

“Is it bulletproof?” Correlates of perception on the protective effect of male circumcision in Malawi

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Abstract

Voluntary male medical circumcision (VMMC) is a highly cost-effective intervention in the fight against new HIV infections. However, despite efforts to scale up VMMC in Malawi uptake remains below the intended target. One potential contributing factor to this issue is a lack of correct understanding regarding the protective benefits of VMMC. This paper is the first to use nationally representative data to find the correlates of understanding the VMMC protective effect. We used data from the Malawi Population-based HIV Impact Assessment (MPHIA) of 2015. The findings show that a large proportion of respondents still lacked a clear understanding of the protective benefits of VMMC. These findings highlight the need for increased efforts to disseminate correct information regarding the protective benefits of male circumcision. Furthermore, integrating this information into the school curriculum could be another effective way of increasing knowledge. Overall, this paper underscores the importance of improving public knowledge and awareness of the benefits of VMMC in Malawi as part of a comprehensive approach to reducing the transmission of HIV.

Keywords: HIV and AIDS; circumcision; MPHIA; Malawi

1. Introduction

Studies have shown that voluntary medical male circumcision (VMMC) can have a protective effect against HIV of up to 60% (Auvert *et al.*, 2005; Bailey *et al.*, 2007; Gray *et al.*, 2007; Procter and Kaul, 2017; WHO, 2019). VMMC is currently the only one-off HIV prevention tool available, making it a long term cost-effective tool, as demonstrated by some studies (Galárraga *et al.*, 2018). Following the WHO recommendation in 2007, several countries have rolled out its implementation with a concentrated focus being made in countries highly affected by HIV and AIDS (Ledikwe *et al.*, 2014; Hines *et al.*, 2017). The 2019 UNAIDS report reaffirms the social and clinical benefits of VMMC as an effective HIV prevention method. In addition, the report highlights that VMMC serves as an entry point for providing men and boys with a range of health services, leading to broader health benefits and improved health outcomes. At the United Nations High-Level Meeting on Ending AIDS in June 2016, a new target was set in political declaration to reach 25 million young men with VMMC services in high incidence areas by 2020 (Assembly, 2016). By the end of December 2018, only 11 million circumcisions had been performed in 15 priority countries in eastern and southern Africa, including Malawi. Given the current pace of implementation, achieving the 25 million circumcisions by 2020 may be unrealistic.

VMMC scale-up and uptake have varied across countries due to several factors. Previous studies have documented a combination of factors that have led to either increased as well as low uptake of VMMC across countries and communities. In Kenya fear of pain during and after the procedure, concerns about loss of income during the healing period and fear of being shunned by the community have been identified as some of the factors contributing to low uptake of VMMC (Galárraga *et al.*, 2018). Similarly in Zimbabwe, the fear of the unknown and concerns about potential unsatisfactory sexual performance are among the primary reasons for the low uptake of VMMC among eligible individuals (Chikutsa and Maharaj, 2015).

Several studies have focused on studying the level of knowledge about the protective effect of VMMC, yet to date, little is understood about the factors that contribute to one's level of knowledge about the protective effect of VMMC. In a study to understand the meaning attached to circumcision among men and women in Zimbabwe, it was found that being circumcised is considered to be clean and that a circumcised penis is much cleaner compared to an uncircumcised one (Chikutsa and Maharaj, 2015). In a study looking at knowledge attitude and acceptance of VMMC among male students in Botswana, the differences in the level of knowledge about the protective effect of VMMC were higher than previously reported in other studies (Tapera *et al.*, 2017). However, the sample from this study was not nationally

representative as it focused on the younger population, hence raising questions regarding the generalisability of the results.

