American Economic Journal: Applied Economics 3 (January 2011): 1–34
http://www.aeaweb.org/articles.php?doi=10.1257/app.3.1.1

Do Teenagers Respond to HIV Risk Information? Evidence from a Field Experiment in Kenya†

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We use a randomized experiment to test whether and what information changes teenagers' sexual behavior in Kenya. Providing information on the relative risk of HIV infection by partner's age led to a 28 *percent decrease in teen pregnancy*, *an objective proxy for the incidence of unprotected sex. Self-reported sexual behavior data suggests substitution away from older* (*riskier*) *partners and toward same-age partners. In contrast*, *the official abstinence-only HIV curriculum had no impact on teen pregnancy. These results suggest that teenagers are responsive to risk information, but their sexual behavior is more elastic on the intensive than on the extensive margin.* (*JEL* D83, I12, J13, O12)

Nearly 2 million people become infected with HIV/AIDS every year in sub-Saharan Africa, the great majority of them through sex, and a quarter of them before the age of 25.[1] AIDS is incurable and no successful HIV vaccine has been developed yet. Thus, ensuring the adoption of safer sexual behavior among youths remains critical to combating the disease.

Now that the great majority of children in Africa acquire at least some primary education, some have argued that primary schools offer a unique opportunity to deliver HIV prevention education to youths before they become sexually active (World Bank 2002). There is, however, considerable debate over whether scalable school-based HIV/AIDS education programs can be effective in limiting the spread of HIV/AIDS among youths, and over what should be the content of these programs. Many sub-Saharan African countries have incorporated HIV/AIDS education in their school curriculum, but the great majority of those curricula are limited to *risk avoidance* information; they aim at completely eliminating

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[1] UNAIDS (2008) Report on the Global AIDS Epidemic.

pre-marital sex by promoting abstinence until marriage. They omit to provide *risk reduction* information, for example that condom use reduces the risk of HIV transmission.

Voluntarily limiting information so that youths are unaware of the "low risk" option (e.g., condom-protected sex) and only face the choice set {high risk; no risk} might be socially optimal since individuals do not internalize the epidemiological externalities of their own behavior, and therefore what might be optimal at the individual level (a low but nonzero risk level) might be suboptimal from a public health perspective. However, if sexual behavior is more elastic on what we could call the *intensive* margin (what type of sex to have and with whom) than on the extensive margin (whether to have sex or not), HIV education programs that focus only on abstinence may be ignoring an important margin along which youths could reduce their risk of infection.

This paper uses data from a field experiment to measure the responsiveness of teenagers to HIV information and compares their responses along both the risk avoidance and the risk reduction margins. The risk reduction margin we focus on is *partner selection.* Partner selection is an important risk reduction margin for teenagers in sub-Saharan Africa, where the prevalence of HIV is at least three times higher among teenage girls than among teenage boys.[2] Multiple studies have suggested that this discrepancy is due, in part, to the high incidence of unsafe cross-generational sexual relationships. That is, unprotected sex between teenage girls and adult men more than five years their senior.[3, 4] Men involved in these relationships, often called "sugar daddies," are more likely to be infected with HIV than teenage boys since they have been sexually active for longer. Thus, compared to relationships with teenage boys, cross-generational relationships pose a higher risk of HIV infection for teenage girls. On the other hand, older men, who typically have more income, are usually better able to provide for the teenage girl and the baby if the sexual relationship leads to pregnancy. Since the distribution of income is more readily observable by teenage girls than the distribution of HIV infection, adult men may have an advantage over teenage boys in negotiating unprotected sex. Most HIV prevention campaigns may not reduce this advantage, since they only provide information on the average HIV risk (the overall prevalence) and their key message is that "Anyone can give you HIV." Though true in essence, this message obscures the fact that in sub-Saharan Africa, 25-year-old men are much more likely to have HIV than 16-year-old boys.

In this context, providing teenage girls with full information on HIV prevalence disaggregated by gender and age groups may reduce the incidence of unprotected

[2]For example, random tests administered by J. R. Glynn et al. (2001) showed that prevalence in the 15–19 age group was 22 percent among women, but only 4 percent among men in Kisumu (Kenya); the same statistic was 21 percent for women and 3 percent for men in Ndola (Zambia). For Kenya as a whole, prevalence rates are lower (see Figure 1), but the ratio between teenage girls and teenage boys is about the same.

[3]Marie Laga et al. (2001), Nancy Luke and Kathleen M. Kurz (2002), Simon Gregson et al. (2002), R. J. Kelly et al. (2003), and Shelley Clark (2004).

[4]The prevalence gap between young women and young men is also due to the fact that risk of male-to-female HIV transmission is greater than the risk of female-to-male transmission (Thomas A. Peterman et al. 1988), but this biological factor accounts for only a third of the gap observed (Gregson et al. 2002).

cross-generational partnerships, and along with it new HIV infections of young women by older partners. The total amount of sexual activity might increase, however, if teenage girls who learn that sex with teenage boys is relatively safe increase their sexual activity with teenage boys. This might have negative public health consequences, both in terms of teen pregnancies and in terms of lifetime HIV risk and its epidemiological implications (Jeremy Magruder 2007). A rigorous test of the impact of risk reduction information and how it compares with the impact of risk avoidance information is thus needed.

Using data from a randomized field experiment involving 328 primary schools, this paper compares the effects of providing abstinence-only versus detailed HIV risk information on teenage sexual behavior. Half of the schools, randomly selected, received teacher training on the national HIV/AIDS curriculum, which focuses on average risk and encourages abstinence until marriage, but does not discuss risk reduction strategies (such as condom use or selection of safer partners). In 71 schools, randomly selected after stratifying by teacher training status, an information campaign provided teenagers with information on the prevalence of HIV disaggregated by age and gender group (the "Relative Risk Information Campaign," henceforth RR). The randomized design ensured that there would be, in expectation, no systematic difference in the prior information held by the students across groups at the onset of the programs. This ensures rigorous identification of the impact of each of the two types of risk information, by comparing behaviors and outcomes across groups over time.

The results suggest that the teacher training on the national HIV/AIDS curriculum had no effect on the likelihood that teenage girls started childbearing within a year, suggesting no reduction in risky behavior. In contrast, the relative risk information led to a 28 percent decrease in the likelihood that girls started childbearing within a year, suggesting an important decrease in the incidence of unprotected sex among those girls. Furthermore, we find that the pregnancies averted by the relative risk information provision would have been with partners more than five years older, suggesting that the reduction in the incidence of unsafe sex corresponds to a reduction in unsafe sex *with older partners*. The relative risk information also led to an increase in self-reported sexual activity among teenage boys, suggesting that girls substituted away from older partners and toward their agemates. But there was no increase in pregnancies among teenage couples, consistent with the fact that teenage girls report higher rates of condom use, presumably in order to avoid pregnancy with resource-constrained teenage boys.

Taken together, these results suggest that the behavioral choices of teenagers are not responsive to risk avoidance messages, but are responsive to information on the relative riskiness of potential partners. Overall, the relative risk information led to an increase in reported sexual activity, but to a decrease in unsafe sex. This suggests that teenage sexual behavior is more elastic on the margin of what type of sex to engage in—the choice of partner and the choice of protection level—than on the margin of whether to engage in sex or not. These results suggest that, in the fight against HIV, risk reduction messages might be more effective than risk avoidance messages.

Prior evidence on the effectiveness of sexual health education in Africa is almost nonexistent.[5] Melanie Gallant and Eleanor Maticka-Tyndale (2004) review 11 studies of HIV education programs conducted in sub-Saharan Africa, and show that the mixed results generated by those studies are questionable, either because they do not have a convincing identification strategy, or because they rely solely on self-reported measures of risk-taking, which are likely to suffer from social desirability biases. The only prior randomized controlled experiment in Africa that studied biological outcomes lacked statistical power to detect small or moderate effects, and thus can only reject very large effects (R. J. Hayes et al. 2005). This paper overcomes these shortcomings by using a randomized experiment that involved a large sample of primary schools in Kenya, combined with data on teenage pregnancy, arguably an objective measure of the incidence of unprotected sex.

Our finding that teenagers are responsive to risk information is in line with studies of youth behavior in other contexts, which have found that youths are responsive to information on the returns to education (Robert Jensen 2010), responsive to prices (Jonathan Gruber and Jonathan Zinman 2001; Rosalie Liccardo Pacula et al. 2001), and responsive to regulatory incentives (Thomas S. Dee and William N. Evans 2001; Steven D. Levitt and Lance Lochner 2001). Our results also relate to the literature on health information provision and behavior. While a relatively large US-based literature suggests that information alone is often ineffective at changing behavior (among recent studies, see for examples Julie S. Downs, George Loewenstein, and Jessica Wisdom 2009 for negative results on food choices, and Kevin C. Davis et al. 2009 for mixed results on smoking behavior), the evidence for developing countries is much scanter. Using a randomized prospective design in India, Jyotsna Jalan and E. Somanathan (2008) show that informing households that their drinking water is contaminated increases the probability that they start purifying their water. In Bangladesh, using data from a controlled experiment, Malgosia Madajewicz et al. (2007) find that informing households that their well water has an unsafe concentration of arsenic raises the probability that they switch to another well. Our paper contributes to this nascent literature on how and when risk information affects health behavior in a less developed context.

The remainder of the paper is organized as follows. Section I describes the Kenyan context and the experimental design. Section II presents the theoretical motivation behind the experimental design. Section III presents the data and outlines the evaluation strategy. Section IV presents the results, and Section V concludes.

I. Background and Experimental Design

The experiment took place in two rural districts of Western Kenya, and involved a total of 328 primary schools. Among them, 163 were randomly chosen for Treatment 1, the Teacher Training on the national HIV/AIDS curriculum for primary school,

[5] Studies in the United States have yielded mixed evidence. Douglas B. Kirby (2008) reviews 56 US-based studies and finds that most abstinence programs do not delay initiation of sex, while two thirds of the more comprehensive programs (that include both abstinence and risk reduction information) seem to have an impact on both margins (delay of initiation and increased condom use).

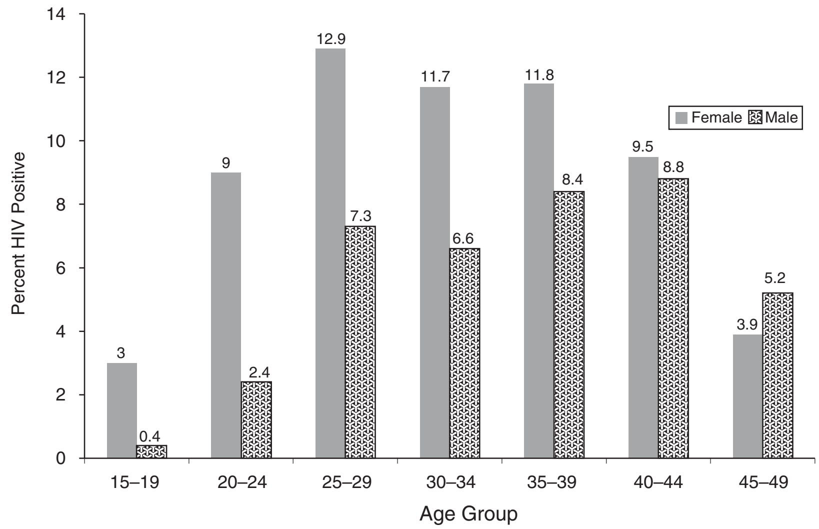

Figure 1. HIV Prevalence by Gender and Age Groups, Kenya

Source: Kenya Demographic and Health Survey, 2003

which focuses on abstinence-only messages. In addition, 71 schools were sampled to receive Treatment 2, the RR, that provided students in eighth grade with information on HIV prevalence by sex and age. Before describing these two treatments in detail, we present some background summary statistics on HIV and sexual behavior among youths in Kenya.

