Peer Effects in the Demand for Male Circumcision *

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Abstract

This paper addresses two questions: 1) How to promote demand for male circumcision in the context of secondary schools in Malawi and 2) What is the role of peer effects in the demand for male circumcision. We randomly provided free male circumcision and transportation vouchers to male students across 33 public secondary schools near Lilongwe, Malawi. Using a two-step randomized design, we first assigned classrooms into three groups (100% Treatment, 50% Treatment, or No Treatment classrooms) and then also randomly selected half of male students in 50% Treatment classrooms for treatment. We find that our intervention substantially increased the demand for male circumcision by on average 15.4 percentage points (188%). We also find evidence of peer effects since untreated students in 50% Treatment classrooms were 3.8 percentage points (79%) more likely to get circumcised than students in No Treatment classrooms. Finally, we provide evidence of important reinforcement effects when close friends within the same classroom receive the intervention together. (JEL: C93, D1, I12)

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1 Introduction

HIV/AIDS is one of the worlds most serious health challenges and huge efforts have been put into practice worldwide to address this problem. Although HIV/AIDS treatment reached 8 million out of 34 million people living with HIV by the end of 2011, a 20-fold increase since 2003, HIV/AIDS prevention remains an important challenge since the number of new infected people in 2011 was 2.5 million, only 20% lower than in 2001 (UNAIDS 2012).

Various HIV/AIDS prevention strategies, including HIV/AIDS education, condom distribution, HIV testing, and conditional cash transfers have been implemented. Recently, male circumcision has received much attention after three studies showed that male circumcision can reduce HIV transmission risk by 50 percent (Auvert et al. 2005; Bailey et al. 2007; Gray et al. 2007). For example, the World Health Organization (WHO) strongly recommended male circumcision as a key strategy for reducing female to male transmission of HIV (WHO 2007), and there is a global mobilization for scaling up male circumcision especially in the countries with high HIV incidence of heterosexually-acquired HIV infection and low male circumcision.[1] However, the demand for male circumcision is still very low even with heavily subsidized price and proper information (Chinkhumba, Godlonton, and Thornton 2014). Major barriers are lack of information and accessibility and psychological cost including fear of pain, religious and cultural norms, and concern over a long recovery period.

In this paper, we first look at how improved access to male circumcision increases its demand. We also focus on the role that peer effect might play in increasing demand for circumcision. Specifically we study male students in secondary school in Malawi who had a reasonable chance of being or becoming sexually active.[2] In our experimental school setting, we randomly assign classrooms into three groups: 100% Treatment, 50% Treatment, or No Treatment classroom. All students in 100% Treatment classroom are received free male circumcision offer with transportation support while no students in No Treatment classroom received the offer. In 50% Treatment classroom, randomly selected half of students receive the offer. Students are allowed to take-up free male circumcision at the assigned hospital, but only randomly selected subset of students was offered transportation

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

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

support.

The role of peer effects in the male circumcision context is theoretically ambiguous. It may be positive if friends might provide emotional support that reduces psychological cost or private information about the benefits of the circumcision procedure. Alternatively, negative experience from male circumcision (i.e. complication or pain) might decrease a friends demand for male circumcision. Through a detailed survey of peer networks in the classroom and in school, combined with random assignment, we study how peer effects affect the demand for male circumcision.

Our paper contributes to a growing literature of role of peer effect in health intervention programs in developing countries. For example, Godlonton and Thornton (2012) find significant peer effect in the take up of HIV testing in Malawi. A 10 percent point increase in the probability of having a neighbor within 0.5km learning his/her HIV result leads to a 1.1 percent point increase in learning ones own HIV result. Chong et al. (2013) also find that the treatment effects of online sexual education are largest when the peers were treated together. Oster and Thornton (2012) also find a strong positive peer effect on take-up of new health technology (menstruation cup) in the short term, but not in the long term.[3]

In our setting, an intervention that was mainly based on offering transportation incentives is used to generate arguably exogenous variation in the cost of male circumcision. We find that male students who received a transportation incentive are around three times more likely to take-up male circumcision. In addition, untreated students in 50% Treatment classrooms were 79% more likely to get circumcised than students in No treatment classrooms, suggesting positive externality in demand for male circumcision. Additionally we find evidence of important reinforcement effects when close friends within the same classroom receive the intervention together.