A more recent systematic review noted that women’s knowledge about the protective effect of VMMC also plays a critical role in promoting uptake in their communities. However, the proportion of women with the correct knowledge of the VMMC effect between countries and groups ranged from 9.8% to 91.8% (Grund *et al.*, 2019a). With reference to Malawi, the need for further studies regarding VMMC information has been established (Maughan-Brown *et al.*, 2015). Very few papers touch on the angle of perceived benefits of male medical circumcision for sexual pleasure and HIV protection in Malawi (Mkandawire *et al.*, 2014; Rennie *et al.*, 2015; Shacham *et al.*, 2014; Zamawe & Kusamula, 2016). Contrary to popular belief, such studies have found that most women would indulge in risky sexual behaviour if they learnt of their partners’ partial HIV-protective benefits due to circumcision (Kapumba and King, 2019). The results vary substantially among these studies, thereby allowing for further inquisition. Not only that, the studies were of limited samples, thereby providing less generalisability to the nation as a whole, as compared to our sample size, which is national.

Knowledge about the protective effect of VMMC plays a big role in the uptake of VMMC services (Chikutsa and Maharaj, 2015). Therefore, this paper will contribute to the existing literature gap relating to factors contributing to knowledge about the VMMC protective effect. Our study goes beyond the analysis from the previous studies in the literature as it answers three questions; (1) Does male circumcision alone reduce the risk, or chance, of a man getting HIV completely? (2) Do you agree or disagree with the following statement: Men who are circumcised do not need to use condoms to protect themselves from HIV? (3) Do you agree or disagree with the statement: Circumcised men can have multiple sexual partners and not be at risk for HIV? Furthermore, our data is nationally representative compared to most studies and much more recent, beyond the VMMC intervention periods. This is therefore important as it makes the results generalisable to the whole country. We use data from the Malawi Population-based HIV Impact Assessment (MPHIA) 2015-16 national survey, involving an analytical sample of respondents aged 15-64 from 11000 households.

Conducting this analysis in Malawi is important considering that Malawi is one of the countries with low VMMC uptake, well below its national target and could benefit considerably from insights generated from this analysis (NSO and International, 2016; Carrasco, Nguyen and Kaufman, 2018). The 2015 to 2022 National HIV Strategic Plan planned to conduct 2,458,727 VMMCs to be performed among males aged 10-34 years from 2015 to 2020 to achieve 60% coverage. This was meant to avert 91,746 new infections by the end of the year 2050. However, from 2012 to 2017, Malawi had

only performed a cumulative total of 561,313 VMMC representing 23% of the number of VMCMs required to reach the 60% coverage.

On the other hand, the current National HIV Strategic Plan (2020-2025) sets a target of 940,000 VMCMs to be performed over 5 years to attain 80% coverage in the 15-49 age brackets in the 12 priority districts in Malawi. However, only about 939 573 VMCMs were conducted by 2020, approximately 38% of the target (NAC, 2020; Matoga *et al.*, 2022). Given the current pace of implementation, achieving the 2025 target would, therefore, require accelerated efforts toward increasing uptake among eligible people. Hence, understanding people's perceptions towards VMCM is key to successfully implementing and achieving the above target.

Apart from the above, understanding people's perceptions of circumcision may be important to unearth factors that have the potential to hamper the Malawi Development Goal of reducing HIV. Not only that, but it would also help identify potential factors that could impinge on the reduction of HIV prevalence as set out in the Sustainable Development Goal 3.3. This would also mean that the country would identify potential factors that may feed into policy, which would help reduce the socio-economic inequality in HIV knowledge (Chirwa, Sithole and Jamu, 2019; Chirwa, 2020).

2. Material and methods

Data

The study used data from the Malawi Population-Based HIV Impact Assessment (MPHIA). This was a household-based national survey conducted between November 2015 and August 2016. The survey aimed to measure the status of Malawi's national HIV response. This was the first survey in Malawi which measured national HIV incidence, pediatric HIV prevalence, and viral load suppression. In terms of design, the MPHIA used a two-stage, stratified cluster approach based on the 2008 Malawi Population and Housing Census. The first stage involved selecting 500 Enumeration Areas (EA) using a probability proportional to size method. In the second stage, a sample of households was randomly selected within each EA or cluster (MoH, 2017; MPHIA, 2019).

The survey was implemented by ICAP at Columbia University in collaboration with local partners, including the Centre for Social Research (CSR) at the University of Malawi, the National Statistical Office (NSO), and the College of Medicine-Johns Hopkins Project (COM-JHP) at the University of Malawi (MoH, 2017; MPHIA, 2019). The data is in a public repository. For a detailed description of the data and download, please visit <https://phia-data.icap.columbia.edu/>.