A. *Background on HIV, Teenagers, and HIV Education in Kenya*

HIV Prevalence.—The principal mode of transmission of HIV in Kenya is heterosexual contact (Republic of Kenya Ministry of Health 2001). The 2003 Kenya Demographic and Health Survey estimated that 7 percent of Kenyan adults are infected with HIV (Kenya Central Bureau of Statistics, Kenya Ministry of Health, and ORC Macro 2004). The breakdown by age and gender group is presented in Figure 1. The highest infection level is for women in the 25–29 age group (12.9 percent). Levels of infection among young women rise quickly (3 percent in the 15–19 age group and 9 percent in the 20–24 age group). In contrast, prevalence rises gradually with age among men, starting at 0.4 percent in the 15–19 age group, rising to 2.4 percent in the 20–24 age group, and reaching its peak (8.8 percent) in the 40–44 age group.

HIV-Related Knowledge and Sexual Behavior among Teenagers.—Table 1, panel A presents summary statistics on HIV-related knowledge and behavior collected at baseline among a subset of students sampled for the experiment. At the time they completed the survey, the students were enrolled in the eighth grade (the last grade of primary school). Due to high levels of repetition through primary school, students in the eighth grade are relatively old, 15 years old on average.

Table 1—Summary Statistics on Knowledge and Behavior among Adolescents in Study Area

	Girls (1)	Boys (2)
Panel A. Baseline knowledge, attitudes and practice (self-reported) among eighth graders		
Average age	15.10	15.52
	(1.2)	(1.5)
Share reporting having had sex	0.21	0.48
Share thinking condoms can prevent HIV infection	0.45	0.66
Share thinking condoms can prevent pregnancy	0.46	0.71
Share thinking men above 25 have a higher HIV infection rate than teenage boys	0.29	0.25
Share reporting that some girls in the class have a partner who is not a student	0.61	0.57
Observations	1,176	1,246
	Sample mean	
Panel B. Partnership Survey (girls who started childbearing within a year of starting eighth grade)*		
Share reporting that the pregnancy was wanted	0.13	
Share reporting age difference with male partner > 5 years	0.49	
Share reporting age difference with male partner > 10 years	0.16	
Share reporting that the partnership was consensual	0.99	
Share reporting that the male partner made regular cash payments to the teenage girl prior to the pregnancy	0.70	
Share reporting that the male partner is currently providing financial support to the teenage girl	0.79	
Share married if age difference < 5 years	0.45	
Share married if 5 years < age difference < 10 years	0.77	
Share married if age difference > 10 years	0.82	
Observations	184	

Notes: Standard deviations are presented in parentheses. Panel A: Self-reported data collected among teenagers enrolled in grade 8 in 2004, prior to RR information campaign. The survey was self-administered. Panel B: Childbearing data collected in August 2005 for teenage girls enrolled in a RR comparison school at baseline (2004), and who had begun childbearing by July 2005. In 55 percent of cases, the teenage girl was interviewed herself. In the rest of cases, she was not at home on the day of the enumerator's visit and a relative (typically her mother) answered questions on her behalf.
* A girl is considered to have "started childbearing" if she has ever given birth or ever been pregnant.

Overall, 21 percent of girls and 48 percent of boys sampled for the survey reported they had ever had sex. Knowledge of risk reduction strategies among these students was relatively limited, however. While 46 percent of girls and 71 percent of boys thought that condoms could protect from HIV infection, only 29 percent of girls and 25 percent of boys knew that older men were more likely to be HIV positive than teenage boys.

Panel B of Table 1 presents data collected at the end of the study among girls in the control group who had started childbearing within a year. The data suggests that the great majority (87 percent) of teen pregnancies we observed were unplanned. Overall, 49 percent of teenage pregnancies observed in the control group were with partners more than 5 years older, and 16 percent with partners more than 10 years older.[6]

[6]In a study conducted in western Kenya, Luke (2003) finds evidence that a larger age difference between partners is associated with both a lower probability of condom use and higher transfers from the male to the female partner.

In 70 percent of teen pregnancies, the partnership involves regular cash transfers from the male to the female partner prior to the pregnancy. However, the older the male partner, the more likely pregnancy triggers marriage. While the rate of marriage is 45 percent if the teenage girl gets pregnant with a partner less than 5 years older, it rises to 77 percent if the age difference between partners is 5 to 10 years, and to 82 percent if the age difference is greater than 10 years.

National Policy on HIV Education.—The Kenya Ministry of Education, Science, and Technology (MoEST) integrated HIV/AIDS education into the primary school curriculum in 2001. The national HIV/AIDS curriculum includes information on the biology of HIV/AIDS, how it is transmitted, how to care for people living with AIDS, and the consequences of the HIV/AIDS epidemic on families, schools, and the country of Kenya more generally (with estimates of the prevalence as of 1999, the year in which the textbooks were printed). The HIV curriculum also includes a prevention section which emphasizes moral values, refusal skills, and abstinence until marriage. The curriculum does not mention condoms and provides only limited scope for teachers to discuss protected sex in response to students' questions. It does not cover partner selection, and although they cover love relationships between same-age boys and girls, the official textbooks do not mention cross-generational relationships (and their associated risk). The proposed strategies to avoid infection are to "Avoid Sex" and to "Say NO to sex before marriage."[7] All sexual activity outside of marriage, irrespective of the age of the partner, is thus considered equally risky.

While the HIV/AIDS curriculum was introduced in 2001, HIV/AIDS education was in effect largely absent from Kenyan primary schools by early 2003. Only a few schools had included HIV/AIDS in their timetable, and when asked why they did not teach the mandated curriculum, schools and their teachers would often say they were not familiar with its content or did not know how to teach the topic. In response, the Kenya Institute of Education (KIE) and the MoEST trained a number of trainers to provide in-service training for teachers on HIV/AIDS education methodology. The training was being phased in over a large period of time (starting in 2003), which allowed randomization.

B. *Experimental Design*

Treatment 1: The Teacher Training Program (*TT*).—In 2003, 328 primary schools in the Bungoma and Butere/Mumias districts of Kenya's Western Province were sampled for a randomized evaluation designed to test the effectiveness of the national HIV prevention curriculum for primary schools.[8] After stratifying the 328 schools by location, test scores, and student sex ratio, half of the schools were randomly chosen to receive Teacher Training (henceforth TT) on the HIV/AIDS

[7] These are quotes from the official textbook *Let Us Talk About AIDS, a book for Class 6, 7 and 8* (Kenya Institute of Education 1999, 19, 26).

[8] A total of seven divisions were sampled from those two districts. All public primary schools in those seven divisions were sampled for the study. At the mean, each school in the sample has two other primary schools within a two kilometer radius. None of these schools had participated in any randomized experiment prior to this one.

curriculum in 2003. The training was conducted jointly by one facilitator from the AIDS Control Unit of the Ministry of Education, two facilitators from the Kenya Institute of Education, and one trained staff member from the non-governmental organization ICS. Three teachers per primary school (typically, the math, English, and physical education teachers, rotating across upper primary classes) were trained during multiple week-long in-service training sessions.

During the training, teachers discussed the material in the official HIV/AIDS curriculum and learned how to discuss HIV/AIDS issues in class. Teachers were also trained on how to set up a health club in their school, to encourage HIV avoidance through active learning activities such as role plays. Finally, they were given the latest estimates of HIV/AIDS prevalence in the region of study.[9]

Overall, the TT program had a large impact on the extent to which HIV education was provided in schools. Teachers were 50 percent more likely to have mentioned HIV/AIDS in the last week in schools sampled for the training, compared to control schools. In addition, a year after the training, 86 percent of the schools whose teachers had been trained had established health clubs (Esther Duflo et al. 2006). As a result, in a survey administered in 2005 (two years after the training), students in schools where teachers had been trained scored higher on knowledge questions about HIV/AIDS, such as how HIV/AIDS is transmitted, what HIV stands for, etc. (Duflo et al. 2006). This suggests that the TT program had a first stage effect on the quantity of HIV education provided to students.

Treatment 2: The Relative Risk Information Campaign (*RR*).—Information on the distribution of HIV infections by age and gender is typically not given to adolescents by their teachers, even in schools sampled for the TT program, because it is not included in the official curriculum. To test the effect of this information on teenage behavior, the RR was conducted in 2004 in 71 schools selected among the 328 schools involved in the TT experiment. The RR campaign was conducted by the non-governmental organization ICS. A trained project officer visited each of those 71 schools and, with the authorization of the teachers, spoke to grade 8 students for a 40-minute period. At the start of the period, the students were asked to complete an anonymous, self-administered survey to determine how much they knew about the distribution of HIV in the Kenyan population.[10] After the survey, students were shown a 10-minute educational video on "sugar daddies."[11] The video screening was followed by an open discussion about cross-generational sex. During the discussion, the project officer shared the results of studies conducted in Kenya

[9] The training was done prior to the round of HIV tests performed on the general population as part of the Kenya Demographic and Health Survey of 2003. Thus the prevalence estimates available at the time were based on antenatal surveillance sites. Prevalence in the study area was estimated at 12 percent.

[10] The results of this survey were discussed in Section IA and are presented in Table 1, panel A.

[11] The animated movie, "*Sara: The Trap*," was produced by ACE Communications, 2000, for UNICEF. The synopsis of the movie, as provided by the distributor, is the following: *This episode addresses the issue of sexual exploitation of young girls by older men popularly known as "sugar daddies." Sara is approached by Mbutu, a local shop keeper, who tries to trap her into a sexual liaison. Mbutu offers to pay for Sara's schooling and to give her other gifts. At school, Sara tells her friends what has happened, and girls in the school yard show off gifts that they have received from"sugar daddies." Later Sara goes to the market to run errands. Mbutu gives her money for her Uncle and a necklace. He bribes Sara to meet him that night. With the help of her friends and pet monkey, Sara is able to sabotage Mbutu's plan to rape her and expose him to their fellow villagers.*

and Zambia (Glynn et al. 2001) and Zimbabwe (Gregson et al. 2002) on the role of cross-generational sex in the spread of HIV. In particular, the project officer wrote on the blackboard the detailed prevalence rates of HIV, disaggregated by gender and age group, in the nearby city of Kisumu, a city well-known to the students.[12] The prevalence rates shared with students had been published by the World Health Organization (WHO) in 1997 and were reported in the Kenyan Government's brochure *AIDS in Kenya* of 2001 (Republic of Kenya Ministry of Health 2001).[13] In accordance with the Kenyan government policy, the project officers conducting the RR program did not volunteer information on condoms nor demonstrate how to use condoms, but scientifically answered students' questions about condoms.