2 Background, Experimental Design, and Data

2.1 Background: Male circumcision in Malawi

Malawi is located in southeast sub-Saharan Africa with the population of 15.9 million people and a low life expectancy of 55 years (UNFPA 2012). It is estimated that 10.6% of people aged 15 to

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

54 years are living with HIV and prevalence of male circumcision in Malawi is very low with 21.6% of men being circumcised (NSO 2011).[4] Male circumcision is practiced 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).[5]

The numbers of male circumcisions per year in Malawi were very small (589 in 2008, 1,234 in 2009, and 1,296 in 2010) but it has recently begun to substantially increase due to the scale-up project. For the year 2011 alone, 11,881 people became circumcised (WHO 2012). However, the estimated number of male circumcision between 2008 and 2011 in total is only 0.7% of the target number (2.1 million) to achieve 80% of male circumcision prevalence in Malawi. There is an ongoing debate about the main factors explaining the low take-up of circumcision in Malawi, which range from limited access to the circumcision surgery to very low demand for male circumcision.[6] In addition, the Malawian Government recognizes the need to improve the current awareness, knowledge, and attitude on male circumcision in order to increase informed demand for circumcision among the non-circumcising population (NAC 2012).[7]

2.2 Experimental Design

The male circumcision program was a part of broader HIV/AIDS prevention program, which includes HIV/AIDS education, male circumcision, and conditional cash transfers. This program was implemented in a sample of 3,974 boys (9^{th} - 11^{th} grade) at 33 public schools in four rural districts in Lilongwe, Malawi. As discussed previously, the provision of the male circumcision intervention as well as the other interventions in the context of secondary schools was of interest because for

[4]The true prevalence of complete male circumcision is likely to be much lower than this because many of those reporting being circumcised practice incomplete circumcision which removes part of the foreskin. Incomplete circumcision may not have the protective benefits of male circumcision (Bengo et al. 2010)

[5]Most of Muslim and Yao people live in the southern region of Malawi while the majority of ethnicity in the central region to which the project catchment is belonging is the Chewa. Chewa people consist of 34.1% of the total population and only 6.2% of them practice male circumcision according to Malawi DHS 2010.

[6]Malawi Government is trying to build medical male circumcision delivery capacity within existing health facilities and to expand medical circumcision training into clinical officers and registered nurses (GOM 2012)

[7]The acceptability of male circumcision in Malawi among non-circumcised people who received information on the medical benefits was 36.8% (Bengo et al. 2010) while the median proportion of uncircumcised men willing to get circumcised from 13 studies in sub-Saharan Africa was 65% (Westercamp and Bailey 2007). However, the willingness to get circumcised does not necessarily mean actual circumcision take-uptake-up decision. The recent study to quantify the actual demand for male circumcision in Malawi shows that only 41 men or 3.3% out of 1,252 uncircumcised adult men got medical circumcision service (Chinkhumba, Godlonton, and Thornton 2014).

this population it represents the formative years for sexual and reproductive behavior.

Table 1 shows the experimental design of the study. We stratified 124 classrooms of 33 schools by grade and randomly assign classrooms 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 (Group 1). No students in the No Treatment classrooms received an offer (Group 4). In 50% Treatment classroom, we randomly selected half of students at individual level for the treatment (Group 2), and the remaining students were not treated (Group 3). The experiment design that randomizes treatment across classes and also within classroom allows us to measure not only direct effect but also peer effect of the male circumcision offer. This two-step randomized design is similar to the design used in Duflo and Saez (2003) to estimate peer effects.

The male circumcision offer consists of free surgery at the assigned hospital and two complication check-ups (3-day and 1-week after surgery) at students school. For transportation subsidies, students can choose either direct pick-up service or transportation voucher which is reimbursed after circumcision surgery at the hospital. The amount of a transportation voucher varies according to the distance between the hospital and students school.[8]

Table 1: Experimental Design

	Group	Assignment	Classrooms	Students
100% Treatment	G1	Treatment	41	1,293
50% Treatment	G2	Treatment	41	679
	G3	No treatment		679
No Treatment	G4	No treatment (Control)	42	1,323
Total			124	3,974

Notes: The randomization was done in two stages. First, classrooms for each grade across 33 schools were randomly assigned to 100% treatment, 50% treatment and no treatment. Then, within 50% treatment, only half of the students were randomly assigned to treatment at individual level.