Ethical clearance

This paper uses secondary data from MPHIA. All survey procedures comply with the World Medical Association Declaration of Helsinki (World Medical Association, 2008). Ethical clearance for the study was done by the Institution Review Boards from Malawi and the USA. These include the National Health Sciences Research Committee in Malawi (NHSRC) and the Institutional Review Boards at the Center for Disease Control and Prevention (CDC; Atlanta, USA), Columbia University Medical Center and Westat (a statistical survey research organisation). Consent was obtained using an electronic tablet, where the participant had to sign or use a fingerprint as a sign of agreement. The respondents were recruited only if they agreed to the consent. During the consent process, respondents were told in advance that the data would be used in future research. Data were anonymised to allow for secondary data use in research (MoH, 2017; MPHIA, 2019).

Dependent Variables

In the survey, people were asked to indicate their understanding of three questions regarding circumcision. The first question was, does male circumcision alone reduce the risk, or chance, of a man getting HIV completely? The responses were 1 - protects completely, 2 - protects somewhat, 3 - not at all, 4-do not know. We thus coded this variable to take a value of 1 if a respondent answered that circumcision offers partial protection, i.e. the respondent said “protects somewhat” and zero otherwise. The second question which was asked was, do you agree or disagree with the following statement: Men who are circumcised do not need to use condoms to protect themselves against HIV? The response to this question was 1 – agree, 2 – disagree, 3 - unsure/do not know. This variable was assigned a value of 1 if a respondent indicated that they disagreed and zero otherwise. The third question was, do you agree or disagree with the following statement: Men who are circumcised can have multiple sexual partners and not be at risk of HIV? To this question, the participants were asked to select from one of the responses, 1 – agree, 2 – disagree, 3 - unsure/do not know. In the analysis, this variable was assigned a value of 1 if the respondent disagreed (i.e. option 2) and zero otherwise.

Independent variables

We based our choice of dependent variables on the previously mentioned studies. In this paper, work status was recoded as 1 if the respondent was working and zero otherwise. The gender of the respondent was coded as 1 if male and 0 if female. Residence took the value of 1 if the respondent was from an urban area and 0 if they came from a rural area. Marital status referred to whether the respondents were married or not. All married respondents were assigned a value of 1 and 0 if otherwise. Education was classified into four categories- no education, primary, secondary, and post-secondary were all recoded 1 if the condition held and 0 otherwise. Having no formal education was the reference category.

Religion was categorised into three; Christian (1 or 0), Muslim (1 or 0) and no religion (1, or 0). Wealth quintiles were used to measure the socio-economic status of the respondent (Filmer and Pritchett, 2001; ICF Macro, 2018). These were split into five quintiles -quintile 1, quintile 2, quintile 3, quintile 4, and quintile 5. Age was categorised into, age:15-24; age: 25-34; age: 35-44; age:45-54 and age: 55+. Each was assigned a value of 1 if a condition was met and 0 otherwise. Taking into account the positive role HIV testing programmes have had in the country in disseminating HIV and AIDS messages, we also incorporated HIV testing as a variable. This took the value of 1 if a person had ever been tested and 0 otherwise.

Statistical analysis

We analysed the data on two levels. First, the univariate statistics were calculated to show the distribution of the variables. Second, we adopted the logit regression models to assess the relationship between the dependent variables and the independent covariates. From the logit model, we interpreted the relative risk (odds) ratios (Cameron and Trivedi, 2010; Wooldridge, 2012).

Methodological framework

Our analysis used the health belief model to develop a conceptual framework to understand the factors that affect the perceived effect of circumcision on HIV and AIDS and behaviours. The theory was developed by social psychologists Hochbaum, Rosenstock and others in the 1950s. The theory was initially used to explore people's perceptions of a personal threat to diseases and their belief that the recommended intervention will influence their decision to adopt the intervention or behaviour. The model was later on extended to behavioural responses to health-related conditions. Among the many facts of the theory, the theory explains perceived benefits and how it helps reduce perceived threats to health behaviour. We have adapted and developed to suit this study as in Figure 1;