The 71 schools chosen for the RR program were selected randomly after stratifying by participation in the TT program of 2003. Thus, the RR program was implemented both in schools where teachers had been trained and in schools where teachers had not been trained. This design thus generated four groups of schools: schools with both the TT and RR programs, schools with TT only, schools with RR only, and schools with neither of the two programs.

II. Theoretical Motivation

This section provides a simple conceptual framework that incorporates the key facts observed in Section IA, and highlights the theoretical ambiguity in the overall sign of the effects of the two information sets (TT and RR).

Consider that a teenage girl's utility depends on her consumption of purchased goods as well as her health level, the number of sexual partnerships she is in, and whether she has a child. Utility might be non-monotonic in the number of sexual partners, and having a child could be either desirable or undesirable.

Engaging in a sexual partnership entails both a risk of HIV infection and a risk of pregnancy. The health level that enters the utility is therefore a function of the girl's HIV infection status, which itself depends on whether she engages in sexual partnerships, and on the characteristics of the partners she chooses. Whether a teenage girl gets pregnant and has a child depends on whether she engages in unprotected sexual partnerships.

Raising a child is costly. In other words, consumption of purchased goods is constrained by a budget constraint of the form: $pC + fF = W + Transf$, where C is the consumption of purchased goods and p is their price; f is the cost of rearing a child and F is a dummy equal to 1 if a girl has a child; W is the girl's initial cash endowment; and $Transf$ is the net amount she gets in transfers from her sexual partner(s), itself the outcome of bargaining between the teenage girl and her partner(s). Finally, we consider that the consumption of purchased goods is subject to a survival constraint: $C \geq \underline{C}$.

[12] The city of Kisumu is the capital of Nyanza Province. While prevalence in Kisumu is higher than in the rest of Kenya, the ratios between male and female by age groups and the ratios between age groups by gender are similar.

[13] The HIV prevalence rates provided to the students were as follows:

Age	15–19	20–24	25–29	30–39
Female	22 percent	36 percent	35 percent	32 percent
Male	4 percent	13 percent	28 percent	32 percent.

Teenage girls maximize their expected utility based on their beliefs about the risks of HIV infection and pregnancy occurring, and how those risks vary with condom use and partners' characteristics.

A subcase of this model is the one in which girls derive no utility from being in a sexual partnership and no utility from children. In such a case, the only reason why teenage girls might want to engage in a sexual partnership is if the expected cost of children is lower than the expected transfers from partners. This subcase of the model can be called the "poverty-driven prostitution" case.[14]

A. *Comparative Static* 1*: Impact of the Official HIV Prevention Curriculum*

The framework above generates the following predictions regarding the impact of introducing general information about HIV (through the Teacher Training program) on teenage girls' demand for sexual partnerships:

- The program will have no effect on girls who already know about HIV at the time the information is provided.
- For girls who overestimate the risk of HIV at baseline and update their beliefs about the HIV risk downward when exposed to the TT program, the program will generate an increase in the demand for unprotected sexual partnerships.
- For girls who are unaware or underestimate the risk of HIV at baseline and update upward their beliefs about the HIV risk when exposed to the TT program, the impact will be ambiguous.
  - Girls' reservation transfer will go up, and therefore their demand for sexual partnerships, holding the level of partners' transfers constant, will decrease.
  - But men may have the resources to increase the amount they transfer. If they can match girls' new reservation transfer, the demand for sexual partnerships among teenage girls will remain unchanged. The average age of the male partner will increase if older men have a higher willingness or ability to pay than teenage boys.

B. *Comparative Static* 2*: Impact of Providing Relative Risk Information*

The predictions regarding the impact of introducing relative risk information are the following:

- If all men have the same reservation price for sex with teenage girls (*Transf* is independent of the male partner's age), information on the distribution of prevalence among men unambiguously leads teenage girls to move toward lower-risk partners (teenage boys) and thus reduce the rate of cross-generational transmission of HIV.
- However, in a setting where teenage boys have a lower reservation price (either because they are poorer than older men, or because they have a lower taste for

[14] This subcase seems to be what most aid agencies and practitioners in Africa have in mind. A number of calls have been made for programs offering young women "economic alternatives to trading their bodies for material and financial gain" (Population Services International 2005).

unprotected sex), the impact of the RR information on the transmission rate is ambiguous, for two reasons:

  – First, the adjustment might occur on the transfer size margin rather than on the partner selection margin. Older men could simply compensate girls for the greater HIV risk they pose by transferring more resources to them (e.g., marrying them).
  – Second, even if the adjustment happens on the partner type rather than on the transfer size margin, girls who face a binding survival constraint might need to increase the number of men they engage in a partnership with. If younger men can or are willing to transfer only half of what older men can transfer, teenage girls in the "poverty-driven prostitution" case may need to have two simultaneous teenage boyfriends in order to meet their survival constraint. This would increase the incidence of unprotected sex between teenage girls and teenage boys.

- Finally, if information about the average prevalence of HIV in the area is already known at the time teenagers receive the RR information, providing RR information may trigger entry into sexual activity by previously abstaining teenage girls. They learn that the infection rate among teenage boys is below the average infection rate, and thus revise downward their beliefs about the risk of engaging in sex with teenage boys, which can affect the decision to enter sexual activity for girls at the margin.

Given these potential positive effects of the RR information on the amount of within-cohort sexual activity, providing RR information might thus have negative public health consequences, even if it reduces cross-generational sex. While individuals consider the full cost of getting infected with HIV themselves, they may not internalize the fact that they might transmit the disease to others once they get infected; this means that while it might be privately optimal for individuals to choose a nonzero risk level, this level of risk will be higher than the socially optimal level.

Overall, the theoretical predictions of both programs are thus unclear. The TT program could either increase, leave unchanged, or decrease the level of unprotected sexual activity. The RR information could either have no impact at all, or reduce cross-generational relationships with a one-for-one substitution toward same-age relationships, or reduce cross-generational relationships with a more than one-for-one increase in same-age relationships. An empirical test is thus needed.

III. Data and Estimation Strategy

A. *Timeline and Sample*

The study timeline is presented in Figure 2. The TT program was phased into 164 schools over 4 months, from February 2003 to May 2003. The RR campaign was phased into 71 schools over 4 months, from July 2004 to October 2004.[15]

[15] The school year in Kenya starts in January and ends in early December. Every November, students in grade 8 take the Kenya Certificate of Primary Education (KCPE) exam, the gateway exam to secondary school. Students who

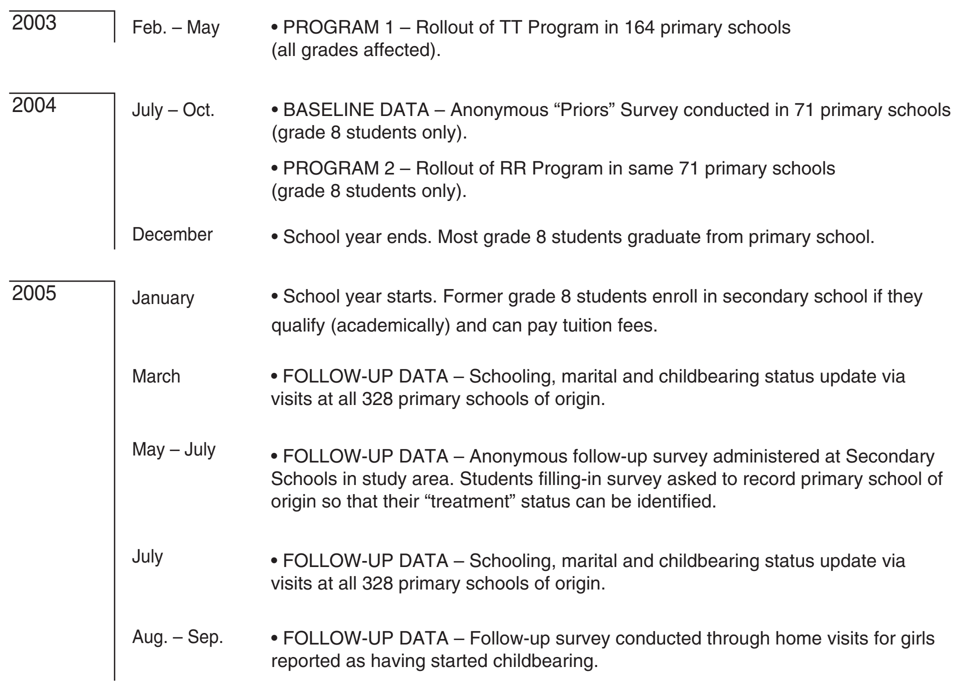

Figure 2. Study Timeline

The TT program affected all students in a school, whereas the RR program affected only students in grade 8, the last grade of primary school. All students enrolled in grade 8 at the time of the RR campaign (2004) were sampled for the study and are hereafter referred to as the “study cohort.”

No comprehensive baseline survey was administered to the study cohort. However, as described in Section IB, students in RR schools were asked to fill a short, anonymous “priors” survey just before the RR information was provided to them. Summary statistics issued from this survey are presented in Table 1, panel A.

By 2005, most of the students in the study cohort had left primary school. Information on their whereabouts could still be collected at their primary school of origin, however. Appendix Table A1 presents summary statistics on their schooling status as of July 2005, averaged by school and broken down by gender and treatment status. Attrition is relatively low, below 2 percent, and cannot be distinguished across groups.

B. *Outcomes*

We focus on two key outcomes: the incidence of unprotected sex between teenage girls and male partners five or more years older; and the incidence of unprotected

perform well on the exam and whose family can afford the tuition fees begin secondary school the following January.

sex between teenage girls and teenage boys. Our main measure of the incidence of unprotected sex is the incidence of childbearing. To complement the childbearing data, we report evidence from self-reported sexual behavior data.[16]

Childbearing Data.—Childbearing data was collected in two steps. First, information on schooling status, marital status, and childbearing status was obtained during two primary school visits conducted in March and July 2005. At each visit, the list of all students on the grade 8 registers of 2004 was read aloud to an assembly of pupils in grades 6, 7, and 8 (often the siblings, neighbors, or friends of students on the list). For each of the students on the list, the following questions were asked: Is *X* still in school? If yes, in what grade? In what school? 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 pregnant?[17]

Second, enumerators conducted a home follow-up visit with girls who had been reported to have started childbearing by July 2005. This follow-up took place in August/September 2005, and included a question on the age of the child's father, in order to identify pregnancies that resulted from a cross-generational relationship. When the teenage girl herself could not be found (for example, because she had moved with her husband to another district), a relative (typically, the mother) was interviewed. Appendix Table A2 shows that the results are unchanged when we split the sample according to whether the girl was interviewed herself or not.[18]

Childbearing is not a perfect proxy for the incidence of risky sex, for various reasons. First, adolescent girls who are in a long-term relationship with one partner are more likely to get pregnant than those who have several short-term relationships.[19] Second, since pregnancy by a teenage boy is unlikely to result in marriage or child support (see Section IA), teenage girls who get pregnant might be more likely to abort if the father of the child is a teenager. Furthermore, teenage girls might be more likely to engage in nonvaginal sex with teenage partners, as a means

[16] Data on the incidence of HIV and other sexually transmitted infections is not available. A pilot biomarker follow-up conducted in 2007 indicates that the incidence of HIV and other sexually transmitted infections in this age group is not high enough for this study to have statistical power to detect significant differences in HIV prevalence between the treatment and the control groups.

