abstinence until marriage, and on the risk of HIV infection in casual sexual relationship, one possible explanation for this result is that some girls who would have been persuaded to delay marriage (or marriage-like relationship) by the provision of free uniforms get discouraged by the risk of STI, and, if they chose to stay sexually active, decide to privilege committed relationships, where the cost of pregnancies is lower, and hence pregnancies are more likely. We propose a model developing this argument at length in section 6.

Interestingly, however, the combined effect of the two programs was greater than the sum of the parts for boys: for them, the two programs implemented together led to a significant decrease in marriage and fertility rates (with the caveat that observed fertility for boys might be a very imperfect measure of true fertility). This is consistent with the fact that their female classmates, as discussed above and in the model section, were more likely to choose to be either abstinent or to engage in committed relationships with men old enough to marry them.

4.4 Age Heterogeneity

While all youths in our sample were enrolled in the same grade at baseline (grade 6), there was non-negligible heterogeneity in their age at the onset of the study. Figure 1 presents the age distribution for students in our sample, separately for girls and boys, and by treatment groups, at the onset of the study. One specific concern is the fact that the age distribution for girls was not exactly comparable across groups. It is therefore important to verify that the differential early fertility impacts we observe across groups are not driven by differences in the age composition of the sample. To address this, Figure 2 presents the average pregnancy rate for each treatment group separately for each baseline age group. The overall pattern of findings seems to hold across age groups.

5 Long-Run Effects: The Biomarkers and Survey Data

The estimations of equation (1) on the long-run outcomes measured through the follow-up survey are presented in Tables 3, 4 and 5. In all these tables, we control for year of birth and randomization strata, as in Table 2, but also for the timing of the follow-up survey (since the follow-up survey spanned a 24-month window). For each outcome, we show the regression results estimated on the unweighted data, as well as when using sampling weights to reflect the fact that those interviewed during the intensive tracking phase were sampled to represent a larger share of individuals.

5.1 Consistency with the Roll-Call Data Results

Reassuringly, the results on the schooling and fertility outcomes presented in Table 3 are consistent with the roll call data results observed in the shorter-run. Namely, the uniforms program, when implemented in isolation, was successful at increasing educational attainment, and decreased the risk of teenage pregnancy and marriage. The probability to be pregnant by 16 decreases by 2.2 percentage points in the uniform group, a number very close to the 2.7 percent reduction found in the roll call data after 3 years. The lack of catch up that we already noted between the 3-year and the 5-year follow-ups is still apparent in the 7-year follow-up: The probability to have ever started childbearing by the time of the survey is 3.2 percentage points lower (although only the unweighted regression is significant at the 10% level). As in the roll call data, the teacher training program, by itself, had no significant impact on schooling and fertility overall. Finally, the interaction between the two programs had the previously discussed muting effect on the ability of the uniforms program to improve schooling and decrease pregnancy for girls.

5.2 Long-Run Impacts on Sexually Transmitted Infections

Other than confirming the roll call results, the key new piece of evidence provided by the long-run follow-up data concerns the results on sexual health. These results are presented in Table 5. Columns 1 and 2 show the estimated program effects on infection with HIV, and column 3 and 4 show the estimated program effects on infection with HSV2. The first interesting result is that HIV infection in our cohort is remarkably low – at less than 1% among both boys and girls in the control group. While it implies that this particular study, despite its very large sample size, is completely underpowered to estimate the impact of the programs on HIV transmission, this low infection rate is extremely good news, and an important result in its own right. It is considerably smaller than the HIV rate observed among 20-year olds in the Kenya DHS survey of 2003 (about six times smaller), in a region where the infection rates have historically been higher, suggesting that the younger cohorts of Kenyans have managed to considerably reduce their exposure to HIV, even in the absence of any special program. Their overall STI risk level is not negligible, however, as evidenced by the relatively high rate of infection with HSV2, at 12% among girls and 8.5% among boys (column 3).[4]

Somewhat surprisingly given its large impact on teen pregnancy, we find that the uniforms program did not decrease HSV2 infection. In fact, the coefficient estimate for girls is positive,

[4]The presence of HSV2 antibodies is a marker of risky sexual behavior and is also a risk factor for HIV transmission, since the risk of HIV transmission when having sex with an infected partner is considerably increased for people who have other STIs (Grosskurth et al., 1995; Corey et al., 2004).

although the coefficient estimate cannot be distinguished from zero. This is not a statistical power issue: for girls, we can reject a reduction of 1.8 percentage points in the risk of being infected with HSV2 at the 5% level, a 15% reduction. At best, the effect is therefore very modest. The teacher training program did not have any significant impact on HSV2 infection either, whether we look at boys or girls. The two programs implemented together, in contrast, appear to have had a relatively large impact for girls, reducing the risk of HSV2 infections by 2.1 percentage points in the unweighted sample (p-value: 0.025) and 1.7 percentage points in the weighted sample (p-value: 0.145), corresponding to a 20% to 14% decrease compared to the control group. We can reject the equality of the effect of the combined program and either program taken in isolation. For boys, however, the interaction of the two programs had no effect on HSV2 infection rates.

5.3 Self-Reported Sexual Behavior

Table 5 presents data from the long-term follow-up survey on self-reported sexual behavior. We find patterns broadly consistent with the observed effects on fertility and marriage. For girls, the uniform program reduced the likelihood that they report being sexually active (columns 1-2), and reduced the age of their partner (column 11-12). The first result may be a reporting effect, to the extent that some sexually active girls who were never pregnant may report that they never had sex. The second result is consistent with girls shifting to more casual relationships with boys their own age (committed relationships are more likely with older men, who can provide for a child if born). In contrast, the teacher training program increased partner age, and increased the likelihood of reporting that the first pregnancy was wanted. This is however not the case in the schools where uniforms were provided in addition to the teacher training. Also note that the vast majority of pregnancies (more than 70%) are unwanted in the control group. For boys, the teacher training program and the two programs implemented together reduced the self-reported onset of sexual activity (columns 3-4).

5.4 Summary of Results

Overall, the observed effects of the uniform program are all consistent with each other: Girls were more likely to stay in school, and less likely to become pregnant. They had younger partners and were less likely to get married early. The pregnancies, when they occurred, were no more likely to be wanted or to be within marriage. The only disappointing result (from the point of view of public policy) is the lack of reduction in HSV2 infection. Likewise, the observed effects of the teacher training program are consistent with each other, if a bit discouraging: the teacher training on the HIV curriculum had no effect on HSV2 infection or pregnancies, but led to a decrease in the number of unwanted pregnancies.

What is more interesting is the combined effect of these programs. Why was the effect of the combined program on teenage pregnancies among girls lower than that of the uniforms program only, while the effect on STI was larger? In the next section, we propose a model which, under a very reasonable set of assumptions, predicts exactly the set of results we observe in our data.

6 A Model

To interpret these results, we propose a model where girls decide how much sex to have, in what type of relationships, and with what level of protection, based on the expected costs and benefits. They also decide how much to invest in education. In the model (and in reality), girls who are not pregnant can be in school if they choose to (if they pay the fees and spend time in school), but they have to leave school the moment they get pregnant. When choosing how much sex to have, they just take into account the risk of sexually transmitted infections and the risk of getting pregnant, which includes the risk of losing the option to be in school.

6.1 Set-up

Denote the pleasure of sex as $U(s)$. Sex can be either "marital" sex (that is, with a fixed partner, with the view of future marriage, particularly in case of pregnancy), s_M, or casual sex, s_C. Hence, $s = s_M + s_C$.

The cost of sex has two components. One is the risk of STIs. The cost of contracting an STI is D. The perceived probability of getting an STI from having marital sex is $\pi_M(p)$, where p is the level of protection adopted; the corresponding number for casual sex is $\pi_C(p)$. To simply notation we will assume: $\pi_M(p_M) = a_M - \delta p_M$, and $\pi_C(p_C) = a_C - \delta p_C$. Protection is also costly, however: the cost of protection is $\lambda(p)$. This cost is increasing and convex: $\lambda'(.) > 0$ and $\lambda''(.) > 0$.

The other cost of sex is the risk of pregnancy: we assume the probability of getting pregnant is $\nu(p)$ in any kind of sex, given level of protection p. $\nu'(.) < 0$ and $\nu''(.) > 0$. The benefit of pregnancy is the utility from having a child (including the possibility of marriage with the father of the child). We denote it by B_M for the case of marital sex and B_C for the case of casual sex. The cost of pregnancy varies in the population: we model it as a loss of future earnings. The level of future earnings of someone depends on their investment in education e. Denote this by $y_0 + \theta y(e)$, with $y'(e) > 0$ and $y''(e) < 0$. Once a girl gets pregnant she cannot invest in education: she then gets y_0. We assume that that $B_M > B_C$, and that the utility of having a child as a teenager is never, in itself, worth the opportunity cost of pregnancy: $B_i - \theta y(e)$ is negative for $i = M$ or C.

Finally let the cost of investing in education be given by $e(\gamma) = e\gamma$.

Girls differ according to θ (their ability), their perceptions of costs and benefits of getting pregnant, and the cost of education they face.

The girl maximizes

$$U(s_M + s_C) - s_M\pi_M(p_M)D - s_C\pi_C(p_C)D + s_M\nu(p_M)[B_M + y_0] + s_C\nu(p_C)[B_C + y_0] + (1 - s_M\nu(p_M))[y_0 + \theta y(e)] + (1 - s_C\nu(p_C))[y_0 + \theta y(e)] - e\gamma - s_M\lambda(p_M) - s_C\lambda(p_C)$$

by choosing s_M, s_C, p_M, p_C and e. In writing this expression in this way we assume that the probabilities of getting pregnant or getting an STI is small at each sex interaction (so that we the probability of being pregnant or getting an STI is less than one for the level of sex that will be chosen), and ignore the fact that if you get pregnant from one kind of sex you cannot get pregnant from the other kind.

Our experiment affected two things: the uniform program lowered the cost of education γ, and the HIV-AIDS education program increased the perceived STI risk associated with casual sex, π_C (it may also have changed π_M, but the key point is that it insisted on the danger of sex before marriage, and therefore increased the wedge between π_M and π_C). The objective of the next subsections is to provide some comparative statics with respect to these two parameters.

6.2 The optimal choice of sex and education

The FOC wrt s_M and s_C tells us that

$$U'() = \pi_M(p_M)D + \nu(p_M)\theta y(e) + \lambda(p_M) - \nu(p_M)B_M \tag{2}$$

and:

$$U'() = \pi_C(p_C)D + \nu(p_C)\theta y(e) + \lambda(p_C) - \nu(p_C)B_C \tag{3}$$

The FOC wrt p_M and p_C yield

$$s_M(-\pi'_M(p_M)D + \nu'(p_M)(B_M - \theta y(e)) - \lambda'(p_M)) = 0 \tag{4}$$

and

$$s_C(-\pi'_C(p_C)D + \nu'(p_C)(B_C - \theta y(e)) - \lambda'(p_C)) = 0 \tag{5}$$

Finally the FOC wrt e yields

$$(1 - s_M\nu(p_M))\theta y'(e) - \gamma = 0 \tag{6}$$

and

$$(1 - s_C\nu(p_C))\theta y'(e) - \gamma = 0 \tag{7}$$

To solve the problem, first observe that, generically, equations 2 and 3 cannot both be satisfied at the same time. So the individual chooses s_M, p_M and e to maximize v_M, s_C, p_C and e to maximize v_C, assess the utility of each option at the optimal, and decides what to do.