[8] 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 walk to the hospital if they choose the voucher option.

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. Free male circumcision surgery and transportation subsidies were provided to a total of 1,972 male students after the baseline survey in 2012 and the remaining 2,002 male students who were temporarily untreated (Group 3 and Group 4) received the same treatment one year later.[9]

We first collect the list of enrolled students at 33 participating schools. The baseline survey was performed to measure detailed baseline information including demographic information, HIV knowledge, sexual behaviors, and friendship network. At the end of the survey we gave students 10 kwacha (6 cents), and sold condoms with subsidized price at 5 kwacha to measure a demand for safe sex.

Table 2 presents a summary statistics and randomization balance. Column (1) in Table 2 shows the average age of students is 16.7 years old and 17% of the sample is belonging to circumcising tribes, defined as a tribe with over 20% circumcised men in 2010 Malawi DHS. 6% reported that they are religiously Muslim.[10] In general, students showed high level of HIV/AIDS knowledge (Average number of correctly answer questions are 17.32 (86.6%) out of 20 questions) but relatively low knowledge on the medical benefit of male circumcision (63.9%).[11] 45.9% of the sample has experience of HIV voluntary testing in the past and 9.2% of the students self-report that they are currently engaged in sexual relationship.

Column (2) in Table 2 presents a test of the randomization balance. We find that all but one observable characteristic (% Muslim) are not significantly different between the treatment and control group. Furthermore, the p-value of joint F-test from a regression of treatment on a full set of baseline characteristic is 0.285, meaning that it does not reject the null hypothesis that all baseline coefficients are jointly equal to zero.

The follow-up survey was conducted after a year. The effective survey follow-up rate is 91.9%.[12]

[9] 518 and 123 students circumcised in the first and second round, respectively. The period for the second round was much shorter than the first round.

[10] There are 240 Muslim students in the sample and 84.6% of them reported that they have been circumcised before the baseline survey.

[11] Not shown, 39% believed male circumcision is very painful and 15% has a misconception that male circumcision is only for Muslim.

[12] 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 random selected 15% students from

Table 2: Baseline statistics and Randomization Balance

Dependent variable:	Avg. (S.D.) (1)	Male circumcision offer (2)
Age (year)	16.65	-0.010
	(1.94)	(0.008)
Circumcision ethnicity	0.170	0.029
	(0.376)	(0.022)
Muslim	0.060	0.070*
	(0.238)	(0.040)
Orphan	0.057	-0.026
	(0.232)	(0.037)
Father's tertiary education	0.180	-0.015
	(0.384)	(0.027)
Mother's tertiary education	0.068	-0.010
	(0.253)	(0.037)
Father's white-collar job	0.239	0.027
	(0.426)	(0.023)
Mother's white-collar job	0.096	-0.030
	(0.295)	(0.034)
Household asset count (0-16)	7.38	0.003
	(3.46)	(0.006)
Conventional school	0.243	-0.002
	(0.429)	(0.079)
Repeated in primary school	0.777	0.001
	(0.416)	(0.023)
HIV/AIDS knowledge (0-20)	17.32	-0.006
	(1.73)	(0.007)
HIV testing experience	0.462	0.039
	(0.499)	(0.031)
Currently in sexual relation	0.092	-0.030
	(0.288)	(0.035)
p-value of joint F-test		0.285
Observations		3,943
R-squared		0.008

Notes: This sample consists of 3,974 male students who were interviewed at baseline survey. Circumcising ethnicity is defined as a tribe with over 20% of male population circumcised in 2010 Malawi DHS. Parents' tertiary education is 1 when parents graduate from a 2-year college or a 4-year university. Parents' white-collar job is 1 when parents have a government or professional job. Household Assets count is defined the total number of assets they have from 16 asset questions. HIV/AIDS knowledge is constructed by counting the correct answers from 20 HIV/AIDS knowledge questions. Condom Attitude is constructed by counting the appropriate answers from 18 questions. Column (2) presents results of a regression of male circumcision offer on a full set of baseline characteristics. It shows randomization balance for male circumcision intervention through OLS regression with grade fixed effects. Robust standard errors clustered by classroom are in parentheses.

