Male Circumcision, Peer Effects and Risk Compensation[1*]

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This paper uses a four-year long follow-up of an intervention based on a two-step randomized design within classrooms in secondary schools in Malawi to understand the impact of male circumcision on risky sexual behaviors and the role that peers play in the decision and consequences of being circumcised. Our analysis yields three main results. First, we show that the intervention substantially increased the demand for male circumcision for the students assigned to the treatment group. Second, we find evidence of positive peer effects in the decision to get circumcised among untreated students. Third, we find evidence of risk compensation using biomarkers of sexually transmitted infection for those who got circumcised due to the intervention, but not for those induced by peer effects. We discuss the implication of these results for research on HIV prevention as well as peer effects. (JEL: C93, D1, I12)

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1. Introduction

HIV/AIDS is one of the world's most serious health challenges. 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 infections in 2011 was 2.5 million, only 20% lower than in 2001 (UNAIDS 2012).

Recently, male circumcision has received much attention as an HIV prevention strategy after three efficacy trials showed that male circumcision can reduce HIV transmission risk by 50 percent (Auvert et al. 2005; Bailey et al. 2007; Gray et al. 2007). In addition, male circumcision also reduces herpes simplex virus type 2 (HSV-2) and human papillomavirus (HPV) infection (Tobian et al, 2009). To promote demand for male circumcision, the World Health Organization (WHO) strongly recommends 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 countries with high HIV incidence of heterosexually acquired HIV infection and low male circumcision rates.

However, there are two major concerns related to scaling up male circumcision: weak demand and potential risk compensation. First, the demand for male circumcision is still very low even with a heavily subsidized price and proper information (Chinkhumba et al. 2014). Among the major barriers discussed in the literature are financial constraints, lack of information, awareness, and accessibility, fear of pain, as well as religious and cultural norms. Second, even if a scale-up project is successful in increasing the take-up of male circumcision, such programs might have limited impacts if circumcised men are more likely to engage in risky sex behaviors (Cassell et al., 2006; Kalichman et al., 2007; Sawires et al., 2007; Mattson et al., 2008; Bingenheimer and Geronimus, 2009; Eaton and Kalichman, 2009; Padian et al., 2009; Brooks et al., 2010; Weiss et al., 2010).

This paper attempts to understand the role that peers play in the decision to get circumcised as well as the long-term impact of male circumcision on risky sexual behaviors. The motivation for this paper is twofold. One motivating factor is to understand peer effects, which have been shown to affect behavior in a wide range of areas including education (Sacerdote, 2000 Zimmerman , 2003; Foster, 2006; Lyle, 2007; Kremer and Levy, 2008), health (Kremer and

Miguel, 2004; Godlonton and Thornton, 2012; Oster and Thornton, 2012; Chong et al. 2013) and labor (Mas and Moretti, 2009; Bandiera, Barankay and Rasul, 2010). More specifically there is interest among researchers and policy makers to understand the role that peer effects may play in the take-up of certain interventions or the adoption of certain technologies. This is because take-up is often considered suboptimal or because potential spillovers to peers might justify subsidizing an intervention (Miguel and Kremer, 2004)

The second motivation is to understand whether in addition to the direct biological effects of male circumcision on the probability of transmission of HIV, there are also behavioral responses that could reduce or amplify the impact of getting circumcised. One concern is that circumcision leads to risk compensation if individuals overestimate the protection that male circumcision provides and therefore engage in riskier sexual practices (WHO 2007).[6] Moreover, the settings of scale-up projects are different from those in the original efficacy trials in many ways, and thus behavioral responses could also be also different. First, current beliefs and attitudes to circumcision could be substantially different from those in the efficacy trials since biological impacts of male circumcision on HIV and HSV-2 infections were not established. Second, efficacy trials were combined with intensive health education and individual HIV counselling throughout all the follow-up visits up to 24 months. This suggests that risk compensation in original RCT may be underestimated compared to the current male circumcision scale-up projects where knowledge of the benefits of male circumcision is widely accepted and follow-up HIV counseling is often limited. Third, as take-up of male circumcision is not as high as that in the clinical trial, circumcision takers are self-selected in non-study scale up project setting. As a result, those who decided to take-up male circumcision could be different from those who do not,

[6] Efficacy trials do not consistently show a relationship between male circumcision and risk compensation behaviors. For example, the studies by Bailey et al., 2007 in Kenya and Auvert et al., 2005 in South Africa find some evidence of risk compensation while Gray et al., 2007 in Uganda do not find such evidence. More importantly, impacts of male circumcision on HIV and HSV-2 infection in the scale-up setting could be different from those in efficacy trials due to the following reasons. First, a long-term change in risk compensation behaviors may mitigate a protective effect against HIV and HSV-2 infection. Actually, these studies were closed early by the safety monitoring board and provided male circumcision to the control group when an interim analysis proved the protective effect of male circumcision against HIV infection, and therefore risk compensation behaviors in the long-term cannot be evaluated. Risk compensation in these studies could be underestimated. Several studies try to explore risk compensation in the long-term by comparing risk sexual behaviors between circumcised and uncircumcised men in the post-trial follow-up of the trial in Uganda (Kong et al, 2012; Gray et al, 2012) and Kenya (Mattson et al, 2008; Wilson et al., 2014). These do not find compelling evidence of increased risky sexual behaviors among circumcised men, however, these results may be driven by confounders that may affect both circumcision take-up and risky sexual behaviors.

and therefore the impacts of male circumcision in scale up project could be also different from efficacy trials.

In our analyses, we use a four-year long follow-up of an intervention based on a two-step randomized design within classrooms in secondary schools in Malawi in order to: (1) estimate the take-up of male circumcision from the provision of free male circumcision and transportation vouchers, (2) understand the role that peers within classrooms play in the take-up of male circumcision among students not assigned initially to treatment, (3) measure risk compensation from a 4 year follow-up that collected biomarkers of sexually transmitted diseases and (4) understand if the risk compensation is different for males who take up circumcision because of the direct inducement of the intervention or the indirect peer effect.

We take advantage of a large-scale HIV prevention program implemented in 124 classrooms in 33 public secondary schools in Malawi by the Africa Future Foundation (AFF), an international non-governmental organization (NGO). AFF provided free male circumcision at the assigned clinic, and randomized the intensity of the transportation support for the surgery. Classrooms were randomly assigned into three groups: *100% Treatment*, *50% Treatment*, or *No Treatment* classrooms. All male students in *100% Treatment* classrooms received a free male circumcision offer with *stronger* transportation support in the first round, while no students in No Treatment classroom received the offer in the first round, but received *weaker* transportation support offer in the second round. In 50% Treatment classrooms, half of the students were randomly selected to receive the *stronger* transportation support in the first round. In the first round of the intervention, free male circumcision surgery and transportation subsidies were provided to a total of 1,972 male students in 2012. During the first round, all students including those untreated are allowed to take-up free male circumcision at the assigned hospital. In the second round, the remaining 2,002 male students who were temporarily untreated in the first round received the offer with weaker transportation support. This was due to funding constraints of the collaborating NGO and it resulted in less intense intervention.

We attempted to interview all students for a short-term follow-up at the end of the first round and prior to the start of the second round. In addition, the two youngest cohorts (9^{th} and 10^{th} graders in 2011) were selected for the long-term follow-up that was implemented after four years from the baseline survey. The main advantages of our setting and data are the relatively long follow-up period, the randomized two-step design that allows the estimation of the direct and peer effects of the intervention, an administrative dataset of all the circumcisions performed at the only provider in the study area, and the collection of biomarkers for sexually transmitted diseases (HIV and HSV-2).

We begin our analysis using the administrative data collected at the end of the first round to understand take-up of male circumcision. We find that male students who received a transportation incentive are around three times more likely to take-up male circumcision. Next, we also use our administrative data to understand the influence of peers on the decision to get circumcised. Untreated students in 50% Treatment classrooms were 79% more likely to get circumcised than students in No treatment classrooms, suggesting a positive externality in the demand for male circumcision. Since at baseline we also collected a roster of friends within the classroom, we also use an alternative empirical strategy that uses the experimental variation in the fraction of peers that was offered treatments to further understand peer effects. The results using this method to capture peer effects are also positive but less precise. However, we find evidence of important reinforcement effects when close friends within the same classroom receive the intervention together. The effects described above persist even in the long run after treatment is offered to everybody in the study, a finding that is consistent with the shorter and less intense intervention in the second stage.

Having established that there are positive direct and (indirect) peer effects in the decision to adopt the take-up of male-circumcision, we analyze the long-term impact of male circumcision on bio-markers as well as risky sexual behaviors. In a nutshell, we find evidence that is consistent with risk compensation among those who received the more intense transportation support. Our main results show an increase in STIs when measuring specific IgG and IgM antibodies to HSV-2. These results are corroborated with other measures of risky sexual behaviors that we have implemented, including self-reports of unprotected sex, the purchase of condoms when offered during follow-up (as in Thornton, 2013) and the measurement of reported sexual behavior using the item count technique (as in Coffman et al, 2013).

Our third main finding is that risky sexual behavior among those who decide to get circumcised because of peer effects are different from those who take-up circumcision because they received were allocated to the treatment group. In our setting, when a boy gets circumcised as a result of peer pressure, we do not observe any evidence of compensating behavior. We further explore this striking difference by analyzing observable characteristics of compliers in the two groups that get circumcised and somewhat surprisingly do not find a consistent pattern of observable characteristics (such as self-declared safe sex practices) of the two groups of male students who select into treatment based on the direct intervention channel or the indirect peer effect channel.

Our findings contribute to four main strands of the literature. First, our paper contributes to the literature on peer effects (briefly reviewed earlier) and in particular to the literature on the role of peer effects 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 0.5 km learning his/her HIV result leads to a 1.1 percent point increase in learning one's 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.

Second, our work contributes to the literature on how to increase male circumcision take-up. For example, previous trials show that financial compensation (Thirumurthy et al, 2014) or educating religious leaders (Downs et al, 2017) can promote circumcision take-up significantly.

Third, our paper contributes to the risk compensation literature. Risk compensation behaviors are well known in the economic literature as the "Pelzman effect", an example of moral hazard. For example, risk compensation in seat belt (Peltzman, 1975; Evans and Graham, 1991) and bicycle helmet (Thompson and Rivara, 1999) are well documented. As mentioned earlier, the early efficiency trials (Bailey et al., 2007, Auvert et al., 2005, Gray et al., 2007) find mixed evidence on risk compensation but these studies are based on short term and self-reported outcomes. To the best of our knowledge, our study is the first to show causal effects of male circumcision on risk compensation using biomarkers and a long term follow-up.

Finally, and maybe most importantly are the implications of different long-term behaviors for male students who take up circumcision directly through the program or indirectly through peer effects. Our reading of the literature on the role of peer effects in the take-up of technologies or interventions is that most studies aim to understand short-term take-up decisions but then do not perform long-term follow-up studies to validate that such interventions have the desired outcomes. Our results, imply that at least in our setting, this is an important issue and that take-up of male circumcision through two different mechanisms (direct inducement of transport intervention and indirect inducement through peer effect) can lead to very different behavioral responses.

The paper is organized as follows. Section 2 provides background information on the Malawian context and the male circumcision intervention. In Section 3 we describe the data followed in section 4 by the empirical strategies. Section 5 presents the main results. The final section presents conclusions.

2 Background and Experimental Design

2.1. HIV and Male Circumcision in Malawi

Malawi has been heavily affected by the HIV pandemic with an HIV prevalence rate of 10.6% for people aged 15 to 54 (NSO 2011) and a life expectancy at birth of 55 years (UNFPA, 2012). The prevalence of male circumcision in Malawi is relatively low with 21.6% of men being circumcised (NSO 2011).[7] Male circumcision is practiced mainly for religious and cultural reasons: 93.3% of Muslims are circumcised while only 11.6% of Christians practice circumcision (Bengo et al. 2010). Culturally, 86.8% of those belonging to the Yao tribe practice male circumcision while other tribes have low levels of male circumcision (NSO 2011). The baseline circumcision rate in our sample is 10.5% which reflects the fact that most residents in the catchment area of our study are non-muslim from non-Yao tribes.[8]

Medical male circumcision for HIV prevention has become an important component of Malawi's national HIV prevention program since 2010 (Need citation). Nevertheless, despite recent growth, the number of medical male circumcisions was still small at the time when our

[7] The true prevalence of complete male circumcision could be lower because many of those reporting being circumcised practice incomplete circumcision which only removes part of the foreskin. Incomplete circumcision may not have the full protective benefits of male circumcision (Bengo et al. 2010)

[8] Most people belonging to the Yao tribe 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.

study was implemented in 2012.[9] The estimated number of male circumcisions between 2008 and 2011 was only 0.7% of the target number (2.1 million) needed to achieve 80% of male circumcision prevalence in Malawi.

2.2. Study Setting and Experimental Design

This study was conducted in the context of larger HIV prevention project implemented in public secondary schools in four catchment districts of Lilongwe by the Africa Future Foundation.[10] The target population of the study is male secondary school students identified through a school-based baseline survey. Our sample includes 3,970 male students enrolled in 9th to 11th grade at 124 classrooms in 33 secondary schools in the catchment area. Due to the budget constraints of the implementing NGO, for the long-term follow-up survey, we focus only on the 2,663 students who were 9th and 10th graders at the time of enrollment. In terms of their organizational structure, most schools (28 out of 33) have one class per grade and there are limited cross-grade school activities.

In order to increase the demand for male circumcision among teenagers, AFF began an initiative to encourage the take-up of male circumcision in the fall of 2011. First, it established a medical male circumcision clinic within the premises of the Daeyang Luke Hospital located in the catchment area of the study. The clinic was equipped with a self-contained surgical unit and surgical beds to perform modern and safe medical circumcisions performed by appropriately trained medical personnel.[11]

Table 1 summarizes the two-stage randomization phase-in design of the study. Figure A1 presents detailed information on each randomization process. 124 available classrooms within the 33 schools were stratified by grade and randomly assigned into three groups: *100% Treatment*, *50% Treatment*, and *No Treatment* classrooms. All male students in the 100% Treatment classrooms received the male circumcision offer with transportation subsidies during the first round of treatment (Group 1). No students in the No Treatment classrooms received an

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[9] Starting from very small numbers (589 in 2008, 1,234 in 2009, and 1,296 in 2010), there was a sizeable increase in 2011, when 11,881 people became circumcised (WHO 2012).