It follows that either $s_M = 0$ or $s_C = 0$, and the utility function can be rewritten $max(v_M, v_c)$ where:

$$v_M = argmax_{s_M,p_m,e}[U(s_M) - s_M\pi_M(p_M)D + s_M\nu(p_M)[B_M + y_0] \\ + (1 - s_M\nu(p_M))[y_0 + \theta y(e)] - e\gamma - s_M\lambda(p_M)]$$

and

$$v_c = argmax_{s_C,p_C,e}[U(s_C) - s_C\pi_C(p_C)D + s_C\nu(p_C)[B_C + y_0] \\ + (1 - s_C\nu(p_C))[y_0 + \theta y(e)] - e\gamma - s_C\lambda(p_C)]$$

The first step is therefore to chose how much sex, protection, and education a girl would chose for the kind of sex that they would decide to have. Without loss of generality, the first order conditions can be re-written without subscripts:

$$\frac{\partial v}{\partial s} = u'(s) - (a - \delta p)D + \nu(p)(B - \theta y(e)) - \lambda(p) = 0 \tag{8}$$

$$\frac{\partial v}{\partial p} = \delta D + \nu'(p)(B - \theta y(e)) - \lambda'(p) = 0 \tag{9}$$

$$\frac{\partial v}{\partial e} = (1 - s\nu(p))\theta y'(e) - \gamma = 0 \tag{10}$$

We derive the second order conditions in the appendix, but one turns out to be important in the proofs below. The second order conditions requires that the determinant of the hessian matrix be negative. This implies that:

$$
\begin{aligned}
& u''(s)s[\nu''(p)(B-\theta y(e))-\lambda''(p)](1-s\nu(p))\theta y''(e) \\
& -u''(s)[-s\nu'(p)\theta y'(e)]^2 \\
& -s[\nu''(p)(B-\theta y(e))-\lambda''(p)][-\nu(p)\theta y'(e)]^2<0
\end{aligned} \tag{11}
$$

6.3 Comparing marital sex and casual sex

We consider that marital sex differs from casual sex in two ways: the perceived benefit of pregnancy, B, is higher, and the perceived risk of getting an STI, a is lower. We start by showing that an decrease in a leads to an increase in sex, a decrease in protection, and a decrease in education.

Proposition 1 *Everything else equal, for any specific kind of sex, when the perceived risk of STI, a increase, sex is lower, protection is higher, and effort in education chosen is higher.*

Proof. Taking the total derivative of all the first order conditions with respect to a yields:

$$-Dda+u''(s)ds-[\nu(p)\theta y'(e)]de=0 \tag{12}$$

$$dp-[\nu'(p)\theta y'(e)]de=0 \tag{13}$$

$$-[\nu(p))\theta y'(e)]ds-[s\nu'(p))\theta y'(e)]dp+[(1-s\nu(p))\theta y''(e)]de=0 \tag{14}$$

Re-arranging these equations imply:

$$
\begin{aligned}
\frac{da}{dp}= & -\frac{u''(s)s\nu'(p)}{D\nu(p)} \\
& +\frac{u''(s)(1-s\nu(p))y''(e)[\nu''(p)(B-\theta y(e))-\lambda''(p)]}{D\theta\nu(p)\nu'(p)y'(e)^2}dp \\
& -\frac{\nu(p)[\nu''(p)(B-\theta y(e))-\lambda''(p)]}{D\nu'(p)}dp
\end{aligned} \tag{15}
$$

This expression cannot be unambiguously signed without resorting to the second order conditions: the first and last terms are indeed positive, but the middle term is negative: it reflects that fact that, as protection increases, sex decreases, and that tends to reduce the cost of HIV transmission.

However, multiplying $\frac{da}{dp}$ by $D\theta^2 s\nu(p)\nu'(p)y'(e)^2$ (a negative number is $\nu'(p)<0$ and all the other terms are positive), we obtain the left hand side of equation 11. The second order condition thus implies hat $\frac{da}{dp}$ (and hence $\frac{dp}{dpa}$) must be positive. Similar manipulations of the total derivative allows us to show that $\frac{ds}{da} < 0$ and $\frac{de}{da} > 0$ (proof in the appendix). ■

Intuitively, as the perceived risk of STI increase, there is a direct effect on the level of sex and protection chosen. Choosing more protection increases the cost of sex, which further reinforces the effect on lowering the level of sex. Because sex and protection go up, the risk of pregnancy goes down, which makes investing in education more worthwhile.

Proposition 2 *Everything else equal, for any specific kind of sex, when the perceived benefit of pregnancy, B increases, sex is higher, protection is lower, and effort in education chosen is lower*

Proof. Taking the total derivative of all the first order conditions with respect to B gives us:

$$\nu(p)dB + u''(s)ds - [\nu(p)\theta y'(e)]de = 0 \tag{16}$$

$$\nu'(p)dB + [\nu''(p)(B - \theta y(e)) - \lambda''(p)]dp - [\nu'(p)\theta y'(e)]de = 0 \tag{17}$$

$$-[\nu(p)\theta y'(e)]ds - [s\nu'(p))\theta y'(e)]dp + [(1 - s\nu(p))\theta y''(e)]de = 0 \tag{18}$$

Manipulating these expressions allow us to solve for dB/dp

$$\begin{aligned}\frac{dB}{dp} &= -\frac{[\nu''(p)(B - \theta y(e)) - \lambda''(p)]}{\nu'(p)} \\ &+ \frac{[\nu(p)\theta y'(e)]^2[\nu''(p)(B - \theta y(e)) - \lambda''(p)]}{(1 - s\nu(p))\theta y''(e)u''(s)\nu'(p)}dp \\ &+ \frac{s\nu'(p))[\theta y'(e)]^2}{(1 - s\nu(p))\theta y''(e)}dp = 0\end{aligned} \tag{19}$$

Multiplying this expression by $-su''(s)\nu'(p)[(1 - s\nu(p))\theta y''(e)]$ (which is positive) gives us the right hand-side of equation 11. Hence, dB/dp is negative.

Similar manipulations allow us to sign ds/dB (positive) and de/dB (negative) (see appendix). ■

Combining these two propositions, we get the following comparison between casual sex and marital sex.

Proposition 3 *Keeping other parameters constant, the level of sex is higher, and the level of protection is lower, under marital sex than under casual sex. Educational investment is also lower.*

Proof. Obvious from combining 1 and 2, and the assumption that B is higher and a is lower under marital sex than under casual sex. ■

An immediate implication is that girls that choose marital sex are more likely to get pregnant. Whether or not they are more likely to get STIs or less likely to get STI depends on the relationship between the level of risk in each type of relationship and the increase in sexual activity in marital relationships.

6.4 The effects of the uniform program

The uniform program reduces the cost of education, γ.

Taking the total derivative of all the first order conditions while letting γ vary yields:

$$u''(s)ds + [\delta D + \nu'(p)(B - \theta y(e)) - \lambda'(p)]dp - [\nu(p)\theta y'(e)]de = 0 \quad (20)$$

$$dp - [\nu'(p)\theta y'(e)]de = 0 \quad (21)$$

$$-[\nu(p))\theta y'(e)]ds - [s\nu'(p))\theta y'(e)]dp + [(1 - s\nu(p))\theta y''(e)]de - d\gamma = 0 \quad (22)$$

Note that because of a first-order condition (see equation 9), equation 20 simplifies to:

$$u''(s)ds - [\nu(p)\theta y'(e)]de = 0 \quad (23)$$

We would are now ready to solve the above system of equations to solve for $dp/d\gamma, ds/d\gamma, de/d\gamma$, and using the second-order conditions to sign them.

Proposition 4 *When γ increases, for each type of sex, p decreases, s increases and e decreases.*

Proof. From equation 21, we have:

$$de = \frac{\nu''(p)(B - \theta y(e)) - \lambda''(p)}{\nu'(p)\theta y'(e)}dp \quad (24)$$

Plugging this into equation 23 yields

$$ds = \frac{\nu(p)[\nu''(p)(B - \theta y(e)) - \lambda''(p)]}{\nu'(p)u''(s)}dp \quad (25)$$

Plugging in all the above to equation 22 yields an expression for $d\gamma/dp$:

$$\begin{aligned}\frac{d\gamma}{dp} = & -\frac{\nu^2(p)}{\nu'(p)}\frac{\theta y'(e)}{u''(s)}[\nu''(p)(B-\theta y(e)) - \lambda''(p)] \\ & - s\nu'(p)\theta y'(e) \\ & + \frac{(1-s\nu(p))y''(e)}{\nu'(p)y'(e)}[\nu''(p)(B-\theta y(e)) - \lambda''(p)]\end{aligned} \tag{26}$$

Once again manipulating equation 11 allows us to sign this expression: $\frac{d\gamma}{dp}$ is negative.

Similar manipulations of the total derivative allow us to sign $ds/d\gamma > 0$, and $de/d\gamma < 0$. ■

Thus, since the uniform program reduces the cost of education, it leads to a reduction of s, p and an increase in e both for girls who chose marital sex and for girls who chose casual sex. Moreover, when we evaluate the utility at the optimal choice for both type of sex, the gain in utility is higher for casual sex than for marital sex, since the level of educational effort is higher under casual sex. Therefore, there will also be a switch from marital sex to casual sex. As we showed in proposition 3 this will further reduce sexual activity, increase educational effort, and increase the use of protection during sex.

The uniform program should thus lead to an unambiguous increase in education, and an unambiguous reduction in the occurrence of teenage pregnancy. The effect on STI will depend on the true relationship between a_C and a_M: If a_C is indeed higher than a_M, the reduction in STI due to the reduction in sex and the increase in condom use may be counterbalanced by an increase in the riskiness of casual relationships. These results are summarized in the proposition below:

Proposition 5 *The uniform program on its own should lead to a reduction in teenage pregnancy, and increase in educational attainment. The effect on STI is ambiguous.*

6.5 The effects of the teacher training program

The teacher training program puts emphasis on abstinence till marriage. The message given to the youth is that sex is dangerous, and their best bet is abstinence till marriage. Condoms are not to be demonstrated in class, although the curriculum leaves some places to discuss the topic. In the framework of the model, we interpret this as saying that the program increases a_C, leaving a_M unchanged, or even possibly reducing it.