[17] This technique of collecting childbearing and marital outcomes generates accurate data. Among a subsample of 282 teenage girls that were tracked at their home and interviewed, 88 percent of those who were reported as having started childbearing by their former schoolmates had indeed started childbearing, and 92 percent of those who were reported as not having started childbearing had indeed not started. The accuracy rates were similar across groups.

[18] In the presence of concurrent partnerships, it is possible that a girl might not know who the true biological father of her child is. However, as long as a childbearing girl is married or supported by an older partner, it is safe to assume that, even if she had a concomittant teenage partner, she *must have had* unprotected sex with that older partner, in order to be able to convince him that he is the father. In addition, given that older partners are typically wealthier, we can expect that in the presence of ambiguity about the biological father, the teenage girl (and her relatives) would choose to "blame" the pregnancy on the older (wealthier) partner.

[19] In particular, partners willing to have a child might decide to undergo HIV testing to ensure they are both negative before having unprotected sex. This is unlikely for the age group in this sample since 87 percent of pregnancies by teenage girls in the area of study are declared unplanned, as shown in Table 1, panel B. In addition, voluntary HIV counseling and testing services are not offered to minors in Kenya, unless they are considered "mature." The definition of "mature" is unclear, but informal discussions with Voluntary HIV Counselling and Testing (VCT) counselors from the Kenya Ministry of Health suggest that adolescents below 18 rarely get tested. VCT is widely available in the study area for adults, however. We do not have data on the impact of the information campaigns on the demand for HIV testing among adults in the study area.

of avoiding pregnancy. Anal sex is of particular concern since it is highly risky in terms of HIV transmission. All in all, the RR information could have increased the incidence of unprotected sex with teenage partners in the treatment group, but also increased the incidence of abortion and/or the incidence of anal intercourse, therefore generating no increase in pregnancy rates among same-age partners. Given this, comparing the incidence of childbearing with same-age partners across groups could underestimate the impact of the RR information on the incidence of risky sex.

It is difficult to estimate the importance of these effects, since neither data on anal sex nor data on abortion is available. However, as a rough test of differential incidence of abortions across groups, we can compare mortality rates among girls. Because abortion is illegal in Kenya, those that do happen tend to be unsafe and often result in maternal death.[20] The results are shown in Appendix Table A1, row 6. The mortality rate among girls between July 2004 and July 2005 was low (less than 0.2 percent) and similar across groups, providing some suggestive evidence that the incidence of abortion was not greater in the RR treatment group than in the RR comparison group. This is obviously an extremely coarse test, but it suggests that, overall, the incidence of childbearing in the sample seems a reasonable, though imperfect, proxy for the incidence of unprotected sex.

Self-Reported Sexual Behavior.—Since childbearing data is not a perfect proxy for unprotected sex, it can be insightful to complement it with self-reported sexual behavior data.

As most students in the study sample left primary school shortly after the RR information program was implemented, conducting a follow-up survey with everyone was not feasible. Instead, a follow-up survey was administered to students enrolled in a secondary school in the study area between May and July 2005, about seven to nine months after the RR program. The survey included questions on sexual activity, characteristics of sexual partners, condom use, and primary school of origin, to identify the treatment status of each student. Overall, 55 percent of the secondary school students who completed the follow-up survey came from one of the 328 primary schools that participated in the study.

As shown in Appendix Table A1, the likelihood that students in the study sample had enrolled in secondary school by 2005 is balanced across RR treatment and RR control schools, suggesting that the students who filled the follow-up behavioral survey were not differentially selected across RR treatment and RR control groups. This is not the case for the TT program, as a higher fraction of students in the TT control group enrolled in secondary school than in the TT treatment group. This selection issue should be kept in mind while analyzing the results of the behavioral survey.

Another important caveat to the behavioral survey is that it includes only teenagers who joined secondary school, and those are clearly not representative of all teenagers. In Kenya, only students with sufficient financial resources and with high

[20] Unsafe abortion is a leading cause of maternal deaths in developing countries (David A. Grimes 2003). Up to 50 percent of maternal deaths in sub-Saharan Africa are due to induced abortion (K. O. Rogo 1993). Statistics on the risk of death conditional on getting an illegal abortion are not, to the best of our knowledge, available.

enough scores at the primary school exit exam can go to secondary school. This means that the behavioral data at hand includes only the richer and arguably smarter students in the sample.[21]

Finally, self-reported data on sexual behavior may suffer from reporting biases, and has been found to be often inconsistent with biological outcomes (Mark Gersovitz et al. 1998). For example, in a study conducted in Western Kenya, Glynn et al. (2001) found that 12 percent of women who reported being virgins were HIV-positive, and most of them had other sexually transmitted infections, making it unlikely that they acquired HIV nonsexually. Likewise, self-reported sexual data are typically impossible to reconcile at the population level (e.g., heterosexual men typically report much more sexual activity than heterosexual women do).

While overall the self-reported data in this paper seems consistent with the biological (childbearing) data, it is important to keep in mind that the estimates obtained with that data could suffer from reporting biases. In particular, it is possible that students who received the RR information recognized that the NGO conducting the survey in secondary schools was the same NGO that had talked to them about sexual partnerships the year before, and they might have been less wary of truthfully reporting their sexual activity than students who were less familiar with the NGO.

Control Cohorts.—In order to compute difference-in-differences estimates of the RR program effects, data was collected on control cohorts, when possible. Recall that the study cohort is made of students enrolled in grade 8 in 2004. We use two control cohorts: the older cohort (grade 8 of 2003) and the younger cohort (grade 7 of 2004). For the older cohort, we could collect data on childbearing incidence using the same method as that described in Section IIIB. We do not have data on partner's age for that cohort, however. For the younger cohort, we collected data on partner's age by conducting follow-up surveys at the homes of girls who had started childbearing by July 2005.

C. *Estimation Strategy*

Econometric Specifications.—The randomized design provides a straightforward source of identification. For both the TT and the RR programs, random assignment of schools to the treatment and comparison groups ensures that, in expectation, the schools in either group are similar in all other respects except in that treatment schools were exposed to the program. Table 2 shows the baseline school averages for a series of school and pupils outcomes, by treatment groups. Except for class size, which is lower on average in RR treatment schools, all other differences in pre-treatment school characteristics are small and insignificant. The sample is less

[21] The fact that girls in the RR treatment group were not more likely to enroll in secondary school than girls in the RR control group, despite the decrease in pregnancy in the RR treatment group that we document below, is interesting in itself. It suggests that girls who know that they can go to secondary school (because their parents can afford the fees and because they are performing well enough in grade 8) are not the marginal girls whose pregnancy rate was affected by the RR information program (although their partner choice might have been affected). This is not surprising, since the opportunity cost of pregnancy for girls who can attend secondary school is very high (pregnancy is de facto incompatible with schooling in Kenya).

Table 2—Verifying Balance between Groups in Terms of School Characteristics and Outcomes for Pre-Program Cohort

	RR information			TT on HIV/AIDS curriculum		
	Comparison group (C) (1)	Treatment group (T) (2)	Difference T–C (3)	Comparison group (C) (4)	Treatment group (T) (5)	Difference T–C (6)
Panel A. School characteristics at baseline						
Class size	38.2	34.4	−3.8	37.4	37.3	−0.06
	[15.9]	[17.4]	(1.540)**	[16.9]	[15.7]	(1.281)
Pupils' sex ratio (girls/boys)	1.07	1.12	0.049	1.06	1.10	0.040
	[0.489]	[0.668]	(0.072)	[0.476]	[0.586]	(0.059)
Teacher-pupil ratio	0.026	0.026	0.000	0.025	0.027	0.003
	[0.026]	[0.022]	(0.003)	[0.021]	[0.028]	(0.003)
Teachers' sex ratio (females/males)	1.033	0.921	−0.112	1.003	1.014	0.011
	[0.914]	[0.777]	(0.119)	[0.92]	[0.852]	(0.099)
KCPE results (2003)	251.0	249.4	−1.6	252.2	249.0	−3.2
	[29.0]	[27.4]	(3.9)	[28.6]	[28.5]	(3.2)
Sampled for TT on HIV/AIDS curriculum	0.50	0.49	−0.003	0.00	1.00	
			(0.067)			
Sampled for RR information	0.00	1.00		0.22	0.22	−0.002
						(0.046)
Panel B. Girls enrolled in eighth grade in 2003 (control cohort for RR): outcomes at the end of 2004						
Percent repeating class 8	0.246	0.209	−0.04	0.236	0.238	0.002
			(0.021)*			(0.018)
Percent in secondary school	0.449	0.458	0.008	0.472	0.430	−0.043
			(0.026)			(0.021)**
Percent in professional training	0.037	0.036	−0.001	0.037	0.036	−0.001
			(0.008)			(0.007)
Percent out of school	0.259	0.289	0.029	0.246	0.286	0.040
			(0.022)			(0.018)**
Percent married	0.077	0.083	0.006	0.071	0.085	0.014
			(0.012)			(0.010)
Percent who had begun childbearing	0.144	0.139	−0.004	0.134	0.152	0.018
			(0.018)			(0.015)
Observations	4,783	1,212	5,995	3,016	2,979	5,995
Panel C. Boys enrolled in eighth grade in 2003 (control cohort for RR): outcomes at the end of 2004						
Percent repeating class 8	0.226	0.220	−0.006	0.227	0.223	−0.004
			(0.022)			(0.018)
Percent in secondary school	0.521	0.509	−0.012	0.528	0.508	−0.020
			(0.027)			(0.023)
Percent in professional training	0.015	0.009	−0.006	0.017	0.010	−0.007
			(0.004)			(0.004)*
Percent out of school	0.229	0.254	0.025	0.217	0.252	0.036
			(0.023)			(0.019)*
Percent married	0.009	0.007	−0.002	0.010	0.007	−0.003
			(0.005)			(0.004)
Observations	4,845	1,229	6,074	3,079	2,995	6,074
Number of schools	252	71	323	163	160	323

Notes: These are school averages. Panel A: school characteristics collected through school visits in 2004. Panels B and C: students' outcomes collected in 2004 for the cohort of students enrolled in grade 8 in 2003, which is the cohort just one year older than the cohort involved in the RR experiment. Data collected by asking whereabouts of students at their 2003 primary school. Standard deviations in brackets. Columns 3 and 6: standard errors are in parenthesis. Five schools did not have an eighth grade class in 2003 and therefore are excluded from the table.