[10] AFF's catchment area includes the four districts are Chimutu, Chitukula, Tsbango, and Kalumba. For details of AFF programs, see Data Appendix.

[11] The medical male circumcision surgeries were performed under local anesthesia in the assigned clinic by medical personnel using the standard forceps-guided method.

offer during the first round of the treatment (Group 4). In 50% Treatment classroom, we randomly selected half of students for the treatment (Group 2), and the remaining students were not treated during the first round of the treatment (Group 3). Assignment to the treatment in 50% Treatment classrooms was done at the individual level.[12] This two stage experimental design that randomizes treatment both across and within classes allows us to measure not only the direct effect but also peer effect of the male circumcision offer. As summarized in Table 1, 41 classrooms (across 24 schools) were assigned to 100% Treatment, 41 classrooms (across 25 schools) were assigned to 50% Treatment, and 42 classrooms (across 28 schools) were assigned to the No Treatment group.[13]

The timeline of the project was as follows: after the baseline survey that was collected between October 2011 and May 2012, male students assigned to treatment in Groups 1 and 2 received the transportation subsidies during December 2011 to April 2013 (Round 1). The short-term follow-up survey was conducted between January and June of 2013. Since our research design was based on a phase-in design, at the time of the short-term follow-up survey, the untreated students during Round 1 (Groups 3 and 4) had not received the transportation support yet. Groups 3 and 4 received less intensive transportation subsidies (than Groups 1 and 2) from July to December 2013 (Round 2). A long-term follow-up survey for 9th and 10th graders was implemented approximately 4 years after the baseline survey between October 2015 and August 2016.

After the baseline survey, AFF provided to the selected students (Groups 1 and 2) a male circumcision offer that consisted of free access to the surgery, complication check-ups, and transportation support to the clinic.[14] Students receiving the offer could choose either a direct pick-up service provided by AFF from the school to the clinic or a transportation voucher that was reimbursed after the circumcision surgery at the hospital was performed. The amount of the voucher varied according to the distance between the clinic and student's school.[15] These

[12] AFF wanted to keep the demand constant due to the capacity constraints. During the study period, maximum number of surgery per day was 19.

[13] This standard two-step randomized design to estimate peer effects was first proposed in Duflo and Saez (2003).

[14] Those already circumcised and those with HIV, severe anemia, or penis abnormality such as hypospadias were not eligible for the medical male circumcision procedure. During the study period, 394 study participants received male circumcision at the assigned clinic and 12 people were refused to receive the procedure; Seven were already circumcised; four had penis abnormality, and one was HIV positive.

[15] Although we set the transportation voucher amounts to reflect the minimum public transportation fees, many of rural areas do not have access to public transportation and students who live in rural areas often walked to the

vouchers were student specific and student participants were not allowed to trade these vouchers among themselves.

The intensity of the transportation support in Round 1 and 2 is different. The transportation vouchers for independent travel to the clinic was give out twice during Round 1. The first voucher did not specify an expiration date but specified six possible dates available to use for the pick-up service to the clinic (Panel A of Figure A3). The second voucher specified an expiration date (the end date of Round 1) and one possible pick-up date (Panel B of Figure A3). In the beginning of Round 2, Groups 3 and 4 were also given the offer. However, the Round 2 treatment was less intense due to budgetary constraints that were not anticipated at the start of the project. The treatment lasted only for 6 month and the travel vouchers were offered only once (Panel C of Figure A3).[16]

The male circumcision surgeries were performed in the assigned clinic by medical personnel. Post-circumcision care was provided after three days and one week at the student's school to check and disinfect the wound, and record complications. In pre- and post-surgical counselling sessions, participants were advised that male circumcision provides only partial protection against HIV infection and thus practicing safe sex after the surgery was encouraged and recommended (Figure A2).

3. Data

We use four main sources of data for this research: baseline, short term and long term follow survey data as well as administrative data from the circumcision clinic. At baseline, we started with a list of 10,715 enrolled students at the 33 participating schools. We managed to successfully get consent and complete the baseline survey for 74.4% of the students in the school roll-call lists. Of the 7,971 secondary students who completed the baseline, 3,997 were girls and 3,974 were male students.

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hospital when they chose the voucher option.

[16] One may worry that the timing of the circumcision offers are also different between the treatment and control group, and it could be problematic if risk compensation pattern is non-linear over time. We address this concern using bio-markers that captures a lifetime and recent infections separately, which is discussed in Section 5.

The baseline survey was designed to measure detailed background characteristics including student information about HIV knowledge, sexual behaviors, and their friendship network. At the end of the survey we gave students 10 kwacha (6 cents), and offered them a chance to buy condoms at the subsidized price of 5 kwacha to measure the demand for safe sex as in Thornton (2008).

In Table 2 we present summary statistics and balance tests of baseline observables. Columns (1) to (4) and (5) to (9) of Table 2 refer to the full sample (9th to 11th graders) and the long-term follow-up sample (9th and 10th graders), respectively. In columns (1) and (5), we show the mean characteristics for those in the control group. As shown in Column (1), the average age of study participants in the control group is 16.8 years and 16% belong to ethnic groups that practice circumcision and 10% are already circumcised. In general, study participants showed a high level of HIV/AIDS knowledge: the average number of correct answers to the HIV/AIDS knowledge questionnaire was 17.4 out of 20 questions. Nevertheless, they have a relatively low knowledge on the medical benefit of male circumcision (63.9%). In addition, 36% of control group study participants believed that male circumcision is painful and 15% believe that that male circumcision is only for Muslim. 31% ever had sex and 9% are currently engaged in a sexual relationship. Columns (2) to (4) and (6) to (9) present mean differences between treatment the treatment groups (Groups 1 to 3) and the control group (Group 4). The results confirm that classroom randomization was well implemented: the proportion of statistically significant mean difference at the 10% significance level is 9 out of 60 (15%) in full sample (Columns (2) to (4)) and 9 out of 60 (15%) in long-term follow-up sample (Columns (6) to (9))

We also asked students to list three best friends within the classroom regardless of sex, but in the analysis, we reconstructed friendship data by reordering best male friends after excluding friends without baseline survey and female friends. Table A1 shows summary statistics for the friendship networks. In Panel A, Column (1) includes the original friendship network data, and Column (3) presents reordered male friends after excluding female friends and those who did not participate in baseline survey. Almost all (3,832 out of 3,844) have at least one male friend, and around 80% (3,135 out of 3,844) have 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 (Table A2).

Our main outcome variables are male circumcision take-up rates, self-reported sexual behaviors, and HIV and HSV2 bio-marker test results.[17] [18] One advantage of our setting is that we do not need to rely on self-reported data, which is easily affected by social desirability bias, on circumcision take-up since we collected a hospital administrative dataset containing the complete records of all the medical circumcisions performed at the assigned clinic.[19] It records the name and age of the patient as well as the medical record related to the procedure, which includes the date of the surgery, the dates of any follow-up visits as well as information on possible side effects related to the procedure. In addition, and very important for our study, the administrative record also records the voucher used for either the direct pick-up service or the transport voucher used for public transportation. During the study period, 502 were circumcised in the first round and 124 in the second, which likely reflects the lower intensity of treatment in the second round.[20]

We also use the short- and long-term follow-up surveys implemented one and four years after the baseline survey to measure sexual behaviors, and sexually transmitted diseases (HIV and HSV-2) infection. The long-term follow-up survey, focusing only 9th and 10th graders, included several novel measures of sexual behaviors and STDs infection, which will be the main outcomes variables used to analyze the impact of the circumcision intervention. In terms of bio-markers, HSV-2 and HIV infections were evaluated using rapid test kits. For HSV-2, we use two measures of infection: the IgG is a permanent marker of HSV-2 infection that has occurred at any point during a person's lifetime (Obasi et al., 1999) while IgM shows recent infection

[17] HIV serostatus was measured with Determine HIV 1/2 and Unigold Recombigen HIV test. Different results between the two HIV tests were not found in this study. Participants who tested HIV positive were advised to receive proper treatment at the collaborating hospital.

[18] Biological data was not collected at baseline because the NGO was concerned that students who tested HIV positive at school may affect their ability to continue their studies. Instead, HIV testing were done when students came to the clinic for the circumcision.

[19] It is unlikely for students to get circumcised in other medical facilities because there are few facilities nearby that provide male circumcision on a regular basis. One exception is the Banja La Mtsogolo (BLM) clinic located in the Chitukula district, which is one of our four catchment districts. However, this clinic charged around $10 for the surgery and complication check-ups, which should seriously limit the demand for the circumcision procedure, especially for the population of secondary school students.

[20] In the second round, 2,002 male students from Group 3 and Group 4 were offered the transportation treatment, a number that is roughly similar to the 1,972 students from Group 1 and 2 who received it in the first round.

(Workowski and Bolan, 2015).[21] [22]

Our main outcome for measuring risky behavior is the HSV-2 test for Sexually Transmitted Diseases (STDs), a test that has been used successfully in a number of related studies (Baird et al, (2012), Duflo et al, (2015). Since HSV-2 is almost exclusively sexually transmitted through sexual, our rapid test results could be a good measure for risky sexual behaviors. Our preferred test is the one for IgG antibodies because the prevalence in our setting is high compared to other types of STIs.

One potential complication with using the results from an HSV-2 and HIV test to capture changes in risky sexual behavior after circumcision is that male circumcision prevents HSV-2 and HIV infections. Therefore, the increase of HSV-2 infection we estimate is a low bound of the true effects induced by risk compensation. The discussion in the medical literature (Tobian et al.) suggests that both anatomical and cellular factors could explain a biological mechanism that would reduce the HSV-2 infections for circumcised individuals who engage in unprotected sexual activities.

In addition, we implemented an alternative measure of risky sexual behavior using the item count technique (ICT) (Miller, 1984; Coffman et al, 2013). This is to further account for potential measurement error in self-reported responses, since numerous studies point out that self-reported answers are poor proxies for true attitudes toward private and sensitive subjects like sexual activities (Palen et al., 2008; Minnis et al., 2009). The ICT methodology asks respondents to report the total number of true statements in a set of questions that may include a sensitive item, instead of directly endorsing it. Participants were randomly given one of two sets of questions. One set included only four non-sensitive items (*short-form*) and the other set included four non-sensitive items and an extra sensitive statement of our interest (*long-form*). We used two sensitive questions of interest: ``I think I have to use a condom in case of sex with somebody that I do not know well'' (Using condoms for casual sex) and ``I had sex with more than two people in last 12 months'' (Multiple sexual partners). We can measure the impact of treatment on

[21] Although we have implemented a test for HIV during the follow-up, given the low incidence of HIV, our power calculations indicated that our study was not powered to detect differences in HIV rates between treatment and control groups.

[22] Misclassification of HSV-2 status might have occurred since there was no supplementary testing. However, all IgM positive cases are also IgG positive in our study sample. Moreover, there is no reason that misclassification of HSV-2 would be systematically different across the treatment status.

the sensitive statement by estimating a differential proportion of respondents who agree with the sensitive statement between the treatment and control group. Details of the ICT methodology are described in the Appendix. Lastly, at the end of the survey we again gave students 10 kwacha (6 cents), and offered to sell them condoms at a subsidized price of 5 kwacha to measure the demand for condoms.

In the baseline and two follow-up surveys we also included questions that are typically asked in surveys that are based on self-reported sexual behaviors. These include questions about attitude toward condom, inconsistent use of condom, unprotected sex with recent a partner and multiple sexual partner. Using these secondary outcomes, we created an 8-item risk score to summarize self-reported sexual behaviors in a single index.

We conclude this section with an analysis of attrition rates in the follow-up surveys and biomarker test participation. We were able to track about 91.9% and 86.8% of study subjects during the first and second follow-up surveys, respectively.[23] A smaller percentage (78.2%) participated in the bio-marker test. Table A3 suggests that attrition from the sample is not correlated with treatment assignment, with one exception in G2 at the first follow-up. In addition, there is no statistically significant differences between the treatment group (F-tests results).

4 Estimation Strategy

We employ a number of empirical strategies to capture the direct effect of being assigned to the more intense male circumcision intervention as well as possible peer effects in this setting. Our

[23] While the long-term follow-up survey were implemented for entire baseline 9th and 10th graders, the data collection for the short-run follow-up was conducted in two stages. In the first stage, we revisited the schools in our sample and attempted to re-interview all the students in our initial sample. We successfully interviewed 67.9% of the baseline sample students (or 2,698 students) using interviews conducted at school. During the second stage, we implemented a more extensive tracking exercise as in Thomas et al. (2001) and Thomas et al. (2012). First, we selected a subsample of 15% of the students (191 students) among those who did not participate in the school follow-up survey and attempted to visit them at home to complete the survey. The home survey follow-up rate was 74.9%. Combining the school and home visits results in an effective survey follow-up rate of 91.9%. The effective survey rate (ESR) is a function of the regular school follow-up rate (RFR) and intensive home-visit follow-up rate (HFR) as follows: ESR = RFR + (1 - RFR) * HFR. Overall, ESR is 91.9% (67.9% + 32.1% * 74.9%). We run a weighted regression with a weight 6.67 for home-visit survey since we randomly selected 15% students from the attrition sample (Baird et al. 2012)

first empirical strategy estimates the following model:

$$(1) \qquad Y_{ijk} = \beta_0 + \beta_1 \cdot G1_{ijk} + \beta_2 \cdot G2_{ijk} + \beta_3 \cdot G3_{ijk} + \gamma' X_{ij} + \delta_k + \varepsilon_{ijk}$$

where Y_{ijk} denotes an outcome of interest such as male circumcision take-up, sexual behaviors, and bio-marker test results for individual student i at classroom j in school k. G1, G2, and G3 refer Group 1, Group 2, and Group 3, respectively. The control vector, X, includes age, circumcising ethnicity, circumcising religion (Muslim), orphan status, parent's education, parent's job, household assets and school type, and the assignments to HIV/AIDS education and girl's CCT program. δ is school fixed effects[24], and ε is a random error. Errors are clustered at the classroom level. 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, both β_1 and β_2 capture the direct effects of being assigned in Group 1 and Group 2. The difference between β_1 and β_2 also captures possible peer effects, given that Group 2 has peer who did not received the treatment in the classroom (Group 3) while everybody in Group 1 received the treatment. In addition, β_3 might capture possible peer effects, given that a key difference between Group 3 and Group 4 is existence of peer who received the treatment (Group 2) within the classroom.