The comparative statics with respect to a have been discussed in proposition 1: an increase in a leads to a reduction in sex, an increase in protection, and an increase in educational effort. However, the resulting utility is lower than it was before: the HIV-AIDS training program thus reduces the utility of casual sex, and make marital sex relatively more attractive. Since the level of sex is higher, and the level of education and educational effort are lower under marital sex, the effect on teenage pregnancy are ambiguous. However, there should be a decline in the number of pregnancies that do not lead to a marriage. The effect on STI is ambiguous, and depends on the true ratio between a_M and a_C and the extent to which sex is higher in marital relationship: if a_M is in fact not much lower than a_C, the effect of a reduction in casual sex may be more than compensated by the increase in the risk of contamination within marital relationship, even though each sexual interaction is safer in a marital relationship. These results are summarized in the proposition below:

Proposition 6 *The teacher training program on its own has ambiguous effects on teenage pregnancy, STIs, and education. There should be a decline in out-of-wedlock pregnancies, and a decline in the age at marriage.*

6.6 Combining the programs

We are now in a position to discuss what happens when the two programs are combined: we are simultaneously reducing γ and increasing a_c. For each type of sex chosen, these two programs go in the same direction: they lead to less sex, more protection, and more educational effort. However, while the uniform program makes casual sex relatively more attractive, the teacher training programs makes marital sex relatively more attractive. Because these two forces pull in opposite directions, there should be fewer people switching from one type of sex to the other than under either program taken in isolation.

The overall results depend on the relative magnitude of the effect of increasing a_c and the effect of decreasing γ, and we are thus not in a position to derive a general result. Assuming that there is little switching between one type of sex and the other, however, the combined program should lead to an increase in education, a decrease in pregnancies, and a decrease in STI (compared to no program). Compared to the uniform only program, since fewer girls switch to casual sex where the level of protection is higher but the level of STI contamination given protection is also higher than under marital sex, we may expect a lower effect on teenage pregnancies and drop out, but a higher effect on STIs. Compared to the training only program, since fewer girls switch to marital sex where the level of protection is low and sex is higher, we may expect a larger reduction in teenage pregnancy, and a larger effect on STI. Note that the combined program is thus the only one that is predicted to have an unambiguous effect on STI in most cases, because it leads to a reduction in sex and an increase in protection in the overall sample (as the education program), but without causing a switch to more casual relationships.

6.7 Comparison of theoretical results and empirical results

The model's predictions fit the pattern in the data quite well: the education subsidy reduced drop-out and teenage pregnancy rates, but not STI rates, perhaps because casual relationships are indeed somewhat more likely to lead to STI than marital relationships. Training teachers on the official HIV/AIDS curriculum did not reduce teenage pregnancies but led to earlier marriage and somewhat reduced out of wedlock pregnancies (at least in the roll call data). It also did not lead to a reduction in STI risk, presumably because the increase in sex and the reduction in protection within the marital relationship more than compensate for the fact that the risk of transmission is lower, keeping level of sexual activity and protection constant.[5] The two programs implemented jointly had a lower effect than the education subsidy alone on both drop-out and teen pregnancy rates, but consistent with the model's prediction, the combination of the two programs was the only intervention that led to a clear reduction in STI rates.

7 Conclusion

It is widely believed that improving the education of women is a critical step in reducing fertility and improving maternal and child health in developing countries. The findings of this paper helps shed some light on this important question. Using experimental data, we show that reducing the cost of education by providing free uniforms to students conditionally on their enrollment in school leads to reductions in the dropout rates of both boys and girls, and to reductions in teen childbearing and marriage rates. This suggests that girls who have access to completely free education are willing and able to defer childbearing and marriage in order to reap the benefits of education. Their determination to do so, however, depends on their beliefs about the value of marriage. We find that HIV prevention curricula that focus on an abstinence-until-marriage message tend to increase the relative utility of marriage (by increasing the perception that sex outside marriage would lead to an STI) and counteract the effects of increased access to schooling on fertility behavior.

More generally, our findings show that the interplay between perceived HIV risk, schooling opportunities and early fertility is complex, and policies that focus on only one of these issues at a time have a potential to backfire. While we find that combining an education subsidy

[5]It is likely the case that the teacher training program led girls to under-estimate the risk of infection in marital relationships, which are generally with older partners, themselves more likely to be infected (Dupas, 2011).

with Kenya's abstinence-until-marriage curriculum can reduce the rate of STIs for young women, it does not reduce their risk of early fertility, and does not increase their schooling attainment as much as if the education subsidy had been implemented alone. The model of schooling and sexual behavior that we propose to explain this result suggests that combining the education subsidy with a different type of HIV message (for example, a "use condoms to prevent both STIs and pregnancy" message) would likely have had an even greater impact on educational attainment and possibly health than the subsidy alone.

Our findings also imply a particularly important role of the ability to stay in school: the reduction in teenage pregnancies obtained through the education subsidy alone is almost as large as the reduction it caused in school dropouts. This does not imply that every girl who did not drop out because of the program would have had a child otherwise, since some girls who would have stayed in school if not pregnant may also have been induced by the program to remain sexually inactive or use contraception. But this suggests that giving girls additional motivation to delay their first pregnancy (the opportunity to go to school if they do so) is an extremely powerful (and inexpensive) way to reduce early fertility. Most government and international effort have focused on ease of access to basic education (up to grade 6 or 9). This result suggest that education gains in the upper end of that range, or even secondary school, especially for girls, may have a much larger impact on reducing early fertility than we would expect based on the causal effect of years of primary education.

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A Model Appendix

A.1 First and Second order Conditions

The utility function when choosing either type of sex can be written:

$$v(s) = u(s) - s(a - \delta p)D + s\nu(p)[B + y_0] + (1 - s\nu(p))[y_0 + \theta y(e)] - e\gamma - s\lambda(p) \quad (A.1)$$

The first order conditions are:

$$\frac{\partial v}{\partial s} = u'(s) - (a - \delta p)D + \nu(p)(B - \theta y(e)) - \lambda(p) = 0 \quad (A.2)$$
$$\frac{\partial v}{\partial p} = s[\delta D + \nu'(p)(B - \theta y(e)) - \lambda'(p)] = 0 \quad (A.3)$$
$$\frac{\partial v}{\partial e} = (1 - s\nu(p))\theta y'(e) - \gamma = 0 \quad (A.4)$$

For positive s, A.3 simplifies to:

$$\delta D + \nu'(p)(B - \theta y(e)) - \lambda'(p) = 0 \quad (A.5)$$

The second order partial derivatives are:

$$\frac{\partial^2 v}{\partial s^2} = u''(s) \quad (A.6)$$
$$\frac{\partial^2 v}{\partial p^2} = s[\nu''(p)(B - \theta y(e)) - \lambda''(p)] \quad (A.7)$$
$$\frac{\partial^2 v}{\partial e^2} = (1 - s\nu(p))\theta y''(e) \quad (A.8)$$
$$\frac{\partial^2 v}{\partial s \partial p} = [\delta D + \nu'(p)(B - \theta y(e)) - \lambda'(p)] = 0 \quad (A.9)$$
$$\frac{\partial^2 v}{\partial s \partial e} = -\nu(p)\theta y'(e) \quad (A.10)$$
$$\frac{\partial^2 v}{\partial p \partial e} = -s\nu'(p)\theta y'(e) \quad (A.11)$$

Note that $\frac{\partial^2 v}{\partial s \partial p} = 0$ from the first-order condition.
The Hessian matrix H is:

$$\begin{pmatrix} \frac{\partial^2 v}{\partial s^2} & \frac{\partial^2 v}{\partial s \partial p} & \frac{\partial^2 v}{\partial s \partial e} \\ \frac{\partial^2 v}{\partial p \partial s} & \frac{\partial^2 v}{\partial p^2} & \frac{\partial^2 v}{\partial p \partial e} \\ \frac{\partial^2 v}{\partial e \partial s} & \frac{\partial^2 v}{\partial e \partial p} & \frac{\partial^2 v}{\partial e^2} \end{pmatrix}$$

The second order condition requires the Hessian matrix to be negative definite, which is true if and only if: if $\frac{\partial^2 v}{\partial s^2} < 0$; $\frac{\partial^2 v}{\partial s^2}\frac{\partial^2 v}{\partial p^2} - (\frac{\partial^2 v}{\partial s \partial p})^2 > 0$; and $|H| < 0$.

This implies:

$$\frac{\partial^2 v}{\partial s^2} = u''(s) < 0 \tag{A.12}$$

$$\frac{\partial^2 v}{\partial p^2} = s[\nu''(p)(B - \theta y(e)) - \lambda''(p)] < 0 \tag{A.13}$$

$$\frac{\partial^2 v}{\partial e^2} = (1 - s\nu(p))\theta y''(e) < 0 \tag{A.14}$$

and:

$$\frac{\partial^2 v}{\partial s^2}\frac{\partial^2 v}{\partial p^2} = u''(s)s[\nu''(p)(B - \theta y(e)) - \lambda''(p)] > 0. \tag{A.15}$$

The determinant of H is equal to:

$$\begin{aligned} |H| =& \frac{\partial^2 v}{\partial s^2}\frac{\partial^2 v}{\partial p^2}\frac{\partial^2 v}{\partial e^2} + 2\left(\frac{\partial^2 v}{\partial s \partial p}\frac{\partial^2 v}{\partial s \partial e}\frac{\partial^2 v}{\partial p \partial e}\right) \\ & - \frac{\partial^2 v}{\partial s^2}\left(\frac{\partial^2 v}{\partial p \partial e}\right)^2 - \frac{\partial^2 v}{\partial p^2}\left(\frac{\partial^2 v}{\partial s \partial e}\right)^2 - \frac{\partial^2 v}{\partial e^2}\left(\frac{\partial^2 v}{\partial s \partial p}\right)^2 \end{aligned} \tag{A.16}$$

The second and last terms above are zero, because $\frac{\partial^2 v}{\partial s \partial p} = 0$. Plugging in the second order partial and mixed derivatives, we derive the following inequality.

$$\begin{aligned} & u''(s)s[\nu''(p)(B - \theta y(e)) - \lambda''(p)](1 - s\nu(p))\theta y''(e) \\ & - u''(s)[-s\nu'(p)\theta y'(e)]^2 \\ & - s[\nu''(p)(B - \theta y(e)) - \lambda''(p)][-\nu(p)\theta y'(e)]^2 < 0 \end{aligned} \tag{A.17}$$

A.2 Comparative statics

A.2.1 Comparative statics with respect to a

Taking the total derivative of all the first order conditions while letting a vary yields:

$$-Dda + u''(s)ds - [\nu(p)\theta y'(e)]de = 0 \tag{A.18}$$

$$dp - [\nu'(p)\theta y'(e)]de = 0 \tag{A.19}$$

$$-[\nu(p)\theta y'(e)]ds - [s\nu'(p))\theta y'(e)]dp + [(1 - s\nu(p))\theta y''(e)]de = 0 \tag{A.20}$$

Plugging the previous line into A.20, we can get ds in terms of dp.