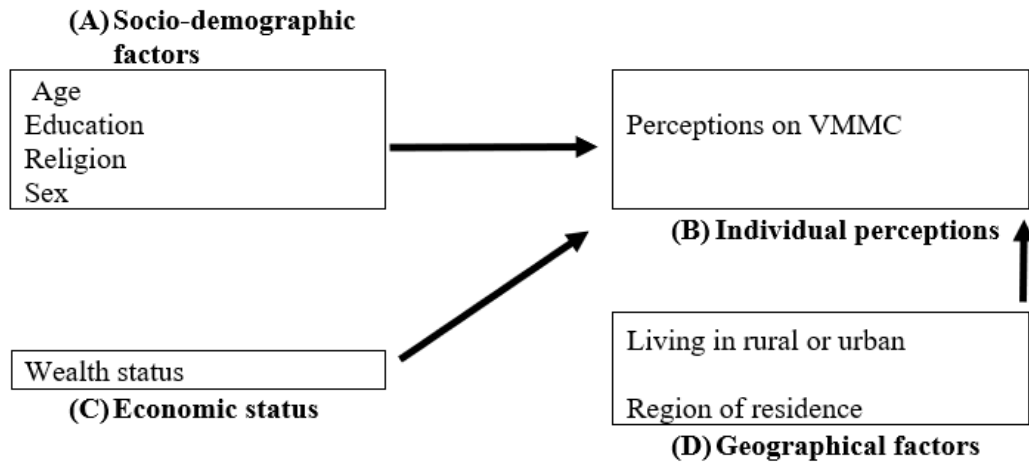


Figure 1: Conceptual framework for understanding perceptions regarding VMMC

3. Results

The univariate analysis is presented in Table 1. In the survey, 31% reported that they were working. Males comprised 42% of the sample, and 18% lived in urban areas. In terms of marital status, 85% were married. The predominant education qualification was primary education (85%), and the lowest percentage was post-secondary education (3%). Most respondents were Christians (81%), and those without religion made up 8% of the sample. The percentage of people who had ever been tested for HIV was 86%.

Table 1: Sample Characteristics

Explanatory Variables	Mean	N	Min	Max
Work status	31%	4298	0	1
Sex of respondent	42%	5823	0	1
Residence	18%	2496	0	1
Marital status	85%	11784	0	1
No education	12%	1664	0	1
Primary	65%	9012	0	1
Secondary	20%	2773	0	1
Postsecondary	3%	416	0	1
Christian	81%	11230	0	1
Moslem	12%	1664	0	1
No religion	8%	1109	0	1
Quintile 1	17%	2357	0	1
Quintile 2	20%	2773	0	1
Quintile 3	20%	2773	0	1
Quintile 4	21%	2911	0	1
Quintile 5	22%	3050	0	1
Age:15-24	19%	2634	0	1
Age: 25-34	35%	4852	0	1
Age: 35-44	24%	3327	0	1
Age:45-54	14%	1941	0	1
Age: 55+	8%	1109	0	1
<i>N</i> = 13864				

Table 2: Perceptions on circumcision

Perception	Mean	N	Min	Max
Circumcised do not need a condom to protect from HIV- Agree	10%	1386	0	1
Circumcised do not need a condom to protect from HIV -Disagree	69%	9566	0	1
Circumcised do not need a condom to protect from HIV -Not sure	21%	2911	0	1
Male circumcision alone reduces the risk, or chance, of a man getting HIV -Completely	13%	1802	0	1
Male circumcision alone reduces the risk, or chance, of a man getting HIV -Somewhat	56%	7764	0	1
Male circumcision alone reduces the risk, or chance, of a man getting HIV -No at all	8%	1109	0	1
Male circumcision alone reduces the risk, or chance, of a man getting HIV -Don't know	23%	3189	0	1
Men who are circumcised can have multiple sexual partners and not be at risk for HIV - Agree	9%	1248	0	1
Men who are circumcised can have multiple sexual partners and not be at risk for HIV - Disagree	72%	9982	0	1
Men who are circumcised can have multiple sexual partners and not be at risk for HIV - Not sure	20%	2773	0	1
Ever tested for HIV	86%	1192 3	0	1
N = 13864				