In some of our specifications, we also restrict ourselves only to the 50% Treatment classrooms. An alternative way to estimate the main direct effect of the intervention is by comparing the difference in outcomes between students in group G2 who received the intervention and students in group G3 who did not receive the intervention during the first round. Both of these groups (G2 and G3) are within the same classrooms and contain students who are exposed to the same peer effects since 50% of their peers are treated.

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

[24] Our results are almost identical when we include grade fixed effects instead of school fixed effects.

(2) $Y_{ijk} = \alpha_0 + \alpha_1 \cdot G2_{ijk} + \alpha_2 \cdot Peer_{ijk} + \gamma' X_{ijk} + \psi + \varepsilon_{ijk}$

(3) $Y_{ijk} = \kappa_0 + \kappa_1 \cdot G2_{ijk} + \kappa_2 \cdot Peer_{ijk} + \kappa_3 \cdot (G2_{ijk} \cdot Peer_{ijk}) + \gamma' X_{ij} + \psi_j + \varepsilon_{ijk}$

where $Peer_{ij}$ is an indicator variable taking value 1 if a male friend on the friendship roster was offered treatment in Round 1. The unit of observation is a student-friend pair, so a student who indicated three male friends in his classroom as his best friends enters the analysis three times. ψ is classroom fixed effect and errors are clustered at the classroom level. Since receiving the offer within our 50% Treatment classrooms is randomly assigned, whether a best received the treatment in the classroom is also random. It is worth noting that the peer effect that α_2 in equation (2) captures is different from the peer effect β_3 in equation (1) since one captures possible peer effects coming from the smaller group of best friends and the other reflects peer effects from the larger group of classroom students. Even though we did not explicitly provide information on free male circumcision opportunity to both Group 3 and Group 4 in the first round, Group 3 can find this opportunity more easily than Group 4 due to their peer (Group 2).

In equation (3), we estimate another type of peer effect, resulting from potential complementarities between your offer and his friend's 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.

In our setting, the role of peer effects in the demand for male circumcision is theoretically ambiguous. It may be positive if friends provide emotional support that reduces the psychological cost or share private information about the benefits of the circumcision procedure. Alternatively, a negative experience following male circumcision (i.e. complication or pain) might decrease a friend's demand for male circumcision.

5 Results

5.1 Impacts of intervention on the take-up of male circumcision

Figure 1 shows the cumulative prevalence of male circumcision over time based on hospital records data and self-reported data in the follow-up. The solid lines present take-up based on hospital administrative data and the dotted lines are based on self-reported data. We rely more on hospital records data since self-reported data may suffer from recall bias.[25] Hospital administration data is not available after December 2013 because the clinic was closed after the program was ended by the NGO. At the beginning of the project, male circumcision prevalence was about 11.0%. Due to the difference in intensity of transportation support, take-up among treated students in 100% Treatment (G1) and 50% Treatment classrooms (G2) significantly increased during Round 1. Untreated students in 50% Treatment classroom (G3) were also more likely to take-up male circumcision during Round 1 than the control group (G4). 249 (18.6%) out of 1,342 students in G1 and G2 and 64 (7.5%) out of 851 students in G3 and G4 were additionally circumcised at the assigned hospital during the study period.

In panel A of Table 3 we present estimates of the impact on the intervention on the demand for male circumcision that are based on equation (1), while in Panel B we combine the two treatment arms (G1 and G2) in order to increase statistical power. The dependent variables are male circumcision take-up from hospital administration data at the end of the first round (Columns (1)-(2) and (5)-(6)), and the second round (Columns (3)-(4) and (7)-(8)). In columns (1)-(4) we use the full sample of 9-11th graders, although our preferred estimates are those in columns (5)-(8) which are restricted to the long term follow-up cohort of 9th and 10th graders. The results confirm that the intensive support intervention for male circumcision significantly increased the demand for male circumcision. At the end of Round 1, G1 and G2 were 14.1 and 16.9 percentage points (290% and 363%) more likely to get circumcised than those in control classrooms (G4), respectively (Columns (5)-(6)). These effects are sustained until the end of Round 2 (Columns (7)-(8)), although they become smaller, which is not surprising given the phase-in design. We find similar pattern for full sample (Columns (1)-(4)). In Panel B of Table 3 we show that for our preferred specification when we use the pooled treatment groups (G1 and G2), the demand for circumcision for being assigned to treatment in Round 1 increases by 15% at the end of Round 1 and by 10% at the end of Round 2.

We also test whether the take-up of male circumcision is heterogeneous by prior beliefs such as

[25] For example, only 17% and 43 % of those who circumcised at the study hospital recall the month-year and year of the circumcision at the time of the follow-up survey, respectively.

knowledge about the benefits of male circumcision, beliefs about how painful male circumcision is, and beliefs that male circumcision is only appropriate for Muslim. Columns (1) to (6) of Table A4 compares the G1, G2, and G3 groups with the control group. In general, we find that those who think that male circumcision is painful or that it is only for appropriate for Muslim are less likely to receive MC in general. The interactions of these variables and the male circumcision variable are also negative, suggesting that individuals with these prior beliefs are less responsive to the circumcision intervention, although we note that many of the coefficients in this table are imprecisely estimated.

5.2. Peer effects on male circumcision take-up

As discussed in Section 4, we estimate different types of peer effects based on Equations (1), (2), and (3). We start with results presented in Panel A of Table 3 that use equation (1). The G3 untreated students in 50% Treatment classrooms, were depending on specifications between 3.2% and 4.2% points more likely to receive male circumcision than the G4 (No treatment) classroom students. Moreover, this effect is getting larger after Round 2 an increase by 6-7%. We interpret this result as the spillover effects within the classroom from the other half of classmates who received the offer of male circumcision in Round 1. Moreover, this increase persists (and even increases) at the end of the study period. (Panel B1). A second way to look at the existence of spillovers is to test whether take-up rates of G1 and G2 are different given that everybody in G1's classroom are treated in Round 1 while G2 had peer who did not received an offer initially. Somewhat surprisingly, we do not evidence of spill-overs using these two groups. The difference in take up is not statistically significant and if anything, the take-up rate is larger in G2 than G1 by 2.6% in Round 1 and .8% in Round 2.[26]

Another way to test for the existence of peer effects is based on equation (2) and (3) using the restricted sample of 50% Treatment classroom (G2 and G3). In this analysis, we take advantage of the details of the friend networks. As Table 4 shows, we find that having a higher proportion of friends who are treated increases one's circumcision take up in general (Panel B and C). However, the coefficient is not statistically significant. Panel D provides evidence of a

[26] One potential explanation of this (non-significant) difference might be the scarcity heuristic argument, which states that when a resource is less readily available people are more likely to perceive it as more valuable (Cialdini, R.B., 2009).

complementarity between a student's offer and his friend's offer that increase a student's take-up of circumcision. The impacts are large, statistically significant, and robust across the specifications, which suggests the existence of important reinforcement effects among peers in school.

Lastly, we study the role of popular kids in the classroom on male circumcision take-up. Most popular kids are defined as a person who had the largest number of classmates who claim him to be one of the top three closest friend. Column (1) of Table A5 shows that an experimentally induced male circumcision offer to the most popular students in the classroom decreases male circumcision take-up (Panel A), especially when the most popular one thinks male circumcision is painful.

5.2. Mechanism of peer effects

In this section, we try understand the mechanisms through which peer effects promote the demand for male circumcision by taking advantage of our detailed hospital administrative data. We explore two channels through which peer effects might work in our setting. The first is that students might organize each other to come to the hospital together. We capture this channel when students are coming to the hospital on the same day as their friend. Another possibility which we call the social learning channel, arises in a situation when a student who has experienced the male circumcision procedure influences his friend to take-up circumcision. We capture this channel when students and their friends receive the male circumcision on different days.[27]

Table 5 uses the stacked 50% treatment classroom sample. In this analysis, the unit of observation is a single friendship relationship. The dependent variable in Column 1 is male circumcision take-up, and the dependent variables in Columns (2) to (5) are take up of male circumcision without a friend's take up, concurrently with a friend, and before or after my friend respectively. These last three categories are mutually exclusive, and thus the sum of these

[27] It is possible that students might discuss in a way that "I will take it if you take it". This case would capture social learning channel in our analysis but the nature of discussion is the other channel. It would lead us to overestimate social learning channel. The results should be interpreted with this caveat.

coefficient is the same to the coefficient in Column 1: Columns (3)-(4) show results when a friend did not receive an offer; Columns (5)-(6) show results when one takes-up male circumcision with a friend on the same date, and; (7)-(8) show results when one takes-up male circumcision separately from a friend. Panel A confirms that one is more likely to take-up male circumcision when your best friend also take it up. The coefficients in Columns (5)-(8) are similar, which implies that two mechanisms discussed above are playing an important role. Panel B1 and C1 further disaggregates the above responses depending on whether a friend did or did not receive an offer. As expected, peer effects are particularly significant when both a student and his friend received an offer, which corresponds to the results shown at Panel D of Table 4.

5.3 Long-term impacts of male circumcision on STD infections and sexual behaviors

In this section, we study the long-term impacts of male circumcision on HSV2 and HIV infections, sexual behaviors measured by ICT, and a range of self-reported sexual behaviors. As explained previously, one of the major concern related to the scale up of male circumcision relates to possible risk compensation resulting from circumcised men engaging in risky sexual behaviors. In this analysis, we focus only on the baseline 9^{th} and 10^{th} graders who were included in the long-term follow-up survey.

Panel A of Table 6 shows that the cumulative probability of HSV-2 infection measured by IgG in G1 and G2 increases by about 3.8% and 2.8% points after four years, respectively, and the corresponding increases for IgM are 1.9% and 2.2% points. Interestingly, we do not find such evidence for G3 even though circumcision take up rate of G3 are comparable at the end of the experiment and the long-term follow-up survey. Lastly, we do not find a long-term impact of the intervention on testing HIV positive, although we not that our study was not powered to detect HIV impacts.

Table 7 present results using the Item Count Technique (ICT) to analyze responses to two sensitive risky sexual behavior: “I think I have to use a condom in case of sex with somebody that I do not know well” (Columns (1) and (2)) and “I had sex with more than two people in last 12 months” (Columns (3) and (4)). As a reminder, half of the survey respondents were randomly given a set of straightforward true/false statements, while the other half also received the additional sensitive statement about risky sexual behavior.

Table 7 show the regression results of the following estimation:

(4) $$Y_{ijk} = \beta_0 + \sum_{a=1}^{3} \beta_a \cdot Ga_{ijk} + \kappa \cdot long_{ijk} + \sum_{a=1}^{3} \lambda_a \cdot Ga_{ijk} \cdot long_{ijk} + \gamma' X_{ij} + \delta_k + \varepsilon_{ijk}$$

where $long_{ijk}$ is a binary indicator if individual i assigned to a questionnaire with sensitive questions (*long form*). λ is s coefficients of interest that captures the difference in the response of subjects who agree to the sensitive question between the treatment and control group.

The ICT results suggest that the difference in prevalence is about 22% between G1 and G4, and 23% between G2 and G4 (Panel A). Among treated group (G1 and G2), only 38% of students think that they have to use a condom in case of a casual sexual encounter while the corresponding number for the control group is 60% (Panel B). We do not find statistically significant changes in the multiple sex partners question. Table 7 confirms that the changes in sexual behaviors for group G3 which increased take-up through the peer channel is not significant.

Next, we measure the impact of the intervention on condom purchases and self-reported sexual behaviors (Table 8). First, in columns (1) and (2) we do not find statistically significant difference between the groups in the likelihood of purchasing a condom. Second, risky sexual behaviors, measured by using an index of eight major risky sexual behavior indicators, increases among males in the intervention group compared to the control group even though it is not statistically significant. We also find increases in each component of risky sexual behaviors but these changes are not statistically significant.

In sum, we find evidence of risk compensation that diminishes the preventive effect of male circumcision on HIV-1 and HSV-2 infection. Specifically, we find a long term increase of HSV-2 infection among the male circumcision treatment group while there is no significant change in HIV-1 infection. Risky sexual behavior measured using the ICT technique provide complementary evidence to the results using the bio-markers. Secondly, these impacts are driven by individuals who took up circumcision through the direct intervention (G1 and G2) and not through the peer effect channel (G3).

In order to study why biomarker outcomes of G1 and G2 (G12) and G3 are different, we compare complier characteristics of G12 and G3 by restricting the sample to circumcision takers following Kim and Lee (2017) (Table A6). Since everyone has undergone circumcision in the restricted sample, any difference between G12 and G3 is due to the compositional change of circumcision takers. In this sample, circumcision takers of G12 are always takers and compliers driven by the transportation support while circumcision takers of G3 are always takers and compliers driven by peer effects. Thus, using the analysis with the restricted sample allows us to compare the characteristics of two different types of compliers. Our results in Table A6 do not show significant differences in complier characteristics, suggesting that other unobserved characteristics between these groups are driving the differences in sexual behavior and HSV2 infections. However, it is worth noting that our analysis of complier characteristics is based on fairly small sample sizes and as a result we are not powered to detect meaningful differences between these groups.

6 Conclusion

This paper addresses questions on demand for male circumcision and its long-term consequences. Specifically, we study how to promote demand for male circumcision and what is the role of peer effects in demand for male circumcision. In addition, this study provides the first experimental evidence of the long-term impacts of community based male circumcision scale up project. To do this, we implemented a randomized controlled trial that randomly provided free male circumcision and transportation voucher to male students across 33 public secondary schools in Malawi. Classrooms are assigned into three groups: 100% Treatment, 50% Treatment, or No Treatment classrooms. Randomly selected half of male students in 50% Treatment classrooms were treated.

