Externalities and Complementarities of HIV/AIDS Prevention Programs: Evidence from Secondary Schools in Malawi *

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Abstract

We study externalities and complementarities of three HIV/AIDS prevention interventions: HIV/AIDS education, easy access to male circumcision, and education support for girls. The study is based on a sample of 7,971 students in 33 secondary schools near Lilongwe, Malawi and we focus on the behavior within the existing 124 classes in these schools. In order to understand the potential externalities of the decision to get circumcised we randomize the fraction of students within classrooms who get offered this treatment (0%, 50% and 100%). We find evidence of peer effects given that untreated students in *50% Treatment* classrooms were 3.8 percentage points (79%) more likely to get circumcised than students in *No Treatment* classrooms. We also provide evidence of important reinforcement effects in take-up when male circumcision is offered among close friends. Our research design to study the complementarities of these interventions is based on the randomized allocation of the different mix of interventions across classrooms. We find limited evidence of complementarities among the three interventions. (JEL: C93, I12)

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1 Introduction

HIV/AIDS is one of the worlds most serious health challenges and huge efforts have been put into practice worldwide to address this problem. Although HIV/AIDS treatment reached 8 million out of 34 million people living with HIV by the end of 2011, a 20-fold increase since 2003, HIV/AIDS prevention remains an important challenge since the number of new infected people in 2011 was 2.5 million, only 20% lower than in 2001 (UNAIDS 2012). In the last decade, significant progress has been made in understanding the role that specific interventions play in lowering new HIV/AIDS infections. Such interventions include HIV/AIDS education (Gallant and Maticka-Tyndale 2004; Duflo et al. 2006; Dupas 2011), HIV voluntary counseling and testing (The Voluntary HIV-1 Counselling and Testing Efficacy Study Group 2000; Thornton 2008), male circumcision (Auvert et al. 2005; Bailey et al. 2007; Gray et al. 2007), conditional cash transfers (Baird et al. 2010; Baird et al. 2011), and HIV treatment as prevention (Cohen et al. 2011).

The focus of this paper is to study externalities and complementarities of three HIV/AIDS prevention interventions: HIV/AIDS education, easy access to male circumcision, and education support for girls. The first aim of the analysis is to focus on the role that peer effect might play in increasing demand for circumcision. Male circumcision has received much attention after three studies showed that male circumcision can reduce HIV transmission risk by 50 percent (Auvert et al. 2005; Bailey et al. 2007; Gray et al. 2007). For example, the World Health Organization (WHO) strongly recommended male circumcision as a key strategy for reducing female to male transmission of HIV (WHO 2007), and there is a global mobilization for scaling up male circumcision especially in the countries with high HIV incidence and low male circumcision.[1] However, the demand for male circumcision is still very low even with heavily subsidized price and proper information (Chinkhumba, Godlonton, and Thornton 2014). Major barriers are lack of information and accessibility and psychological cost including fear of pain, religious and cultural norms, and concern over a long recovery period.

Specifically we study male students in secondary school in Malawi who had a reasonable chance

[1] 14 priority countries in Eastern and Southern Africa (Botswana, Ethiopia, Kenya, Lesotho, Malawi, Mozambique, Namibia, Rwanda, South Africa, Swaziland, Tanzania, Uganda, Zambia, and Zimbabwe) were strongly recommended for rapid scale up of male circumcision and WHO/UNAIDS set target that 80% of males aged 15 to 49 years in these countries would get circumcised by 2015.

of being or becoming sexually active.[2] In our experimental school setting, we randomly assign classrooms into three groups: 100% Treatment, 50% Treatment, or No Treatment classroom. All students in the 100% Treatment classrooms received the free male circumcision offer with transportation support while no students in the No Treatment classroom received the offer. In 50% Treatment classroom, half of students were randomly selected to receive the offer. Students are allowed to take-up free male circumcision services at the assigned hospital, but only the subset of randomly selected students were offered transportation support.

The second aim of this study is to evaluate the potential complementarities of three HIV/AIDS prevention strategies: HIV/AIDS education, male circumcision for young adults, and education support to young women. Finding the optimal combined mix of biomedical, behavioral, and structural prevention interventions to reduce HIV/AIDS vulnerability remains a key open question in the literature. Indeed, the 2008 international HIV/AIDS Conference in Mexico set the design of the right mix of proven interventions to achieve the best possible effect as a key future goal. (Hankins and de Zalduondo 2010).

The potential importance of complementarities of policies and interventions in the process of development has been repeatedly emphasized by scholars and practitioners. In a nutshell, the existence of complementarities would be proven if a package of interventions implemented together is shown to have a larger impact than the sum of its parts. Complementarities could exist both at the micro-level, which is our focus in this paper, and at the macro-level. At the micro-level, the Millennium Villages Project (Sanchez et al. 2007) and the PROGRESA programs in Mexico are well known examples of initiatives that have embraced the importance of complementarities. Similar arguments have been proposed at the macro-level for understanding the industrialization process (Rosenstein-Rodan 1943; Murphy, Shleifer, and Vishny 1989) and the former communist countries transition to a market economy (Murphy, Shleifer, and Vishny 1992; Dewatripont and Roland 1995).

Despite the important role that complementarities could play, there is limited empirical evidence testing this idea. Our experimental study design allows for the possible estimation of such complementarities. Our empirical strategy is twofold. The first research design was to randomly allocate

[2] Although neonatal male circumcision is easy and cheap, we focus on secondary school male students since secondary school students are soon to be sexually active.

a different mix of the three HIV/AIDS prevention interventions (HIV/AIDS education, male circumcision, and conditional cash transfers to young women) across 124 classes within 33 secondary schools located outside Lilongwe, Malawi. This random allocation of the mix of interventions allows for a simple test of possible complementarities by estimating the potential interaction effects of these policies. The second research design also uses the fact that for two of the interventions (HIV education and male circumcision) we also experimentally varied the fraction of students who get offered this treatment within classrooms (0%, 50%, and 100%). This allows for the estimation of interaction effects within the 50% treatment classrooms.

In our analysis we first show the main effects of the three interventions (HIV/AIDS education, easy access to male circumcision, and education support for girls). Our preliminary analysis suggests a significant increase in HIV/AIDS knowledge level in girls (not boys), a 188% increase in male circumcision take-up and more years of schooling for girls, respectively.

In terms of externalities, we find that untreated students in 50% Treatment classrooms were 79% more likely to get circumcised than students in No treatment classrooms. This results suggests the existence of positive externalities in the demand for male circumcision. Additionally we find evidence of important reinforcement effects when close friends within the same classroom receive the intervention together.

Our preliminary analysis does not find strong evidence for the existence of complementarities for the three interventions within our context. These results are based on a wide range of outcome variables that aim to capture HIV/AIDS knowledge, as well as sexual behaviors. In our discussion we suggest possible reasons for these results but note that these preliminary findings are based only on the first short term follow-up survey. In ongoing future work we plan to continue to measure medium and longer term effects and to expand and improve our outcome measurements.

Our paper contributes to a growing literature of role of peer effect in health intervention programs in developing countries. For example, Godlonton and Thornton (2012) find significant peer effect in the take up of HIV testing in Malawi. A 10 percent point increase in the probability of having a neighbor within 0.5km learning his/her HIV result leads to a 1.1 percent point increase in learning ones own HIV result. Chong et al. (2013) also find that the treatment effects of online sexual education are largest when the peers were treated together. Oster and Thornton (2012) also find a strong positive peer effect on take-up of new health technology (menstruation cup) in the

short term, but not in the long term.[3]

The remainder of the paper is organized as follows: Section 2 provides background information on the three prevention strategies. Section 3 presents the experimental design followed in section 4 by the data section. The empirical strategy is described in section 5, while section 6 presents the main results. Section 7 concludes.

2 Background

2.1 Malawi Education System

Education in Malawi consists of eight years of primary education (Standard 1 through 8) followed by four years of secondary education (Form 1 through 4). Education achievement is still limited. According to the World Bank, primary school completion rate is around 74% in 2012[4], and secondary school enrollment and attendance rate is around 30% and 10%, respectively.[5] In addition to shortage of school supply and lack of demand for education, school tuition and fees explain low enrollment in secondary school.[6] There are three major national exams related with secondary school education in Malawi: Primary School Leaving Certificate Examination (PSLCE) for 8^{th} graders, Junior Certificate Examination (JCE) for 10^{th} graders (Form 2), and Malawi School Certificate Examination (MSCE) for 12^{th} grade students (Form 4).[7] PSLCE is a certificate to apply for secondary education, and MSCE is important specially for employment and university entrance.

The education curriculum includes HIV/AIDS education that provides information on the biology of HIV/AIDS, transmission mechanism of HIV/AIDS as well as the effects of HIV/AIDS epidemic on an individual, his/her family, and society. This curriculum also includes information on how to prevent HIV infection including the use of condoms, safe sex practices, and the role of abstinence outside marriage. However, it does not include information on male circumcision and the relative risk of cross-generational sexual relationships as proposed and discussed at length in

[3] A related literature investigates causal effects of peer in school setting using random assignment of roommates (Sacerdote 2001; Duncan et al. 2005; Eisenberg, Golberstein, and Whitlock 2014) to look at health and education outcomes.

[4] http://data.worldbank.org/indicator/SE.PRM.CMPT.ZS

[5] http://data.worldbank.org/indicator/SE.SEC.NENR/countries

[6] School fee was approximately US$ 21.2 (Malawi Kwacha (MK) 3,500, $1=165MK in 2012) per semester in our catchment area during study time. Students have to pay tuition and fees each semester, otherwise they are dropped out from the school.

[7] Exam fee is $1.8 (MK 300) for JCE and $2.5 (MK 420) for MSCE.

Dupas (2011).

2.2 HIV/AIDS and Male Circumcision in Malawi

Malawi is greatly affected by the HIV pandemic. It is estimated that 10.6% of people aged 15 to 54 years are living with HIV and 910,000 people were living with HIV (UNAIDS (2012)). AIDS is the leading cause of adults death in Malawi, and is a major factor in its low life expectancy of 54.8 years (UNDP (2013)). Prevalence of male circumcision in Malawi is low with a 21.6% circumcision rate (Malawi National Statistical Office and ICF Macro (2011)).[8] The number of male circumcisions per year in Malawi has recently increased rapidly: 589 in 2008, 1,234 in 2009, 1,296 in 2010, and 11,881 in 2011 (WHO (2012)). However, the estimated number of male circumcision between 2008 and 2011 in total is only 0.7% of the government target number (2.1 million) to achieve 80% of male circumcision prevalence in Malawi. Chinkhumba, Godlonton, and Thornton (2014) also show that demand for medical male circumcision is very low.[9] 36.8% among non-circumcised people who received information on the medical benefits show positive attitude to male circumcision in Malawi (Bengo et al. 2010). The corresponding number for other 13 studies in sub-Saharan Africa is 65% (Westercamp and Bailey 2007). The government of Malawi is trying to increase access to the circumcision surgery and promote demand for male circumcision in various ways. For example, in addition to campaign for awareness, knowledge, and attitude on male circumcision (National AIDS Commission (NAC) Malawi (2012)), it tries build medical male circumcision delivery capacity within existing health facilities and to expand medical circumcision training into clinical officers and registered nurses (Government of Malawi (GOM) (2012)).