In Table 2, we investigate the perceptions on voluntary male circumcision. Regarding whether circumcised men do not need a condom to protect themselves, 10% agreed, 69% disagreed, and 21% were unsure/did not know. On whether male circumcision alone reduces the risk, or chance of a man getting HIV, 13% suggested that it completely protects against HIV, 56% indicated it somewhat protects, 8% said it does not offer complete protection, and 23% did not know or were unsure. Regarding whether circumcised men can have multiple sexual partners and not be at risk for HIV, 9% agreed, 72% disagreed, and 20% were not sure. Moving away from the descriptive statistics, we also assessed whether the questions of interest varied according to social and economic status. The results are shown in Figures 1, 2 and 3.

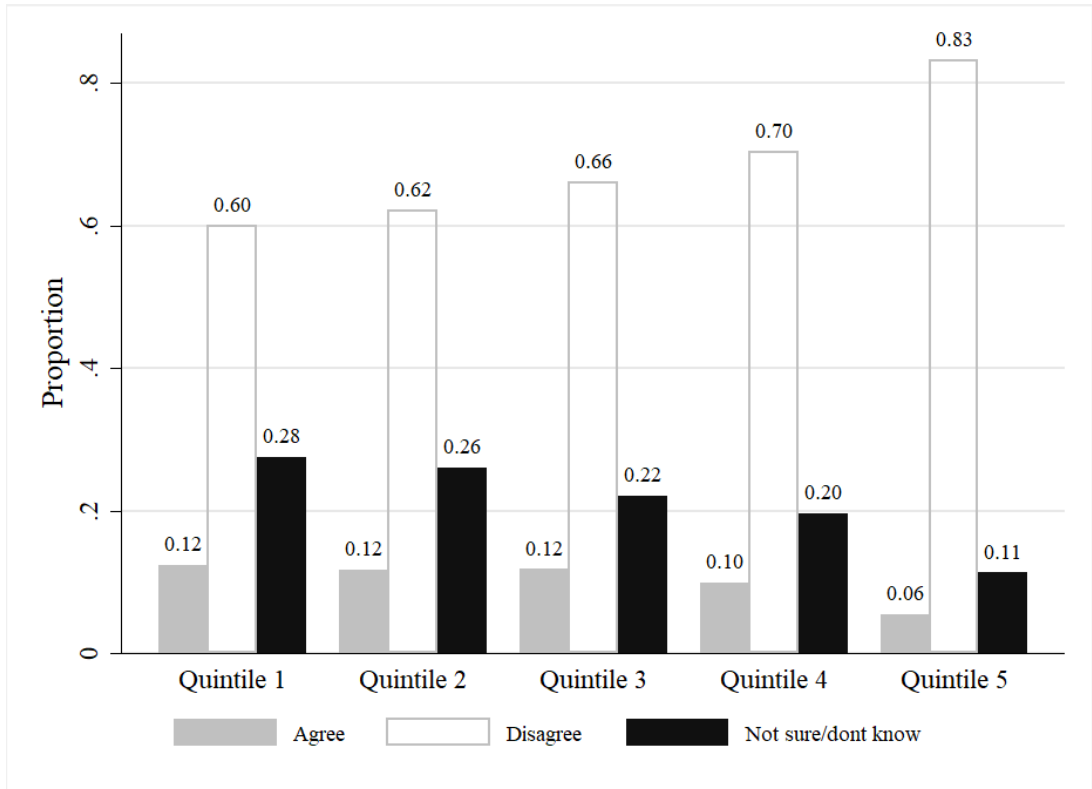


Figure 1: Men who are circumcised do not need a condom to protect themselves from HIV

Respondents were asked whether they agreed with the statement that men who are circumcised do not require a condom to protect themselves from HIV. This was assessed across wealth status to check socio-economic differences. As indicated in Figure 1, it shows that in quintile 1, 12% of the respondents agreed with the statement, 60% disagreed, whereas 28% were not sure. This is somewhat different from the observation made in quintile 5, where 6% agreed, 83% disagreed, and 11% were not sure. Furthermore, we observed two important trends in the response. First, the wealthier were more likely to disagree. Second, those who were wealthier were also less likely to be unsure of the response and third, they were less likely to agree.