We find that our school based intervention substantially increases the demand for male circumcision by on average of 15.0 percentage points. Moreover, we find evidence consistent with important positive peer effects among classroom peers and the peer effects are particularly strong when both one and one's friend are treated. In addition, our results show that the preventive effects of male circumcision against HIV and HSV-2 could be mitigated in the long-run through risk compensation. We detect a significant increase of HSV-2 infection measured by

IgG and IgM after four years from the treatment even though male circumcision decreases HSV-2 infection biologically holding sexual activities constant. Interestingly, we find evidence of risk compensation only among those who were induced to take-up circumcision through transportation support program, but not among those who were induced through the peer effect.

To the best of our knowledge, our study is the first to measure the impact of male circumcision through randomized trial using a scale-up project setting where the preventive effect against HIV is widely known and people can voluntarily accept or decline free male circumcision service. It is also unique because we are able to study risk compensation behaviors in the long-term using biomarkers. Our findings are surprisingly different from results in several efficacy trials that showed 51-60% protective effect against HIV acquisition (Auvert et al., 2005; Bailey et al., 2007; Gray et al., 2007) and 25% protective effect against HSV-2 infection (Tobian et al, 2009). Our community based trial might more closely resemble what the situation is likely to be under non-study conditions. For example, our program carefully provides benefits and risks of the medical male circumcision to study participants, which could be closer to the scale-up settings.

This study has some limitations. The lack of baseline data for HIV and HSV-2 makes comparison of incidences between the treatment and control group impossible. However, there are several reasons to support our finding are robust. First, the treatment and control group had similar baseline characteristics. So it is unlikely that our biomarker results are caused by differences of baseline prevalence of HIV or HSV-2 or baseline variables that are associated with HIV or HSV-2 infection. Second, we have similar results in IgM test for HSV-2 which detects only recent infection so that helps us to prevent bias that might be driven by difference in baseline prevalence. Lastly, the difference in biomarker outcomes are supported by the changes in sexual behaviors measured by item count technique and self-reported.

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, but it also suggests that those who are taking up an intervention as a result of their peers might display very different behavioral responses.

This study also shows that male circumcision scale-up project might not be successful to prevent HIV and HSV-2 infection when those circumcised engage in risk compensation. Our results suggest that male circumcision scale-up projects should be combined with programmes to address risk compensation among circumcised men such as intensive public health campaign and education.

Reference

Angrist, Joshua D. "The perils of peer effects." Labour Economics 30 (2014): 98-108.

Auvert, Bertran, Dirk Taljaard, Emmanuel Lagarde, Jolle Sobngwi-Tambekou, Rmi Sitta, and Adrian Puren, “Randomized, Controlled Intervention Trial of Male Circumcision for Reduction of HIV Infection Risk: The ANRS 1265 Trial,” PLoS Medicine, October 2005, 2 (11), e298.

Bailey, Robert C, Stephen Moses, Corette B Parker, Kawango Agot, Ian Maclean, John N Krieger, Carolyn FM Williams, Richard T Campbell, and Jeckoniah O Ndinya-Achola, “Male circumcision for HIV prevention in young men in Kisumu, Kenya: a randomised controlled trial,” The Lancet, February 2007, 369 (9562), 643–656.

Baird, S., C. McIntosh, and B. Ozler, “Cash or Condition? Evidence from a Cash Transfer Experiment,” The Quarterly Journal of Economics, November 2011, 126 (4), 1709–1753.

Baird, Sarah J, Richard S Garfein, Craig T McIntosh, and Berk Ozler, “Effect of a cash transfer programme for schooling on prevalence of HIV and herpes simplex type 2 in Malawi: a cluster randomised trial,” The Lancet, April 2012, 379 (9823), 1320–1329.

Bengo, Joseph Mfutso, Kondwani Chalulu, Jobiba Chinkhumba, Lawrence Kazembe, Kenneth M Maleta, Francis Masiye, and Don Mathanga, “Situation Analysis of Male Circumcision in Malawi,” Technical Report, College of Medicine, University of Malawi, University of Malawi April 2010.

Binagwaho, Agnes, Elisabetta Pegurri, Jane Muita, and Stefano Bertozzi. "Male circumcision at different ages in Rwanda: a cost-effectiveness study." *PLoS medicine* 7, no. 1 (2010): e1000211.

Bingenheimer, Jeffrey B., and Arline T. Geronimus. "Behavioral Mechanisms in HIV Epidemiology and Prevention: Past, Present, and Future Roles." *Studies in Family Planning* 40, no. 3 (2009): 187-204.

Brooks, Ronald A., Mark Etzel, Lee E. Klosinski, Arleen A. Leibowitz, Sharif Sawires, Greg Szekeres, Mark Weston, and Thomas J. Coates. 2010. “Male Circumcision and HIV Prevention: Looking to the Future.” *AIDS and Behavior* 14 (5): 1203–6.

Cassell, Michael M, Daniel T Halperin, James D Shelton, and David Stanton, “Risk compensation: the Achilles’ heel of innovations in HIV prevention?,” BMJ : British Medical Journal, March 2006, 332 (7541), 605–607.

Chinkhumba, Jobiba, Susan Godlonton, and Rebecca Thornton, “The Demand for Medical Male Circum- cision,” American Economic Journal: Applied Economics, April 2014, 6 (2), 152–177.

Cialdini, Robert B., “Influence: Science and Practice,” 5. ed., internat. ed. Boston, Mass.: Pearson Education 2009

Clark, Shelley, Caroline Kabiru, and Eliya Zulu, “Do Men and Women Report Their Sexual Partnerships Differently? Evidence from Kisumu, Kenya,” International Perspectives on Sexual and Reproductive Health, December 2011, 37 (04), 181–190.

Coffman, Katherine, Lucas Coffman, and Keith M. Marzilli Ericson, “The Size of the LGBT Population and the Magnitude of Anti-Gay Sentiment are Substantially Underestimated,” Technical Report w19508, National Bureau of Economic Research, Cambridge, MA October 2013.

Cornelissen, Thomas, Christian Dustmann, and Uta Schönberg. "Peer effects in the workplace." *American Economic Review* 107.2 (2017): 425-56.

Coutts, E. and B. Jann, “Sensitive Questions in Online Surveys: Experimental Results for the Randomized Response Technique (RRT) and the Unmatched Count Technique (UCT),” Sociological Methods & Research, February 2011, 40 (1), 169–193.

Duflo, Esther, Pascaline Dupas, and Michael Kremer, “Education, HIV, and Early Fertility: Experimental Evidence from Kenya,” American Economic Review, September 2015, 105 (9), 2757–2797.

-, Rachel Glennerster, and Michael Kremer, “Using randomization in development economics research: A toolkit,” Handbook of development economics, 2007, 4, 3895–3962.

Eaton, Lisa and Seth C Kalichman, “Behavioral Aspects of Male Circumcision for the Prevention of HIV Infection,” Current HIV/AIDS reports, November 2009, 6 (4), 187–193.

Godlonton, Susan, Alister Munthali, and Rebecca Thornton, “Responding to Risk: Circumcision, Information, and HIV Prevention,” Review of Economics and Statistics, May 2016, 98 (2), 333–349.

Gray, Ron, Godfrey Kigozi, Xiangrong Kong, Victor Ssempiija, Frederick Makumbi, Stephen Wattya, David Serwadda, Fred Nalugoda, Nelson K. Sewenkambo, and Maria J. Wawer, “The effectiveness of male circumcision for HIV prevention and effects on risk behaviors in a posttrial follow-up study:,” AIDS, March 2012, 26 (5), 609–615.

Gray, Ronald H, Godfrey Kigozi, David Serwadda, Frederick Makumbi, Stephen Watya, Fred Nalu- goda, Noah Kiwanuka, Lawrence H Moulton, Mohammad A Chaudhary, Michael Z Chen, Nelson K Sewankambo, Fred Wabwire-Mangen, Melanie C Bacon, Carolyn FM Williams, Pius Opendi, Steven J Reynolds, Oliver Laeyendecker, Thomas C Quinn, and Maria J Wawer, “Male circumcision for HIV prevention in men in Rakai, Uganda: a randomised trial,” The Lancet, February 2007, 369 (9562), 657–666.

Kalichman, Seth, Lisa Eaton, and Steven Pinkerton, “Circumcision for HIV Prevention: Failure to Fully Account for Behavioral Risk Compensation,” PLoS Medicine, March 2007, 4 (3), e138.

Kim, Hyuncheol Bryant, Booyuel Kim, and Cristian Pop-Eleches, “Peer Effects in the Demand for Male Circumcision: Evidence from Secondary Schools in Malawi,” Technical Report AEA RCT Registry June 2016.

Kim, Hyuncheol Bryant, and Sun-mi Lee. "When public health intervention is not successful: Cost sharing, crowd-out, and selection in Korea's National Cancer Screening Program." Journal of health economics 53 (2017): 100-116.

Kong, X., G. Kigozi, F. Nalugoda, R. Musoke, J. Kagaayi, C. Latkin, R. Ssekubugu, T. Lutalo, B. Nantume, I. Boaz, M. Wawer, D. Serwadda, and R. Gray, “Assessment of Changes in Risk

Behaviors During 3 Years of Posttrial Follow-up of Male Circumcision Trial Participants Uncircumcised at Trial Closure in Rakai, Uganda," American Journal of Epidemiology, November 2012, 176 (10), 875–885.

Mattson, Christine L., Richard T. Campbell, Robert C. Bailey, Kawango Agot, J. O. Ndinya-Achola, and Stephen Moses, "Risk Compensation Is Not Associated with Male Circumcision in Kisumu, Kenya: A Multi-Faceted Assessment of Men Enrolled in a Randomized Controlled Trial," PLoS ONE, June 2008, 3 (6), e2443.

MDHS, "Malawi Demographic and Health Survey 2010," Technical Report, NSO and ICF Macro, Zomba, Malawi and Calverton, Maryland, USA 2011.

Miller, J. D., "A New Survey Technique for Studying Deviant Behavior," Technical Report Ph.D. thesis, The George Washington University 1984.

Minnis, A. M., M. J. Steiner, M. F. Gallo, L. Warner, M. M. Hobbs, A. van der Straten, T. Chipato, M. Macaluso, and N. S. Padian, "Biomarker Validation of Reports of Recent Sexual Activity: Results of a Randomized Controlled Study in Zimbabwe," American Journal of Epidemiology, October 2009, 170 (7), 918–924.

Murray, Christopher J L, Katrina F Ortblad, Caterina Guinovart, Stephen S Lim, Timothy M Wolock, D Allen Roberts, Emily A Dansereau, et al. 2014. "Global, Regional, and National Incidence and Mortality for HIV, Tuberculosis, and Malaria during 1990–2013: A Systematic Analysis for the Global Burden of Disease Study 2013." *The Lancet* 384 (9947): 1005–70.

Muula, Adamson S, Hans W Prozesky, Ronald H Mataya, and Joseph I Ikechebelu. 2007. "Prevalence of Complications of Male Circumcision in Anglophone Africa: A Systematic Review." *BMC Urology* 7 (1).

National Statistical Office of Malawi, and ICF Macro. 2011. "Malawi Demographic and Health Survey 2010." National Statistical Office Malawi. Zomba, MW, September.

NAC, "Malawi Voluntary Medical Male Circumcision Communication Strategy 2012-2016," Technical Report, Na- tional AIDS Commission (NAC) Malawi 2012.

Obasi, Angela, Frank Mosha, Maria Quigley, Zebedayo Sekirassa, Tom Gibbs, Katua Munguti, James Todd, Heiner Grosskurth, Philippe Mayaud, John Changalucha, David Brown, David Mabey, and Richard Hayes, “Antibody to Herpes Simplex Virus Type 2 as a Marker of Sexual Risk Behavior in Rural Tanzania,” The Journal of Infectious Diseases, January 1999, 179 (1), 16–24.

Padian, Nancy S, Anne Buvé, Jennifer Balkus, David Serwadda, and Ward Cates. 2008. “Biomedical Interventions to Prevent HIV Infection: Evidence, Challenges, and Way Forward.” *The Lancet* 372 (9638): 585–99.

Palen, Lori-Ann, Edward A. Smith, Linda L. Caldwell, Alan J. Flisher, Lisa Wegner, and Tania Vergnani, “Inconsistent Reports of Sexual Intercourse Among South African High School Students,” Journal of Adolescent Health, March 2008, 42 (3), 221–227.

Peltzman, Sam, “The Effects of Automobile Safety Regulation,” Journal of Political Economy, 1975, 83 (4), 677– 725.

Sacerdote, Bruce. "Experimental and quasi-experimental analysis of peer effects: two steps forward?." *Annu. Rev. Econ*. 6.1 (2014): 253-272.

Sawires, Sharif R, Shari L Dworkin, Agnès Fiamma, Dean Peacock, Greg Szekeres, and Thomas J Coates. 2007. “Male Circumcision and HIV/AIDS: Challenges and Opportunities.” *The Lancet* 369 (9562): 708–13.

Shafii, Taraneh, Katherine Stovel, and King Holmes, “Association Between Condom Use at Sexual Debut and Subsequent Sexual Trajectories: A Longitudinal Study Using Biomarkers,” American Journal of Public Health, June 2007, 97 (6), 1090–1095.

Smith, JenniferS. and N.Jamie Robinson, “Age Specific Prevalence of Infection with Herpes Simplex Virus Types 2 and 1: A Global Review,” The Journal of Infectious Diseases, October 2002, 186 (s1), S3–S28.

Thornton, Rebecca L, “The Demand for, and Impact of, Learning HIV Status,” American Economic Review, November 2008, 98 (5), 1829–1863.