***Significant at the 1 percent level.
**Significant at the 5 percent level.
*Significant at the 10 percent level.

balanced when it comes to the long-term schooling status of teenagers. Schools in the RR treatment group are significantly less likely to allow their students to repeat grade 8 compared to schools in the RR control group. What's more, schools in the TT treatment group are significantly less likely to see their students go on to secondary school than schools in the TT comparison group.[22]

To estimate the impact of the intervention, we use simple reduced form regression specifications. Denote Y_{isc} the outcome of individual i formerly enrolled in primary school s in cohort c. RR_s is the RR treatment status of school s, and $StudyCohort_c$ is the dummy for being in the study cohort (grade 8 in 2004). TT_s is a dummy equal to 1 if school s received the teacher training on the HIV curriculum.

First, we estimate the simple difference (SD) in means by ordinary least squares with clustering at the school level. The model is a linear probability model,

$$Y_{is1} = \alpha_1 + \beta_1 \times RR_s + \chi_1 \times TT_s + I_i'\gamma_1 + \varepsilon_{is},$$

where I_i is a vector of controls for individual characteristics. The average effect of coming from a RR treatment school ($RR_s = 1$) versus a RR comparison school ($RR_s = 0$) is captured by β_1. Since $RR_s = 1$ was randomly assigned, we should expect $E(\varepsilon_{is} | RR_s) = 0$ so that the estimator of β_1 is unbiased. The average effect of coming from a school that received the teacher training can be captured by $\chi_{1.}$ Since $TT_s = 1$ was also randomly assigned, we should expect $E(\varepsilon_{is} | TT_s) = 0$ so that the ordinary least squares estimator of χ_1 is also unbiased. By comparing β_1 and χ_1, we can thus compare the impact of the two information sets.[23] To increase the precision of the estimators, we control for the observable characteristics of the primary school of origin (for the childbearing data) and for the characteristics of the current secondary school (for the behavioral survey). Finally, when the outcome is binary, we also estimate the effect of the program on the probability that the outcome occurs using a Probit model.

Second, we estimate the difference-in-differences (DD) when data on a control cohort is available:

$$\begin{aligned} Y_{isc} = {} & \alpha_2 + \beta_2 \times RR_s \times StudyCohort_c + \delta \times RR_s + \theta \times RR_s \\ & + \chi_2 \times TT_s + I_i'\gamma_2 + \omega_{isc}. \end{aligned}$$

Comparing the single-difference to the difference-in-differences estimates is useful for two reasons. First, if the randomization of the RR program assignment was not perfect, the difference-in-differences will adjust for potential pre-existing random differences in means between RR treatment and RR comparison schools. Second,

[22] Overall, these pre-existing differences will bias us against finding an effect, since the opportunity cost of getting pregnant is lower for out-of-school girls than it is for in-school girls, who will not be allowed to stay in school while pregnant.

[23] The limited sample size makes it difficult to estimate the interaction between the two programs. Specifications that estimate the impact of the two programs alone and combined are presented in Appendix Table A3. The standard errors are large, but for none of the outcomes considered can we reject the equality between the effect of the RR information alone and the effect of the RR information combined with the teacher training.

the difference-in-differences allows the inclusion of school fixed effects, which allows to control for unobservable school characteristics that enter the equation in an additive way. However, the double-difference estimates could be biased in the presence of treatment spillovers across cohorts. We will come back to this issue when we discuss the results.

Dealing with Selection.—While the childbearing outcome was measured for every girl in the sample, information on partner's age was measured conditional on the girl having either started childbearing (in which case a follow-up survey was administered at home) or joined secondary school (in which case a follow-up survey was administered at school). To see the extent to which this is an issue for estimating the treatment effect on partner selection, let's think of the sample of girls as composed of three groups:

(A) girls who went on to secondary school;

(B) girls who did not go to secondary school and are not engaging in risky sex; and

(C) girls who did not go to secondary school and are engaging in risky sex.

We have data on all girls in group A. We have no data on girls in group B, but to the extent that they are not engaging in risky sex, the age of their partner is not a critical parameter. The main selection problem comes from the fact that, for group C, we only observe partner's age for the subset of girls who got pregnant. In other words, we face the following censored selection model:

$$y^* = RR\beta + \epsilon$$

$$z^* = RR\gamma + u$$

$$y = y^* \text{ if } z^* \geq 0,$$

where *RR* is the relative risk information treatment dummy, y^* is the age difference between the girl and her sex partner, and z^* is the propensity of getting pregnant. y is the observed age difference. We observe it only for those who got pregnant.

The coefficient of interest is β, the estimate of the RR program effect on unprotected partners' age. OLS on the selected sample will yield a consistent estimate of β only if ϵ is uncorrelated with u. In other words, we need to assume that the propensity to get pregnant (when engaging in unprotected sex) is independent of the age of the partner. There are a number of reasons why this assumption may not hold. First, the semen of older partners may be less fertile. This is not so much of a concern in our context, however, since the oldest male partners reported by girls in our sample are still relatively young (below 40), and most likely as fertile as teenage boys. Second, the frequency or timing of intercourse might vary with the partner's age. To the extent that older men are more experienced, they might be better able to avoid

Table 3—Probability That Girls Have Started Childbearing

	Has started childbearing				Has started childbearing, unmarried		Has started childbearing, married	
Specification model	SD OLS (1)	SD PROBIT (ME) (2)	DD OLS (3)	DD-FE OLS (4)	SD OLS (5)	DD OLS (6)	SD OLS (7)	DD OLS (8)
RR information	−0.015 (0.008)*	−0.013 (0.008)*	0.006 (0.013)		−0.009 (0.004)**	0.015 (0.010)	−0.005 (0.006)	0.011 (0.012)
RR information × 2004 cohort			−0.024 (0.016)	−0.020 (0.016)		−0.027 (0.011)**		−0.017 (0.013)
TT on HIV/AIDS curriculum	0.006 (0.007)	0.007 (0.006)	0.008 (0.006)		0.006 (0.004)	0.006 (0.004)	0.000 (0.005)	0.002 (0.005)
Sample								
Control cohort included (2003 cohort)			Yes	Yes		Yes		Yes
Controls								
Individual characteristics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Primary school characteristics	Yes	Yes	Yes		Yes	Yes	Yes	Yes
Primary school fixed effects				Yes				
Observations	5,988	5,988	10,968	10,968	5,988	10,968	5,988	10,968
Mean of dependent variable (2004 cohort, RR = 0)	0.054	0.054	0.054	0.054	0.021	0.021	0.033	0.033

Notes: Data collected by asking whereabouts of students at their 2004 primary school. Specifications: SD = simple difference; DD = difference-in-difference; FE = school fixed effects. Only the 2004 cohort was affected by the RR information program. The dependent variables are individual-level dummies. Robust standard errors in parentheses, clustered at the school level. Columns 2, 6, and 10 report mean marginal effects. "2004 Cohort" = Cohort of students enrolled in grade 8 in 2004. "2003 Cohort" = Cohort of students enrolled in grade 8 in 2003. Individual controls include: age, whether student is repeating grade 8 at baseline, and cohort when applicable. School controls include: gender ratio among pupils, teacher-pupil ratio, average school performance on the national KCPE exam, location, and timing of school visit. School visits were conducted between July and December 2005 for the 2004 cohort, and between July and December 2004 for the 2003 cohort. The timing of visits was balanced across groups.

***Significant at the 1 percent level.
**Significant at the 5 percent level.
*Significant at the 10 percent level.

pregnancy. This would lead us to underestimate β. But the bias could go the other way. As discussed earlier, anal sex or abortion might be more common with teenage boys, with whom pregnancy is particularly unattractive. Given that our identifying assumption may not hold, comparing the effects estimated for the sample of girls who started childbearing with those estimated for the sample of girls who joined secondary school will be important to ascertain the robustness of the results.

IV. Results

A. *Impact on Incidence of Teen Childbearing*

Table 3, columns 1–4 show the estimates of the effects of each program on the incidence of childbearing with four different regression specifications: the simple difference with a linear probability model (OLS); the simple difference with a probit model (reporting marginal effects); the OLS estimate of the difference-in-differences; and the OLS estimate of the difference-in-differences with school fixed effects. The RR information reduced the incidence of childbearing by 1.5 percentage points among treated girls relative to girls in the comparison group (Table 3, column 1). The childbearing rate in the comparison group is 5.4 percent, and thus the RR treatment effect corresponds to a 28 percent decrease in the incidence of childbearing. The magnitude of the RR effect is robust to all specifications. In the difference-in-differences without school fixed effects, the estimate of the coefficient for "RR Information" is close to zero, confirming the absence of ex-ante difference between treatment and comparison schools (column 3, row 1). The estimate of the RR effect on the study cohort is slightly larger than the OLS, but the standard error is also large.

In contrast, the TT program had no impact on the incidence of childbearing (row 3). This, despite the fact that the training had a large impact on the amount of HIV education delivered in schools and increased scores of pupils on HIV knowledge tests (Duflo et al. 2006). This result may reflect the fact that the curriculum promotes abstinence until marriage as the only way to avoid HIV infection, and so would not deter teenagers from marrying and having children at a young age.

Columns 5–8 in Table 3 show estimates of the treatments on childbearing broken down by marital status. The bulk of the decrease in the incidence of childbearing in the RR treatment group corresponds to a decrease in childbearing outside of marriage, while the incidence of childbearing within marriage decreased only slightly and not significantly. This means that, among girls who started childbearing, the proportion of girls who are married is significantly larger in the treatment group than in the comparison group. Since women typically receive greater financial support from their partner when they are married than when they are not, these findings imply that, relative to girls in the comparison groups, girls who received RR information were more likely to refuse to enter into an unprotected sexual relationship with an adult man, *unless* they were guaranteed compensation commensurate with the higher risk involved. In other words, in the absence of the RR information program, girls at the margin (just above the threshold of engaging with an older partner) would have engaged in unprotected sex with an older partner who had relatively limited resources and who would have turned out to not marry in case of a pregnancy.

Since 29 percent of girls in the sample already knew that older men are riskier than teenage boys (as seen in Table 1), it would be interesting to check that the RR treatment effect occurred primarily among those who did *not* know this fact at baseline. Unfortunately, the baseline survey was anonymous, and therefore it is not possible to merge the childbearing data with the survey data to test for heterogeneity in the treatment effect.

B. *Age of Childbearing Partner*

To determine the extent to which the observed decrease in the incidence of childbearing in the RR treatment group corresponds to a decrease in the incidence of unprotected sex with older men, we look at the age differential between girls who have started childbearing and their partners. The data is available for two cohorts: the study cohort (grade 8 of 2004) and one control cohort (grade 7 of 2004).