*** p<0.01, ** p<0.05, * p<0.1

67.9% of the baseline sample students (or 2,698 students) completed the school follow-up survey.[13] We implemented an intensive home follow-up survey for randomly selected 15% students (191 students) among students who did not participate in the school follow-up survey. The home survey follow-up rate was 74.9%. Table 3 presents the determinants of participation in the follow-up survey. Columns (1) and (2) show that there is no differential attrition across the circumcision offer (Column (1)) and other baseline characteristics (Column (2)). Columns (3) and (4) present the result of regression on baseline characteristics and interactions between baseline characteristics and the offer. We also do not find evidence of systematic attrition.

Friendship networks were measured in several dimensions. We first asked students to list three best friends within school and classroom, respectively.[14] In the analysis, we reconstructed friendship data by reordering best male friends after excluding friends without baseline survey and female friends. Table 4 shows summary statistics of in-class friendship networks. In Panel A, Column (1) includes an original friendship network data. Column (2) presents friendship statistics including eligible male friends and excluding female friends and those who did not participate in baseline survey. Based on eligible male friends, we reordered the remaining friendship as shown in Column (3). Around 80% of the sample students have at least two male friends among his three best friends. Panel B presents the network treatment distribution among eligible male friends. It shows substantial variation in the fraction of best male friends who got treated and the fraction of treated friends is well balanced across the baseline characteristics (not shown).

the attrition sample (Baird et al. 2012).

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

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

Table 3: Survey attrition

Dependent variable	= 1 if surveyed in follow-up or home-visit surveys			
	Treatment	Adjusted	Main effect	Interaction
	(1)	(2)	(3)	(4)
Male circumcision	-0.022	-0.017		-0.225
	(0.018)	(0.018)		(0.206)
Age (year)		-0.002	-0.000	-0.003
		(0.005)	(0.006)	(0.008)
Circumcision ethnicity		-0.010	-0.028	0.029
		(0.023)	(0.034)	(0.047)
Muslim		-0.046	-0.015	-0.061
		(0.036)	(0.053)	(0.068)
Orphan		-0.007	0.002	-0.020
		(0.030)	(0.041)	(0.060)
Father's tertiary education		-0.009	-0.026	0.035
		(0.023)	(0.030)	(0.044)
Mother's tertiary education		-0.033	0.014	-0.083
		(0.039)	(0.054)	(0.074)
Father's white-collar job		-0.010	0.025	-0.067**
		(0.018)	(0.026)	(0.033)
Mother's white-collar job		-0.001	0.002	-0.008
		(0.033)	(0.040)	(0.061)
Household asset count		-0.000	-0.010***	0.018***
		(0.003)	(0.003)	(0.005)
Conventional school		0.050**	0.043	0.011
		(0.022)	(0.028)	(0.036)
Repeated in primary school		0.010	-0.008	0.032
		(0.016)	(0.024)	(0.031)
HIV/AIDS knowledge		0.000	-0.003	0.007
		(0.004)	(0.005)	(0.007)
HIV testing		-0.030	0.003	-0.066*
		(0.019)	(0.023)	(0.036)
Currently in sexual relation		-0.053	-0.104**	0.117*
		(0.032)	(0.047)	(0.062)
Observations	3,974	3,943	3,943	
R-squared	0.012	0.019	0.028	

Notes: Regressions are OLS models with grade fixed effects. Columns (3) and (4) present results from one regression with main effects (column (3)) and all covariates interacted with male circumcision offer (column (4)). Robust standard errors clustered by classroom are in parentheses. The weight of 6.67 is given to home-visit survey sample.

*** p<0.01, ** p<0.05, * p<0.10

Table 4: In-class Friendship Networks: Summary Statistics

Panel A: Friendship Reconstruction

	(1) Raw count	(2) Eligible male	(3) Reordered eligible male
First-best friend	3,848	3,268	3,836
Second-best friend	3,844	3,162	3,137
Third-best friend	3,866	3,198	1,621

Panel B: Friendship link treatment status

	Cases	Percent
No friends treated	1,702	42.8%
1 friend treated	831	20.9%
2 friend treated	825	20.8%
3 friend treated	616	15.5%

Notes: Panel A Column (1) includes raw friendship data including friends without baseline survey and female friends. Column (2) excludes friends without baseline survey from Column 1. Column (3) excludes female friends from column (2). Finally, we reorder the remaining friendship data from column (3) 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 (4)).