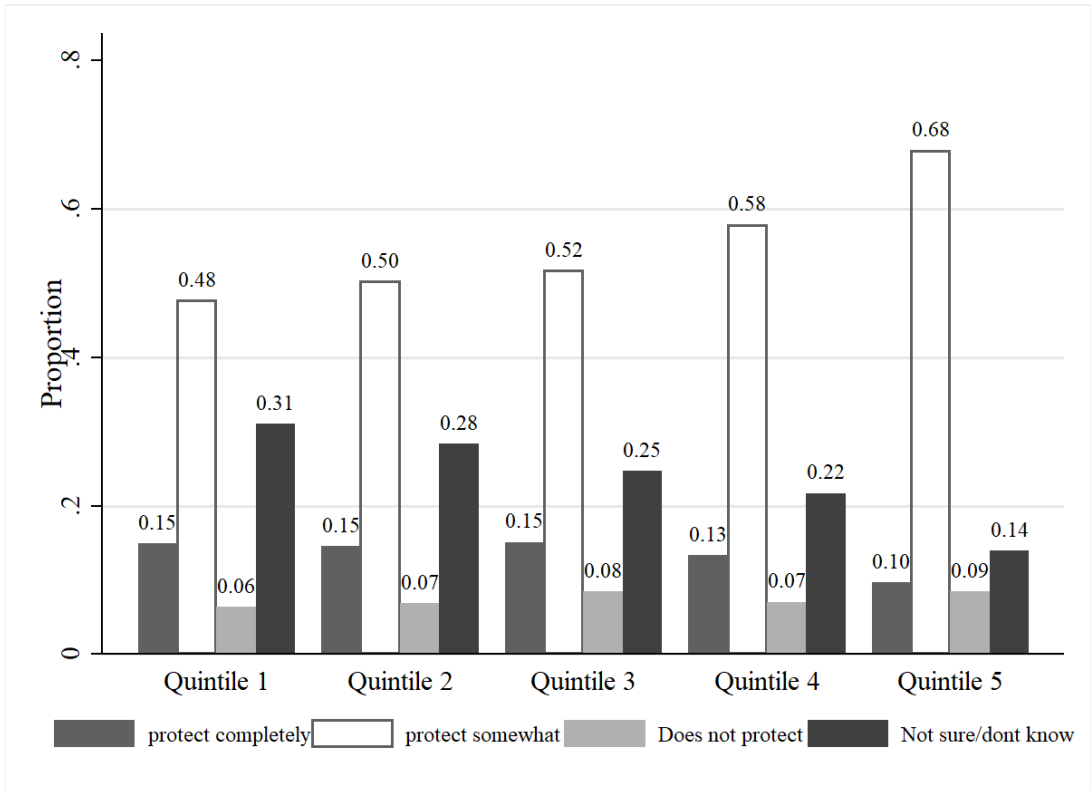


Figure 2: Does male circumcision alone reduce the risk, or chance, of a man getting HIV completely?

In addition to the previous question, respondents were further asked to respond to the question of whether male circumcision alone reduces the risk or chance of becoming infected with HIV, as shown in the figure above. This was again assessed across wealth quintiles. In quintile 1, 15% agreed that circumcision alone gives complete protection, while 48% indicated that circumcision provides partial protection, whereas 6% indicated that circumcision does not protect, and 31% were not sure about the protective effect of circumcision. In quintile 5, about 10% of the respondents agreed to the full protective effect of circumcision, and 68% indicated that circumcision provides partial protection, whereas 9% stated it provided no protective effect, and 14% were not sure about the protective effect at all. This confirms that the wealthier the individual, the more likely they know about the partial protective effect of VMMC.