3 Experimental Design

The experiment covers 33 public schools in four districts: TA Chimutu, TA Chitukula, TA Tsabango, and TA Kalumba (see Appendix Figure 1). We excluded students in private boarding

[8] Male circumcision in Malawi is practiced for religious and cultural reasons. 86.8% of Yao tribe, predominantly Muslim people, practice male circumcision while other tribes have low levels of male circumcision. Only 11.6% of Christian tribes practice circumcision (Bengo et al. (2010)). Most of Muslim and Yao people live in the southern region of Malawi while the majority of ethnicity in the central region to which the project catchment is belonging is the Chewa. Chewa people consist of 34.1% of the total population and only 6.2% of them practice male circumcision according to Malawi DHS 2010. The true prevalence of male circumcision could be lower because it includes incomplete circumcision that may not have the protective benefits of male circumcision (Bengo et al. (2010)).

[9] 41 (3.3%) out of 1,252 uncircumcised adult men received male circumcision with subsidized price.

schools and evening classes. In Table 1, we summarize the experimental design of the study. The randomization process was implemented in two stages. Three types of interventions are randomly assigned to treatment groups independently. For HIV/AIDS education and male circumcision, classrooms are randomly assigned to one of three groups: 100% Treatment, 50% Treatment, and No Treatment classrooms. Treated students in 50% Treatment classrooms are randomly selected at the individual level. Treatments are given to everybody in 100% Treatment classrooms, and no one received treatment in No treatment classrooms. For the girls education support program, classrooms are randomly assigned either to the 100% Treatment or No Treatment group. We expect a minimal spill-over between classes because classrooms are self-contained; there are limited cross-classroom activities; and majority of schools have only one class per grade. This two-step randomized design, which randomizes treatment across classes and also within classroom, allows us to estimate not only direct effect but also peer effects of the interventions.[10]

The HIV/AIDS education intervention was designed to provide the most comprehensive HIV/AIDS education. On the top of the existing HIV/AIDS education curriculum, we additionally provided information on the medical benefits of male circumcision and the relative risk of cross-generational sexual relationships. The education was provided to both male and female students by trained staffs with a government certificate. The HIV/AIDS education was comprised of a 45-minute lecture and 15-minute follow-up discussion. Study participants were assigned one of four research groups: 100% Treatment (E1), Treated in 50% Treatment (E2), Untreated in 50% Treatment (E3), and No treatment group (E4).

The male circumcision offer consists of free surgery at the assigned hospital, two complication check-ups (3-day and 1-week after surgery) at students school, and transportation support. Free surgery and complication check-ups are available for all study participants, but transportation support was randomly given. Selected students can choose either direct pick-up service or use a transportation voucher that is reimbursed after the circumcision surgery at the assigned hospital. The amount of a transportation voucher varies according to the distance between the hospital and a student school.[11] Those aged below 15 required parental consent to take the male circumcision

[10] Our two-stage randomization design is similar to the design used in Duflo and Saez (2003).

[11] Although we set the transportation voucher amounts to reflect the minimum public transportation fees, many rural areas do not have access to public transportation and students who live in rural areas often walked to the hospital when they chose the voucher option.

surgery. Study participants were also assigned to one of four research groups: 100% Treatment (C1), Treated in 50% Treatment (C2), Untreated in 50% Treatment (C3), and No treatment group (C4). Transportation support was given to group C1 and C2 during the study period, and the remaining temporarily untreated group (group C3 and C4) received the same treatment one year later.[12]

Girls' education support program provides one-year school tuition and monthly cash stipends to female students in randomly selected classrooms (S1). School tuition and fees per semester (on average $21.2 (3,500 MK) were directly deposited to each schools account and monthly cash stipends of $1.8 (300 MK) were distributed to treated students directly. Total amount of scholarship is approximately $70 per student during the study period.[13]

It is worth emphasizing that these three interventions (HIV/AIDs education, circumcision for young males, and girls' education support) were randomly allocated independently. The eight possible combinations of interventions are shown in Appendix Table 1.

4 Data

A baseline survey of 7,971 students was conducted in January and April of 2012. The baseline survey was performed to measure information on demographic characteristics, HIV knowledge, sexual behaviors, attitude to and demand for condoms, and friendship network. Table 2 describes baseline characteristics of the sample. Students are on average 16.2 years old. 17.7% of students belong to a circumcising ethnicity.[14] Overall, our sample exhibits higher socioeconomic characteristics than the average population of Malawi. 19.8% and 8.2% of the sample reported that their father and mother received tertiary education, respectively.[15] 79.8% of the students have received HIV/AIDS

[12] In the end, 518 student in group C1 and C2 and 123 students from group C3 and C4 circumcised, respectively. The period that voucher is eligible for group C3 and C4 shorter than that for group C1 and C2.

[13] We started the girls education support program in the third semester of academic year 2011-2012 (April, 2012) and continued the intervention in the first and second semesters of academic year 2012-2013. We increased the amount of monthly stipend from 300 MK to 500 MK in the second semester of academic year 2012-2013 due to the huge depreciation of Malawi Kwacha. Early in 2012, the exchange rate between US Dollar and Malawi Kwacha was 165$. However, the value of Kwacha kept being depreciated after more than 50% currency devaluation on May 7^{th}, 2012 and the exchange rate in early 2013 were 350$. In total, a treated student in the scholarship program received 13,900 MK (3,500 MK * 3 semesters + 300 MK * 6 times + 500 MK * 3 times), which is equivalent to around US $70 per year.

[14] Circumcising ethnicity is defined as a tribe with over 20% of male population circumcised in 2010 Malawi DHS.

[15] In addition, 42.6% of the sample reported that his/her house has electricity while only 9.1% of the population in Malawi has electricity at home (Malawi National Statistical Office and ICF Macro (2011)). This is because our sample represents family who send their children to a secondary school, and our catchment area is located in Lilongwe, the

education at their schools before our HIV/AIDS education program started. These characteristics may explain the high level HIV/AIDS knowledge level, given that 86.6% of the HIV/AIDS knowledge questions were answered correctly.[16]

Appendix Table 2 presents the balance of our randomization. In Columns (1), (2), and (3) we test whether HIV/AIDS education, male circumcision, and the education support for girls vary by the baseline characteristics. The differences between the intervention groups and the control groups are small and statistically insignificant along most baseline characteristics. In terms of HIV/AIDS education, seven of the 55 (12.7%) probability value from t-tests are statistically significant at the 10% significance level.

Appendix Table 3 illustrates that there is no differential sample attrition by treatment status. Among the total 7,971 baseline students, we successfully re-interviewed 5,431 students (68.1%) in the follow-up survey at school.[17] In addition, we implemented an intensive home survey among 15% randomly selected students (N=381) who did not participate in the follow-up survey at school (intensive home survey). We were able to successfully locate and interview 271 (71.1%) students. As a result, 5,702 students completed either the regular school follow-up or home surveys, yielding an effective survey rate of 90.8%.[18] In Appendix Table 4 to Table 6, we further explore the relationship between survey attrition and baseline characteristics by interacting an indicator variable for being surveyed in the school follow-up or home-visit surveys with a number of baseline characteristics. The results alleviate concerns of differential attrition.

Appendix Table 7 shows summary statistics of in-class friendship networks. We first asked students to list three best friends within their classrooms.[19] In the analysis, we reconstructed friendship data by reordering best male friends after excluding friends who are female or did not participate in the baseline survey. In Panel A, Column (1) includes the original friendship network data, and Column (2) presents reordered male friendship statistics. Around 80% of the sample

capital city of Malawi.

[16]In general, students showed high level of HIV/AIDS knowledge at baseline but they showed relatively low knowledge on the medical benefit of male circumcision (62.3%, not shown) and the relative risk of cross-generational sexual relationships (41.9%, not shown).

[17]Main reasons for attrition were due to transfer (44.8%), absence (29.9%), or dropout (14.3%).

[18]The effective survey rate (ESR) is a function of the regular follow-up rate (RFR) at school and intensive home survey. follow-up rate (HFR) as follows: ESR = RFR + (1 RFR) * HFR. Overall, ESR is 92.0% (68.1% + 31.9% * 74.9%). We run a weighted regression with a weight 6.67 for home-visit survey since we random selected 15% students from the attrition sample (Baird et al. 2012).

[19]When surveyed, we matched information with names from the roll call data to make sure the best three friends exist within school or classroom.

students have at least two male friends among their three best friends. Panel B presents the network treatment distribution among eligible male friends. It shows substantial variation in the fraction of best male friends who got treated and the fraction of treated friends is well balanced across the baseline characteristics (not shown).

The main outcome variables of interest in this paper are HIV/AIDS knowledge, male circumcision take-up, attitude to and demand for condoms, and sexual behaviors. The indicator of HIV/AIDS knowledge is constructed based on twenty questions about whether or not the individual is knowledgeable about the fact that abstinence, being faithful to one partner, and the use of condoms reduce the chance of HIV infection (ABC strategy in HIV prevention)[20]; HIV can be transmitted from a mother to her child during pregnancy, delivery, or breastfeeding; benefits of male circumcision; and a relative risk of cross generational sexual relationship. For ease of interpretation, HIV/AIDS knowledge scores are normalized with respect to the control group.

Male circumcision take-up is measured by hospital administrative data.[21] Demand for condom is also measured. At the end of the survey students were given 6 cents (10 MK), and had a chance to purchase condoms with subsidized price at 3 cent (5 MK) to measure a demand for safe sex. Other measure of sexual behaviors include age for first sex, sexual relationship status, multiple sexual partnership. Furthermore, we are currently collecting data on teen pregnancy as a more objective measure of unprotected sex as suggested by Dupas (2011).

5 Empirical Strategy

5.1 Main Impacts of HIV prevention programs

We first take advantage of the random assignment of the three HIV prevention programs to estimate their causal effects. In this regard, we consider the following basic regression equation:

[20] ABC policy stands for Abstinence until marriage, Being faithful to one partner, Condom use always. This ABC policy was adopted first by Uganda Government in 1990s and Malawi Government emphasizes ABC policy on its HIV/AIDS education programs.

[21] There are two source of information on male circumcision take-up: hospital administration data and self-reported survey data. We decide to use hospital data for two reasons. First, we are concerned on social desirability bias on self-reporting data. Second, access to male circumcision through other channel in the catchment area is limited. The only place that provide male circumcision is Banja La Mtsogolo (BLM) that charge around $10 for the surgery and complication check-ups. It is unlikely that secondary school students receive the surgery in BLM.

$$Y_{ij} = \alpha_0 + \alpha_1 C_{ij} + \alpha_2 E_{ij} + \alpha_3 S_{ij} + X_{ij} r' + \delta_j + \varepsilon_{ij} \quad (1)$$

where Y_{ij} is one of our outcomes measures (such as sexual behavior, knowledge about HIV/AIDS or circumcision status) for individual i in grade j; C_{ij}, E_{ij}, S_{ij} is equal to 1 if a student i is assigned to a treatment of male circumcision, HIV/AIDS education, and girls' education support, respectively. X_{ij} is a set of controls such as age, parental education, parents job, household asset ownership.[22] δ is a grade fixed effect and ε_{ij} is a random error.