Tobian, Aaron A.R., David Serwadda, Thomas C. Quinn, Godfrey Kigozi, Patti E. Gravitt, Oliver Laeyendecker, Blake Charvat, Victor Ssempijja, Melissa Riedesel, Amy E. Oliver, Rebecca G. Nowak, Lawrence H. Moulton, Michael Z. Chen, Steven J. Reynolds, Maria J. Wawer, and Ronald H. Gray, "Male Circumcision for the Prevention of HSV-2 and HPV Infections and Syphilis," New England Journal of Medicine, March 2009, 360 (13), 1298–1309.

UNAIDS, "Global report: UNAIDS report on the global AIDS epidemic 2013," Technical Report, UNAIDS, UN- AIDS November 2013.

Weiss, Helen A, Kim E Dickson, Kawango Agot, and Catherine A Hankins. 2010. "Male Circumcision for HIV Prevention: Current Research and Programmatic Issues." *AIDS (London, England)* 24 (0 4): S61–69.

WHO/UNAIDS, "New Data on Male Circumcision and HIV Prevention: Policy and Programme Implications," Technical Report, Montreux, Switzerland 2007.

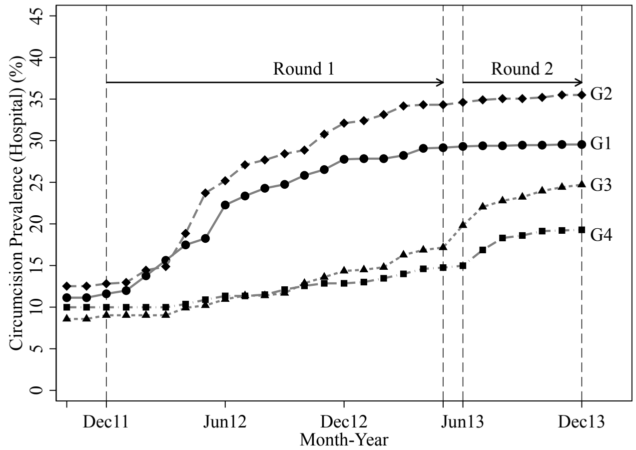
Wilson, Nicholas L., Wentao Xiong, and Christine L. Mattson, "Is sex like driving? HIV prevention and risk compensation," Journal of Development Economics, January 2014, 106, 78–91.

Workowski, Kimberly A. and Gail A. Bolan, "Sexually Transmitted Diseases Treatment Guidelines, 2015," Technical Report MMWR Recomm Rep 2015;64(No. RR-3):1-137, Center for Disease Control and Prevention June 2015.

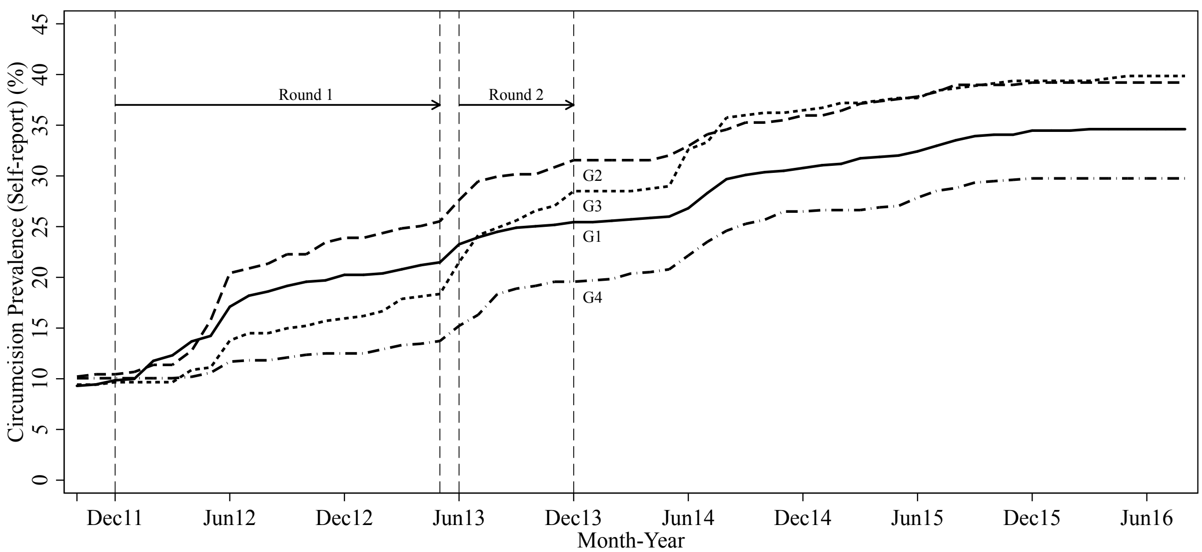
Figures

Figure 1: Cumulative prevalence of male circumcision over time

(a) Hospital Report (9-11th graders)



(b) Self-report (9-10th graders)



Notes: These figures present cumulative male circumcision prevalence rate over time based on the sample of 3,970 9-11th graders (Full sample) in Panel (a) and 2,312 9-10th graders who completed the 2nd follow-up survey in Panel (b). Panel (a) and (b) show the prevalence based on hospital administration and self-reported data, respectively.

Tables

Table 1: Experimental Design

	Group	Assignment	Classrooms (Full Sample)	Students (Full Sample)	Classrooms (Baseline 9th-10th grade)	Students (Baseline 9th-10th grade)
100% Treatment	G1	Treated in Round 1	41	1,293	27	861
50% Treatment	G2	Treated in Round 1	41	679	28	481
	G3	Treated in Round 2		676		470
No Treatment	G4	Treated in Round 2	42	1,322	28	851
Total			124	3,970	83	2,663

Notes: This table present two stage randomization design. First, 124 available classrooms within the 33 schools were stratified by grade and randomly assigned into three groups: 100% treatment, 50% treatment, and No treatment. Second, within 50% treatment classrooms, only half of the students were randomly assigned to treatment in the first round at individual level. Full sample includes all male students from 9th, 10th, and 11th grade at the baseline. The 2nd follow-up survey was conducted only for 9th and 10th grade students at baseline.

Table 2: Baseline statistics and Randomization Balance

	Mean	Difference in Mean (Full Sample)			Mean	Difference in Mean (Baseline 9th-10th grade)		
	G4	(G1vs. G4)	(G2vs. G4)	(G3 vs. G4)	G4	(G1vs. G4)	(G2vs. G4)	(G3 vs. G4)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A. Socio-demographic Characteristics								
Age (Year)	16.809	-0.219	-0.278	-0.229	16.163	0.070	-0.091	0.026
Circumcising ethnicity	0.158	0.033	0.020	-0.011	0.168	0.022	0.013	-0.019
Muslim	0.050	0.021*	0.021	0.000	0.054	0.017	0.019	-0.005
Orphan	0.068	-0.006	-0.025**	-0.021**	0.060	-0.001	-0.027**	-0.013
Father's tertiary education	0.172	0.007	0.020	0.014	0.166	0.020	0.034	0.020
Mother's tertiary education	0.068	-0.004	0.005	0.003	0.069	-0.009	-0.000	0.005
Father's white-collar job	0.223	0.028	0.029	0.011	0.241	0.006	0.000	-0.002
Mother's white-collar job	0.096	-0.004	0.008	0.005	0.105	-0.008	0.002	-0.003
Household asset count (0-16)	7.313	0.382	-0.192	-0.184	7.424	0.181	-0.408	-0.437
Conventional schools	0.186	-0.010	0.179*	0.169	0.095	0.070	0.337***	0.337***
Panel B. HIV/AIDS Knowledge and Sexual Behavior								
HIV/AIDS knowledge (0-20)	17.371	-0.132	-0.025	-0.052	17.398	-0.272**	-0.059	-0.049
Belief in the efficacy of MC	0.671	-0.045*	-0.001	-0.038	0.680	-0.065*	0.004	-0.025
MC is painful	0.358	0.049**	0.041	0.048*	0.345	0.069**	0.037	0.047
MC is only for Muslim	0.149	0.001	0.005	0.017	0.147	0.010	-0.003	0.012
Ever had sex	0.308	-0.012	0.010	0.002	0.254	0.024	0.038	0.038
Sexually active	0.094	-0.021	0.008	0.007	0.059	0.002	0.043*	0.037**
Multiple partners	0.012	0.004	0.004	0.003	0.011	0.003	0.002	0.002
Inconsistent use of condoms	0.045	-0.014*	-0.005	-0.002	0.041	-0.012	-0.004	0.002
Number of condoms purchased	0.919	-0.193*	0.004	0.051	0.784	-0.029	0.175	0.225*
Already circumcised	0.100	0.011	0.025	-0.014	0.106	-0.001	0.013	-0.012
Observations	1,322	2,615	2,001	1,998	851	1,712	1,332	1,321

Notes: Table 2 reports means of selected baseline variables and shows tests for balance between treatment arms. Panel A summarizes demographic and socioeconomic information, and Panel B summarizes HIV/AIDS knowledge and individual sexual behaviors. Columns 1 and 5 show summary statistics for those initially assigned to G4. Columns 2-4 and 6-8 report mean differences (and significance levels for difference of mean tests) between groups having different treatment status. Circumcising ethnicity refers to a tribe of which more than 20% population reported being circumcised in 2010 MDHS. HIV/AIDS knowledge is constructed by counting the correct answers from 20 HIV/AIDS related questions. Inconsistent use of condoms is an indicator variable which becomes one if the respondent did not use condoms at least once during the last sexual intercourse with three most recent partners in the past 12 months. *** Significant at the 1 percent level. ** Significant at the 5 percent level. * Significant at the 10 percent level.

Table 3: Impacts on Male Circumcision Take-up

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Sample	Full sample (9th-11th graders)				9th and 10th graders			
Timing	Round 1		Round 2		Round 1		Round 2	
Data	Hospital Administration Data							
Panel A								
G1 (100% Treatment)	0.137***	0.139***	0.099***	0.099***	0.136***	0.141***	0.105***	0.108***
	(0.023)	(0.022)	(0.024)	(0.023)	(0.017)	(0.017)	(0.019)	(0.019)
G2 (50% Treatment)	0.172***	0.174***	0.133***	0.133***	0.165***	0.169***	0.113***	0.116***
	(0.027)	(0.025)	(0.026)	(0.025)	(0.024)	(0.024)	(0.023)	(0.024)
G3 (50% No Treatment)	0.040*	0.042*	0.064**	0.064**	0.032	0.040*	0.062***	0.068***
	(0.022)	(0.022)	(0.025)	(0.025)	(0.021)	(0.022)	(0.023)	(0.023)
F test (Prob >F)								
G1=G2	0.258	0.243	0.287	0.256	0.258	0.291	0.764	0.762
G1=G3	0.000	0.000	0.221	0.214	0.000	0.000	0.066	0.094
G2=G3	0.000	0.000	0.005	0.005	0.000	0.001	0.044	0.065
R-Squared	0.093	0.103	0.080	0.090	0.099	0.107	0.096	0.105
Panel B								
G1 and G2 combined	0.150***	0.152***	0.112***	0.112***	0.147***	0.151***	0.108***	0.111***
	(0.019)	(0.018)	(0.019)	(0.019)	(0.015)	(0.015)	(0.017)	(0.017)
G3	0.036	0.039*	0.061**	0.061**	0.023	0.032	0.060**	0.066***
	(0.022)	(0.022)	(0.024)	(0.024)	(0.024)	(0.026)	(0.023)	(0.024)
F test (Prob >F)								
G1&G2=G3	0.000	0.000	0.018	0.018	0.000	0.000	0.025	0.042
R-Squared	0.092	0.102	0.079	0.089	0.099	0.107	0.096	0.104
Observations	3,970	3,937	3,970	3,937	2,663	2,643	2,663	2,643
Mean of Dep. Variable from G4	0.048		0.093		0.035		0.075	
Controls	No	Yes	No	Yes	No	Yes	No	Yes

Notes: The circumcision status is based on hospital administration data. All the specifications include school fixed effects. Controls include standard control variables described in Section 4. Robust standard errors clustered by classroom are in parentheses. *** Significant at the 1 percent level. ** Significant at the 5 percent level. * Significant at the 10 percent level.

Table 4: Externalities on Male Circumcision Take-up (50% classrooms)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Sample	Full sample (9th-11th graders)				9th and 10th graders			
Timing	Round 1		Round 2		Round 1		Round 2	
Data	Hospital Administration Data							
Panel A								
MC offer	0.132***	0.132***	0.068***	0.069**	0.133***	0.132***	0.050*	0.054*
	(0.028)	(0.029)	(0.025)	(0.025)	(0.035)	(0.037)	(0.025)	(0.027)
R-squared	0.100	0.113	0.098	0.114	0.099	0.111	0.105	0.124
Panel B								
Rate of close friends who got MC offer	0.033	0.026	0.055	0.050	0.057	0.047	0.071	0.067
	(0.038)	(0.038)	(0.043)	(0.045)	(0.039)	(0.038)	(0.046)	(0.046)
R-squared	0.066	0.080	0.092	0.108	0.064	0.078	0.104	0.121
Panel C								
MC offer	0.133***	0.132***	0.069***	0.070***	0.134***	0.132***	0.050*	0.055**
	(0.028)	(0.030)	(0.025)	(0.025)	(0.035)	(0.037)	(0.025)	(0.026)
Rate of close friends who got MC offer	0.040	0.035	0.059	0.055	0.059	0.050	0.072	0.068
	(0.039)	(0.040)	(0.044)	(0.046)	(0.039)	(0.038)	(0.046)	(0.047)
R-squared	0.101	0.113	0.099	0.115	0.101	0.113	0.108	0.126
Panel D								
MC offer	0.080**	0.088**	0.028	0.037	0.074*	0.081*	-0.001	0.010
	(0.033)	(0.033)	(0.033)	(0.033)	(0.040)	(0.041)	(0.033)	(0.033)
Rate of close friends who got MC offer	-0.033	-0.026	0.002	0.010	-0.020	-0.018	0.003	0.009
	(0.040)	(0.043)	(0.055)	(0.060)	(0.039)	(0.041)	(0.062)	(0.064)
MC offer x Rate of close friends who got MC offer	0.142**	0.119*	0.112	0.087	0.153**	0.133*	0.133	0.115
	(0.066)	(0.066)	(0.077)	(0.080)	(0.073)	(0.071)	(0.087)	(0.087)
R-squared	0.104	0.115	0.101	0.116	0.104	0.116	0.110	0.127
Observations	1,355	1,339	1,355	1,339	951	942	951	942
Mean of Dep. Variable from G4	0.152		0.196		0.142		0.198	
Controls	No	Yes	No	Yes	No	Yes	No	Yes

Notes: This analysis includes only the 50% Treatment classroom sample. Robust standard errors are shown in parentheses clustered at the classroom level. “Rate of close friends who got MC offer” is a variable for male circumcision offer to friends defined as the proportion (rate) of friends who are offered male circumcision. *** Significant at the 1 percent level. ** Significant at the 5 percent level. * Significant at the 10 percent level.