$$-[\nu(p)\theta y'(e)]ds-[s\nu'(p))\theta y'(e)]dp+[(1-s\nu(p))\theta y''(e)]\frac{\nu''(p)(B-\theta y(e))-\lambda''(p)}{\nu'(p)\theta y'(e)}dp=0 \tag{A.21}$$

We solve the above equation for ds, and with some simplification and cancellation, arrive at:

$$ds=\left[-\frac{s\nu'(p)}{\nu(p)}+\frac{(1-s\nu(p))y''(e)[\nu''(p)(B-\theta y(e))-\lambda''(p)]}{\nu'(p)y'(e)^2\nu(p)\theta}\right]dp \tag{A.22}$$

We have now found ds and de in terms of dp. We replace them in equation A.18:

$$\begin{aligned}-Dda+u''(s)&\left[-\frac{s\nu'(p)}{\nu(p)}+\frac{(1-s\nu(p))y''(e)[\nu''(p)(B-\theta y(e))-\lambda''(p)]}{\nu'(p)y'(e)^2\nu(p)\theta}\right]dp\\ &-[\nu(p)\theta y'(e)]\frac{\nu''(p)(B-\theta y(e))-\lambda''(p)}{\nu'(p)\theta y'(e)}dp=0\end{aligned} \tag{A.23}$$

Combining these expressions and simplifying we arrive at an expression for $\frac{da}{dp}$:

$$\begin{aligned}\frac{da}{dp}=&-\frac{u''(s)s\nu'(p)}{D\nu(p)}\\ &+\frac{u''(s)(1-s\nu(p))y''(e)[\nu''(p)(B-\theta y(e))-\lambda''(p)]}{D\theta\nu(p)\nu'(p)y'(e)^2}dp\\ &-\frac{\nu(p)[\nu''(p)(B-\theta y(e))-\lambda''(p)]}{D\nu'(p)}dp\end{aligned} \tag{A.24}$$

Multiply $\frac{da}{dp}$ by $D\theta^2 s\nu(p)\nu'(p)y'(e)^2$ (a negative number) to obtain the left hand side of equation A.17.

The second order condition thus imply $\frac{dp}{da}>0$.

All the proofs work exactly following the same principle. In what follow, we don't provide the details of all the calculations, but provide similar expression for the total derivative p, s and e with respect to each of a, B and γ, provide the expression by which they must be multiplied to be re-intepreted in light of equation A.17. Finally, we sign this expression.

$$\begin{aligned}\frac{da}{ds}=&\frac{u''(s)}{D}\\ &-\left(\frac{1}{D}\right)\frac{s[\nu''(p)(B-\theta y(e))-\lambda''(p)][\theta y'(e)\nu(p)]^2}{-[s\theta\nu'(p)y'(e)]^2+(1-s\nu(p))\theta y''(e)s[\nu''(p)(B-\theta y(e))-\lambda''(p)]}\end{aligned} \tag{A.25}$$

Multiply by :

$$D\left[-[s\theta\nu'(p)y'(e)]^2+(1-s\nu(p))\theta y''(e)s[\nu''(p)(B-\theta y(e))-\lambda''(p)]\right] \tag{A.26}$$

to obtain the left hand side of equation A.17.

We now need to determine if this expression is positive or negative. To to dos, we again turn to inequality A.17. With a little rearrangement, we get:

$$\begin{aligned}&u''(s)\left[s[\nu''(p)(B-\theta y(e))-\lambda''(p)](1-s\nu(p))\theta y''(e)-[-s\nu'(p)\theta y'(e)]^2\right]\\&<s[\nu''(p)(B-\theta y(e))-\lambda''(p)][-\nu(p)\theta y'(e)]^2\end{aligned}$$

Multiplying both sides by $\frac{D}{u''(s)}$, a negative quantity, yields:

$$\begin{aligned}&s[\nu''(p)(B-\theta y(e))-\lambda''(p)](1-s\nu(p))\theta y''(e)-[-s\nu'(p)\theta y'(e)]^2\\&>\frac{D}{u''(s)}s[\nu''(p)(B-\theta y(e))-\lambda''(p)][-\nu(p)\theta y'(e)]^2\end{aligned}$$

On the left-hand side, we have precisely the divisor on line A.26. The right-hand side is positive: $\frac{D}{u''(s)}$ is negative from equation A.12; $s[\nu''(p)(B-\theta y(e))-\lambda''(p)]$ is negative from A.13; and $[-\nu(p)\theta y'(e)]^2$ is positive. Hence, this expression is positive: this simply that $\frac{ds}{da}<0$. That is, when the perceived risk of contracting an STI increases, women choose lower quantities of sex.

Finally, we obtain the following expression for $\frac{da}{de}$:

$$\begin{aligned}\frac{da}{de}=&-\frac{u''(s)[s\theta\nu'(p)y'(e)]^2}{D[\nu''(p)(B-\theta y(e))-\lambda''(p)]y'(e)\nu(p)s\theta}\\&+\frac{u''(s)(1-s\nu(p)\theta y''(e)s[\nu''(p)(B-\theta y(e))-\lambda''(p)]}{D[\nu''(p)(B-\theta y(e))-\lambda''(p)]y'(e)\nu(p)s\theta}\\&-\frac{[\nu(p)\theta y'(e)]}{D}\end{aligned} \tag{A.27}$$

We obtain the left hand side of equation A.17 by multiplying this expression by $D[\nu''(p)(B-\theta y(e))-\lambda''(p)]y'(e)\nu(p)s\theta$, This expression is negative: $s[\nu''(p)(B-\theta y(e))-\lambda''(p)]$ is negative by equation A.13, while the other terms $Dy'(e)\nu(p)\theta$ are positive by definition. Hence, $\frac{de}{da}>0$.

A.2.2 Comparative statics with respect to B

Taking the total derivative of all the first order conditions while letting B vary yields:

$$\nu(p)dB + u''(s)ds - [\nu(p)\theta y'(e)]de = 0 \tag{A.28}$$

$$\nu'(p)dB + [\nu''(p)(B - \theta y(e)) - \lambda''(p)]dp - [\nu'(p)\theta y'(e)]de = 0 \tag{A.29}$$

$$-[\nu(p)\theta y'(e)]ds - [s\nu'(p))\theta y'(e)]dp + [(1 - s\nu(p))\theta y''(e)]de = 0 \tag{A.30}$$

This implies:

$$\begin{aligned} \frac{dB}{dp} &= -\frac{[\nu''(p)(B - \theta y(e)) - \lambda''(p)]}{\nu'(p)} \\ &+ \frac{[\nu(p)\theta y'(e)]^2[\nu''(p)(B - \theta y(e)) - \lambda''(p)]}{(1 - s\nu(p))\theta y''(e)u''(s)\nu'(p)}dp \\ &+ \frac{s\nu'(p))[\theta y'(e)]^2}{(1 - s\nu(p))\theta y''(e)}dp = 0 \end{aligned} \tag{A.31}$$

Which is equal to the left hand side of equation A.17 after multiplying by $-su''(s)\nu'(p)[(1-s\nu(p))\theta y''(e)]$, a positive number. Hence, $\frac{dp}{dB} < 0$. When the benefit of getting pregnant increases, the women choose less protection.

We now solve for for dB/ds:

$$\begin{aligned} \frac{dB}{ds} &= \frac{[\nu(p)\theta y'(e)]^2}{\nu(p)[(1 - s\nu(p))\theta y''(e)]} \\ &+ \frac{u''(s)s[\nu'(p)\theta y'(e)]^2}{[(1 - s\nu(p))\theta y''(e)][\nu''(p)(B - \theta y(e)) - \lambda''(p)]\nu(p)} \\ &- \frac{u''(s)}{\nu(p)} \end{aligned} \tag{A.32}$$

Which is the left hand side of 11 equation, multiplied by by $-s\nu(p)[\nu''(p)(B - \theta y(e)) - \lambda''(p)][(1 - s\nu(p))\theta y''(e)]$. Since $s[\nu''(p)(B - \theta y(e)) - \lambda''(p)] < 0$ from equation A.13; $(1 - s\nu(p))\theta y''(e)$ is negative from A.14; and $\nu(p) > 0$ by definition (it is a probability), this divisor is negative overall, which means that the inequality changes sign. Hence $\frac{ds}{dB} > 0$. When the benefit from being pregnant increases, the women choose more sex.

Finally, solving for $\frac{dB}{de}$, we get:

$$\begin{aligned}\frac{dB}{de} = &+ \frac{[\nu(p)\theta y'(e)]^2[\nu''(p)(B-\theta y(e)) - \lambda''(p)]}{[\nu(p)\theta y'(e)]\nu(p)[\nu''(p)(B-\theta y(e)) - \lambda''(p)] + [s\nu'(p))\theta y'(e)]\nu'(p)u''(s)} \\ &+ \frac{s[\nu'(p)\theta y'(e)]^2 u''(p)}{[\nu(p)\theta y'(e)]\nu(p)[\nu''(p)(B-\theta y(e)) - \lambda''(p)] + [s\nu'(p))\theta y'(e)]\nu'(p)u''(s)} \\ &- \frac{[(1-s\nu(p))\theta y''(e)]u''(s)[\nu''(p)(B-\theta y(e)) - \lambda''(p)]}{[\nu(p)\theta y'(e)]\nu(p)[\nu''(p)(B-\theta y(e)) - \lambda''(p)] + [s\nu'(p))\theta y'(e)]\nu'(p)u''(s)} = 0\end{aligned} \tag{A.33}$$

Which is the left hand-side of equation 11 multiplied by $-s[\nu(p)\theta y'(e)]\nu(p)[\nu''(p)(B - \theta y(e)) - \lambda''(p)] - s[s\nu'(p)\theta y'(e)]\nu'(p)u''(s))$. This expression is positive overall, the sum of two positive terms. The first term $-s[\nu(p)\theta y'(e)]\nu(p)[\nu''(p)(B-\theta y(e)) - \lambda''(p)]$ is positive since $s[\nu''(p)(B-\theta y(e)) - \lambda''(p)] < 0$ from inequality A.13, and $\nu(p)$, θ, and $y'(e)$ are each positive. The second term is overall positive because $u''(s)$ and $\nu'(p)$ are negative while the other terms are positive.

This implies that $\frac{dB}{de} < 0$, and so $\frac{de}{dB} < 0$. When the benefits of pregnancy increase, the women choose lower levels of education.