5.2 Externalities of the Male Circumcision Intervention

Second, we explore main effects as well as externality on male circumcision. Our empirical strategy to measure externality on male circumcision estimates the following model:

$$MC_{ij} = \beta_0 + \beta_1 C1_{ij} + \beta_2 C2_{ij} + \beta_3 C3_{ij} + X_{ij} r' + \delta_j + \varepsilon_{ij} \quad (2)$$

where MC_{ij} denote male circumcision take-up for individual i in grade j. C1, C2, and C3 refer Group C1, Group C2, and Group C3, respectively. We also present heterogeneous treatment effects by three different priors such as knowledge on the medical benefit of male circumcision, fear of pain, and religious norms.

In these specifications, β_3 captures possible peer effects, given that it compares average take-up of circumcision for students who are not assigned to the intervention but who are in a classroom where 50% of their male peers received this offer (group C3) to the base group of students who did not receive the intervention and who are in a classroom where nobody received the intervention (group C4).

In some of our specifications, we also restrict ourselves only to the 50% Treatment classrooms. The cleanest way to estimate the main direct effect of the intervention is by comparing the difference in outcomes between students in group C2 who received the intervention and students in group C3 who did not receive the intervention. Both of these groups (C2 and C3) are within the same classrooms and contain students who are exposed to the same peer effects since 50% of their peers

[22] Since the randomization successfully produced treatment and control classrooms balanced along most baseline characteristics, the inclusion of these controls does not significantly change the treatment effect estimates but sometimes improve statistical precision.

are treated. Next, we extend the analysis of peer effects by using our experimental variation in treatment with the data from the friendship rosters. We try to measure these effects in the restricted sample of 50% Treatment classrooms. We restricted our sample since there is no within class variation in 100% Treatment and No Treatment classrooms. The following linear regression is estimated:

$$MC_{ij} = \beta_0 + \beta_1 Offer_{ij} + \beta_2 Peer_{ij} + X_{ij}r' + \delta_i + \varepsilon_{ij} \tag{3}$$

where $Peer_{ij}$ is a variable for male circumcision offer to friends defined as the proportion (rate) of friends who are offered male circumcision. Since receiving the offer within our 50% Treatment classrooms is randomly assigned, the proportion of ones male best friends in the classroom is also random and independent of ones own offer. Finally we extend equation (3) and interact own offer and the proportion of best friends who receive the offer:

$$MC_{ij} = \beta_0 + \beta_1 Offer_{ij} + \beta_2 Peer_{ij} + \beta_3 Offer_{ij} \cdot Peer_{ij} + X_{ij}r' + \delta_i + \varepsilon_{ij} \tag{4}$$

In this specification β_3 tries to capture potential complementarities between your offer and your friends offers. This type of peer effect could also be defined as a reinforcement effect, and is captured by the coefficient of the interaction term b_3. In our setting, it is certainly possible for such reinforcement effects to be present, if peers make a decision to get circumcised jointly.

5.3 Complementarities of HIV prevention programs

Third, we try to capture potential complementarities between the three HIV prevention interventions by estimating OLS regressions that use the randomized mix of treatments across classroom. Specifically we estimate the following individual level regressions:

$$Y_{ij} = \theta_0 + \theta_1 C_j + \theta_2 E_j + \theta_3 S_j + \theta_4 C_j \cdot E_j + \theta_5 C_j \cdot S_j + \theta_6 E_j \cdot S_j + \theta_7 C_j \cdot E_j \cdot S_j + X_{ij}r' + \delta_j + \varepsilon_{ij} \tag{5}$$

where Y_{ic} is one of our outcomes measures (such as sexual behavior, knowledge about HIV/AIDS or circumcision status); C_j is equal to 1 if a student i is assigned to a classroom where circumcision

services were offered, 0 otherwise; E_j is equal to 1 if a student i is assigned to a classroom where HIV/AIDS education was offered, 0 otherwise; and S_j is equal to 1 if a student i is assigned to a classroom where conditional cash transfers (scholarship) were offered, 0 otherwise. The main coefficients of interest are θ_4, θ_5 ,θ_6, and θ_7, which capture possible interaction effects of the three interventions. For example, θ_4 captures possible complementarities between the circumcision and HIV/AIDS education prevention intervention, in addition to the main effects of the two interventions which are captured in the equation above by θ_1 and θ_2. Note that θ_7 is the coefficient of the triple interaction of the three policies. Finally, X_{ij} is the same set of background controls, and δ_j are a set of grade dummies (corresponding to grade 9, 10 and 11 at the time of the baseline survey).

In some of the tables, we will restrict our analysis to only two of the three interventions, in which case the coefficient of interest will only be a single interaction term. Specifically we estimate the following two regressions for boys (equation (6)) and girls (equation (7)):

$$Y_{ij} = \theta_0 + \theta_1 C_j + \theta_2 E_j + \theta_3 C_j \cdot E_j + X_{ij} r' + \delta_j + \varepsilon_{ij} \tag{6}$$

$$Y_{ij} = \theta_0 + \theta_1 S_j + \theta_2 E_j + \theta_3 S_j \cdot E_j + X_{ij} r' + \delta_j + \varepsilon_{ij} \tag{7}$$

The main coefficients of interest are θ_3 which capture possible interaction effects of the interventions. For example, θ_3 in (5) captures possible complementarities between male circumcision and HIV/AIDS education prevention program for boys.

Our second empirical strategy will also use an additional source of variation in the data and is based on the fact that for the HIV/AIDS education and circumcision interventions we also randomized the fraction of students within classrooms who got offered these treatments (0%, 50% and 100%). Since both the HIV/AIDS education and circumcision intervention were implemented independently and randomly from each other, we can restrict our analysis to classrooms where at least one of the intervention was targeted to only 50% of the class and use the within class variation to estimate the following model:

$$Y_{icj} = \theta_0 + \theta_1 C_{icj} + \theta_2 E_{icj} + \theta_3 C_{icj} \cdot E_{icj} + X_{icj} r' + Class_c + \varepsilon_{icj} \tag{8}$$

where most of the variables are defined as above and $Class_c$ includes a series of classroom fixed effects. Note that in this estimating equation the variables C_{icj} is equal to 1 if a student i is assigned to receive circumcision services, 0 otherwise; E_{icj} is equal to 1 if a student i is assigned to receive HIV/AIDS education, 0 otherwise. The main coefficient of interest θ_3 aims to capture possible complementarities between the circumcision and education intervention.

6 Results

6.1 Impacts of HIV prevention programs

We first present the main impact of our HIV/AIDS prevention interventions on our variables of interest: measures of HIV/AIDS knowledge, male circumcision take-up, as well as a wide range of sexual behaviors. The estimates of equation (1) are reported in Table 3 and Table 4. Column 1 in Table 3 show the impact of the three interventions on overall HIV/AIDS knowledge and Columns 2-5 present impacts on different dimensions of HIV/AIDS knowledge. We find that the HIV/AIDS education, on average, increased knowledge for female students, but not in male students. However, we find that male students actually increase their knowledge about male circumcision (Column 4).

In general, we do not find clear impacts on sexual behaviors of the three interventions. While some coefficients of certain sexual behaviors are statistically significant, the usual concerns arising from multiple inference makes us hesitant to formulate definitive conclusions. The results of the education intervention are consistent with Baird, McIntosh, and Ozler (2011) who show that there was no significant impact of conditional cash transfers to in-school girls on sexual behaviors.

6.2 Externalities of the Male Circumcision Intervention

We now look at the impact on demand for male circumcision by estimating equation (2). Table 5 presents the OLS (Columns 1 to 2) and Probit regression (Columns 3 to 4). Dependent variables in Panels A and B are male circumcision take-up before the control group offer (first round) and overall study period (first and second round), respectively. Panels A1 and B1 present results of whole sample and Panels A2 and B2 show results of restricted sample of 50% Treatment classrooms. Our preferred estimation is Column 2, but the coefcients are similar across the specifications.

We find that students assigned to 100% Treatment and 50% Treatment classrooms were 14.2

(296%) and 18.9 (394%) percentage points more likely to get circumcised than students in control classrooms, respectively (Column 2 of Panel A1). In the restricted sample of 50% treatment classrooms, we also find that treated students were 15.4 percentage points (188%) more likely to take male circumcision compared to untreated peers in the classrooms (Column 2 of Panel A2). Moreover, this increase of male circumcision persists at the end of the study period (Panel B1 and B2).[23]

Appendix Table 8 presents heterogeneous treatment effects by prior beliefs. Column (1) shows that the male circumcision offer increases male circumcision take-up by on average 14.6 percentage points (244%). Columns (2) to (4) show heterogeneous treatment effects by prior knowledge on benefit of male circumcision, prior belief on pain of male circumcision, and religious norm. Our most interesting results are in column (3): while there are lower circumcision rates among those who perceive the procedure to be painful, we also find evidence consistent with smaller responses to the circumcision intervention among those who think that circumcision is painful. This finding is consistent with those found in Chinkhumba, Godlonton, and Thornton (2014).

Next, we explore peer effects in the demand for male circumcision. As shown in Panel A1 of Table 5, Group C3, untreated students in 50% Treatment classrooms, were 3.8 % points (79%) more likely to receive male circumcision than control classroom students. This result reflects the spillover effects within classroom from the other half of classmates who received the offer of male circumcision. We further evaluate a role of peer effect using a data of the friendship roster with restricted sample of 50% treatment classroom (Panel A2). We take advantage of the random assignments of the male circumcision offer to a student and his friends within a classroom to understand peer interactions for the decision of circumcision.

Table 6 presents the results of the equations (3) and (4) in Panel A and B, respectively. We present in Panel B, the peer effect of having a higher proportion of friends who are treated on your own decision to get circumcised. Our preferred estimates from Panel A that estimate equation (2) are also positive and quantitatively important, but they are not statistically significant at conventional levels.

[23]Male circumcision take-up may differ by prior knowledge or belief. Appendix Table 8 present heterogenous treatment effects by knowledge on benefit of male circumcision, prior belief on pain of male circumcision, and religious norm. We find a smaller circumcision take-up rate among those who think that circumcision is painful, which is consistent with Chinkhumba, Godlonton, and Thornton (2014).

The most striking results in Table 6 are those in Panel B, which estimate equation (4) and provide evidence of a complementarity between a students offer and his friends offer that increase the a students take-up of circumcision. The interaction between the offer and the rate of friends who received the offer is large (about 17%), statistically significant and robust across the four specifications and suggest the existence of important reinforcement effects among school peers in our Malawian setting.