Obviously, since the RR information reduced the incidence of childbearing in the RR treatment group, the data is available for differentially selected subsamples

Table 4—Age Gap between Girls Who Have Started Childbearing and Their Partner

	Age difference between teenage girl and her partner		Age gap > 5 years			Age gap > 10 years		
Specification model	SD OLS (1)	DD OLS (2)	SD OLS (3)	SD PROBIT (ME) (4)	DD OLS (5)	SD OLS (6)	SD PROBIT (ME) (7)	DD OLS (8)
RR information	−1.685	1.07	−0.224	−0.226	0.157	−0.064	−0.081	0.166
	(0.609)***	(0.817)	(0.116)*	(0.097)**	(0.121)	(0.061)	(0.052)	(0.084)**
RR information × 2004 cohort		−2.576			−0.351			−0.229
		(1.048)**			(0.190)*			(0.109)**
TT on HIV/AIDS curriculum	−0.708	−0.331	0.074	0.101	0.026	−0.076	−0.066	−0.03
	(0.720)	(0.451)	(0.081)	(0.074)	(0.060)	(0.058)	(0.055)	(0.037)
Sample								
Control cohort included (2005 cohort)		Yes			Yes			Yes
Controls								
Individual characteristics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Primary school characteristics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	120	250	134	134	278	134	134	278
Mean of dependent variable (RR = 0)	5.91	5.91	0.49	0.49	0.49	0.16	0.16	0.16
Standard deviation	(4.16)	(4.16)						

Notes: Data source: follow-up survey conducted through home visits for subsample of girls who had started childbearing by July 2005. Specifications: SD = simple difference; DD = difference-in-difference. Data collected through home visits. Only the 2004 cohort was affected by the RR Information program. The dependent variables are at the individual level. Robust standard errors in parentheses, clustered at the primary school level. Columns 4 and 7 report mean marginal effects. Individual controls include: age, and cohort when applicable. School controls include: gender ratio among pupils, average school performance at national KCPE exam, location.

***Significant at the 1 percent level.

**Significant at the 5 percent level.

*Significant at the 10 percent level.

of each group. The analysis in this section will therefore not tell us anything about how the RR information affected girls' partner selection *overall*. But it will inform us on how the RR information affected girls' selection of partners with whom to have *unprotected* relationships. As discussed in Section IIIC, as long as the RR treatment did not affect the likelihood of getting pregnant conditional on having unprotected sex differentially across relationships' types (cross- or intra-generational), we should expect the ratio of cross-generational to intra-generational pregnancies to be the same across subsamples, *unless* the RR treatment had an impact on the age differentials between girls and the partners with whom they had unprotected sex.

The dependent variable in Table 4, columns 1 and 2, is the age difference between the respondent and her baby's father. The RR treatment effect is negative and significant: among girls who had begun childbearing, the average age gap with the baby's father is 1.7 years smaller for RR treated girls than for girls who did not receive the RR treatment (column 1). This difference is significant at 1 percent. In columns 3–5, the dependent variable is a dummy indicating whether the baby's father is more than 5 years older than the teenage girl. The coefficient of the treatment effect is negative and large (−22 percentage points off of a mean of 49 percent in the control group) and significant at 5 percent (column 3). In contrast, the TT program seems to have,

Table 5—Overall Treatment Effects on Incidence of Childbearing by Male Partner's Age

	Comparison group	RR treatment group				RR treatment effect		
	Base = 100	Point estimate	Std. error	90% CI		Point estimate (%)	90% CI	
Panel A. Effect of relative risks information								
# Teen pregnancies (A)	100.0	72.3	14.8	[47.5	97.0]	−27.7	[−52.5	−3.0]
Share of pregnancies by men > 5 years older (B)	47.6	25.2	11.6	[5.8	44.6]	−47.1	[−87.8	−6.4]
# Pregnancies by men > 5 years older (C = A × B)	47.6	18.2	9.3	[3.66	33.8]	−61.7	[−92.3	−29.0]
# Pregnancies by men ≤ 5 years older (D = A − C)	52.4	54.1	13.9	[30.9	76.2]	3.2	[−41.0	45.4]
		TT treatment group				TT treatment effect		
	Base = 100	Point estimate	Std. error	90% CI		Point estimate (%)	90% CI	
Panel B. Effect of teacher training on HIV curriculum								
# Teen pregnancies	100.0	111.1	13.0	[89.4	132.7]	11.1	[−10.6	32.7]
Share of pregnancies by men > 5 years older	47.6	55	8.1	[41.5	68.5]	15.5	[−12.9	44.0]
# Pregnancies by men > 5 years older	47.6	61.1	12.9	[44.3	82.6]	28.4	[−6.9	73.5]
# Pregnancies by men ≤ 5 years older	52.4	50.0	11.9	[30.1	65.3]	−4.6	[−42.6	24.6]

Notes: In each panel, the first row shows the effect on number of teen pregnancies reported from Table 3, column 1. The second row shows the effect on share of pregnancies by older men reported from Table 4, column 3.

if anything, increased the likelihood that teenage girls start childbearing with older partners, though none of the coefficients are significant (row 4).

The difference-in-difference estimates of the effect of the RR program on the RR cohort are greater in magnitude than the simple difference results. This seems driven by the fact that the coefficients for being in an RR information school (but not in the RR cohort) are large and positive (row 1, columns 2, 5, and 9). This suggests that the RR program might have had negative spillovers onto nontreated students in the RR treatment schools. Indeed, the control cohort available is a *younger* cohort (the seventh graders of 2004). This cohort could have been indirectly and negatively affected by the RR information program if the "sugar daddies" newly turned down by informed eighth graders decided to try their luck with seventh graders instead. Alternatively, the seventh graders could have benefitted from positive information spillovers if the eighth graders shared the information with their younger schoolmates. Note that there would be no room for such spillover effects if the RR information was included in the official curriculum and provided to everyone.[24]

[24] It is possible that similar spillover effects could have been at play across primary schools. On one hand, information on relative risks could have spread to comparison primary schools that are near treatment schools, and girls in those comparison schools may also have avoided unprotected sex with adult partners. This would mean that the treatment effect on childbearing estimated above is an underestimation of the overall effect of the RR information campaign. On the other hand, if adult men responded to the change in the price charged by treated teenage girls by moving away from treatment schools and toward the surroundings of comparison schools when looking for sexual partners, the information campaign may have generated an increase in childbearing by adult men in the comparison schools, and consequently the comparison between treatment and comparison schools would be overestimating the

C. *Overall Impact of RR Information on Pregnancies by Partner's Type*

Table 5 combines the results of Tables 3 and 4 to compute the treatment effects of the RR and TT programs on the incidence of pregnancies with older partners and the incidence of pregnancies with teenage partners. We consider a normalized case in which 100 pregnancies occur in the RR comparison group. Of these, 47.6 are by men more than 5 years older (hereafter labelled "older men"). In the RR treatment group, we would observe 72.3 pregnancies, 18.2 of which are by older men. Thus, the RR program averts 29.4 pregnancies by older partners in the treatment group. This means that the incidence of cross-generational pregnancies declined by 61.7 percent in the RR treatment group relative to the comparison group, while intra-generational pregnancies remained stable. The confidence interval is large ([−92.3 percent; −29.0 percent]), but we can reject the hypothesis that the RR program reduced cross-generational sex by less than 29 percent.

These results suggest that providing teenagers with information on relative risk led to a large decrease in the incidence of unprotected sex between teenage girls and older men, but did not lead to an increase in the incidence of unprotected sex between teenage girls and teenage boys. This suggests that the RR program might have reduced teenagers' exposure to the risk of HIV infection.

In contrast, the TT program had, if anything, a positive impact on the incidence of childbearing by older partners, although the effects cannot be distinguished from zero (none of the coefficient estimates for the TT program in Tables 3 and 4 are statistically significant).

D. *Mechanisms? Suggestive Evidence from Self-Reported Sexual Behavior*

Did the decrease in the incidence of childbearing by older partners in the RR treatment group come from an increase in condom use within cross-generational partnerships or from a decrease in the number of cross-generational partnerships? If teenage girls in the treatment group did not engage in partnerships with older men, did they substitute toward teenage boys (low-risk option) or toward abstinence (zero-risk option)? The general case of the model predicts a one-for-one substitution toward teenage partners, but the "poverty-driven prostitution" subcase (when the survival constraint is binding) implies that the substitution toward teenage boys should be more than one for one (since teenage boys have less resources than older men), and thus would predict an increase in the number of partners reported by teenage girls.

To shed light on these issues, Table 6 presents self-reported data collected among teenagers who joined a secondary school in the study area. This subgroup is not representative of all teenagers in the sample.[25] Nevertheless, studying the impact of the RR program on the self-reported sexual behavior of secondary school students is

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treatment effect. However, since the treatment group is more than four times smaller than the comparison group, it is unlikely that this price effect could explain more than a fourth of the treatment effect found.

[25] Girls enrolled in secondary school have a higher incentive to avoid childbearing than girls who are out of school, since in Kenya childbearing is incompatible with schooling. As such, the sexual behavior of secondary school girls may differ substantially from that of out-of-school girls. Similarly, out-of-school boys are more likely

Table 6—Self-Reported Sexual Behavior for Students Who Joined Secondary School

	Has had sex with multiple partners (1)	Currently has a regular partner[a] (2)	Partner > 5 years older[b] (3)	Ever received money from current partner (4)	Ever had sex (5)	Ever had sex but never used a condom (6)	Used a condom at last sexual intercourse (7)
Panel A. Girls							
RR information	0.007	0.096	−0.069	0.055	0.101	0.034	0.118
	(0.015)	(0.025)***	(0.038)*	(0.089)	(0.031)***	(0.027)	(0.073)
TT on HIV/AIDS curriculum	−0.010	0.009	0.004	0.092	−0.028	−0.021	0.012
	(0.011)	(0.023)	(0.035)	(0.075)	(0.023)	(0.016)	(0.067)
Observations	2,170	2,157	260	246	2,173	2,173	307
Mean of dependent variable (RR = 0)	0.033	0.122	0.074	0.684	0.191	0.107	0.360
Controls							
Individual characteristics	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Secondary school characteristics	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Panel B. Boys							
RR information	0.106	0.027	−0.041	0.228	0.125	0.052	0.024
	(0.032)***	(0.027)	(0.015)***	(0.102)**	(0.036)***	(0.039)	(0.042)
TT on HIV/AIDS curriculum	−0.011	0.002	0.017	−0.036	−0.025	0.005	−0.012
	(0.023)	(0.021)	(0.018)	(0.070)	(0.026)	(0.023)	(0.029)
Observations	2,668	2,641	312	350	2,678	2,678	1,116
Mean of dependent variable (RR = 0)	0.217	0.138	0.036	0.453	0.521	0.333	0.296
Controls							
Individual characteristics	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Secondary school characteristics	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Data source: anonymous follow-up survey conducted among secondary school students. All columns correspond to Linear Probability Model regressions (probit estimates are shown in Appendix Table A3). The dependent variables are individual-level dummies. Robust standard errors in parentheses, clustered at the secondary school level. Individual controls include: age and a dummy indicator for students not coming from a study primary school. Controls at the secondary school level include: location and gender ratio among pupils. Results are robust to the addition of all other available school controls (school size, average performance, school type (day or boarding), tuition costs). Columns 3 and 4: sample restricted to those who declare having a regular partner. Column 7: sample restricted to those who declare ever having had sex.