3 Estimation Strategy

We employ a number of empirical strategies to capture the direct effect of being assigned to the free male circumcision offer and transportation support intervention as well as possible peer effects in this setting. In each specification both OLS and probit model are used. Our first empirical strategy estimates the following model:

$$Y_{ij} = b_0 + b_1 G1_{ij} + b_2 G2_{ij} + b_3 G3_{ij} + r' X_{ij} + \delta_i + \varepsilon_{ij} \quad (1)$$

where Y_{ij} denote an outcome of interest such as male circumcision take-up for individual student i in classroom j. 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, parents education, parents job, household assets and school type.[15] δ_i is grade fixed effects, and ε_{ij} is a random error. 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.

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

In these specifications, b_3 captures possible peer effects, given that it compares average take-up of circumcision for students who are not assigned to the intervention but who are in a classroom where 50% of their male peers received this offer (group G3) to base group of students who did not receive the intervention and who are in a classroom where nobody received the intervention (group G4). In some of our specifications, we also restrict ourselves only to the 50% Treatment classrooms. The cleanest way to estimate the main direct effect of the intervention is by comparing the difference in outcomes between students in group G2 who received the intervention and students in group G3 who did not receive the intervention. 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 with the data from the friendship rosters. We try to measure these effects in the restricted sample of 50% Treatment classrooms. We restricted our sample since there is no within class variation in 100% Treatment and No Treatment classrooms. The following linear regression is estimated:

$$Y_{ij} = b_0 + b_1 Offer_{ij} + b_2 Peer_{ij} + r' X_{ij} + \delta_i + \varepsilon_{ij} \tag{2}$$

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

$$Y_{ij} = b_0 + b_1 Offer_{ij} + b_2 Peer_{ij} + + b_3 Offer_{ij} * Peer_{ij} + r' X_{ij} + \delta_i + \varepsilon_{ij} \tag{3}$$

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

4 Results

4.1 Main results

We first look at the impact on demand for male circumcision by estimating equation (1).[16] Table 5 presents the OLS (columns (1) to (2)) and Probit estimates (columns (3) to (4)). Dependent variables in Panel A and B are male circumcision take-up before the control group offer (first round) and overall study period (first and second round), respectively. Panel A1 and B1 present results of whole sample and Panel A2 and B2 show results of restricted sample of 50% Treatment classrooms. The coefcients are all positive and signicant, and similar across the specifications. Columns (1) to (4) of Table 5 present results of equation (1). As shown in column (2) of Panel A1, students assigned to 100% Treatment and 50% Treatment classrooms were 14.2 and 18.9 percentage points (296% and 394%) more likely to get circumcised than students in control classrooms, respectively. We also found that treated students were 15.4 percentage points (188%) more likely to take male circumcision compared to untreated peers among 50% Treatment classrooms shown in Panel A2. Group 3, untreated students in 50% Treatment classrooms, were 3.8 % points (79%) more likely to receive male circumcision than No treatment classroom students (Panel A1), and this result reflects the spillover effects within classroom from the other half of classmates who received the offer of male circumcision. Moreover, this increase persists (and even increases) at the end of the study period. (Panel B1). Peer effects are discussed further in Section 4.2.

Table 6 presents heterogeneous treatment effects by prior beliefs. Column (1) shows that the male circumcision offer increases male circumcision take-up by on average 14.6 percentage points (244%). Columns (2) to (4) show heterogeneous treatment effects by prior knowledge on benefit of male circumcision, prior belief on pain of male circumcision, and religious norm. Our most interesting results are in column (3): while there are lower circumcision rates among those who perceive the procedure to be painful, we also find evidence consistent with smaller responses to the circumcision intervention among those who think that circumcision is painful. This finding is consistent with those found in Chinkhumba, Godlonton, and Thornton (2014).

[16] Male circumcision take-up is measured from the assigned hospital administration data. It is very unlikely for students to get circumcised in other medical facilities because there are few facilities nearby to provide male circumcision on a regular basis. One exception is Banja La Mtsogolo (BLM) located in AREA 25 of Chitukula district, which is one of four catchment districts. However, they charge around $10 for the surgery and complication check-ups, which seriously dampen the demand, especially for the secondary school students.