6.3 Complementarities of HIV prevention programs

Finally, we describe results on complementarities among the three HIV/AIDS prevention interventions using the randomized mix of treatments across classrooms. In Table 7 and Table 8 we focus on the overall HIV/AIDS knowledge index as well as each dimension of the knowledge. Table 7 show the results based on equation (5), while Panel A, B, and C of Table 8 show the results from all male students, male students in 50% classroom, and all female students based on equation (6), equation (8), and equation (7), respectively.[24] Table 9 to Table 11 is similar in structures to the table discussed just previously; however, here the focus is on capturing the potential role of complementarities in sexual behaviors.

We now describe results on complementarities between the three HIV/AIDS prevention interventions based on equation (5), using the randomized mix of treatments across classrooms. In Table 7, we focus on the HIV/AIDS knowledge index as it represents the overall index of knowledge along all dimensions. Panel A, for male students, and panel B, for female students confirm that the interaction terms of the HIV prevention intervention which are meant to capture the existence of potential complementarities are generally small and statistically insignificant. These results are also confirmed in Table 8, where we present complementarity results based on only two of the three interventions at the time. In sum, our coefficients are generally imprecise and suggest that at least in this setting complementarities might not play an important role.

Table 9 to Table 11 are similar in structures to the table discussed just previously; however, here the focus is on capturing the potential role of complementarities in sexual behaviors. Our preliminary interpretations of these results are consistent with finding limited complementarities

[24]Remember that the 50% treatment within classroom was only implemented within the male circumcision and HIV/AIDS education interventions and as a result our analysis is limited only to potential complementarities between these two.

between our three HIV/AIDS prevention interventions.

7 Discussion and Conclusion

This paper addresses the role that externalities and complementarities play in the provision of HIV/AIDS prevention interventions. To do this, we implemented a randomized controlled trial that randomly administered three interventions (HIV/AIDS education, easy access to male circumcision, and education support for girls) to students across 33 public secondary schools in Malawi. Classrooms were are assigned into three groups: 100% Treatment, 50% Treatment, or No Treatment classrooms.

This paper first addresses two questions about the demand for male circumcision: 1) How to promote demand for male circumcision and 2) What is the role of peer effects in demand for male circumcision. We find that our school based intervention substantially increases the demand for male circumcision by on average of 15.4 percentage points (188%). Moreover, we find evidence consistent with important positive peer effects as well as reinforcement effects among school peers in our Malawian setting.

Our findings have a number of implications for public policies related to the scale-up of male circumcision. First, while a lack of accessibility to male circumcision is major barrier, our results suggest that free male circumcision with well-designed incentives such as transportation support can increase demand for male circumcision substantially. Second, this study sheds light on the important role that peer effects play in the decision to get circumcised.

Secondly, we provide new insights about the role that complementarities of three HIV/AIDS interventions have in the specific context of secondary schools in Malawi. Our evidence showed limited evidence for the existence of such complementarities. Below we briefly discuss possible explanations for these results. One reason may be the relatively short period between baseline and endline surveys. To the extent that changing behaviors related to HIV/AIDS takes time, our current follow-up may not be able to fully capture the full range of possible effects. Secondly, it is possible that many of the self-reported measures of sexual behavior suffer from well-known measurement error problems. Thirdly, given the relatively infrequent sexual relationships of students within classrooms reported in our surveys, it is also possible that the particular complementarity

between circumcision and conditional cash transfers may not play an important role for this specific population.

Finally, the results presented in this chapter are preliminary, and further analysis will be needed in order to substantiate some of the effects presented here. These results are based on the first short term follow-up; we expect to continue to measure the longer term effect of these interventions in the coming years. The continuation of this study will include improved tracking of the sample through: a) household surveys; b) school-based friends and peers questionnaires designed to collect information on marriages and births for the sample that attrited since baseline; and c) a wider range of outcome variables using medical, experimental, and self-reported measures.

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Tables and Figures

Table 1: Experimental Design

1) HIV/AIDS Education

	Group	Assignment	Classrooms	Students
100% Treatment	E1	Treatment	41	2,480
50% Treatment	E2	Treatment	41	1,303
	E3	No treatment		1,263
No Treatment	E4	No treatment (Control)	42	2,925
Total			124	7,971

2) Male Circumcision

	Group	Assignment	Classrooms	Students
100% Treatment	C1	Treatment	41	1,293
50% Treatment	C2	Treatment	41	679
	C3	No treatment		679
No Treatment	C4	No treatment (Control)	42	1,323
Total			124	3,974

3) Girls' Education Support

	Group	Assignment	Classrooms	Students
100% Treatment	S1	Treatment	62	2,102
No Treatment	S2	No treatment (Control)	62	1,895
Total			124	3,997

Notes: For HIV/AIDS education and Male circumcision interventions, the randomization was done in two stages. First, classrooms for each grade across 33 schools were randomly assigned to 100% treatment, 50% treatment and no treatment. Then, within 50% treatment, only half of the students were randomly assigned to treatment.

Table 2: Baseline statistics

Variable	Avg. (S.D.)		
	Whole sample	Boys	Girls
Age (year)	16.157	16.650	15.666
	(1.856)	(1.942)	(1.623)
Circumcision Ethnicity	0.177	0.170	0.184
	(0.382)	(0.375)	(0.387)
Muslim	0.061	0.060	0.061
	(0.239)	(0.238)	(0.239)
Orphan	0.054	0.057	0.052
	(0.227)	(0.231)	(0.221)
Father's Tertiary education	0.198	0.180	0.216
	(0.399)	(0.384)	(0.411)
Mother's Tertiary education	0.082	0.068	0.095
	(0.274)	(0.252)	(0.293)
Father's white-collar job	0.256	0.239	0.273
	(0.436)	(0.426)	(0.445)
Mother's white-collar job	0.106	0.096	0.115
	(0.307)	(0.295)	(0.318)
Household Assets (0-16)	7.585	7.375	7.794
	(3.455)	(3.460)	(3.437)
Received HIV/AIDS education	0.798	0.796	0.801
	(0.401)	(0.403)	(0.399)
HIV/AIDS Knowledge (0-20)	17.282	17.324	17.239
	(1.758)	(1.726)	(1.787)
Condom Attitude (0-18)	11.857	12.461	11.256
	(3.362)	(3.168)	(3.441)
Prob (Take-up Condom)	0.137	0.243	0.031
	(0.344)	(0.429)	(0.174)
No of Condoms purchased	0.481	0.866	0.098
	(1.275)	(1.620)	(0.582)
Sex experience	0.203	0.306	0.100
	(0.402)	(0.461)	(0.300)
Currently in sexual relation	0.072	0.092	0.052
	(0.258)	(0.288)	(0.222)
Multiple sex partners	0.079	0.143	0.016
	(0.270)	(0.350)	(0.123)
Already circumcised	-	0.105	-
		(0.307)	
MC is only for Muslim	-	0.389	-
		(0.487)	
MC is painful	-	0.153	-
		(0.359)	
Pregnancy experience	-	-	0.010
			(0.100)
Observations	7,971	3,974	3,997

Notes: Whole sample consists of 7,971 students who were interviewed at baseline survey. Circumcising ethnicity is defined as a tribe with over 20% of male population circumcised in 2010 Malawi DHS. Parent's tertiary education is 1 when they graduate from a 2-year college or a 4-year university. Parent's white-collar job is coded as 1 when they have a professional or government job. Household Assets are defined the total number of assets they have from 16 asset questions. Condom Attitude is constructed by counting the appropriate answers from 18 questions. HIV/AIDS knowledge is constructed by counting the correct answers from 20 HIV/AIDS knowledge questions.

Table 3: Impact on HIV/AIDS Knowledge

Dependent Variables:	HIV/AIDS knowledge	ABC policy	Benefit of male circumcision	Risk of infection by partner's age	HIV/AIDS general knowledge	Transmission Mechanism	Mother-To-Child Transmission	HIV prevention	HIV social stigma	HIV testing place	HIV treatment availability
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Panel A: whole sample											
HIV/AIDS Education	0.061	0.083**	0.117***	0.032	-0.069	-0.067	0.109***	-0.082**	-0.016	-0.082*	0.042
	(0.043)	(0.040)	(0.037)	(0.039)	(0.043)	(0.049)	(0.041)	(0.037)	(0.035)	(0.047)	(0.028)
Male Circumcision	0.068	0.004	0.094**	-0.094**	0.081*	0.062	0.062	0.068*	0.033	-0.003	0.006
	(0.047)	(0.044)	(0.038)	(0.040)	(0.046)	(0.049)	(0.049)	(0.037)	(0.036)	(0.047)	(0.029)
Girls' Education Support	-0.044	0.004	0.067*	-0.087**	0.014	-0.070	-0.088	0.077**	-0.049	-0.064	0.011
	(0.048)	(0.045)	(0.039)	(0.040)	(0.048)	(0.051)	(0.053)	(0.039)	(0.037)	(0.048)	(0.028)
Obs.	5,676	5,683	5,683	5,683	5,669	5,664	5,683	5,664	5,651	5,674	5,672
Panel B: male students											
HIV/AIDS Education	0.000	0.060	0.089**	-0.058	-0.108*	-0.008	0.029	-0.065	0.026	-0.077	0.051*
	(0.051)	(0.051)	(0.041)	(0.053)	(0.060)	(0.067)	(0.051)	(0.048)	(0.048)	(0.050)	(0.029)
Male Circumcision	0.028	-0.036	0.059	-0.093*	0.115**	0.022	0.035	0.002	0.028	-0.037	0.013
	(0.050)	(0.057)	(0.045)	(0.051)	(0.055)	(0.064)	(0.054)	(0.043)	(0.055)	(0.050)	(0.026)
Girls' Education Support	0.002	0.040	0.037	-0.058	0.065	-0.011	-0.108*	0.091*	-0.014	-0.028	0.006
	(0.059)	(0.055)	(0.049)	(0.056)	(0.060)	(0.070)	(0.059)	(0.053)	(0.055)	(0.051)	(0.028)
Obs.	2,823	2,827	2,827	2,827	2,820	2,818	2,827	2,819	2,814	2,822	2,823
Panel C: female students											
HIV/AIDS Education	0.126**	0.109**	0.150***	0.119**	-0.026	-0.128*	0.196***	-0.104*	-0.058	-0.078	0.030
	(0.063)	(0.054)	(0.057)	(0.057)	(0.060)	(0.070)	(0.059)	(0.055)	(0.059)	(0.073)	(0.050)
Male Circumcision	0.078	0.032	0.066	-0.025	0.016	0.102	0.071	0.117**	0.030	0.008	-0.019
	(0.071)	(0.060)	(0.057)	(0.065)	(0.070)	(0.069)	(0.073)	(0.056)	(0.059)	(0.079)	(0.054)
Girls' Education Support	-0.084	-0.027	0.099*	-0.122**	-0.041	-0.124*	-0.062	0.076	-0.087	-0.086	0.022
	(0.070)	(0.057)	(0.058)	(0.059)	(0.069)	(0.070)	(0.074)	(0.061)	(0.060)	(0.074)	(0.050)
Obs.	2,853	2,856	2,856	2,856	2,849	2,846	2,856	2,845	2,837	2,852	2,849