[a] 75 girls and 25 boys gave inconsistent answers: they declared never having had sex, but declared having a regular partner. In this table, we assume that those who declared having a regular partner lied on the "ever had sex" question, and we recoded "ever had sex = 1" for all those who report having a regular partner. (Appendix Table A3 presents the results when we ignore the regular partner information and assume that the students with such inconsistent reports never had sex.)

[b] Among those who report having a regular partner, 4 percent of girls and 11 percent of boys did not report any information on the age gap with their current partner and 7 percent of girls and 5 percent of boys did not report if they had received/given money from/to their current partner.

***Significant at the 1 percent level.
**Significant at the 5 percent level.
*Significant at the 10 percent level.

interesting in itself and can help shed light on the mechanisms behind the observed decrease in childbearing with older partners.

For a small share of students in the sample, responses to the self-administered sexual behavior questions were inconsistent. Seventy-five girls and 25 boys

to be working, and thus may have more income than secondary school boys, which may raise their ability to make transfers to girls in return for sex.

reported never having had sex, but when asked if they currently had a regular partner with whom they have sex, they responded that they did. We propose two ways to deal with these inconsistencies. First, in Table 6, we assume that the partner information is correct, and code "ever had sex" as 1 if the student reported having a regular partner, even if the student declared never having had sex. Second, in Appendix Table A4, we consider the first answer given as the correct one (i.e., the answer to "did you ever have sex?") and ignore the partner information if it is inconsistent with the "ever had sex" information. The number of observations with partner characteristics and condom use information is smaller in this case, but the results are virtually unchanged, and below we describe only the results in Table 6.

For each outcome, Table 6 shows the results of the OLS estimates of the simple difference between treatment and control group. Panel A shows the coefficient estimates for girls and panel B shows the estimates for boys. The probit estimates are very similar to the OLS estimates, therefore we not show them given space constraints.

The first column of Table 6 shows that girls in the RR treatment group were not more likely to have had multiple partners than other girls. However, they were much more likely to declare having a regular partner (column 2).[26] The likelihood that their partner is more than 5 years their senior is significantly lower, however, and virtually reduced to zero (compared to 7.4 percent in the RR control group, column 3). In contrast, girls in the TT treatment group are not more likely to have a regular partner, and the TT program had no effect on the likelihood that girls choose an older partner. Column 4 documents the effect of the RR information on whether girls report having ever received money from their current partner. The point estimates are positive, suggesting that girls in the RR treatment group are 6 percentage points (less than 10 percent) more likely to have received money. This effect is not significant, however, and lower than that of the TT treatment, also insignificant. Unfortunately, we do not have data on transfer size.

The results for boys are quite different. Boys in the RR treatment group are 10 percentage points more likely to report having had sex with multiple partners. This represents a 48 percent increase compared to the base rate of 22 percent in the control group. However, boys are not more likely to report having a regular partner. Those with a regular partner are less likely to report an age gap greater than 5 years, suggesting that the RR information reduced "sugar mammies" relationships just as it did with "sugar daddies" relationships. We also find that boys in the RR group are much more likely to report having given money to their current partner. This change on the extensive margin is consistent with the hypothesis that teenage girls in the RR group substituted away from older partners and toward their classmates.

Last but not least, the RR program led to an increase in the likelihood that teenagers report ever having had sex (column 5). For girls, the difference between RR

[26] Note that this effect is not just due to the fact that girls in the RR group are more likely to be sexually active. Even conditional on being sexually active, girls in the RR treatment group are 50 percent more likely to report having a regular partner (data not shown).

treatment and control is 10 percentage points, significant at 1 percent. For boys, the difference is 12.5 percentage points, also significant at 1 percent. In contrast, the TT program decreased the likelihood that teenagers report being sexually active, but the effect is small and not significant. These results are consistent with the prediction that, as RR information decreases the perceived riskiness of teenage boys, girls who would abstain in the absence of RR information decide to enter the market for sex with teenage boys when RR information is available.[27]

The increase in sexual activity for both boys and girls in the RR treatment group does not seem to correspond to an increase in unsafe sexual activity. The share of teenagers who ever had sex but never used a condom did not increase significantly (column 6). The share of girls who report having used a condom at their last sexual intercourse is 36 percent in the RR control group, and this increases by 11 percentage points (a 32 percent difference) among girls in the RR treatment group (column 7). However, there is no significant (statistically or economically) change in condom use at last intercourse for boys in the RR treatment group compared to the control.

Overall, the self-reported sexual behavior data at hand, while imperfect, confirms the childbearing results, and suggests that, in response to the RR information, teenage girls substituted away from older partners and toward protected sex with teenage partners, but not more than one-for-one. In addition, the self-reported data suggests that the RR information triggered some teenage girls to enter sexual activity earlier, but with condoms, presumably to avoid pregnancy with a resource-constraint teenage boy. Finally, the self-reported data also confirms the childbearing data in showing that the TT program had virtually no effect on sexual behavior. These results are unchanged when we change the coding of inconsistent responses (see Appendix Table A4).

An important question in interpreting these results is the following: is it really the relative risk information that made a difference in the behavior of girls in the RR group? Or is it just that the RR program was more successful than the TT program at convincing students to protect themselves against HIV? This is a legitimate question for two reasons. First, the RR message was delivered by an NGO worker, while the TT program relied on teachers. Second, the RR message included detailed prevalence data for an area of Kenya whose average prevalence is higher than for Kenya as a whole, therefore higher than the average risk level conveyed by the TT program. For both these reasons, the RR program may have increased perceived HIV risk more than the TT program. Could this be the driving force for the observed effects? Likely not. While a simple shift upward in perceived risk could have triggered the observed decrease in unprotected sex (as proxied by teenage childbearing) in the RR group, it is not enough to explain the observed change in partner selection. The substitution away from older partners and toward younger partners observed among girls in the RR information group can only come from a change in perceived relative risks.

[27] Alternatively, this result could be a pure reporting artifact as discussed in Section IIIB.

Table 7—Cost-Effectiveness of the RR Information Campaign

	US$
Actual Cost per cross-generational pregnancy averted	$98
Scenario 1	
# of Primary HIV infections averted among teenage girls	4.88
Cost per Primary HIV infection averted among teenage girls	$392
Scenario 2	
# of Primary HIV infections averted among teenage girls	2.93
Cost per Primary HIV infection averted among teenage girls	$653
Scenario 3	
# of Primary HIV infections averted among teenage girls	0.98
Cost per Primary HIV infection averted among teenage girls	$1,960

Notes: Assumption in Scenario 1: 25 cases of HIV infection per 100 cross-generational pregnancies. Assumption in Scenario 2: 15 cases of HIV infection per 100 cross-generational pregnancies. Assumption in Scenario 3: 5 cases of HIV infection per 100 cross-generational pregnancies.

E. *Cost-Effectiveness of the RR Information Campaign*

This section provides a rough calculation of the cost-effectiveness of providing RR information to teenagers through schools, and compares it to other HIV prevention programs that have been shown successful. We assume that this information would be provided in itself, outside of existing information programs. This is a very conservative assumption. In most cases, it would be easy for existing programs to add this relative risk information component to their existing curriculum.[28]

The RR information did not change the number of intra-generational pregnancies, but reduced the number of cross-generational pregnancies. Dividing the total cost of the program by the number of pregnancies averted gives an estimate of the cost per cross-generational pregnancy averted just under US$100. To calculate the cost per HIV infection averted, we need an estimate of the ratio of the risk of HIV infection to the risk of cross-generational pregnancy, a ratio which is not available in the literature.[29] Instead, we can compute cost-effectiveness estimates using three possible ratios: $5/100$, $15/100$, and $25/100$.[30] Table 7 shows the cost per HIV infection

[28] A few education programs specifically addressing the risks associated with "sugar daddy relationships" were started after the onset of this study. See for example Population Services International (2005).

[29] What makes this ratio particularly complicated to estimate is the fact that infectiousness of a person with HIV varies with her viral load, and the viral load follows a U-shape; it is very high during the first weeks or months after infection, then decreases substantially and peaks again (in the absence of antiretroviral (ARV) treatment) when the patient develops AIDS eight or nine years later (Magruder 2007).

[30] The choice of these three possible ratios was motivated by the following calculation: (a) In a meta-study, Marie-Claude Boily et al. (2009) estimate that the male-to-female HIV transmission rate in low-income countries is 0.30 percent per unprotected vaginal sex act. Taking the average prevalence rate among men older than 20 to be around 5 percent in Kenya, this implies that the risk of HIV infection may be around $0.05 \times 0.003 = 0.00015$ or 0.015 percent per act between a teenage girl and an older partner; (b) Using probabilities of conception by cycle days presented in Allen J. Wilcox, Clarice R. Weinberg, and Donna D. Baird (1995), I estimate that the risk of conception is 0.046 percent per unprotected vaginal sex act for healthy women in their mid-20s. The ratio of the estimates in (a) and (b) is $0.015/0.046 = 32/100$, which is greater than the most conservative estimate used here

using these ratios. For a ratio of 15/100, US$98 per cross-generational pregnancy averted corresponds to a cost of US$653 per primary HIV infection averted among teenage girls (Scenario 2). It is important to note, however, that these estimates consider only primary cases of HIV transmission, and thus do not include averted secondary HIV infections (i.e., transmission to subsequent sex partners).

These rough cost-effectiveness estimates compare favorably with other HIV prevention programs, such as treating sexually transmitted infections other than HIV (estimated at US$213 per HIV infection averted by Lucy Gilson et al. 1997); male circumcision (estimated at US$1,269–3,911 per infection averted by Ronald H. Gray et al. 2007); or voluntary HIV testing (estimated at US$537 per additional HIV positive person tested by Rebecca L. Thornton 2008).

While our findings suggest that providing RR information could be a cost-effective way to reduce teenage pregnancy and HIV infection among young women, we do not have enough data to gauge what the impact would be on the overall spread of the disease in the population. To fully assess the epidemiological consequences of providing information on HIV risk by group, it would be necessary to look at general equilibrium effects that are outside the scope of this paper, whose focus is on teenagers' responsiveness to risk information. In particular, one should address the question of what becomes of the older men who are turned down by informed teenage girls. On one hand, they might reduce their sexual activity. On the other hand, they might engage in unprotected sex with commercial sex workers, which could have negative epidemiological consequences. We cannot address these issues, nor can we do a meaningful calibration exercise, as we do not have data on the behavior of older men in the study area.