A.2.3 Comparative statics for γ

Taking the total derivative of all the first order conditions while letting γ vary yields:

$$u''(s)ds + [\delta D + \nu'(p)(B-\theta y(e)) - \lambda'(p)]dp - [\nu(p)\theta y'(e)]de = 0 \tag{A.34}$$

$$dp - [\nu'(p)\theta y'(e)]de = 0 \tag{A.35}$$

$$-[\nu(p)\theta y'(e)]ds - [s\nu'(p)\theta y'(e)]dp + [(1-s\nu(p))\theta y''(e)]de - d\gamma = 0 \tag{A.36}$$

Note that because of a first-order condition (see equation A.5), equation A.34 simplifies to:

$$u''(s)ds - [\nu(p)\theta y'(e)]de = 0 \tag{A.37}$$

Manipulating these total derivative gives us:

$$\begin{aligned}\frac{d\gamma}{dp} = &- \frac{\nu^2(p)}{\nu'(p)}\frac{\theta y'(e)}{u''(s)}[\nu''(p)(B-\theta y(e)) - \lambda''(p)] \\ &- s\nu'(p)\theta y'(e) \\ &+ \frac{(1-s\nu(p))y''(e)}{\nu'(p)y'(e)}[\nu''(p)(B-\theta y(e)) - \lambda''(p)]\end{aligned} \tag{A.38}$$

This is equal to the left-hand-side of equestion A.17, multiplied by $u''(s)\nu'(p)y'(e)s\theta$. This product is positive, hence $dp/d\gamma < 0$.

$$\begin{aligned}\frac{d\gamma}{ds} =& -\nu(p))\theta y'(e) \\ & - [s\nu'(p))\theta y'(e)]\frac{\nu'(p)u''(s)}{\nu(p)[\nu''(p)(B - \theta y(e)) - \lambda''(p)]} \\ & + [(1 - s\nu(p))\theta y''(e)]\frac{u''(s)}{\nu(p)\theta y'(e)}\end{aligned} \tag{A.39}$$

Which is the left hand side of inequality A.17, multiplied by $s[\nu''(p)(B - \theta y(e)) - \lambda''(p)]\nu(p)\theta y'(e)$. This expression is negative since $s\nu''(p)(B - \theta y(e)) - \lambda''(p) < 0$ (equation A.13), and the rest of the terms are positive. Hence, $ds/d\gamma > 0$.

Finally, the expression for $d\gamma/de$:

$$\begin{aligned}\frac{d\gamma}{de} =& -[\nu(p)\theta y'(e)]\frac{\nu(p)\theta y'(e)}{u''(s)} \\ & - [s\nu'(p))\theta y'(e)]\frac{\nu'(p)\theta y'(e)}{\nu''(p)(B - \theta y(e)) - \lambda''(p)} \\ & + (1 - s\nu(p))\theta y''(e)\end{aligned} \tag{A.40}$$

Which is A.17, multiplied by $u''(s)s[\nu''(p)(B - \theta y(e)) - \lambda''(p)]$. This expression must be positive (see equation A.15), so $de/d\gamma < 0$.

A.2.4 Summary of comparative statics

	p	s	e
γ (cost of education)	$\frac{dp}{d\gamma} < 0$	$\frac{ds}{d\gamma} > 0$	$\frac{de}{d\gamma} < 0$
a (perceived risk of catching an STI)	$\frac{dp}{da} > 0$	$\frac{ds}{da} < 0$	$\frac{de}{da} > 0$
B (benefit of pregnancy)	$\frac{dp}{dB} < 0$	$\frac{ds}{dB} > 0$	$\frac{de}{dB} < 0$

Figure 1: Age Distribution at Baseline

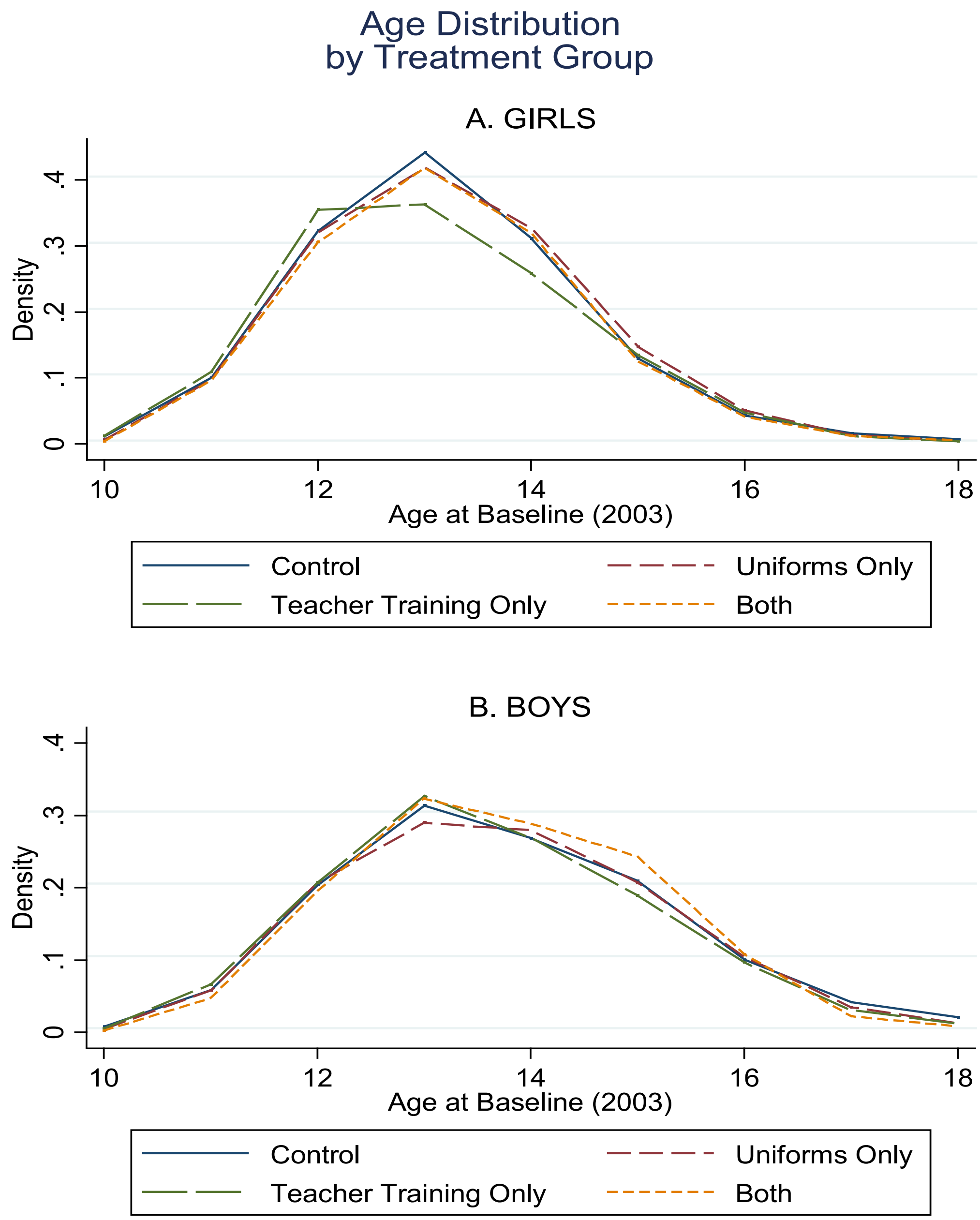
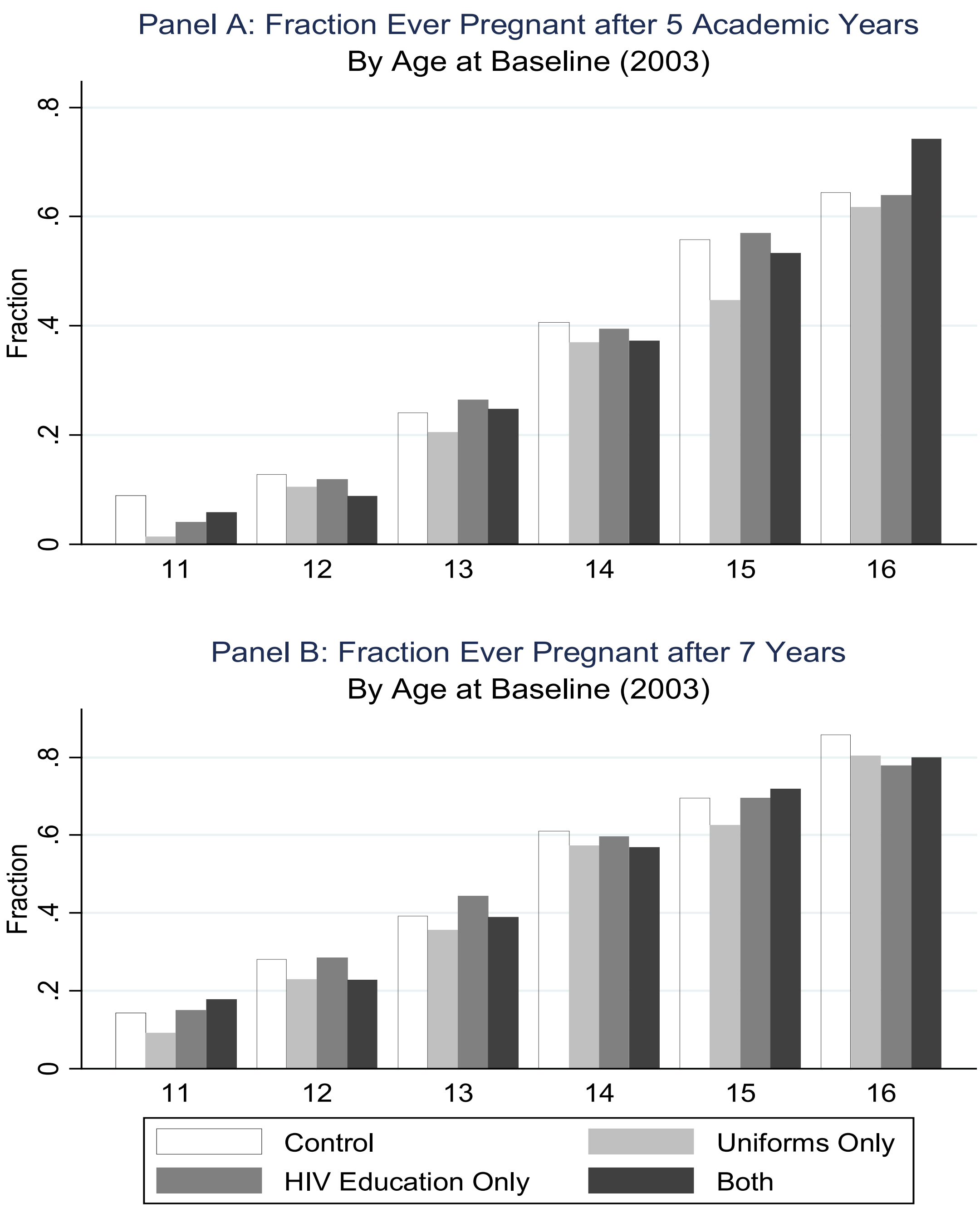


Figure 2: Impacts on Teenage Pregnancy, by Age at Baseline



Notes: Panel A based on Roll Call data. Panel B based on long-term follow-up survey data.