Table 5: My take-up related to my friend's take-up decision timing (50% Treatment Classroom Sample)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent vars.	My uptake		My uptake x No friend uptake		My uptake x Friend's uptake with me		My uptake x Friend's uptake before/after me	
Timing	Round 1							
Data	Hospital Administration Data							
Panel A. Overall								
My MC Offer	0.136***	0.134***	0.093***	0.091***	0.020**	0.019**	0.023*	0.023*
	(0.031)	(0.032)	(0.017)	(0.017)	(0.009)	(0.009)	(0.012)	(0.012)
Observations	2,937	2,903	2,937	2,903	2,937	2,903	2,937	2,903
R-squared	0.108	0.120	0.061	0.070	0.027	0.032	0.036	0.039
Panel B1. When Friend got MC offer								
My MC Offer	0.164***	0.160***	0.085***	0.083***	0.043**	0.041**	0.036***	0.036***
	(0.033)	(0.034)	(0.014)	(0.016)	(0.017)	(0.016)	(0.013)	(0.013)
Observations	1,501	1,482	1,501	1,482	1,501	1,482	1,501	1,482
R-squared	0.134	0.146	0.065	0.073	0.055	0.063	0.056	0.063
Panel B2. When Friend got MC offer & He thinks MC is painful								
My MC Offer	0.133***	0.129***	0.090***	0.086***	0.023	0.022	0.020	0.021
	(0.035)	(0.035)	(0.026)	(0.026)	(0.016)	(0.016)	(0.017)	(0.018)
Observations	633	624	633	624	633	624	633	624
R-squared	0.125	0.140	0.082	0.094	0.056	0.070	0.061	0.071
Panel B3. When Friend got MC offer & He doesn't think MC is painful								
My MC Offer	0.183***	0.178***	0.080***	0.078***	0.057**	0.053**	0.047**	0.047**
	(0.041)	(0.044)	(0.018)	(0.020)	(0.021)	(0.020)	(0.019)	(0.020)
Observations	868	858	868	858	868	858	868	858
R-squared	0.162	0.174	0.078	0.086	0.070	0.083	0.081	0.096
Panel C1. When Friend didn't get MC offer								
My MC Offer	0.109***	0.109***	0.104***	0.103***	-0.003	-0.002	0.008	0.009
	(0.033)	(0.034)	(0.027)	(0.027)	(0.006)	(0.006)	(0.018)	(0.018)
Observations	1,436	1,421	1,436	1,421	1,436	1,421	1,436	1,421
R-squared	0.097	0.113	0.077	0.095	0.020	0.023	0.045	0.048
Panel C2. When Friend didn't get MC offer & He thinks MC is painful								
My MC Offer	0.066**	0.068**	0.070**	0.075**	-0.001	-0.001	-0.003	-0.005
	(0.032)	(0.033)	(0.030)	(0.030)	(0.004)	(0.004)	(0.022)	(0.023)
Observations	584	576	584	576	584	576	584	576
R-squared	0.118	0.130	0.087	0.100	0.063	0.068	0.063	0.073
Panel C3. When Friend didn't get MC offer & He doesn't think MC is painful								
My MC Offer	0.134***	0.128***	0.121***	0.116***	-0.004	-0.003	0.017	0.016
	(0.041)	(0.042)	(0.031)	(0.031)	(0.009)	(0.008)	(0.020)	(0.020)
Observations	852	845	852	845	852	845	852	845
R-squared	0.118	0.148	0.110	0.142	0.022	0.027	0.064	0.075
Mean of Dep. Variable	0.152		0.112		0.013		0.027	
Controls	No	Yes	No	Yes	No	Yes	No	Yes

Notes: This analysis uses a stacked 50% treatment classroom sample where unit of observation is single friendship relationship. Robust standard errors are shown in parentheses clustered at the classroom level. *** Significant at the 1 percent level. ** Significant at the 5 percent level. * Significant at the 10 percent level.

Table 6: Impacts on HSV2 and HIV infections (9th and 10th Grade)

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent vars.	HSV2 IgG Positive		HSV2 IgM Positive		HIV Positive	
Sample	9th and 10th graders					
Data	Hospital Administration Data					
Panel A						
G1 (100% Treatment)	0.038***	0.039***	0.017**	0.019***	-0.002	-0.002
	(0.013)	(0.013)	(0.007)	(0.007)	(0.003)	(0.003)
G2 (50% Treatment)	0.028	0.035	0.020***	0.022***	-0.001	-0.002
	(0.021)	(0.022)	(0.006)	(0.007)	(0.003)	(0.003)
G3 (50% No Treatment)	-0.000	-0.001	0.002	0.003	-0.004	-0.004
	(0.019)	(0.019)	(0.007)	(0.007)	(0.004)	(0.004)
F test (Prob >F)						
G1=G2	0.590	0.819	0.720	0.620	0.878	0.885
G1=G3	0.067	0.037	0.118	0.128	0.698	0.606
G2=G3	0.354	0.216	0.062	0.047	0.587	0.692
R-Squared	0.052	0.062	0.035	0.038	0.017	0.021
Panel B						
G1 and G2 combined	0.034**	0.037***	0.018***	0.020***	-0.002	-0.002
	(0.014)	(0.014)	(0.005)	(0.006)	(0.003)	(0.003)
G3	0.003	-0.000	0.001	0.002	-0.004	-0.004
	(0.022)	(0.021)	(0.008)	(0.007)	(0.004)	(0.004)
F test (Prob >F)						
G1&G2=G3	0.230	0.130	0.060	0.051	0.603	0.642
R-Squared	0.052	0.062	0.035	0.038	0.017	0.021
Observations	2,074	2,058	2,074	2,058	2,074	2,058
Mean of Dep. Variable from G4	0.084		0.012		0.003	
Controls	No	Yes	No	Yes	No	Yes

Notes: This analysis includes only 9th and 10th graders who were surveyed in the 2nd follow-up. Dependent variables are the probability of HSV-2 infection measured by IgG and IgM, and HIV infection. Robust standard errors are shown in parentheses clustered at the classroom level. *** Significant at the 1 percent level. ** Significant at the 5 percent level. * Significant at the 10 percent level.

Table 7: The Impact on Sexual Behaviors (ICT)

	(1)	(2)	(3)	(4)
Dependent vars.	Using condoms for casual sex (ICT)		Multiple partners (ICT)	
Sample	9th and 10th graders			
Data	Hospital Administration Data			
Panel A				
G1 (100% Treatment)	0.154	0.174*	0.033	0.047
	(0.099)	(0.099)	(0.084)	(0.085)
G2 (50% Treatment)	0.248***	0.257***	0.014	0.017
	(0.094)	(0.097)	(0.099)	(0.101)
G3 (50% No Treatment)	0.163	0.176	0.014	0.010
	(0.112)	(0.119)	(0.120)	(0.123)
Long	0.610***	0.619***	0.144*	0.151*
	(0.081)	(0.082)	(0.085)	(0.085)
G1 (100% Treatment) x Long	-0.220	-0.235	-0.074	-0.087
	(0.142)	(0.143)	(0.102)	(0.103)
G2 (50% Treatment) x Long	-0.234*	-0.233*	-0.073	-0.065
	(0.128)	(0.130)	(0.139)	(0.139)
G3 (50% No Treatment) x Long	-0.092	-0.083	-0.108	-0.088
	(0.153)	(0.157)	(0.189)	(0.190)
R-Squared	0.059	0.062	0.026	0.031
Panel B				
G1 and G2 combined	0.187**	0.203**	0.027	0.036
	(0.080)	(0.081)	(0.079)	(0.080)
G3	0.135	0.149	0.020	0.016
	(0.102)	(0.108)	(0.118)	(0.120)
Long	0.607***	0.616***	0.145*	0.152*
	(0.081)	(0.082)	(0.085)	(0.085)
MC Treatment (G1 and G2) x Long	-0.221*	-0.231*	-0.074	-0.079
	(0.115)	(0.116)	(0.101)	(0.101)
G3 (50% No Treatment) x Long	-0.088	-0.078	-0.109	-0.089
	(0.152)	(0.156)	(0.188)	(0.189)
R-Squared	0.058	0.062	0.026	0.031
Observations	2,311	2,294	2,312	2,295
Mean of Dep. Variable from G4 & Short	1.760		2.172	
Controls	No	Yes	No	Yes

Notes: This analysis includes only 9th and 10th graders who were surveyed in the 2nd follow-up. "Using condoms for casual sex" shows the ICT result for the question of which an extra item states. Actual statement for Columns 1 and 2 is "I think I have to use a condom in case of sex with somebody that I do not know well.", and that for Columns 3 and 4 is "I had sex with more than two people in last 12 months." *Long* refers to a set of questions that include a sensitive item. Robust standard errors are shown in parentheses clustered at the classroom level. *** Significant at the 1 percent level. ** Significant at the 5 percent level. * Significant at the 10 percent level.

Table 8: The Impacts on Self-reported Sexual Behaviors

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Dependent vars.	No. of condoms purchased		Ever had sex		Age at sexual debut		Sexually active		Multiple partners in past 12 mon.		Multiple partners in lifetime		Inconsistent condom use		Unprotected sex with last partner	
Sample	9th and 10th graders															
Data	Hospital Administration Data															
Panel A1. 1st Follow-up (9-10th grade sample)																
G1 (100% Treatment)	0.057	0.016	0.002	-0.009	-0.196	-0.190	-0.008	-0.017	-0.005	-0.004	-0.030	-0.036	-0.019	-0.025*	-0.021	-0.026*
	(0.124)	(0.125)	(0.039)	(0.036)	(0.351)	(0.255)	(0.025)	(0.024)	(0.004)	(0.005)	(0.026)	(0.025)	(0.016)	(0.014)	(0.016)	(0.014)
G2 (50% Treatment)	0.165	0.179	0.019	0.025	-1.090**	-1.038**	0.008	0.006	-0.010	-0.010	0.019	0.023	-0.020	-0.026*	-0.019	-0.023
	(0.180)	(0.165)	(0.053)	(0.041)	(0.518)	(0.439)	(0.033)	(0.028)	(0.007)	(0.008)	(0.037)	(0.031)	(0.017)	(0.015)	(0.017)	(0.015)
G3 (50% No Treatment)	-0.117	-0.177	0.033	0.037	-0.438	-0.466	0.004	0.002	0.007	0.010	0.011	0.019	-0.009	-0.015	-0.008	-0.014
	(0.139)	(0.143)	(0.050)	(0.038)	(0.437)	(0.368)	(0.036)	(0.031)	(0.006)	(0.007)	(0.034)	(0.031)	(0.019)	(0.017)	(0.019)	(0.017)
R-Squared	0.052	0.065	0.084	0.150	0.193	0.327	0.046	0.084	0.083	0.094	0.077	0.117	0.047	0.056	0.050	0.060
Panel A2. 1st Follow-up (9-10th grade sample)																
G1 and G2 combined	0.098	0.079	0.009	0.004	-0.470	-0.442	-0.002	-0.008	-0.007*	-0.006	-0.011	-0.013	-0.020	-0.025**	-0.020	-0.025**
	(0.109)	(0.108)	(0.037)	(0.030)	(0.374)	(0.286)	(0.024)	(0.021)	(0.004)	(0.004)	(0.026)	(0.023)	(0.014)	(0.012)	(0.013)	(0.012)
G3 (50% No Treatment)	-0.146	-0.219	0.028	0.029	-0.084	-0.121	0.000	-0.004	0.008	0.011	-0.002	0.004	-0.009	-0.015	-0.008	-0.014
	(0.135)	(0.150)	(0.046)	(0.036)	(0.471)	(0.410)	(0.038)	(0.035)	(0.008)	(0.009)	(0.034)	(0.032)	(0.018)	(0.017)	(0.018)	(0.017)
R-Squared	0.052	0.064	0.084	0.149	0.184	0.320	0.045	0.084	0.083	0.094	0.076	0.116	0.047	0.056	0.050	0.060
Observations	1,851	1,836	1,843	1,828	529	527	1,854	1,839	1,844	1,829	1,843	1,828	1,844	1,829	1,844	1,829
Mean of Dep. Variable from G4	1.013		0.271		15.8		0.107		0.008		0.134		0.037		0.034	
Panel B1. 2nd Follow-up (9-10th grade sample)																
G1 (100% Treatment)	0.124	0.088	0.022	0.018	-0.110	-0.160	0.011	0.003	0.002	0.003	-0.010	-0.007	0.012	0.011	0.010	0.010
	(0.143)	(0.139)	(0.027)	(0.021)	(0.144)	(0.117)	(0.026)	(0.022)	(0.005)	(0.005)	(0.026)	(0.022)	(0.012)	(0.008)	(0.012)	(0.009)
G2 (50% Treatment)	0.377*	0.348	-0.008	0.003	-0.214	-0.114	-0.006	0.002	0.029***	0.030***	-0.021	-0.017	0.017	0.021	0.011	0.015
	(0.224)	(0.240)	(0.038)	(0.032)	(0.183)	(0.178)	(0.037)	(0.032)	(0.010)	(0.009)	(0.036)	(0.034)	(0.019)	(0.017)	(0.018)	(0.017)
G3 (50% No Treatment)	0.190	0.148	-0.024	-0.021	-0.010	0.026	-0.019	-0.018	0.011	0.012	0.025	0.032	-0.011	-0.010	-0.013	-0.011
	(0.243)	(0.242)	(0.039)	(0.031)	(0.198)	(0.176)	(0.038)	(0.033)	(0.013)	(0.013)	(0.035)	(0.031)	(0.018)	(0.016)	(0.017)	(0.016)
R-Squared	0.022	0.024	0.054	0.097	0.063	0.139	0.068	0.101	0.019	0.026	0.045	0.070	0.046	0.072	0.047	0.073
Panel B2. 2nd Follow-up (9-10th grade sample)																
G1 and G2 combined	0.218	0.184	0.011	0.012	-0.150	-0.142	0.005	0.002	0.012**	0.013**	-0.014	-0.011	0.014	0.015	0.010	0.012
	(0.137)	(0.140)	(0.027)	(0.021)	(0.144)	(0.127)	(0.027)	(0.022)	(0.006)	(0.006)	(0.024)	(0.021)	(0.011)	(0.009)	(0.011)	(0.009)
G3 (50% No Treatment)	0.116	0.073	-0.015	-0.016	0.023	0.012	-0.014	-0.018	0.003	0.004	0.028	0.035	-0.013	-0.012	-0.013	-0.012
	(0.225)	(0.220)	(0.037)	(0.030)	(0.183)	(0.160)	(0.036)	(0.031)	(0.013)	(0.014)	(0.036)	(0.032)	(0.018)	(0.017)	(0.018)	(0.017)
R-Squared	0.021	0.024	0.053	0.096	0.063	0.139	0.068	0.101	0.017	0.025	0.045	0.070	0.046	0.072	0.047	0.073
Observations	2,312	2,295	2,306	2,289	1,454	1,443	2,312	2,295	2,303	2,286	2,306	2,289	2,303	2,286	2,303	2,286
Mean of Dep. Variable from G4	1.397		0.607		17.8		0.549		0.026		0.329		0.071		0.069	
Controls	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes

Notes: In Panel A1 and A2, we ran a weighted regression because 15 percent of students in the attrition sample were randomly selected for intensive home-visit survey in the 1st follow-up. Column (1)-(2) provide the results from an experiment we conducted during survey by giving students 10 kwachas and selling two condoms at subsidized price 5 kwachas (Thornton, 2008). Robust standard errors are shown in parentheses clustered at the classroom level. *** Significant at the 1 percent level. ** Significant at the 5 percent level. * Significant at the 10 percent level.

Appendix Figures

Appendix Figure A.1: Study Design

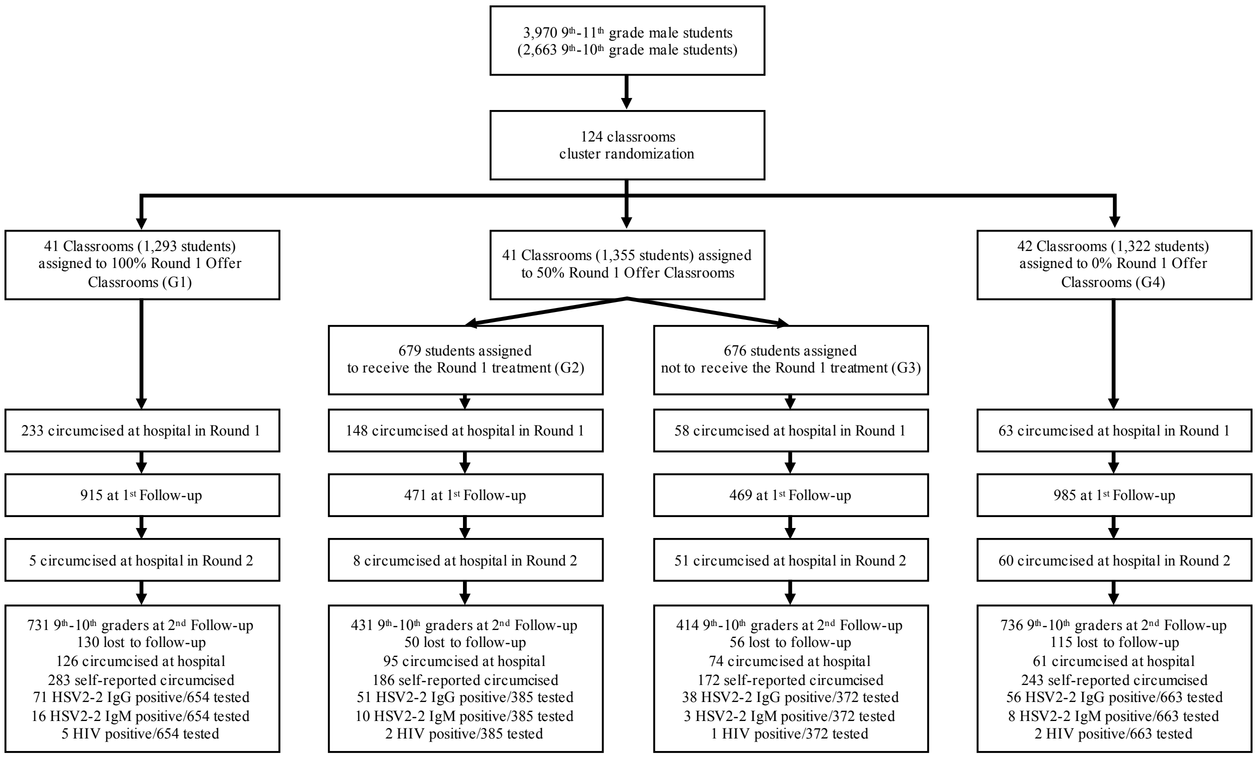


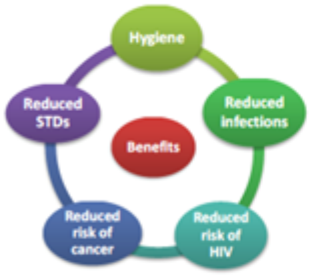
Figure A.2: Male Circumcision Brochure

7 things you want to know about male circumcision

Q1 What is male circumcision?

A: Male circumcision (MC) is the surgical removal of the foreskin; the skin that covers the tip of the penis

Q2 What are the benefits of MC?



Q3 Is it safe to get circumcised?

A: Likewise any other surgeries, there are some risks to male circumcision. But, the complications are rare and are easily resolved. MC provided at Daeyang Luke Hospital is performed by professionally trained clinical officers. It is performed at an adequately equipped and sterile health facility.

Q4 Is MC only for the Muslim?

A: *No*. Although MC is important for some traditions, MC is being performed regardless of faiths and cultures around the world.

MC provided at DLH is different from traditional MC found in some parts of Malawi. It is performed to follow the guideline of the World Health Organization (WHO). **It's clean, sterile, and safe.**

Q5 How does MC protect HIV and STIs?

A: The inside of the foreskin is soft and mist and is more likely to get a tidy tear or sore that allows HIV to enter the body more easily.

The circumcised male genital is dry providing protection against entry of the virus. Male circumcision modifies acidity of the penis, which is unfavorable for HIV to survive. Hence, MC reduces chances of HIV and STI transmission.

Q6 How long will it take to recover?

A: You will be sore for a few days after surgery but you can continue with your normal routine after 2-3 days of the surgery.

Full healing will take 4-6 weeks. Follow-up visits which ensure proper healing are provided after 1 - 3 days at your school.

Q7 MUST DOs after surgery

- Don't get your dressing wet
- Return to the hospital if you experience serious pain, bleeding or discharge
- Avoid disturbing the sutures through physical activity or bicycle riding
- ***Avoid sex for 6-weeks* until healing is complete!**

  : Resuming sex before full healing can cause damage to your penis and put you and your partner at risk for HIV infection.

MUST REMEMBER

Though it is proved that MC is very effective to reduce HIV infection risk, it doesn't offer full protection against HIV infection. It's important to always practice safe sex

source: Banja la Mtsogolo

It takes a team approach to defend yourself

Male Circumcision **(MC)** and ABC are one team altogether against HIV

Abstaining from sex

Being faithful to one partner

Condom use

WHY MALE CIRCUMCISION?

1 It can help to prevent HIV infection. It is estimated that a man who is circumcised appears to be **60% less likely** to get HIV

2 It can reduce the risk of STI's.

3 It keeps your partner safe from HIV infection indirectly as well as yourself.

4 It is an investment for your invaluable Health & Future.

Daeyang Luke Hospital, in the capital of Malawi, Lilongwe was opened in March 2008. The hospital continues to build its reputation for excellent service and superior medical treatment throughout the nation. The hospital serves people who are suffering without means to receive proper medical care.

Contacts: Daeyang Luke Hospital. P.O.BOX 30330, Capital City, Lilongwe 3, Malawi

Tel: Chimwemwe: 0995586711
Gerald: 0999288740
Bright: 0995703699

Daeyang Luke Hospital

MALE CIRCUMCISION (MC)
MDULIDWE WA ABAMBO

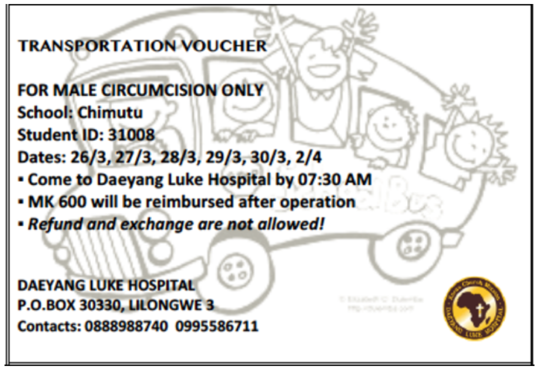
Source: www.malecircumcision.org

Daeyang Luke Hospital

Notes: This brochure was translated in Chichewa and distributed to students and used for counselling.

Figure A.3: Transportation Vouchers

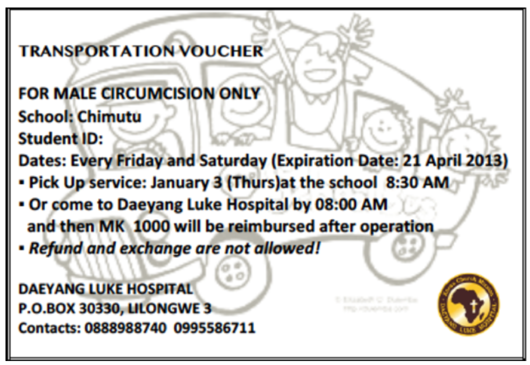
(a) 1st transportation voucher for Round 1


TRANSPORTATION VOUCHER

FOR MALE CIRCUMCISION ONLY
School: Chimutu
Student ID: 31008
Dates: 26/3, 27/3, 28/3, 29/3, 30/3, 2/4
- Come to Daeyang Luke Hospital by 07:30 AM
- MK 600 will be reimbursed after operation
- *Refund and exchange are not allowed!*

DAEYANG LUKE HOSPITAL
P.O.BOX 30330, LILONGWE 3
Contacts: 0888988740 0995586711

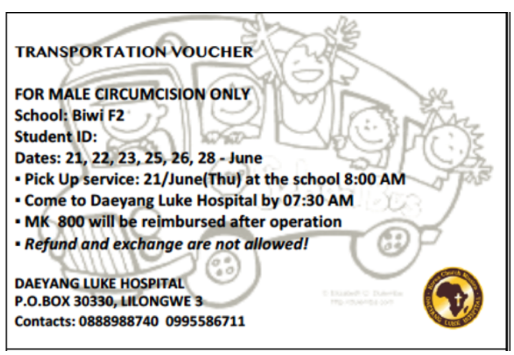
(b) 2nd transportation voucher for Round 1


TRANSPORTATION VOUCHER

FOR MALE CIRCUMCISION ONLY
School: Chimutu
Student ID:
Dates: Every Friday and Saturday (Expiration Date: 21 April 2013)
- Pick Up service: January 3 (Thurs)at the school 8:30 AM
- Or come to Daeyang Luke Hospital by 08:00 AM
  and then MK 1000 will be reimbursed after operation
- *Refund and exchange are not allowed!*

DAEYANG LUKE HOSPITAL
P.O.BOX 30330, LILONGWE 3
Contacts: 0888988740 0995586711

(c) Transportation voucher for Round 2


TRANSPORTATION VOUCHER

FOR MALE CIRCUMCISION ONLY
School: Biwi F2
Student ID:
Dates: 21, 22, 23, 25, 26, 28 - June
- Pick Up service: 21/June(Thu) at the school 8:00 AM
- Come to Daeyang Luke Hospital by 07:30 AM
- MK 800 will be reimbursed after operation
- *Refund and exchange are not allowed!*

DAEYANG LUKE HOSPITAL
P.O.BOX 30330, LILONGWE 3
Contacts: 0888988740 0995586711

Appendix Tables

Table A1: In-class Friendship Networks: Summary Statistics

Panel A: Friendship Reconstruction			
	Raw count	Eligible male	Reordered eligible male
	(1)	(2)	(3)
First-best friend	3,844	3,102	3,832
Second-best friend	3,839	2,818	3,135
Third-best friend	3,860	2,668	1,621

Panel B: Friendship link treatment status		
	Case	Percentage
No friend treated	1,697	42.75%
One friend treated	833	20.98%
Two friends treated	823	20.73%
Three friends treated	617	15.54%

Notes: Panel A Column (1) includes raw friendship data including friends without baseline survey and female friends. Column (2) excludes friends without baseline survey and further excludes female friends from column (1). Finally, we reorder the remaining friendship data from column (2) as first, second, or third best male friends if available. Panel B present friendship statistics based on reordered eligible male best friend data (Panel A, column (3)).