Notes: Column (1) shows standardized HIV/AIDS knowledge score which is constructed from 20 HIV/AIDS questionnaire and the following columns (2)-(11) are based on subset of the full question set. All columns use grade fixed effects and robust standard errors clustered by classroom are reported in parentheses. Control variables include age, orphan status, father's tertiary education, mother's tertiary education, father's white-collar job, mother's white-collar job, and household assets. The weight of 6.67 is given to home-visit survey sample. *** p<0.01, ** p<0.05, * p<0.10

Table 4: Impacts on Sexual Behaviors

Dependent Variables:	Male circumcision take-up (1)	Attitude to condome (2)	Prob (Take-up Condom) (3)	No. of condoms purchased (4)	Currently in Sex relation (5)	Prob (Take-up Condom) *Current Sex (6)	No. of condoms purchased * Current Sex (7)	Age for first sex (8)	Multiple sex partners (9)	Sex with friend in school (10)	Sex with friend outside school (11)	Age of last sex partner (12)	Pregnancy (13)
Panel A: male students													
HIV/AIDS Education	0.006	-0.079	-0.009	-0.014	-0.008	0.001	0.017	-0.297	0.025	0.003	-0.016	0.021	
	(0.017)	(0.183)	(0.024)	(0.100)	(0.022)	(0.017)	(0.066)	(0.189)	(0.024)	(0.015)	(0.017)	(0.187)	
Male Circumcision	0.144***	-0.005	0.011	0.051	-0.003	0.013	0.039	-0.330*	0.002	0.016	-0.043**	-0.368*	
	(0.022)	(0.166)	(0.023)	(0.093)	(0.020)	(0.017)	(0.064)	(0.196)	(0.023)	(0.016)	(0.018)	(0.189)	
Girls' Education Support	0.018	0.184	-0.019	-0.077	-0.042**	0.002	0.009	-0.300	-0.013	-0.038**	-0.008	-0.079	
	(0.024)	(0.178)	(0.024)	(0.099)	(0.021)	(0.016)	(0.062)	(0.187)	(0.025)	(0.015)	(0.017)	(0.202)	
Obs.	3,952	2,826	2,816	2,810	2,827	2,816	2,810	904	2,827	2,827	2,827	471	
Mean of Dep. Var.	0.130	12.85	0.256	1.008	0.126	0.059	0.237	15.72	0.158	0.054	0.097	16.173	
Panel B: female students													
HIV/AIDS Education		-0.073	-0.005	0.031	0.011	0.005	0.056	-0.037	0.014	0.007	0.006	-0.188	-0.016
		(0.188)	(0.011)	(0.057)	(0.025)	(0.005)	(0.048)	(0.216)	(0.014)	(0.009)	(0.012)	(0.447)	(0.020)
Male Circumcision		-0.038	-0.006	-0.029	-0.024	0.006	-0.011	-0.125	-0.024*	-0.007	0.020	-0.179	-0.034**
		(0.211)	(0.010)	(0.039)	(0.025)	(0.006)	(0.029)	(0.268)	(0.013)	(0.011)	(0.014)	(0.641)	(0.016)
Girls' Education Support		0.102	0.003	-0.033	-0.034	-0.002	-0.047	0.026	-0.020	-0.003	0.001	0.467	-0.020
		(0.204)	(0.011)	(0.059)	(0.024)	(0.006)	(0.051)	(0.234)	(0.014)	(0.009)	(0.012)	(0.440)	(0.018)
Obs.		2,855	2,839	2,819	2,856	2,839	2,819	378	2,856	2,856	2,856	253	2,846
Mean of Dep. Var.		11.89	0.036	0.112	0.093	0.008	0.023	16.51	0.023	0.020	0.052	20.51	0.023

Notes: Condom attitude is constructed from 18 related questions. Column (4) shows the number of condoms actually purchased by students. Students received 10 kwacha during the survey and could buy condoms at 5 kwacha per two condoms if they wanted. All columns use grade fixed effects and robust standard errors clustered by classroom are reported in parenthesis. Control variables include age, orphan status, father's tertiary education, mother's tertiary education, father's white-collar job, mother's white-collar job, and household assets. The weight of 6.67 is given to home-visit survey sample.*** p<0.01, ** p<0.05, * p<0.10

Table 5: Impact on Male Circumcision Take-up

Dependent variable:	Circumcision take-up			
	OSL		Probit	
	(1)	(2)	(3)	(4)
Panel A1. Round 1, whole Sample				
100% Treatment (C1)	0.138***	0.142***	0.174***	0.179***
	(0.027)	(0.027)	(0.035)	(0.036)
50% Treatment (C2)	0.193***	0.189***	0.264***	0.261***
	(0.030)	(0.031)	(0.045)	(0.046)
50% No Treatment (C3)	0.041**	0.038*	0.070*	0.068*
	(0.020)	(0.021)	(0.036)	(0.036)
p-value of F-test: (100% treatment = 50% treatment)	0.1452	0.2181	0.0942	0.1822
Mean of Dep. Var. in Control		0.048		
Controls	No	Yes	No	Yes
Observations	3,974	3,952	3,974	3,952
Panel A2. Round 1, 50% Treatment classroom only				
Treatment	0.151***	0.154***	0.149***	0.146***
	(0.032)	(0.033)	(0.029)	(0.028)
Mean of Dep. Var. in Control		0.082		
Controls	No	Yes	No	Yes
Observations	1,358	1,350	1,358	1,350
Panel B1. Round 1 & 2, whole sample				
100% Treatment (C1)	0.095***	0.099***	0.114***	0.118***
	(0.029)	(0.029)	(0.034)	(0.035)
50% Treatment (C2)	0.162***	0.155***	0.199***	0.189***
	(0.030)	(0.031)	(0.039)	(0.040)
50% No Treatment (C3)	0.074***	0.066**	0.098***	0.089**
	(0.028)	(0.027)	(0.038)	(0.036)
p-value of F-test: (100% treatment = 50% treatment)	0.0738	0.1495	0.0502	0.1349
Mean of Dep. Var. in Control		0.094		
Controls	No	Yes	No	Yes
Observations	3,974	3,952	3,974	3,952
Panel B2. Round 1 & 2, 50% Treatment classroom only				
Treatment	0.088***	0.092***	0.089***	0.091***
	(0.025)	(0.026)	(0.025)	(0.025)
Mean of Dep. Var. in Control		0.158		
Controls	No	Yes	No	Yes
Observations	1,358	1,350	1,358	1,350

Notes: First two columns use OLS models and the third and fourth columns report marginal effects from Probit models. After the follow-up survey, students who didn't get MC offer in the first round (50% No Treatment and Control Groups) received the same intervention in the second round of male circumcision intervention. All columns use grade fixed effects and robust standard errors clustered by classroom are in parentheses. Control variables include age, circumcising ethnicity, circumcising religion (Muslim), orphan status, father's tertiary education, mother's tertiary education, father's white-collar job, mother's white-collar job, household assets and school type. *** p<0.01, ** p<0.05, * p<0.10

Table 6: Externalities on Male Circumcision Take-up

Dependent Variable:		
	(1)	(2)
Panel A		
MC offer	0.151***	0.154***
	(0.033)	(0.019)
Rate of friends who got MC offer	0.047	0.043
	(0.039)	(0.035)
Panel B		
MC offer	0.083**	0.092***
	(0.038)	(0.030)
Rate of friends who got MC offer	-0.047	-0.042
	(0.040)	(0.040)
MC offer x Rate of friends who got MC offer	0.186**	0.169***
	(0.072)	(0.064)
Mean of Dep. Var.	0.158	
classroom fixed effects	x	x
Controls	No	Yes
Observations	1,358	1,350

Notes: This analysis includes only 50% Treatment classroom sample. Robust standard errors are parentheses. Control variables include age, circumcising ethnicity, circumcising religion (Muslim), orphan status, father's tertiary education, mother's tertiary education, father's white-collar job, mother's white-collar job, household asset ownership and school type with classroom fixed effects. *** p<0.01, ** p<0.05, * p<0.10

Table 7: Complementarities between HIV/AIDS Education, MC, Girls' Education Support

Dependent Variables:	HIV/AIDS knowledge (1)	Mother-To-Child Transmission (2)	ABC policy (3)	Benefit of male circumcision (4)	Risk of sugar daddy (5)
Panel A: Male students					
HIV/AIDS Education	-0.078	-0.233**	0.060	0.093	-0.044
	(0.117)	(0.094)	(0.091)	(0.077)	(0.113)
Male Circumcision (MC)	-0.014	-0.047	-0.139	0.005	-0.032
	(0.101)	(0.067)	(0.122)	(0.098)	(0.113)
Girls' Education Support (ES)	0.013	-0.185**	0.037	0.043	0.013
	(0.082)	(0.084)	(0.114)	(0.102)	(0.108)
MC x HIV/AIDS Education	0.115	0.313***	0.087	0.054	-0.031
	(0.176)	(0.119)	(0.146)	(0.112)	(0.150)
MC x ES	-0.100	-0.069	0.080	0.047	-0.173
	(0.123)	(0.138)	(0.166)	(0.136)	(0.145)
HIV/AIDS Education x ES	-0.040	0.294**	-0.155	-0.081	-0.104
	(0.144)	(0.128)	(0.147)	(0.122)	(0.149)
MC x HIV/AIDS Education x ES	0.178	-0.146	0.138	0.048	0.170
	(0.209)	(0.186)	(0.217)	(0.153)	(0.193)
Obs.			2,827		
Panel B: Female students					
HIV/AIDS Education	0.041	0.232**	0.078	0.103	-0.014
	(0.118)	(0.101)	(0.105)	(0.124)	(0.103)
Male Circumcision (MC)	-0.045	0.112	-0.047	-0.001	-0.236*
	(0.119)	(0.129)	(0.123)	(0.123)	(0.120)
Girls' Education Support (ES)	-0.046	0.068	0.015	0.042	-0.244**
	(0.125)	(0.131)	(0.100)	(0.128)	(0.105)
MC x HIV/AIDS Education	0.311*	0.018	0.223	0.086	0.305*
	(0.176)	(0.146)	(0.182)	(0.176)	(0.173)
MC x ES	-0.071	-0.173	-0.083	0.149	0.291
	(0.221)	(0.244)	(0.206)	(0.172)	(0.187)
HIV/AIDS Education x ES	-0.057	-0.187	-0.073	0.073	0.141
	(0.155)	(0.140)	(0.131)	(0.154)	(0.132)
MC x HIV/AIDS Education x ES	0.022	0.140	0.079	-0.194	-0.346
	(0.281)	(0.263)	(0.258)	(0.236)	(0.245)
Obs.			2,856		

Notes: Column (1) shows standardized HIV/AIDS knowledge score which is constructed from 20 HIV/AIDS questionnaire and the following columns (2)-(5) are based on subset of the full question set. All columns use grade fixed effects and robust standard errors clustered by classroom are reported in parenthesis. Control variables include age, orphan status, father's tertiary education, mother's tertiary education, father's white-collar job, mother's white-collar job, and household assets. The weight of 6.67 is given to home-visit survey sample.*** p<0.01, ** p<0.05, * p<0.10