Table 1. Baseline Characteristics, by Treatment Group

Panel A. Baseline Characteristics of Schools	Uniforms Only	HIV Education Only	Both	Control	Uniforms Only vs. Control		HIV Education Only vs. Control		Both vs. Control	
					Diff	*p-val*	Diff	*p-val*	Diff	*p-val*
Average Score on Primary School Graduation Exam in 2003	255.2	249.4	248.6	249.3	5.9	*0.097**	0.1	*0.66*	-0.8	*0.468*
	[29.6]	[24.8]	[32.]	[26.1]						
School Size	464.6	489.3	473.8	498.9	-34.3	*0.292*	-9.5	*0.777*	-25.1	*0.587*
	[203.1]	[208.8]	[185.7]	[194.3]						
Sex Ratio (Female/Male) among Students in 2002	1.016	1.024	1.012	1.016	0.000	*0.945*	0.008	*0.455*	-0.004	*0.823*
	[.124]	[.127]	[.105]	[.135]						
Number of Latrines on school compound	11.6	11.2	9.9	11.1	0.54	*0.215*	0.14	*0.635*	-1.13	*0.081**
	[6.3]	[6.4]	[5.7]	[5.5]						
Number of primary schools within 2 km radius	2.01	2.16	2.06	2.06	-0.04	*0.845*	0.10	*0.521*	0.01	*0.925*
	[1.95]	[1.82]	[1.8]	[1.76]						
Total Number of Teachers in 2003	14.2	14.6	13.8	14.6	-0.40	*0.786*	0.04	*0.439*	-0.76	*0.282*
	[4.2]	[5.3]	[4.4]	[4.7]						
Average Age of Teachers in 2003	40.0	39.6	39.6	39.6	0.34	*0.455*	0.01	*0.796*	0.03	*0.845*
	[3.1]	[3.8]	[3.8]	[3.5]						
Sex Ratio (Female/Male) among Teachers in 2003	1.22	1.18	1.30	1.15	0.07	*0.856*	0.03	*0.788*	0.15	*0.281*
	[1.]	[.848]	[.987]	[.829]						
Share Ever Pregnant by End 2005 Among Girls in Grade 8 in 2003	0.207	0.227	0.227	0.230	-0.023	*0.198*	-0.003	*0.784*	-0.003	*0.76*
	[.134]	[.144]	[.148]	[.128]						
Share Married by End 2005 Among Girls in Grade 8 in 2003	0.127	0.139	0.163	0.137	-0.010	*0.191*	0.002	*0.861*	0.026	*0.044***
	[.119]	[.106]	[.126]	[.101]						
Panel B. Baseline Characteristics of Study Cohort (Grade 6 in 2003)										
Number of Girls in Grade 6	29.3	28.8	28.0	29.4	-0.15	*0.859*	-0.63	*0.862*	-1.45	*0.451*
	[15.4]	[15.3]	[14.4]	[14.]						
Number of Boys in Grade 6	28.2	30.7	30.3	30.4	-2.21	*0.225*	0.31	*0.498*	-0.14	*0.739*
	[13.3]	[14.6]	[14.7]	[14.1]						
Sex Ratio (Female/Male)	1.065	0.968	0.964	1.011	0.05	*0.127*	-0.04	*0.184*	-0.05	*0.156*
	[.412]	[.297]	[.356]	[.325]						
Averge Age among Girls (at baseline)	13.21	13.12	13.18	13.14	0.07	*0.464*	-0.02	*0.378*	0.04	*0.856*
	[.56]	[.64]	[.59]	[.6]						
Averge Age among Boys (at baseline)	13.79	13.72	13.77	13.77	0.01	*0.878*	-0.05	*0.362*	0.00	*0.965*
	[.62]	[.69]	[.62]	[.66]						
Number of Schools	83	83	80	82						

Notes: School Averages. Standard deviations in brackets.

Table 2. Short- and Medium Run Impacts: Roll Call Data

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Impacts after 3 years						Impacts after 5 years		
	Dropped Out of Primary School	Attendance rate (while enrolled)	Ever Married	Ever Pregnant[1]	Ever Pregnant and Married	Ever Pregnant and Unmarried	Dropped Out of Primary School	Ever Married	Ever Pregnant
Panel A. Girls									
Uniforms (U)	-0.032	-0.002	-0.026	-0.027	-0.023	-0.004	-0.053	-0.030	-0.044
	(0.012)**	(0.006)	(0.010)**	(0.011)**	(0.010)**	(0.006)	(0.017)***	(0.015)**	(0.017)***
Teacher Training on HIV (H)	0.003	-0.008	0.010	-0.008	0.006	-0.014	-0.015	0.022	0.000
	(0.011)	(0.006)	(0.009)	(0.011)	(0.009)	(0.006)**	(0.015)	(0.014)	(0.015)
Interaction (UxH)	0.013	0.010	0.015	0.024	0.020	0.005	0.044	0.012	0.032
	(0.017)	(0.008)	(0.014)	(0.016)	(0.013)	(0.008)	(0.023)*	(0.021)	(0.023)
Observations	9120	8236	9111	9076	9076	9076	8870	8396	8307
Mean of Dep. Var. (Control)	0.188	0.939	0.128	0.160	0.114	0.046	0.300	0.265	0.329
Total effect U + H + UxH	-0.016	0.000	-0.001	-0.011	0.003	-0.013	-0.024	0.004	-0.012
p-value (Test: U +H + UxH = 0)	*0.169*	*0.955*	*0.962*	*0.294*	*0.821*	*0.02***	*0.151*	*0.794*	*0.484*
Panel B: Boys									
Uniforms (U)	-0.024	-0.001	-0.008	-0.002	-0.004	0.001	-0.039	-0.006	0.005
	(0.011)**	(0.008)	(0.004)*	(0.003)	(0.002)	(0.001)	(0.016)**	(0.008)	(0.005)
Teacher Training on HIV (H)	0.010	-0.021	0.000	-0.002	-0.002	0.000	0.010	0.006	0.004
	(0.010)	(0.008)***	(0.005)	(0.002)	(0.002)	(0.001)	(0.014)	(0.008)	(0.005)
Interaction (UxH)	0.000	0.022	-0.002	-0.002	0.001	-0.002	0.018	-0.004	-0.008
	(0.015)	(0.011)**	(0.006)	(0.003)	(0.003)	(0.002)	(0.020)	(0.011)	(0.008)
Observations	9465	8989	9397	9437	9386	9386	9265	8581	8901
Mean of Dep. Var. (Control)	0.127	0.908	0.022	0.011	0.010	0.002	0.211	0.059	0.032
Total effect U + H + UxH	-0.014	0.000	-0.010	-0.006	-0.005	-0.001	-0.011	-0.004	0.001
p-value (Test: U +H + UxH = 0)	*0.171*	*1.000*	*0.016***	*0.02***	*0.027***	*0.643*	*0.483*	*0.710*	*0.934*

*Notes: Data Source: Roll Call Data (see test section 3.1.1 for details). Estimates obtained through OLS regressions that include controls controls for year of birth, the timing of the roll call visits, school size and randomization strata dummies. Standard errors clustered at the school level. ***, **, * indicate significance at 1, 5 and 10%.*

Columns 1 -6: Data collected through five school visits conducted at regular intervals over three academic years (2003, 2004, 2005). Columns 7 -9: Include four additional school visits conducted in 2006 and 2007.

[1] For boys, "ever pregnant" is equal to 1 if the respondent ever had a child or a pregnant partner

Table 3. Long-Run Impacts: Individual Long-term Follow-up Survey Data (after 7 years)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Panel A. Girls	Completed primary school		Grades Completed		Ever Married		Ever pregnant[1]		Ever Pregnant, Married		Ever Pregnant, Unmarried		Had started childbearing by age 16	
Uniforms (U)	0.042	0.039	0.223	0.198	-0.039	-0.039	-0.032	-0.033	-0.038	-0.040	0.005	0.006	-0.023	-0.022
	(0.015)***	(0.017)**	(0.080)***	(0.088)**	(0.018)**	(0.021)*	(0.019)*	(0.021)	(0.018)**	(0.020)*	(0.012)	(0.012)	(0.011)**	(0.012)*
Teacher Training on HIV (H)	0.006	-0.003	-0.004	-0.029	0.025	0.020	0.020	0.018	0.026	0.023	-0.006	-0.005	-0.006	-0.009
	(0.015)	(0.017)	(0.081)	(0.086)	(0.018)	(0.020)	(0.020)	(0.022)	(0.018)	(0.020)	(0.013)	(0.014)	(0.012)	(0.014)
Interaction (UxH)	-0.034	-0.042	-0.136	-0.162	0.006	0.007	0.007	0.006	0.003	0.002	0.005	0.005	0.020	0.026
	(0.021)	(0.024)*	(0.116)	(0.121)	(0.028)	(0.030)	(0.029)	(0.031)	(0.027)	(0.029)	(0.017)	(0.019)	(0.016)	(0.017)
Observations	5713	5713	5713	5713	5720	5720	5724	5724	5720	5720	5720	5720	5724	5724
Mean of Dep. Var. (Control)	0.803	0.803	9.167	9.167	0.392	0.392	0.494	0.494	0.380	0.380	0.114	0.114	0.085	0.085
Sampling Weights		Yes		Yes		Yes		Yes		Yes		Yes		Yes
Total effect U + H + UxH	0.014	-0.006	0.083	0.007	-0.008	-0.012	-0.005	-0.009	-0.009	-0.015	0.004	0.006	-0.009	-0.005
p-value (Test: U +H + UxH = 0)	*0.355*	*0.720*	*0.354*	*0.943*	*0.674*	*0.565*	*0.802*	*0.673*	*0.649*	*0.468*	*0.730*	*0.626*	*0.349*	*0.662*
Panel B: Boys														
Uniforms (U)	0.027	0.036	0.046	0.074	-0.003	0.009	-0.015	-0.004	-0.006	0.006	-0.009	-0.010	-0.004	-0.005
	(0.013)**	(0.014)**	(0.079)	(0.082)	(0.014)	(0.016)	(0.016)	(0.018)	(0.013)	(0.015)	(0.007)	(0.009)	(0.004)	(0.004)
Teacher Training on HIV (H)	-0.013	0.000	-0.106	-0.046	-0.001	-0.003	0.006	0.003	0.001	0.003	0.005	0.002	-0.003	-0.005
	(0.013)	(0.014)	(0.075)	(0.079)	(0.014)	(0.016)	(0.015)	(0.017)	(0.013)	(0.015)	(0.007)	(0.008)	(0.003)	(0.003)
Interaction (UxH)	0.000	-0.014	0.046	-0.025	-0.001	-0.002	0.004	0.002	0.003	-0.004	0.000	0.004	0.005	0.008
	(0.019)	(0.020)	(0.109)	(0.117)	(0.019)	(0.022)	(0.021)	(0.025)	(0.018)	(0.021)	(0.010)	(0.012)	(0.005)	(0.005)
Observations	6597	6597	6597	6597	6596	6596	6600	6600	6596	6596	6596	6596	6600	6600
Mean of Dep. Var. (Control)	0.855	0.855	9.504	9.504	0.185	0.185	0.214	0.214	0.161	0.161	0.053	0.053	0.015	0.015
Sampling Weights		Yes		Yes		Yes		Yes		Yes		Yes		Yes
Total effect U + H + UxH	0.014	0.022	-0.014	0.003	-0.005	0.004	-0.005	0.001	-0.002	0.005	-0.004	-0.004	-0.002	-0.002
p-value (Test: U +H + UxH = 0)	*0.292*	*0.121*	*0.871*	*0.970*	*0.672*	*0.782*	*0.688*	*0.953*	*0.876*	*0.717*	*0.561*	*0.598*	*0.554*	*0.452*

*Notes:See text section 3.1.2 for details on the data source. Estimates obtained through OLS regressions that include controls for year of birth, the timing of the survey, school size and randomization strata dummies. Standard errors clustered at the school level. ***, **, * indicate significance at 1, 5 and 10%.*

[1] For boys, "ever pregnant" is equal to 1 if the respondent ever had a child or a pregnant partner.