Estimating the long-term impact of the RR information on the welfare of the teenage girls in the sample is also difficult. The program reduced the incidence of teenage childbearing, which often has negative long-term outcomes for both mother and child, especially since teenage births tend to be unwanted (Thomas K. LeGrand and Cheikh S. M. Mbacké 1993; Saul D. Hoffman 1998; Cristian Pop-Eleches 2006). While the program did not increase the number of births to teenage fathers in the short run, in the longer run the program might still lead women to have children with relatively younger men than they would have otherwise. To the extent that younger fathers have fewer resources than older fathers, and that early childhood investments are important, the overall welfare impact of the RR program on women and their future children is unclear.

V. Conclusion

This paper uses a randomized field experiment to study changes in the sexual behavior of Kenyan teenagers in response to information on HIV risk. Using the incidence of pregnancy as an objective proxy for the incidence of unprotected sex, we provide evidence that in 71 primary schools of Western Kenya the provision of information on the relative risk of HIV infection by type of partner led to

(25/100). Therefore, the cost-effectiveness estimates provided can be seen as "conservative" estimates of the cost-effectiveness of the program.

a 61 percent (CI: 29 percent–92 percent) decrease in the incidence of pregnancies with older (riskier) partners among teenage girls, without increasing pregnancies with same-age partners. In contrast, the official HIV/AIDS curriculum for primary schools, which provided general information about the risk of HIV but did not inform teenagers of the risk distribution in the population, had no impact on the incidence of unprotected sex, as measured by pregnancy rates. Self-reported sexual behaviors are consistent with the pregnancy results, and suggest that teenage girls who received information on the relative riskiness of older partners substituted away from older partners and toward condom-protected sex with same-age partners.

One shortcoming of the data used in the paper is that given the anonymity of the survey data, it is not possible to test whether the treatment effect varied with prior beliefs. As a result, one could wonder whether the treatment effect was truly due to the information on the age profile of risk, and not due solely to the 10-minute video used to trigger the discussion on "sugar daddies" with the students. The video did not mention HIV, but portrayed "sugar daddies" as predators. It is possible, though unlikely, that the video alone would have had a similar effect as that observed. Another concern in terms of external validity is that the RR was conducted by an independent nonprofit organization. It is possible that the same information, if included in the official HIV/AIDS curriculum for primary schools and delivered by teachers, would not be as effective. In particular, the information was delivered by young women, who might have been perceived as role models by the school girls enrolled in the study.

Nevertheless, the findings of this paper suggest that the sexual behavior of teenagers is responsive to information, and it appears more elastic on the intensive than on the extensive margin. This result suggests that HIV education campaigns may achieve a wider health impact if they include both risk reduction and risk avoidance information.

More generally, these results speak to the importance of considering both the intensive and extensive margins of behavior when designing prevention programs. Public health interventions often focus their efforts on the extensive margin of a risky behavior: they aim at the complete elimination of the behavior and urge complete abstinence from the activity. Accordingly, they rarely provide information on the relative riskiness of different varieties of a risky activity—information that would enable people to reduce the intensity of their exposure to risk while remaining active. For example, it is virtually impossible to find any information on how dangerous smoking 2 cigarettes per day is, compared to smoking 0 or smoking 20. Likewise, clean syringe access programs were illegal in many US states for many years after the onset of the HIV crisis. However, the amount of information or the type of services that a prevention campaign may need to provide in order to maximize its health impact depends on the relative elasticity of behavior at two margins: at the intensive margin (the choice between high- and low-risk varieties of an activity) and at the extensive margin (the choice between some activity and no activity at all). The empirical evidence presented in this paper suggests that, in the case of sexual behavior, people are much more elastic on the intensive margin than on the extensive one.

Appendix

Table A1—Status of Study Sample at Follow-up, by Treatment Group

	RR information			TT on HIV/AIDS curriculum		
	Comparison group (C) (1)	Treatment group (T) (2)	Difference T−C (3)	Comparison group (C) (4)	Treatment group (T) (5)	Difference T−C (6)
Panel A. Girls						
Status unknown (attrited)	0.021	0.013	−0.008	0.018	0.020	0.001
			(0.008)			(0.007)
Percent repeating class 8	0.235	0.212	−0.023	0.223	0.237	0.014
			(0.022)			(0.018)
Percent in secondary school	0.461	0.450	−0.010	0.479	0.438	−0.041
			(0.026)			(0.021)*
Percent in professional training	0.045	0.052	0.007	0.047	0.046	−0.001
			(0.009)			(0.008)
Percent out of school	0.267	0.295	0.028	0.262	0.285	0.022
			(0.025)			(0.020)
Percent dead	0.0014	0.0016	0.0002	0.0008	0.0021	0.0014
			(0.0016)			(0.0013)
Observations	5,007	1,189	6,196	3,229	2,967	6,196
Number of schools	254	71	325	164	161	325
Panel B. Boys						
Status unknown (attrited)	0.014	0.013	0.021	0.013	0.015	−0.002
			(0.022)			(0.019)
Percent repeating class 8	0.219	0.189	0.000	0.210	0.214	0.001
			(0.002)			(0.001)
Percent in secondary school	0.487	0.499	−0.030	0.491	0.488	0.004
			(0.019)			(0.016)
Percent in professional training	0.039	0.034	0.012	0.036	0.039	−0.003
			(0.025)			(0.021)
Percent out of school	0.263	0.284	−0.005	0.268	0.266	0.004
			(0.008)			(0.007)
Percent dead	0.0006	0.0004	−0.0002	0.0011	0.0000	−0.0011
			(0.0007)			(0.00061)*
Observations	5,485	1,335	6,820	3,454	3,366	6,820

Notes: Data collected by asking whereabouts of students at their 2004 primary school. Status as of July 2005. Study sample composed of students enrolled in eighth grade in 2004. The table presents school averages. Standard errors in parenthesis. Three schools did not have an eighth grade class in 2004 and therefore are excluded from the table.
*** Significant at the 1 percent level. ** Significant at the 5 percent level. * Significant at the 10 percent level.

Table A2—Robustness of Table 4 Results to Source of Data on Partner's Age
(*Dependent variable: Age gap > 5 years*)

Sample	All those to whom the Home Survey was administered (1)	Home Survey administered to self (2)	Home Survey administered to relative (3)
RR information	−0.224	−0.223	−0.197
	(0.116)*	(0.210)	(0.154)
TT on HIV/AIDS curriculum	0.074	0.092	0.232
	(0.081)	(0.119)	(0.117)*
Observations	134	79	55
R^2	0.25	0.35	0.39
Mean of dependent variable	0.431	0.427	0.441

Notes: Robust standard errors are in parentheses, clustered at the school level. Column 1 reproduces column 3 of Table 4.
*** Significant at the 1 percent level. ** Significant at the 5 percent level. * Significant at the 10 percent level.

Source: Follow-up survey conducted at the girl's home.

Table A3—Testing for an Interaction Effect between RR and TT Information Sets

Sample		All	Girls who started childbearing		Secondary school girls	
Corresponding specification in main tables:		Table 3, col. 1	Table 4, col. 1	Table 4, col. 3	Table 6, col. 5	Table 6, col. 9
		Has started childbearing (1)	Age difference between teenage girl and her partner (2)	Age gap >5 years (3)	Age gap >5 years (4)	Ever had sex (5)
α	RR only	−0.007	−2.33	−0.158	−0.061	0.109
		(0.010)	(1.183)*	(0.131)	(0.061)	(0.045)**
	TT only	0.009	-0.904	0.093	0.008	−0.025
		(0.007)	(0.855)	(0.092)	(0.044)	(0.025)
γ	Both RR and TT	−0.016	−2.251	−0.166	−0.068	0.069
		(0.014)	(0.960)**	(0.161)	(0.038)*	(0.039)*
	Observations	5,988	120	134	260	2,173
	p-value, test $(\alpha = \gamma)$	0.55	0.94	0.96	0.874	0.442

Note: Robust standard errors are in parentheses
***Significant at the 1 percent level.
**Significant at the 5 percent level.
*Significant at the 10 percent level.

Table A4—Self-Reported Sexual Behavior for Students Who Joined Secondary School: Alternative Coding of Inconsistent Reports

	Has had sex with multiple partners (1)	Currently has a regular partner[a] (2)	Partner >5 years older[b] (3)	Ever received money from current partner (4)	Ever had sex (5)	Ever had sex but never used a condom (6)	Used a condom at last sexual intercourse (7)
Panel A. Girls Model	OLS	OLS	OLS	OLS	OLS	OLS	OLS
RR information	0.007	0.071	−0.080	0.071	0.079	0.015	0.154
	(0.015)	(0.021)***	(0.040)*	(0.090)	(0.028)***	(0.025)	(0.081)*
TT on HIV/AIDS curriculum	−0.010	0.019	0.014	0.059	−0.017	−0.016	−0.034
	(0.011)	(0.020)	(0.029)	(0.084)	(0.022)	(0.015)	(0.073)
Observations	2,170	2,206	196	193	2,170	2,170	267
Mean of dependent variable (RR = 0)	0.033	0.090	0.078	0.710	0.159	0.088	0.354
Controls							
Individual characteristics	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Secondary school characteristics	Yes	Yes	Yes	Yes	Yes	Yes	Yes

(*Continued*)

Table A4—Self-Reported Sexual Behavior for Students Who Joined Secondary School: Alternative Coding of Inconsistent Reports (*Continued*)

	Has had sex with multiple partners	Currently has a regular partner	Partner >5 years older	Ever gave money to current partner	Ever had sex	Ever had sex but never used a condom	Used a condom at last sexual intercourse
Panel B. Boys model	OLS	OLS	OLS	OLS	OLS	OLS	OLS
RR information	0.106	0.035	−0.049	0.169	0.127	0.06	0.029
	(0.032)***	(0.027)	(0.019)**	(0.113)	(0.036)***	(0.039)	(0.041)
TT on HIV/AIDS curriculum	−0.011	0.003	0.021	−0.063	−0.024	0.005	−0.017
	(0.023)	(0.019)	(0.021)	(0.073)	(0.025)	(0.023)	(0.030)
Observations	2,668	2,713	288	325	2,668	2,668	1,090
Mean of dependent variable (RR = 0)	0.217	0.125	0.036	0.458	0.511	0.328	0.291
Controls							
Individual characteristics	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Secondary school characteristics	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: See Table 6 notes.

[a] 75 girls and 25 boys gave inconsistent answers: they declared never having had sex, but declared having a regular partner. In this table, we ignore the regular partner information and assume that those students never had sex. (Table 6 presents the results when we assume that those who declared having a regular partner lied on the "ever had sex" question).

[b] Among those who report ever having had sex and having a regular partner, 7 percent of girls and 13 percent of boys did not report any information on the age gap with their current partner, and 10 percent of girls and 6 percent of boys did not report if they had received/given money from/to their current partner.

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