Table 8: Complementarities of HIV prevention programs on HIV/AIDS knowledge

Dependent Variables:	HIV/AIDS knowledge	ABC policy	Benefit of male circumcision	Risk of infection by partner's age	HIV/AIDS general knowledge	Transmission Mechanism	Mother-To-Child Transmission	HIV prevention	HIV social stigma	HIV testing place	HIV treatment availability
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Panel A: male students											
HIV/AIDS Education (EDU)	-0.094	-0.015	0.048	-0.075	-0.141	0.070	-0.082	-0.023	-0.059	-0.047	0.018
	(0.076)	(0.075)	(0.061)	(0.079)	(0.089)	(0.104)	(0.071)	(0.062)	(0.073)	(0.055)	(0.040)
Male Circumcision (MC)	-0.061	-0.109	0.019	-0.106	0.081	0.096	-0.065	0.036	-0.051	-0.007	-0.018
	(0.068)	(0.086)	(0.068)	(0.073)	(0.061)	(0.091)	(0.071)	(0.058)	(0.074)	(0.040)	(0.035)
EDU x MC	0.198*	0.160	0.087	0.032	0.072	-0.164	0.228**	-0.082	0.176*	-0.064	0.068
	(0.104)	(0.103)	(0.080)	(0.100)	(0.132)	(0.135)	(0.094)	(0.110)	(0.100)	(0.109)	(0.051)
Obs.	2,823	2,827	2,827	2,827	2,820	2,818	2,827	2,819	2,814	2,822	2,823
Panel B: male students in 50% Treatment Classrooms											
HIV/AIDS Education (EDU)	-0.004	-0.254	-0.126	-0.068	0.315**	0.013	-0.115	0.075	0.205	-0.037	-0.130
	(0.147)	(0.180)	(0.124)	(0.166)	(0.159)	(0.237)	(0.183)	(0.191)	(0.155)	(0.155)	(0.129)
Male Circumcision (MC)	0.126	0.230	-0.094	-0.038	0.307	0.244	-0.278	0.068	0.177	0.066	-0.003
	(0.162)	(0.187)	(0.121)	(0.178)	(0.194)	(0.261)	(0.240)	(0.181)	(0.169)	(0.164)	(0.112)
EDU x MC	-0.079	0.164	0.184	0.050	-0.728*	-0.056	0.549*	-0.434	-0.177	-0.360	-0.000
	(0.233)	(0.236)	(0.169)	(0.242)	(0.373)	(0.387)	(0.297)	(0.349)	(0.221)	(0.334)	(0.166)
Obs.	429	431	431	431	429	428	431	428	426	428	429
Panel C: female students											
HIV/AIDS Education (EDU)	0.147	0.139*	0.127	0.111	0.084	-0.219***	0.255***	-0.232**	-0.101	-0.147	0.056
	(0.089)	(0.084)	(0.088)	(0.085)	(0.077)	(0.081)	(0.083)	(0.093)	(0.088)	(0.097)	(0.071)
Girls' Education Support (ES)	-0.067	0.000	0.074	-0.129	0.063	-0.213***	-0.008	-0.050	-0.129*	-0.151*	0.048
	(0.101)	(0.088)	(0.086)	(0.091)	(0.089)	(0.079)	(0.117)	(0.062)	(0.072)	(0.089)	(0.076)
EDU x ES	-0.050	-0.063	0.037	0.020	-0.213*	0.161	-0.123	0.231**	0.079	0.130	-0.049
	(0.130)	(0.113)	(0.111)	(0.113)	(0.119)	(0.131)	(0.124)	(0.107)	(0.113)	(0.142)	(0.106)
Obs.	2,853	2,856	2,856	2,856	2,849	2,846	2,856	2,845	2,837	2,852	2,849

Notes: Column (1) shows standardized HIV/AIDS knowledge score which is constructed from 20 HIV/AIDS questionnaire and the following columns (2)-(11) are based on subset of the full question set. All columns use grade fixed effects and robust standard errors clustered by classroom are reported in parenthesis. Control variables include age, orphan status, father's tertiary education, mother's tertiary education, father's white-collar job, mother's white-collar job, and household assets. The weight of 6.67 is given to home-visit survey sample.*** p<0.01, ** p<0.05, * p<0.10

Table 9: Complementarities on Sexual Behaviors

Dependent Variables:	Male circumcision uptake	Condom attitude (0-18)	Willingness to buy condoms	No. of condoms purchased	Sex experience	Age for first sex	Currently in Sex relation	Multiple sex partners	Sex with friend in school	Sex with friend outisde school	Age for last sex partner	STI experience	Pregnancy
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
Panel A: Male students													
HIV/AIDS Education	-0.021	-0.002	-0.043	-0.113	0.014	-0.786**	-0.035	0.053	0.071**	-0.023	-0.165	-0.014	
	(0.018)	(0.360)	(0.047)	(0.167)	(0.056)	(0.356)	(0.046)	(0.051)	(0.031)	(0.031)	(0.287)	(0.018)	
Male Circumcision	0.133***	0.103	0.015	0.063	0.041	-0.775**	-0.002	0.070	0.071**	-0.011	-0.748***	-0.020	
	(0.034)	(0.286)	(0.045)	(0.174)	(0.046)	(0.307)	(0.032)	(0.046)	(0.031)	(0.034)	(0.285)	(0.023)	
Girls' Education Support (ES)	0.019	0.593*	-0.039	-0.130	-0.020	-0.809**	-0.054*	0.015	-0.014	0.012	-0.428	-0.014	
	(0.026)	(0.327)	(0.040)	(0.153)	(0.046)	(0.324)	(0.032)	(0.045)	(0.020)	(0.033)	(0.324)	(0.018)	
Male Circumcision x HIV/AIDS Education	0.073	0.301	0.050	0.213	-0.054	0.673	0.025	-0.082	-0.119**	-0.013	0.545	0.303	
	(0.050)	(0.485)	(0.068)	(0.246)	(0.065)	(0.491)	(0.068)	(0.068)	(0.047)	(0.057)	(0.579)	(0.299)	
Male Circumcision x ES	-0.006	-0.499	-0.008	-0.027	-0.066	0.510	-0.015	-0.109**	-0.040	-0.071*	0.944	0.005	
	(0.053)	(0.432)	(0.066)	(0.258)	(0.059)	(0.479)	(0.046)	(0.054)	(0.036)	(0.042)	(0.597)	(0.024)	
HIV/AIDS Education x ES	0.031	-0.393	0.083	0.251	-0.000	0.550	0.053	-0.016	-0.041	0.010	0.280	-0.009	
	(0.031)	(0.553)	(0.064)	(0.243)	(0.073)	(0.588)	(0.060)	(0.066)	(0.037)	(0.048)	(0.485)	(0.025)	
HIV/AIDS Education x MC x ES	-0.086	0.103	-0.090	-0.375	0.055	-0.416	-0.018	0.121	0.078	0.044	-1.143	-0.270	
	(0.069)	(0.714)	(0.099)	(0.374)	(0.090)	(0.698)	(0.088)	(0.086)	(0.057)	(0.073)	(0.898)	(0.270)	
Obs.	3,952	2,826	2,816	2,810	2,827	904	2,827	2,827	2,827	2,827	471	2,749	

Notes: All columns use grade fixed effects and robust standard errors clustered by classroom are reported in parentheses. Control variables include age, orphan status, father's tertiary education, mother's tertiary education, father's white-collar job, mother's white-collar job, and household assets. The weight of 6.67 is given to home-visit survey sample. *** p<0.01, ** p<0.05, * p<0.10

Table 10: Complementarities on Sexual Behaviors (continued)

Dependent Variables:	Male circumcision uptake (1)	Condom attitude (0-18) (2)	Willingness to buy condoms (3)	No. of condoms purchased (4)	Sex experience (5)	Age for first sex (6)	Currently in Sex relation (7)	Multiple sex partners (8)	Sex with friend in school (9)	Sex with friend outisde school (10)	Age for last sex partner (11)	STI experience (12)	Pregnancy (13)
Panel B: Female students													
HIV/AIDS Education		0.202	0.018	0.153	-0.043	-0.214	0.012	-0.023	0.009	0.017	-1.001	0.141	-0.054
		(0.369)	(0.020)	(0.123)	(0.051)	(0.378)	(0.053)	(0.035)	(0.019)	(0.022)	(0.877)	(0.181)	(0.053)
Male Circumcision		0.227	0.018	0.066	-0.018	-0.015	-0.001	-0.047	-0.003	0.064**	-0.309	0.005	-0.071*
		(0.378)	(0.024)	(0.060)	(0.048)	(0.459)	(0.055)	(0.032)	(0.018)	(0.028)	(1.215)	(0.034)	(0.041)
Girls' Education Support (ES)		0.661**	0.023	0.073	-0.073	-0.203	-0.058	-0.056**	0.001	0.016	-0.589	0.152	-0.063
		(0.310)	(0.018)	(0.047)	(0.047)	(0.408)	(0.041)	(0.027)	(0.016)	(0.015)	(0.795)	(0.154)	(0.044)
Male Circumcision x HIV/AIDS Education		0.301	-0.042	-0.217	-0.037	0.187	-0.077	0.006	-0.012	-0.057	0.678	-0.170	0.045
		(0.528)	(0.031)	(0.155)	(0.064)	(0.562)	(0.068)	(0.040)	(0.024)	(0.040)	(1.313)	(0.150)	(0.054)
Male Circumcision x ES		-0.851*	-0.052	-0.175*	0.035	0.023	0.048	0.032	-0.024	-0.065*	2.050	-0.197	0.078
		(0.459)	(0.032)	(0.091)	(0.058)	(0.676)	(0.075)	(0.033)	(0.023)	(0.035)	(1.386)	(0.183)	(0.052)
HIV/AIDS Education x ES		-0.578	-0.042	-0.228	0.085	0.579	0.053	0.061	-0.011	0.003	2.374**	-0.037	0.073
		(0.461)	(0.026)	(0.139)	(0.063)	(0.483)	(0.061)	(0.039)	(0.023)	(0.028)	(0.977)	(0.412)	(0.059)
HIV/AIDS Education x MC x ES		0.290	0.087**	0.350*	-0.010	-0.763	-0.050	-0.001	0.045	0.049	-4.338***	0.090	-0.093
		(0.717)	(0.042)	(0.181)	(0.091)	(0.963)	(0.094)	(0.055)	(0.040)	(0.049)	(1.623)	(0.408)	(0.067)
Obs.		2,855	2,839	2,819	2,856	378	2,856	2,856	2,856	2,856	253	2,793	2,846

Notes: All columns use grade fixed effects and robust standard errors clustered by classroom are reported in parentheses. Control variables include age, orphan status, father's tertiary education, mother's tertiary education, father's white-collar job, mother's white-collar job, and household assets. The weight of 6.67 is given to home-visit survey sample. *** p<0.01, ** p<0.05, * p<0.10