Table 5: Impact on Male Circumcision Take-up

Dependent variable:	Circumcision take-up			
	OSL		Probit	
	(1)	(2)	(3)	(4)
Panel A1. Round 1, whole Sample				
100% Treatment (G1)	0.138***	0.142***	0.174***	0.179***
	(0.027)	(0.027)	(0.035)	(0.036)
50% Treatment (G2)	0.193***	0.189***	0.264***	0.261***
	(0.030)	(0.031)	(0.045)	(0.046)
50% No Treatment (G3)	0.041**	0.038*	0.070*	0.068*
	(0.020)	(0.021)	(0.036)	(0.036)
p-value of F-test: (100% treatment = 50% treatment)	0.1452	0.2181	0.0942	0.1822
Mean of Dep. Var. in Control		0.048		
Controls	No	Yes	No	Yes
Observations	3,974	3,952	3,974	3,952
Panel A2. Round 1, 50% Treatment classroom only				
Treatment	0.151***	0.154***	0.149***	0.146***
	(0.032)	(0.033)	(0.029)	(0.028)
Mean of Dep. Var. in Control		0.082		
Controls	No	Yes	No	Yes
Observations	1,358	1,350	1,358	1,350
Panel B1. Round 1 & 2, whole sample				
100% Treatment (G1)	0.095***	0.099***	0.114***	0.118***
	(0.029)	(0.029)	(0.034)	(0.035)
50% Treatment (G2)	0.162***	0.155***	0.199***	0.189***
	(0.030)	(0.031)	(0.039)	(0.040)
50% No Treatment (G3)	0.074***	0.066**	0.098***	0.089**
	(0.028)	(0.027)	(0.038)	(0.036)
p-value of F-test: (100% treatment = 50% treatment)	0.0738	0.1495	0.0502	0.1349
Mean of Dep. Var. in Control		0.094		
Controls	No	Yes	No	Yes
Observations	3,974	3,952	3,974	3,952
Panel B2. Round 1 & 2, 50% Treatment classroom only				
Treatment	0.088***	0.092***	0.089***	0.091***
	(0.025)	(0.026)	(0.025)	(0.025)
Mean of Dep. Var. in Control		0.158		
Controls	No	Yes	No	Yes
Observations	1,358	1,350	1,358	1,350

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

Table 6: Heterogeneous effects by prior beliefs

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

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

Next we revisit the analysis of peer effect using the second strategy which also uses the reported friend networks. We take advantage of the random assignments of male circumcision offer to a student and his friends within a classroom to understand peer interactions for the decision to get circumcised. Table 7 presents the results of the equation (2) and (3). While Panel A repeats the main effects discussed earlier, we present in Panels B and C, the peer effect of having a higher proportion of friends who are treated on your own decision to get circumcised. Our preferred estimates from Panel C that estimate equation (2) are also positive and quantitatively important, but they are not statistically significant at conventional levels.

The most striking results in Table 7 are those in Panel D, which estimate equation (3) and provide evidence of a complementarity between a students offer and his friends offer that increase the a students take-up of circumcision. The interaction between the offer and the rate of friends who received the offer is large (about 17%), statistically significant and robust across the four specifications and suggest the existence of important reinforcement effects among school peers in our Malawian setting.

Table 7: Externalities on Male Circumcision Uptake

Dependent variable:	Circumcision take-up			
	(1)	(2)	(3)	(4)
Panel A:				
MC offer	0.151***	0.154***	0.150***	0.154***
	(0.019)	(0.019)	(0.033)	(0.019)
Panel B:				
Rate of friends who got MC offer	0.043	0.038	0.038	0.035
	(0.035)	(0.034)	(0.038)	(0.036)
Panel C:				
MC offer	0.151***	0.155***	0.151***	0.154***
	(0.019)	(0.019)	(0.033)	(0.019)
Rate of friends who got MC offer	0.050	0.044	0.047	0.043
	(0.034)	(0.033)	(0.039)	(0.035)
Panel D:				
MC offer	0.086***	0.093***	0.083**	0.092***
	(0.030)	(0.030)	(0.038)	(0.030)
Rate of friends who got MC offer	-0.040	-0.040	-0.047	-0.042
	(0.036)	(0.036)	(0.040)	(0.040)
MC offer x Rate of friends who got MC offer	0.177***	0.165**	0.186**	0.169***
	(0.067)	(0.066)	(0.072)	(0.064)
Mean of Dep. Var.	0.158			
grade fixed effects	x	x		
classroom fixed effects			x	x
Controls	No	Yes	No	Yes
Observations	1,358	1,350	1,358	1,350