Table A2: Baseline Statistics and Randomization Balance by the Fraction of Treated Friends

	Mean	Difference in Mean (Full Sample)			Mean	Difference in Mean (Baseline 9th-10th grade)		
	No friend treated	(1 vs. 0 Treated)	(2 vs. 0 Treated)	(3 vs. 0 Treated)	No friend treated	(1 vs. 0 Treated)	(2 vs. 0 Treated)	(3 vs. 0 Treated)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A. Socio-demographic Characteristics								
Age (Year)	16.760	-0.114	-0.198	-0.285	16.151	0.005	0.051	0.069
Circumcising ethnicity	0.165	0.002	0.005	0.019	0.172	0.012	0.000	-0.005
Muslim	0.056	0.005	0.010	0.009	0.058	0.005	0.005	0.010
Orphan	0.065	-0.014	-0.003	-0.023**	0.060	-0.024**	-0.002	-0.013
Father's tertiary education	0.176	0.004	0.008	0.009	0.170	0.023	0.032	-0.003
Mother's tertiary education	0.070	0.012	-0.012	-0.009	0.070	0.011	-0.012	-0.016
Father's white-collar job	0.226	0.022	0.016	0.033	0.237	0.017	0.021	-0.015
Mother's white-collar job	0.098	0.015	-0.009	-0.018	0.104	0.014	-0.005	-0.026
Household asset count (0-16)	7.338	0.064	0.049	0.073	7.361	-0.072	0.091	-0.212
Conventional schools	0.207	0.118*	0.060	-0.015	0.158	0.214***	0.138**	0.034
Panel B. HIV/AIDS Knowledge and Sexual Behavior								
HIV/AIDS knowledge (0-20)	17.354	0.010	-0.118	-0.104	17.375	-0.022	-0.204*	-0.219**
Belief in the efficacy of MC	0.674	-0.039	-0.036	-0.057**	0.686	-0.034	-0.055*	-0.069**
MC is painful	0.364	0.025	0.054**	0.060**	0.349	0.027	0.054**	0.099***
MC is only for Muslim	0.152	0.007	0.008	-0.014	0.148	0.012	0.005	0.004
Ever had sex	0.313	-0.003	-0.006	-0.033	0.267	0.008	0.031	-0.002
Sexually active	0.100	-0.020	-0.006	-0.036**	0.071	-0.003	0.018	-0.005
Multiple partners	0.015	-0.001	-0.001	-0.002	0.012	-0.003	0.002	0.005
Inconsistent use of condoms	0.047	-0.008	-0.009	-0.026***	0.043	-0.010	-0.003	-0.019**
Number of condoms purchased	0.916	-0.013	-0.113	-0.154	0.813	0.131	0.043	-0.028
Already circumcised	0.108	-0.010	0.006	-0.007	0.106	-0.009	0.011	-0.004
Observations	1697	2530	2520	2314	1098	1655	1683	1521

Notes: This table reports means of selected baseline variables and mean differences (and significance levels for difference of mean tests) between groups having friendship link treatment status as presented in Table A1 Panel B.
*** Significant at the 1 percent level. ** Significant at the 5 percent level. * Significant at the 10 percent level.

Table A3: Attrition

Dependent variable	Surveyed in 1st follow-up (full sample)		Surveyed in 1st follow-up (9-10th grade)		Surveyed in 2nd follow-up (9-10th grade)		Biomaker Testing (HIV and HSV2)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
100% Treatment (G1)	-0.014	-0.010	-0.029	-0.021	-0.007	-0.006	0.003	0.004
	(0.020)	(0.020)	(0.026)	(0.025)	(0.018)	(0.020)	(0.022)	(0.024)
50% Treatment (G2)	-0.015	-0.010	-0.048	-0.042	0.025	0.023	0.028	0.031
	(0.026)	(0.026)	(0.031)	(0.031)	(0.022)	(0.021)	(0.028)	(0.028)
50% No Treatment (G3)	0.011	0.013	0.005	0.011	0.010	0.012	0.018	0.022
	(0.022)	(0.022)	(0.030)	(0.031)	(0.022)	(0.022)	(0.024)	(0.024)
F test (Prob >F)								
G1=G2	0.973	1.000	0.613	0.558	0.133	0.184	0.341	0.301
G1=G3	0.376	0.421	0.366	0.394	0.488	0.477	0.530	0.459
G2=G3	0.258	0.337	0.068	0.069	0.436	0.571	0.749	0.777
R-squared	0.045	0.051	0.074	0.082	0.024	0.033	0.026	0.039
Observations	3,970	3,937	2,663	2,643	2,663	2,643	2,663	2,643
Mean of Dep. Variable from G4	0.947		0.940		0.865		0.779	
Controls	No	Yes	No	Yes	No	Yes	No	Yes

Notes: This table is to test for systemic attrition by regressing a dummy of the survey or testing completion on a set of indicators for treatment arms. Two mean dependent variables from G4 in Columns (1)-(4) refer to the effective survey rate. The effective survey rate (ESR) a function of the regular school follow-up rate (RFR) and intensive home-visit follow-up rate (HFR) after we random selected 15% students from the attrition sample (Baird et al. 2012): ESR = RFR + (1-RFR) * HFR. *** Significant at the 1 percent level. ** Significant at the 5 percent level. * Significant at the 10 percent level.

Table A4: Heterogeneous effects by prior beliefs

	(1)	(2)	(3)	(4)	(5)	(6)
Sample	Full sample (9th-11th graders)			9th and 10th graders		
	G1 vs. G4	G2 vs. G4	G3 vs. G4	G1 vs. G4	G2 vs. G4	G3 vs. G4
Timing	Round 1					
Data	Hospital Administration Data					
MC offer	0.173***	0.191***	0.029	0.165***	0.186***	0.021
	(0.029)	(0.037)	(0.029)	(0.031)	(0.041)	(0.025)
Knowing MC benefit	-0.004	0.005	-0.001	0.006	0.004	0.003
	(0.013)	(0.013)	(0.013)	(0.013)	(0.014)	(0.013)
MC offer x Knowing MC benefit	0.008	-0.031	-0.004	0.002	-0.032	-0.022
	(0.023)	(0.031)	(0.027)	(0.028)	(0.034)	(0.027)
Think that MC is very painful	-0.017	-0.019	-0.016	-0.016	-0.024*	-0.014
	(0.012)	(0.012)	(0.012)	(0.013)	(0.012)	(0.012)
MC offer x Think that MC is very painful	-0.034	-0.060*	0.002	-0.042	-0.054	0.005
	(0.022)	(0.035)	(0.023)	(0.028)	(0.033)	(0.026)
Think that MC is only for Muslim	-0.028**	-0.031**	-0.031**	-0.014	-0.017	-0.014
	(0.013)	(0.013)	(0.014)	(0.017)	(0.016)	(0.018)
MC offer x Think that MC is only for Muslim	-0.022	-0.013	0.054	-0.029	-0.058	0.045
	(0.028)	(0.059)	(0.034)	(0.034)	(0.052)	(0.046)
R-Squared	0.136	0.165	0.080	0.120	0.184	0.072
Observations	2,590	1,975	1,977	1,697	1,315	1,305
Mean of Dep. Variable from G4		0.048			0.035	
Controls	Yes	Yes	Yes	Yes	Yes	Yes

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 school fixed effects and robust standard errors clustered by classroom are in parentheses. *** Significant at the 1 percent level. ** Significant at the 5 percent level. * Significant at the 10 percent level.

Table A5: When the most popular kid got MC offer in the 50% treatment classrooms

Dep. Var.	MC Take-up			
	(1)	(2)	(3)	(4)
Panel A:				
My MC offer	0.154***		0.154***	0.133***
	(0.019)		(0.019)	(0.031)
Most popular kid got MC offer		-0.268*	-0.264*	-0.282*
		(0.148)	(0.150)	(0.151)
My MC offer x Most popular kid got MC offer				0.035
				(0.039)
Classroom F.E.	Yes	Yes	Yes	Yes
Observations	1,350	1,350	1,350	1,350
R-squared	0.152	0.108	0.152	0.153
Panel B: When most popular kid thinks that MC is painful				
My MC offer	0.181***		0.181***	0.123***
	(0.026)		(0.026)	(0.047)
Most popular kid got MC offer		-0.294*	-0.284*	-0.331**
		(0.153)	(0.155)	(0.156)
My MC offer x Most popular kid got MC offer				0.087
				(0.056)
Classroom F.E.	Yes	Yes	Yes	Yes
Observations	613	613	613	613
R-squared	0.185	0.113	0.185	0.189
Panel C: When most popular kid thinks that MC is not painful				
My MC offer	0.134***		0.134***	0.143***
	(0.027)		(0.027)	(0.040)
Most popular kid got MC offer		-0.103	-0.094	-0.085
		(0.078)	(0.075)	(0.076)
My MC offer x Most popular kid got MC offer				-0.018
				(0.054)
Classroom F.E.	Yes	Yes	Yes	Yes
Observations	737	737	737	737
R-squared	0.140	0.110	0.140	0.140

Notes: This analysis uses a stacked 50% treatment classroom sample where unit of observation is single friendship relationship. Robust standard errors are shown in parentheses clustered at the classroom level. *** Significant at the 1 percent level. ** Significant at the 5 percent level. * Significant at the 10 percent level.

Table A6: Compliers Characteristics

Sample	MC takers in G1, G2, G3							
	N	Coefficient on G12	Std. Error	Constant	Std. Error	R squared	Mean of dep. Var.	Std. Dev.
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A. Baseline Characteristics								
Age (Year)	439	-0.668*	(0.359)	17.414***	(0.368)	0.013	16.834	(1.955)
Circumcising ethnicity	438	0.061	(0.055)	0.121**	(0.051)	0.003	0.174	(0.379)
Muslim	438	0.017	(0.020)	0.017	(0.018)	0.001	0.032	(0.176)
Orphan	439	0.035	(0.033)	0.052*	(0.029)	0.002	0.082	(0.275)
Father's tertiary education	438	0.037	(0.058)	0.155**	(0.059)	0.001	0.187	(0.391)
Mother's tertiary education	436	0.001	(0.035)	0.052	(0.034)	0.000	0.053	(0.224)
Father's white-collar job	439	0.089*	(0.046)	0.155***	(0.048)	0.005	0.232	(0.423)
Mother's white-collar job	437	-0.024	(0.050)	0.103*	(0.053)	0.001	0.082	(0.275)
Household asset count (0-16)	439	0.861	(0.581)	6.397***	(0.649)	0.008	7.144	(3.292)
Conventional schools	439	-0.084	(0.127)	0.362**	(0.148)	0.004	0.289	(0.454)
Ever had sex	438	-0.065	(0.081)	0.397***	(0.080)	0.002	0.340	(0.474)
Sexually active	439	-0.033	(0.043)	0.103**	(0.041)	0.002	0.075	(0.264)
Multiple partners	438	0.004	(0.016)	0.017	(0.016)	0.000	0.021	(0.142)
Inconsistent use of condoms	437	0.002	(0.022)	0.034	(0.024)	0.000	0.037	(0.188)
Number of condoms purchased	439	-0.316	(0.224)	1.103***	(0.222)	0.005	0.829	(1.578)
Think that MC is painful	438	-0.033	(0.059)	0.362***	(0.054)	0.001	0.333	(0.472)
Think that MC is only for Muslim	438	-0.088	(0.062)	0.207***	(0.063)	0.008	0.130	(0.337)
Panel B. 1st Follow-up Characteristics								
Ever had sex	350	0.009	(0.076)	0.326***	(0.075)	0.000	0.334	(0.472)
Sexually active	351	-0.034	(0.062)	0.152***	(0.054)	0.001	0.123	(0.328)
Multiple partners	350	0.013**	(0.006)	-0.000	(0.000)	0.002	0.011	(0.106)
Inconsistent use of condoms	350	0.014	(0.025)	0.022	(0.022)	0.001	0.034	(0.182)
Number of condoms purchased	353	0.071	(0.276)	0.913***	(0.255)	0.000	0.975	(1.693)
Think that MC is painful	352	0.065	(0.054)	0.109**	(0.047)	0.003	0.165	(0.372)
Think that MC is only for Muslim	352	0.021	(0.021)	0.022	(0.019)	0.001	0.040	(0.196)

Notes: This table compares compliers characteristics of students in G1 and G2 (G12) and those in G3 by restricting the sample to circumcision takers in G1, G2 and G3. Standard errors clustered by classroom are in parentheses. *** Significant at the 1 percent level. ** Significant at the 5 percent level. * Significant at the 10 percent level.

Table A7: Externalities on HSV2 and HIV Infections (50% Treatment class only)

	(1)	(2)	(3)	(4)	(5)	(6)
Sample	HSV2 IgG Positive		HSV2 IgM Positive		HIV Positive	
Data			2nd Follow-up			
Panel A						
MC offer	0.022	0.032	0.020**	0.019*	-0.000	-0.001
	(0.031)	(0.030)	(0.009)	(0.009)	(0.003)	(0.003)
R-squared	0.067	0.079	0.035	0.046	0.010	0.016
Panel B						
Peer offer	0.009	0.009	-0.005	-0.005	0.003*	0.003*
	(0.013)	(0.013)	(0.006)	(0.005)	(0.002)	(0.002)
R-squared	0.066	0.077	0.030	0.041	0.011	0.017
Panel C						
MC offer	0.023	0.032	0.020**	0.018*	-0.000	-0.001
	(0.031)	(0.030)	(0.009)	(0.010)	(0.003)	(0.003)
Peer offer	0.009	0.010	-0.005	-0.005	0.003	0.003*
	(0.013)	(0.013)	(0.005)	(0.005)	(0.002)	(0.002)
R-squared	0.067	0.079	0.036	0.046	0.011	0.017
Panel D						
MC offer	0.039	0.050	0.017	0.016	-0.003	-0.004
	(0.035)	(0.034)	(0.012)	(0.012)	(0.002)	(0.003)
Peer offer	0.026	0.027	-0.007	-0.007	-0.000	0.000
	(0.021)	(0.021)	(0.006)	(0.006)	(0.000)	(0.001)
MC offer x Peer offer	-0.033	-0.034	0.005	0.004	0.005	0.005
	(0.031)	(0.032)	(0.011)	(0.011)	(0.004)	(0.004)
R-squared	0.068	0.080	0.036	0.046	0.012	0.018
Observations	1,735	1,719	1,735	1,719	1,735	1,719
Mean of Dep. Variable from G4	0.113		0.017		0.002	
Controls	No	Yes	No	Yes	No	Yes

Notes: This analysis includes only the 50% Treatment classroom sample. Robust standard errors are shown in parentheses clustered at the classroom level. *** Significant at the 1 percent level. ** Significant at the 5 percent level. * Significant at the 10 percent level.