Table 11: Complementarities of HIV prevention programs on Sexual Behaviors

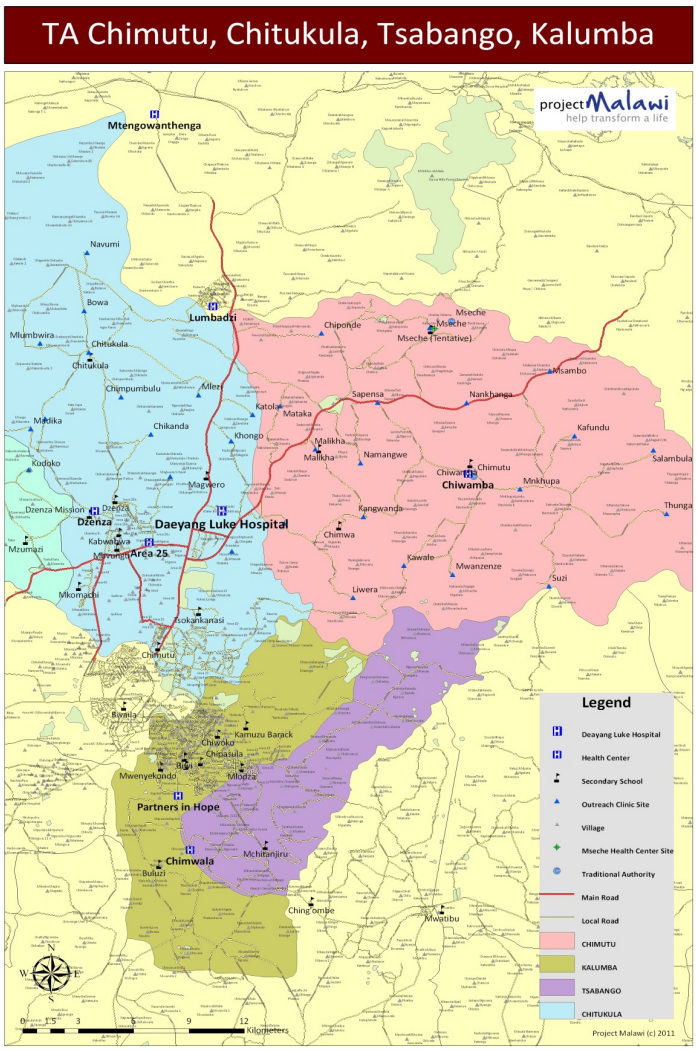
Dependent Variables:	Male circumcision take-up (1)	Attitude to condome (2)	Prob (Take-up Condom) (3)	No. of condoms purchased (4)	Currently in Sex relation (5)	Prob (Take-up Condom) *Current Sex (6)	No. of condoms purchased * Current Sex (7)	Age for first sex (8)	Multiple sex partners (9)	Sex with friend in school (10)	Sex with friend outside school (11)	Age of last sex partner (12)	Pregnancy (13)
Panel A: male students													
HIV/AIDS Education (EDU)	-0.005	-0.247	-0.003	0.012	-0.012	-0.001	-0.020	-0.469	0.043	0.045**	-0.020	-0.012	
	(0.017)	(0.286)	(0.034)	(0.128)	(0.031)	(0.020)	(0.079)	(0.284)	(0.032)	(0.020)	(0.024)	(0.240)	
Male Circumcision (MC)	0.133***	-0.174	0.018	0.080	-0.005	0.011	0.004	-0.474**	0.019	0.058***	-0.046**	-0.392	
	(0.028)	(0.214)	(0.034)	(0.130)	(0.025)	(0.025)	(0.089)	(0.225)	(0.028)	(0.021)	(0.023)	(0.253)	
EDU x MC	0.024	0.365	-0.013	-0.058	0.007	0.005	0.077	0.333	-0.038	-0.091***	0.007	0.063	
	(0.034)	(0.360)	(0.050)	(0.188)	(0.045)	(0.037)	(0.139)	(0.343)	(0.044)	(0.030)	(0.035)	(0.415)	
Obs.	3,952	2,826	2,816	2,810	2,827	2,816	2,810	904	2,827	2,827	2,827	471	
Panel B: male students in 50% Treatment classrooms													
HIV/AIDS Education (EDU)	0.167***	-0.791*	0.054	0.290	-0.084	-0.064**	-0.234**	-1.830***	-0.110*	0.066	-0.068	-0.413	
	(0.048)	(0.477)	(0.084)	(0.333)	(0.062)	(0.026)	(0.102)	(0.558)	(0.063)	(0.076)	(0.051)	(0.488)	
Male Circumcision (MC)	-0.074*	-0.581	0.016	0.135	-0.100	-0.050	-0.168	-1.934**	-0.047	0.024	-0.054	-0.871*	
	(0.039)	(0.538)	(0.076)	(0.305)	(0.070)	(0.038)	(0.144)	(0.747)	(0.073)	(0.053)	(0.058)	(0.469)	
EDU x MC	0.089	1.082	0.094	0.311	0.185**	0.187***	0.716**	2.900***	0.214**	-0.086	0.193**	0.725	
	(0.067)	(0.728)	(0.120)	(0.481)	(0.093)	(0.071)	(0.282)	(0.833)	(0.100)	(0.102)	(0.088)	(0.618)	
Obs.	617	431	428	427	431	428	427	130	431	431	431	79	
Panel C: female students													
HIV/AIDS Education (EDU)		0.219	0.002	0.090	-0.006	0.003	0.090	-0.163	-0.011	0.007	-0.009	-0.529	-0.030
		(0.275)	(0.016)	(0.099)	(0.040)	(0.010)	(0.091)	(0.344)	(0.023)	(0.014)	(0.021)	(0.766)	(0.034)
Girls' Education Support (ES)		0.381	0.010	0.024	-0.050	-0.004	-0.014	-0.109	-0.043**	-0.003	-0.014	0.090	-0.032
		(0.259)	(0.015)	(0.044)	(0.034)	(0.008)	(0.021)	(0.320)	(0.019)	(0.012)	(0.017)	(0.759)	(0.030)
EDU x ES		-0.557	-0.014	-0.109	0.036	0.002	-0.065	0.295	0.050*	0.001	0.025	0.770	0.031
		(0.370)	(0.021)	(0.098)	(0.052)	(0.010)	(0.081)	(0.444)	(0.028)	(0.019)	(0.025)	(0.901)	(0.042)
Obs.		2,855	2,839	2,819	2,856	2,839	2,819	378	2,856	2,856	2,856	253	2,846

Notes: All columns use grade fixed effects and robust standard errors clustered by classroom are reported in parentheses. Control variables include age, orphan status, father's tertiary education, mother's tertiary education, father's white-collar job, mother's white-collar job, and household assets. The weight of 6.67 is given to home-visit survey sample. *** p<0.01, ** p<0.05, * p<0.10

Appendix

Appendix Figure 1: Map of Project Areas

Figure 1: Map of Project Areas



Appendix Table

Table 1: Random Allocation of Research Groups

Group	HIV/AIDS education	Male Circumcision	Girls' Education Support
G1	x	x	x
G2	o	x	x
G3	x	o	x
G4	x	x	o
G5	o	o	x
G6	o	x	o
G7	x	o	o
G8	o	o	o

Notes: Three HIV/AIDS prevention interventions were independently allocated to each other and as a result, students in different classrooms could have been allocated to an eight different mix of interventions. Since male circumcision was provided to only boys while education support (scholarship) to only girls, Intent-to-treat analysis for ineligible genders (e.g. boys for girls' education support and girls for male circumcision assignments) was applied.

Table 2: Balance of Randomization

Dependent Variable:	HIV/AIDS Education Whole sample (1)	Male Circumcision Boys (2)	Girls' Education Support Girls (3)
Age (year)	-0.012*	-0.008	0.011
	(0.007)	(0.008)	(0.011)
Circumcision Ethnicity	0.016	0.029	0.036
	(0.020)	(0.022)	(0.028)
Muslim	0.031	0.066	-0.017
	(0.028)	(0.042)	(0.040)
Orphan	0.009	-0.033	-0.029
	(0.026)	(0.036)	(0.034)
Father's Tertiary education	0.021	-0.014	0.061**
	(0.020)	(0.028)	(0.024)
Mother's Tertiary education	-0.021	-0.009	-0.030
	(0.027)	(0.037)	(0.032)
Father's white-collar job	0.000	0.028	-0.035
	(0.017)	(0.022)	(0.024)
Mother's white-collar job	0.040	-0.030	-0.006
	(0.025)	(0.034)	(0.032)
Household Assets (0-16)	0.010*	0.003	0.001
	(0.006)	(0.006)	(0.008)
Received HIV/AIDS education	0.026	0.031	-0.007
	(0.029)	(0.030)	(0.041)
HIV/AIDS Knowledge (0-20)	-0.003	-0.006	-0.005
	(0.005)	(0.007)	(0.007)
Condom Attitude (0-18)	0.001	0.001	-0.002
	(0.003)	(0.003)	(0.004)
Prob. (Take-up Condom)	-0.075	0.007	0.265**
	(0.048)	(0.054)	(0.126)
No of Condoms purchased	0.016	-0.014	-0.080**
	(0.012)	(0.014)	(0.038)
Sex experience	-0.029	0.037	-0.036
	(0.019)	(0.026)	(0.039)
Currently in sexual relation	0.045	-0.033	0.093**
	(0.027)	(0.036)	(0.047)
Multiple sex partners	-0.004	-0.015	-0.096
	(0.027)	(0.033)	(0.064)
Already circumcised	-	0.013	-
		(0.029)	
MC is only for Muslim	-	0.037**	-
		(0.019)	
MC is painful	-	-0.003	-
		(0.029)	
Pregnancy experience	-	-	-0.127
			(0.097)
Observations	7,906	3,923	3,972
R-squared	0.016	0.010	0.018

Notes: Whole sample consists of 7,971 students who were interviewed at baseline survey. Circumcising ethnicity is defined as a tribe with over 20% of male population circumcised in 2010 Malawi DHS. Parent's tertiary education is 1 when they graduate from a 2-year college or a 4-year university. Parent's white-collar job is coded as 1 when they have a professional or government job. Household Assets are defined the total number of assets they have from 16 asset questions. Condom Attitude is constructed by counting the appropriate answers from 18 questions. HIV/AIDS knowledge is constructed by counting the correct answers from 20 HIV/AIDS knowledge questions. Columns (1) - (2) show randomization balance for three different interventions. Robust standard errors clustered by classroom are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Appendix Table

Table 3: Attrition/Retention Bias Test

Dependent Variable:	Staying in follow-up or home surveys (1)
MC	-0.019
	(0.016)
HIV/AIDS education	0.008
	(0.020)
Girls' Education Support	0.017
	(0.021)
p-value of joint F-test	0.358
Observations	7,971
R-squared	0.001