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

4.2 Impact of male circumcision on sexual behaviors

Table 8 presents the impact of male circumcision on a range of sexual behaviors. Columns (1) to (3) report the results on condom attitude, willingness to buy condoms, and the number of condom purchased. As mentioned earlier, we sold subsidized condoms to address the limited reliability of self-reported sexual behaviors. Our coefficients are generally imprecise and do not imply large effects, with the possible exception of reinforcement effects between own and friends' offer. In Panel B2 we observe significant and large increases in the willingness to purchase and the number of condoms purchased. Columns (4) to (11) present preliminary results on self-reported sexual behaviors (such as having a sexual partner, the age of the partner, previous sex experience) and they imply a limited impact on sexual activities. While our measures of sexual behavior suffer from well-known self-reporting biases, they do not suggest that moral hazard (i.e. an increase of risky sexual behaviors after male circumcision) plays a major concern in this setting.

Table 8: Impacts on Sexual Behaviors

Dependent variables:	Condom attitude (0-18) (1)	Willingness to buy condoms (2)	No. of condoms purchased (3)	Sex experience (4)	Age for first sex (5)	Currently in Sex relation (6)	Multiple sex partners (7)	Sex with friend in school (8)	Sex with friend outside school (9)	Age for last sex partner (10)	STI experience (11)
Panel A. Whole sample											
Male Circumcision	-0.011	0.011	0.053	-0.003	-0.308	-0.001	0.001	0.016	-0.042**	-0.346*	0.050
	(0.168)	(0.023)	(0.093)	(0.023)	(0.199)	(0.020)	(0.023)	(0.016)	(0.018)	(0.191)	(0.052)
Obs.	2,834	2,824	2,818	2,835	905	2,835	2,835	2,835	2,835	472	2,757
Mean of Dep. Var.	12.85	0.256	1.008	0.319	15.72	0.126	0.158	0.054	0.097	16.17	0.037
Panel B. 50% Treatment Classroom only											
Panel B1											
MC offer	-0.052	0.045	0.254	-0.038	-0.512	-0.013	-0.002	0.012	-0.021	-0.365	0.192
	(0.244)	(0.037)	(0.152)	(0.033)	(0.410)	(0.032)	(0.029)	(0.022)	(0.037)	(0.381)	(0.183)
Panel B2											
MC offer	-0.246	-0.071	-0.272	-0.120	-0.885	-0.004	-0.118*	-0.027	-0.011	-1.029	0.487
	(0.541)	(0.056)	(0.222)	(0.077)	(0.633)	(0.051)	(0.061)	(0.025)	(0.069)	(0.737)	(0.463)
% of friends who got MC offer	0.669	-0.156	-0.604	-0.105	-1.598	0.030	-0.154*	0.010	0.014	-0.662	0.098
	(0.788)	(0.114)	(0.461)	(0.129)	(1.361)	(0.098)	(0.089)	(0.044)	(0.102)	(0.837)	(0.094)
MC offer x % of friends who got MC offer	0.542	0.298**	1.361**	0.211	0.972	-0.022	0.301**	0.103	-0.025	1.541	-0.772
	(1.162)	(0.126)	(0.526)	(0.154)	(1.608)	(0.157)	(0.134)	(0.079)	(0.167)	(2.101)	(0.748)
Mean of Dep. Var.	12.82	0.267	1.065	0.319	15.58	0.121	0.167	0.052	0.095	16.26	0.108
Observations	936	932	929	936	299	936	936	936	936	152	912

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

5 Conclusion

This paper addresses two questions on demand for male circumcision: 1) How to promote demand for male circumcision and 2) What is the role of peer effects in demand for male circumcision. To do this, we implement 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 15.4 percentage points (188%). Moreover, we find evidence consistent with important positive peer effects as well as reinforcement effects among school peers in our Malawian setting.

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