Table 4. Long-Run Impacts on Sexually Transmitted Infections (after 7 years)

	(1)	(2)	(3)	(4)	(5)	(6)
	Blood Test: HIV positive		Blood Test: HSV2 positive		Reports having symptoms of an STI in previous 12 months	
Panel A. Girls						
Uniforms (U)	0.008	0.004	0.009	0.013	-0.008	-0.009
	(0.005)	(0.006)	(0.012)	(0.014)	(0.006)	(0.006)
Teacher Training on HIV (H)	0.002	-0.002	0.006	0.008	-0.004	-0.005
	(0.005)	(0.006)	(0.011)	(0.013)	(0.005)	(0.006)
Interaction (UxH)	-0.010	-0.004	-0.039	-0.039	0.007	0.008
	(0.008)	(0.009)	(0.015)**	(0.018)**	(0.007)	(0.008)
Observations	2385	2385	5514	5514	5718	5718
Mean of Dep. Var. (Control)	0.009	0.009	0.113	0.113	0.029	0.029
Sampling Weights		Yes		Yes		Yes
Total effect U + H + UxH	0.000	-0.002	-0.024	-0.018	-0.005	-0.006
p-value (Test: U +H + UxH = 0)	*0.985*	*0.813*	*0.025***	*0.145*	*0.388*	*0.300*
Panel B: Boys						
Uniforms (U)	0.002	0.001	0.010	0.006	0.005	0.003
	(0.002)	(0.002)	(0.008)	(0.009)	(0.005)	(0.005)
Teacher Training on HIV (H)	0.001	0.000	0.002	-0.002	0.001	0.002
	(0.002)	(0.002)	(0.008)	(0.010)	(0.005)	(0.005)
Interaction (UxH)	0.000	0.001	-0.017	-0.013	0.001	0.000
	(0.003)	(0.003)	(0.012)	(0.014)	(0.008)	(0.008)
Observations	2661	2661	6307	6307	6596	6596
Mean of Dep. Var. (Control)	0.001	0.001	0.074	0.074	0.022	0.022
Sampling Weights		Yes		Yes		Yes
Total effect U + H + UxH	0.003	0.002	-0.005	-0.009	0.007	0.005
p-value (Test: U +H + UxH = 0)	*0.358*	*0.355*	*0.626*	*0.352*	*0.198*	*0.281*

*Notes: Data Source: Cols. 1-4 - Data Source Lab Tests performed on blood draws taken during individual follow-up survey conducted after 7 years. Col. 5-6 -individual follow-up survey. Estimates obtained through OLS regressions that include controls for year of birth, the timing of the survey, school size and randomization strata dummies. Standard errors clustered at the school level. ***, **, * indicate significance at 1, 5 and 10%.*

Table 5. Long-Run Impacts: Reported Sexual Behavior

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Panel A. Girls	Ever had sex		Age at first sex		Has had multiple sex partners		Used a condom last time had sex		First pregnancy/ child was wanted		Age of oldest partner ever	
Uniforms (U)	-0.043	-0.028	-0.062	0.070	-0.027	-0.037	0.008	0.017	0.002	-0.009	-0.387	-0.270
	(0.020)**	(0.021)	(0.081)	(0.095)	(0.016)	(0.019)**	(0.020)	(0.022)	(0.023)	(0.029)	(0.176)**	(0.225)
Teacher Training on HIV (H)	0.005	0.010	-0.152	-0.099	-0.009	-0.007	-0.016	-0.010	0.051	0.037	0.157	0.199
	(0.022)	(0.023)	(0.080)*	(0.092)	(0.016)	(0.018)	(0.020)	(0.022)	(0.023)**	(0.029)	(0.200)	(0.256)
Interaction (UxH)	0.022	0.010	0.315	0.089	0.028	0.053	-0.016	-0.027	-0.053	-0.051	0.208	0.117
	(0.030)	(0.030)	(0.120)***	(0.138)	(0.023)	(0.026)**	(0.028)	(0.031)	(0.034)	(0.042)	(0.279)	(0.354)
Observations	5722	5722	3579	3579	5718	5718	3702	3702	2459	2459	3683	3683
Mean of Dep. Var. (Control)	0.680	0.680	16.997	16.997	0.261	0.261	0.282	0.282	0.304	0.304	24.953	24.953
Sampling Weights		Yes		Yes		Yes		Yes		Yes		Yes
Total effect U + H + UxH	-0.016	-0.008	0.101	0.060	-0.008	0.009	-0.024	-0.020	0.000	-0.023	-0.022	0.046
p-value (Test: U +H + UxH = 0)	*0.446*	*0.710*	*0.191*	*0.498*	*0.648*	*0.654*	*0.267*	*0.372*	*0.985*	*0.448*	*0.907*	*0.852*
Panel B: Boys												
Uniforms (U)	-0.019	-0.011	0.009	-0.084	0.009	0.014	-0.026	-0.041	-0.042	-0.081	0.036	0.021
	(0.015)	(0.016)	(0.093)	(0.102)	(0.016)	(0.018)	(0.019)	(0.022)*	(0.042)	(0.046)*	(0.126)	(0.155)
Teacher Training on HIV (H)	-0.002	0.012	0.223	0.177	0.002	0.003	-0.014	-0.001	0.031	0.005	0.412	0.326
	(0.016)	(0.016)	(0.093)**	(0.106)*	(0.017)	(0.019)	(0.018)	(0.021)	(0.039)	(0.044)	(0.125)***	(0.151)**
Interaction (UxH)	-0.024	-0.03	-0.014	0.047	-0.027	-0.026	0.056	0.052	-0.023	0.041	-0.354	-0.249
	(0.023)	(0.023)	(0.129)	(0.140)	(0.024)	(0.027)	(0.026)**	(0.031)*	(0.054)	(0.062)	(0.184)*	(0.218)
Observations	6597	6597	4618	4618	6590	6590	4760	4760	893	893	4724	4724
Mean of Dep. Var. (Control)	0.756	0.756	16.440	16.440	0.447	0.447	0.489	0.489	0.588	0.588	18.500	18.500
Sampling Weights		Yes		Yes		Yes		Yes		Yes		Yes
Total effect U + H + UxH	-0.045	-0.029	0.218	0.140	-0.016	-0.009	0.016	0.010	-0.034	-0.035	0.094	0.098
p-value (Test: U +H + UxH = 0)	*0.005****	*0.074**	*0.016***	*0.210*	*0.324*	*0.620*	*0.381*	*0.637*	*0.375*	*0.421*	*0.454*	*0.524*

*Notes: Data Source: Individual Follow-up Survey conducted after 7 years. Estimates obtained through OLS regressions that include controls for year of birth, the timing of the survey, school size and randomization strata dummies. Standard errors clustered at the school level. ***, **, * indicate significance at 1, 5 and 10%.*

Table A1. Accuracy of Roll Call Method

	(1)	(2)	(3)	(4)
	Dep. Var.: Dummy equal to 1 if Roll Call data is consistent with Quality Control data			
Sample:	Girls reported as having started childbearing in roll call data	Girls reported as having not started childbearing in roll call data	Girls reported as having a child in roll call data	Girls reported as not having a child in roll call data
Uniforms (U)	0.009	0.004	0.005	0.016
	(0.033)	(0.057)	(0.040)	(0.047)
Teacher Training on HIV (H)	-0.040	-0.087	-0.053	0.030
	(0.040)	(0.059)	(0.044)	(0.038)
Interaction (UxH)	0.002	0.042	-0.012	-0.023
	(0.054)	(0.089)	(0.064)	(0.062)
Observations	1144	276	931	452
Mean of Dep. Var. (Control)	0.789	0.826	0.792	0.892
Total effect U + H + UxH	-0.029	-0.041	-0.060	0.023
p-value (Test: U +H + UxH = 0)	*0.384*	*0.524*	*0.134*	*0.577*

Notes: To check the accuracy of the childbearing data obtained through the Roll Call method, a subset of girls were randomly sampled for a "Quality Control" survey administered at their home in early 2006. Girls who had been identified as having started childbearing according to the roll call were oversampled. The childbearing information collected through the home visits was obtained from the target respondent herself in 44% of the cases; from her mother in 27% of the cases; from another female relative in 10% of the cases; and from a male relative in the rest of the cases.