Notes: Out of 7,971 baseline students, 5,431 students (68.1%) stayed in endline survey and 2,540 students were lost. 15% of 2,540 lost students, or 381 students were randomly selected for home survey candidates. Out of 381 students, we found out 271 students (71.1%) and conducted home survey. Thus, 5,702 students completed endline or home surveys and its effective survey rate is 90.8% (68.1% + 31.9% x 71.1%). Weight for home survey is 6.67 since we did 15% random sampling from the attrition. Robust standard errors clustered by classroom are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Appendix Table

Table 4: Relationship between survey attrition and baseline characteristics

Dependent variable	= 1 if surveyed in follow-up or home-visit surveys			
	Treatment	Adjusted	Main effect	Interaction
	(1)	(2)	(3)	(4)
HIV/AIDS Education	0.001	-0.001		0.254
	(0.014)	(0.014)		(0.162)
Age		-0.007*	-0.002	-0.013
		(0.004)	(0.005)	(0.008)
Orphan		-0.043**	-0.038	-0.008
		(0.022)	(0.030)	(0.044)
Father's tertiary education		-0.007	-0.004	-0.005
		(0.017)	(0.022)	(0.031)
Mother's tertiary education		-0.050*	-0.031	-0.037
		(0.026)	(0.034)	(0.052)
Father's white-collar job		-0.016	-0.027	0.020
		(0.012)	(0.017)	(0.023)
Mother's white-collar job		-0.012	-0.028	0.029
		(0.022)	(0.031)	(0.043)
Household Assets (0-16)		-0.001	0.002	-0.005
		(0.002)	(0.003)	(0.004)
Conventional School		0.053***	0.091***	-0.075**
		(0.018)	(0.027)	(0.036)
Observations	7,971	7,957	7,957	
R-squared	0.011	0.016	0.018	

Notes: Regressions are OLS models with grade fixed effects. Columns (3) and (4) present results from one regression with main effects (column 3) and all covariates interacted with one of three HIV/AIDS prevention interventions (column 4). The weight of 6.67 is given to home-visit survey sample. Baseline values of the following variables are included as controls: age, orphan status, parents' tertiary education, parents' white-collar job, household asset ownership, and school type. Robust standard errors clustered by classroom are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Appendix Table

Table 5: Relationship between survey attrition and baseline characteristics(continued)

Dependent variable	Male Circumcision (whole sample) = 1 if surveyed in follow-up or home-visit surveys				Male Circumcision (eligible boys) = 1 if surveyed in follow-up or home-visit surveys				Male Circumcision (ineligible girls) = 1 if surveyed in follow-up or home-visit surveys			
	Treatment	Adjusted	Main effect	Interaction	Treatment	Adjusted	Main effect	Interaction	Treatment	Adjusted	Main effect	Interaction
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
Male Circumcision	-0.018	-0.014		-0.036	-0.022	-0.020		-0.115	-0.014	-0.008		0.070
	(0.015)	(0.014)		(0.128)	(0.018)	(0.018)		(0.151)	(0.022)	(0.021)		(0.197)
Age		-0.007*	-0.006	-0.003		-0.003	-0.002	-0.001		-0.015**	-0.012*	-0.006
		(0.004)	(0.005)	(0.007)		(0.004)	(0.006)	(0.008)		(0.006)	(0.007)	(0.010)
Orphan		-0.044**	-0.054*	0.023		-0.010	-0.001	-0.019		-0.082**	-0.101**	0.054
		(0.022)	(0.030)	(0.045)		(0.030)	(0.041)	(0.060)		(0.040)	(0.049)	(0.081)
Father's tertiary education		-0.007	-0.012	0.011		-0.010	-0.023	0.027		-0.001	0.001	-0.003
		(0.017)	(0.021)	(0.034)		(0.023)	(0.030)	(0.045)		(0.025)	(0.029)	(0.056)
Mother's tertiary education		-0.049*	-0.034	-0.034		-0.022	0.026	-0.084		-0.072**	-0.070	-0.005
		(0.026)	(0.033)	(0.052)		(0.039)	(0.052)	(0.073)		(0.034)	(0.043)	(0.070)
Father's white-collar job		-0.017	-0.008	-0.018		-0.007	0.028	-0.066**		-0.025	-0.032	0.022
		(0.012)	(0.015)	(0.025)		(0.018)	(0.027)	(0.033)		(0.017)	(0.020)	(0.038)
Mother's white-collar job		-0.012	-0.026	0.033		-0.003	0.001	-0.013		-0.029	-0.056*	0.077
		(0.022)	(0.026)	(0.039)		(0.033)	(0.041)	(0.061)		(0.027)	(0.032)	(0.052)
Household Assets (0-16)		-0.001	-0.005*	0.010**		-0.001	-0.010***	0.018***		-0.001	-0.002	0.001
		(0.002)	(0.003)	(0.004)		(0.003)	(0.003)	(0.005)		(0.003)	(0.004)	(0.007)
Conventional School		0.052***	0.056**	-0.012		0.054**	0.050*	0.005		0.051**	0.063**	-0.047
		(0.018)	(0.022)	(0.029)		(0.022)	(0.028)	(0.034)		(0.023)	(0.029)	(0.049)
Observations	7,971	7,957	7,957		3,974	3,964	3,964		3,997	3,993	3,993	
R-squared	0.011	0.016	0.018		0.012	0.016	0.020		0.012	0.022	0.023	

Notes: Regressions are OLS models with grade fixed effects. Columns (3) and (4) present results from one regression with main effects (column 3) and all covariates interacted with one of three HIV/AIDS prevention interventions (column 4). The weight of 6.67 is given to home-visit survey sample. Baseline values of the following variables are included as controls: age, orphan status, parents' tertiary education, parents' white-collar job, household asset ownership, and school type. Robust standard errors clustered by classroom are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Appendix Table

Table 6: Relationship between survey attrition and baseline characteristics(continued)

Dependent variable	Girls' Education Support (whole sample) = 1 if surveyed in follow-up or home-visit surveys				Girls' Education Support (eligible girls) = 1 if surveyed in follow-up or home-visit surveys				Girls' Education Support (ineligile boys) = 1 if surveyed in follow-up or home-visit surveys			
	Treatment	Adjusted	Main effect	Interaction	Treatment	Adjusted	Main effect	Interaction	Treatment	Adjusted	Main effect	Interaction
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
Girls' Education Support	0.006	0.004		0.160	0.040*	0.038*		0.068	-0.027	-0.029		0.094
	(0.020)	(0.020)		(0.155)	(0.022)	(0.022)		(0.207)	(0.025)	(0.025)		(0.173)
Age		-0.007*	-0.000	-0.014*		-0.015**	-0.012	-0.006		-0.003	0.002	-0.012
		(0.004)	(0.005)	(0.007)		(0.006)	(0.008)	(0.011)		(0.004)	(0.006)	(0.009)
Orphan		-0.043**	-0.044	-0.003		-0.081**	-0.071	-0.025		-0.008	-0.014	0.009
		(0.022)	(0.034)	(0.044)		(0.039)	(0.057)	(0.079)		(0.030)	(0.045)	(0.060)
Father's tertiary education		-0.007	-0.025	0.028		-0.003	-0.009	0.001		-0.010	-0.040	0.060
		(0.017)	(0.026)	(0.034)		(0.025)	(0.038)	(0.051)		(0.023)	(0.031)	(0.044)
Mother's tertiary education		-0.050*	-0.043	-0.012		-0.070**	-0.069	-0.000		-0.019	-0.001	-0.039
		(0.026)	(0.039)	(0.053)		(0.034)	(0.050)	(0.069)		(0.038)	(0.058)	(0.076)
Father's white-collar job		-0.016	-0.019	0.001		-0.024	-0.041	0.035		-0.006	0.007	-0.036
		(0.012)	(0.018)	(0.025)		(0.017)	(0.027)	(0.034)		(0.018)	(0.023)	(0.035)
Mother's white-collar job		-0.012	0.016	-0.054		-0.028	-0.004	-0.049		-0.005	0.020	-0.044
		(0.022)	(0.031)	(0.041)		(0.027)	(0.038)	(0.053)		(0.032)	(0.045)	(0.062)
Household Assets (0-16)		-0.001	-0.004	0.006		-0.001	-0.005	0.006		-0.001	-0.005	0.007
		(0.002)	(0.003)	(0.005)		(0.003)	(0.004)	(0.007)		(0.003)	(0.004)	(0.005)
Conventional School		0.053***	-0.002	0.100**		0.049**	-0.008	0.102**		0.056**	0.003	0.100**
		(0.019)	(0.024)	(0.039)		(0.023)	(0.035)	(0.048)		(0.023)	(0.030)	(0.048)
Observations	7,971	7,957	7,957		3,997	3,993	3,993		3,974	3,964	3,964	
R-squared	0.011	0.016	0.020		0.014	0.024	0.027		0.012	0.016	0.021	

Notes: Regressions are OLS models with grade fixed effects. Columns (3) and (4) present results from one regression with main effects (column 3) and all covariates interacted with one of three HIV/AIDS prevention interventions (column 4). The weight of 6.67 is given to home-visit survey sample. Baseline values of the following variables are included as controls: age, orphan status, parents' tertiary education, parents' white-collar job, household asset ownership, and school type. Robust standard errors clustered by classroom are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Appendix Table

Table 7: In-class Friendship Networks: Summary Statistics

	(1)	(2)
Panel A: Friendship Reconstruction		
	Raw count	Reordered eligible male
First-best friend	3,848	3,836
Second-best friend	3,844	3,137
Third-best friend	3,866	1,621
Panel B: Friendship link treatment status		
	Cases	Percent
No friends treated	1,702	42.8%
One friend treated	831	20.9%
Two friends treated	825	20.8%
Three friends treated	616	15.5%

Notes: Panel A Column (1) includes raw friendship data including friends without baseline survey and female friends. Column (2) present best eligible male friends after excluding those without baseline survey and female friends. Panel B present friendship statistics based on reordered eligible male best friend data.

Appendix Table

Table 8: Heterogeneous effects by prior beliefs

Dependent variable	Circumcision take-up			
	(1)	(2)	(3)	(4)
MC offer	0.146***	0.144***	0.162***	0.151***
	(0.021)	(0.023)	(0.023)	(0.023)
Knowing MC benefit		0.007		
		(0.012)		
MC offer x Knowing MC benefit		0.003		
		(0.023)		
Think that MC is very painful			-0.023**	
			(0.010)	
MC offer x Think that MC is very painful			-0.038*	
			(0.021)	
Think that MC is only for Muslim				-0.014
				(0.016)
MC offer x Think that MC is only for Muslim				-0.032
				(0.029)
Observations	3,952	3,949	3,945	3,942

Notes: This table shows the heterogeneous effects on take-up of male circumcision. MC offer variable equals 1 when students get MC offer either from 100% Treatment classrooms or from 50% Treatment classrooms. All columns use grade fixed effects and robust standard errors clustered by classroom are in parentheses. Control variables include age, circumcising ethnicity, circumcising religion (Muslim), orphan status, father's tertiary education, mother's tertiary education, father's white-collar job, mother's white-collar job, household assets and school type. *** p<0.01, ** p<0.05, * p<0.10