Table A2. Attrition in Roll Call Data

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Outcomes missing after 3 years				Outcomes missing after 5 years		
	Dropped Out of Primary School	Attendance rate (when enrolled) over 5 surprise visits	Ever Married	Ever Pregnant	Dropped Out of Primary School	Ever Married	Ever Pregnant
Panel A. Girls							
Uniforms (U)	0.001	-0.002	-0.002	-0.005	-0.014	-0.001	-0.002
	(0.005)	(0.009)	(0.005)	(0.005)	(0.010)	(0.014)	(0.014)
Teacher Training on HIV (H)	-0.003	0.013	0.000	-0.001	-0.019	-0.021	-0.024
	(0.006)	(0.009)	(0.006)	(0.006)	(0.010)*	(0.015)	(0.015)
Interaction (UxH)	0.012	0.004	0.012	0.013	0.028	0.014	0.020
	(0.008)	(0.012)	(0.008)	(0.009)	(0.013)**	(0.021)	(0.021)
Observations	9487	9487	9487	9487	9487	9487	9487
Mean Attrition (Control Group)	0.037	0.131	0.038	0.044	0.076	0.123	0.132
Total effect U + H + UxH	0.010	0.015	0.010	0.007	-0.005	-0.008	-0.006
p-value (Test: U +H + UxH = 0)	*0.121*	*0.051**	*0.161*	*0.343*	*0.667*	*0.676*	*0.762*
Panel B: Boys							
Uniforms (U)	-0.002	0.000	-0.002	-0.002	-0.002	-0.004	0.018
	(0.005)	(0.008)	(0.006)	(0.006)	(0.010)	(0.019)	(0.010)*
Teacher Training on HIV (H)	0.005	0.009	0.002	0.004	-0.004	-0.020	0.009
	(0.005)	(0.006)	(0.006)	(0.006)	(0.009)	(0.017)	(0.008)
Interaction (UxH)	0.001	-0.008	0.005	-0.001	0.002	0.014	-0.021
	(0.008)	(0.010)	(0.009)	(0.009)	(0.013)	(0.023)	(0.014)
Observations	9802	9802	9802	9802	9802	9802	9802
Mean of Dep. Var. (Control)	0.030	0.077	0.038	0.037	0.059	0.133	0.085
Total effect U + H + UxH	0.004	0.001	0.005	0.001	-0.004	-0.010	0.006
p-value (Test: U +H + UxH = 0)	*0.550*	*0.767*	*0.531*	*0.882*	*0.742*	*0.638*	*0.584*

*Notes: Dependent variables are dummies equal to 1 if the information is missing for the respondent. Estimates obtained through OLS regressions that include controls for year of birth, school size, randomization strata dummies and roll call dates. Standard errors clustered at the school level. ***, **, * indicate significance at 1, 5 and 10%.*

Table A3. Survey Rates during Long-Run Follow-up (after 7 years)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Identified as Dead during Regular Tracking (RT)	If not dead: Found and Surveyed during RT	If not Found in RT: Sampled for Intensive Tracking (IT)	If Sampled for IT: Found and Surveyed during IT	If not Dead: Found and Surveyed (RT or IT)	Final Follow-up Sample (with sampling weights)			
Panel A. Girls						Surveyed	Non-missing Grades Completed	Non-missing fertility	Non-missing HSV2 Status
Uniforms (U)	-0.001	0.087	0.003	-0.044	0.060	0.007	0.013	0.006	0.009
	(0.004)	(0.016)***	(0.016)	(0.029)	(0.013)***	(0.014)	(0.014)	(0.014)	(0.016)
Teacher Training on HIV (H)	0.001	0.044	-0.021	0.008	0.022	0.015	0.021	0.015	0.014
	(0.003)	(0.017)**	(0.015)	(0.030)	(0.014)	(0.014)	(0.014)	(0.014)	(0.016)
Interaction (UxH)	-0.004	-0.040	0.027	0.076	-0.008	0.015	0.009	0.016	0.022
	(0.005)	(0.023)*	(0.023)	(0.043)*	(0.020)	(0.020)	(0.020)	(0.020)	(0.022)
Observations	9487	9359	4637	1291	9359	6021	6021	6021	6021
Mean (Control Group)	0.013	0.444	0.154	0.783	0.565	0.942	0.940	0.944	0.910
Total effect U + H + UxH	-0.004	0.091	0.009	0.040	0.074	0.037	0.043	0.037	0.045
p-value (Test: U +H + UxH = 0)	*0.357*	*0****	*0.590*	*0.192*	*0****	*0.009****	*0.003****	*0.01****	*0.003****
Panel B. Boys									
Uniforms (U)	-0.001	0.070	-0.023	0.043	0.044	0.024	0.024	0.025	0.030
	(0.004)	(0.017)***	(0.022)	(0.028)	(0.015)***	(0.010)**	(0.010)**	(0.010)**	(0.014)**
Teacher Training on HIV (H)	0.003	0.003	-0.046	-0.013	-0.017	-0.005	-0.006	-0.005	-0.004
	(0.004)	(0.018)	(0.018)**	(0.026)	(0.015)	(0.010)	(0.010)	(0.010)	(0.014)
Interaction (UxH)	-0.001	-0.011	0.045	0.016	0.012	0.000	0.002	0.001	0.013
	(0.005)	(0.026)	(0.029)	(0.037)	(0.022)	(0.014)	(0.014)	(0.014)	(0.019)
Observations	9802	9643	4041	1179	9643	6788	6788	6788	6788
Mean (Control Group)	0.016	0.554	0.138	0.845	0.670	0.969	0.969	0.969	0.919
Total effect U + H + UxH	0.001	0.062	-0.024	0.046	0.039	0.019	0.020	0.021	0.039
p-value (Test: U +H + UxH = 0)	*0.979*	*0.001****	*0.244*	*0.072**	*0.013***	*0.048***	*0.043***	*0.042***	*0.005****

Notes: See Text, Section 3.1.2 for a description of the tracking procedure used.

Table A4. Checking for Differential Attrition across Treatment Arms in Long-Run Data

	(1)	(2)	(3)	(4)	(5)	(6)
	After 3 years: Ever pregnant (Roll Call Data)			After 5 years: Ever pregnant (Roll Call Data)		
Sample:	Full Sample	LR Follow-up Sample (unweighted)	LR Follow-up Sample (weighted)	Full Sample	LR Follow-up Sample (unweighted)	LR Follow-up Sample (weighted)
Panel A. Girls						
Uniforms (U)	-0.027	-0.030	-0.023	-0.044	-0.040	-0.036
	(0.011)**	(0.013)**	(0.014)*	(0.017)***	(0.018)**	(0.021)*
Teacher Training on HIV (H)	-0.008	-0.012	0.000	0.000	0.004	0.012
	(0.011)	(0.012)	(0.013)	(0.015)	(0.018)	(0.021)
Interaction (UxH)	0.024	0.025	0.012	0.032	0.027	0.015
	(0.016)	(0.017)	(0.018)	(0.023)	(0.026)	(0.029)
Observations	9076	5658	5658	8307	5346	5346
Mean of Dep. Var. (Control)	0.160	0.133	0.133	0.329	0.271	0.271
Sampling Weights			Yes			Yes
Total effect U + H + UxH	-0.011	-0.017	-0.011	-0.012	-0.009	-0.009
p-value (Test: U +H + UxH = 0)	*0.292*	*0.128*	*0.400*	*0.481*	*0.616*	*0.664*
Panel B: Boys						
Uniforms (U)	-0.002	-0.005	-0.005	0.004	0.002	0.001
	(0.003)	(0.003)*	(0.003)	(0.005)	(0.006)	(0.007)
Teacher Training on HIV (H)	-0.002	0.000	0.001	0.004	0.003	0.000
	(0.002)	(0.003)	(0.004)	(0.005)	(0.006)	(0.007)
Interaction (UxH)	-0.002	-0.002	-0.002	-0.008	-0.007	-0.005
	(0.003)	(0.003)	(0.004)	(0.008)	(0.008)	(0.010)
Observations	9437	6526	6526	8901	6321	6321
Mean of Dep. Var. (Control)	0.011	0.011	0.011	0.032	0.029	0.029
Sampling Weights			Yes			Yes
Total effect U + H + UxH	-0.006	-0.007	-0.006	0.000	-0.002	-0.004
p-value (Test: U +H + UxH = 0)	*0.018***	*0.005****	*0.015***	*0.965*	*0.648*	*0.513*

*Notes: Data Source: Roll Call Data. Estimates obtained through OLS regressions that include controls for year of birth, the timing of the roll call visits, school size and randomization strata dummies. Standard errors clustered at the school level. ***, **, * indicate significance at 1, 5 and 10%.*

Columns 1 -3: Data collected through five school visits conducted at regular intervals over three academic years (2003, 2004, 2005). Columns 4 -6: Include four additional school visits conducted in 2006 and 2007.

Table A5. HIV Education and Knowledge

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	HIV was mentioned in class in the last 4 weeks	HIV was ever mentioned in class	Knows that HIV kills	Knows that healthy looking individuals can have HIV	Knows that condoms can prevent pregnancy	Knows that condoms can prevent HIV infection	Mentions abstinence when asked for ways to avoid HIV infection	Mentions condoms when asked for ways to avoid HIV infection	Mentions faithfulness when asked for ways to avoid HIV infection	Knows that older men are more likely to have HIV than younger men
Panel A. Girls										
Uniforms (U)	0.050	-0.023	0.006	0.041	-0.004	-0.006	0.037	-0.020	0.043	-0.021
	(0.036)	(0.026)	(0.015)	(0.024)*	(0.028)	(0.026)	(0.027)	(0.033)	(0.019)**	(0.022)
Teacher Training on HIV (H)	0.100	0.058	-0.017	0.001	0.025	0.016	0.042	0.049	0.048	-0.058
	(0.034)***	(0.023)**	(0.016)	(0.024)	(0.029)	(0.027)	(0.027)	(0.032)	(0.018)***	(0.024)**
Interaction (UxH)	-0.068	-0.003	0.019	-0.057	0.005	0.018	-0.098	-0.023	-0.071	0.032
	(0.048)	(0.033)	(0.021)	(0.033)*	(0.040)	(0.039)	(0.040)**	(0.045)	(0.026)***	(0.034)
Observations	4399	4399	4412	4382	4412	4366	4419	4419	4419	4412
Mean of Dep. Var. (Control)	0.463	0.821	0.880	0.598	0.542	0.591	0.457	0.461	0.104	0.316
Total effect U + H + UxH	0.082	0.032	0.008	-0.015	0.026	0.028	-0.019	0.006	0.02	-0.047
p-value (Test: U +H + UxH = 0)	_0.024**_	_0.163_	_0.567_	_0.492_	_0.333_	_0.306_	_0.486_	_0.870_	_0.301_	_0.049**_
Panel B: Boys										
Uniforms (U)	0.007	-0.003	0.004	-0.004	0.058	0.029	0.020	-0.013	0.010	-0.011
	(0.029)	(0.023)	(0.021)	(0.015)	(0.019)***	(0.021)	(0.024)	(0.029)	(0.018)	(0.023)
Teacher Training on HIV (H)	0.015	0.058	-0.015	0.003	0.061	0.040	0.053	0.018	0.040	-0.043
	(0.031)	(0.022)***	(0.021)	(0.016)	(0.018)***	(0.023)*	(0.025)**	(0.031)	(0.018)**	(0.023)*
Interaction (UxH)	0.062	0.013	0.022	0.006	-0.053	-0.026	-0.005	-0.036	-0.029	0.068
	(0.043)	(0.031)	(0.028)	(0.021)	(0.027)**	(0.032)	(0.035)	(0.042)	(0.026)	(0.033)**
Observations	5005	5005	5002	5005	4995	4973	5019	5019	5019	5013
Mean of Dep. Var. (Control)	0.494	0.775	0.651	0.875	0.684	0.666	0.453	0.568	0.121	0.318
Total effect U + H + UxH	0.084	0.068	0.011	0.005	0.066	0.043	0.068	-0.031	0.021	0.014
p-value (Test: U +H + UxH = 0)	_0.009***_	_0.004***_	_0.603_	_0.774_	_0.001***_	_0.049**_	_0.006***_	_0.288_	_0.213_	_0.546_

Notes: Data Source: Anonymous in-class survey self-administered by Grade 8 students in 2005. Estimates obtained through OLS regressions that include controls for school size and randomization strata dummies. Standard errors clustered at the school level. ***, **, * indicate significance at 1, 5 and 10%.