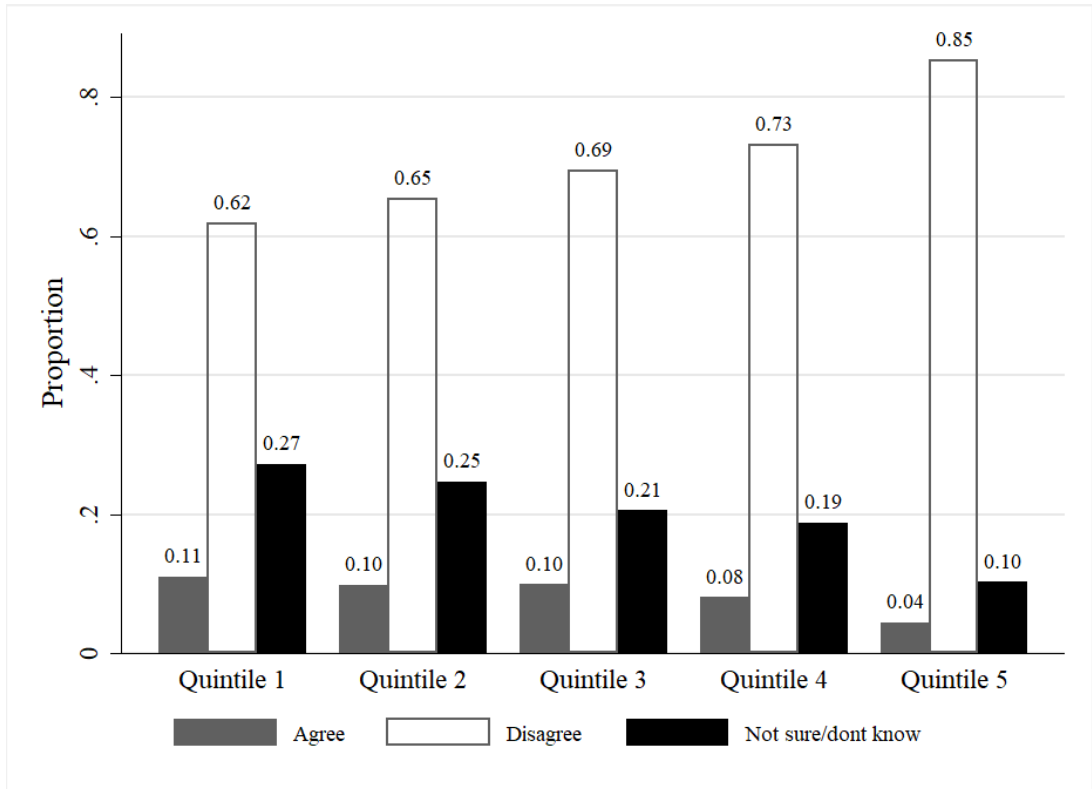


Figure 3: Men who are circumcised can have multiple sexual partners and not be at risk for HIV

Regression results

The results regarding whether the respondents agreed or disagreed with the following statement: Circumcised men can have multiple sexual partners and not be at risk of HIV are reported in column A of Table 3. No significant difference was observed in terms of work status. In terms of being male, we observed that males were likely to disagree. Those who lived in urban areas, were more likely to disagree; than the rural dwellers. We found no statistical difference in terms of marital status. Respondents who had primary, secondary and post-secondary education were more likely to disagree with the statement—than those without any formal education. In terms of wealth status, we found that being in quintile 2; quintile 3; quintile 4 and quintile 5, were more likely to disagree than those in quintile 1. Similar to the previous analysis, respondents who had had an HIV test were likely to disagree. These results are in Table 3, column A.

Table 3- Regression results

Variables	A		B		C	
	β	95%CI	β	95%CI	β	95%CI
Work status	1.052	[0.942,1.174]	1.099*	[0.987,1.225]	1.064	[0.968,1.170]
Sex of respondent	2.192***	[1.962,2.449]	2.449***	[2.198,2.730]	1.794***	[1.634,1.969]
Urban residence	1.629***	[1.391,1.907]	1.590***	[1.367,1.848]	1.095	[0.966,1.240]
Marital status	0.983	[0.868,1.113]	0.912	[0.808,1.030]	0.944	[0.844,1.056]
Primary education	1.583***	[1.381,1.813]	1.574***	[1.375,1.802]	1.306***	[1.145,1.488]
Secondary education	3.950***	[3.273,4.767]	3.675***	[3.064,4.408]	2.317***	[1.968,2.727]
Post secondary education	6.976***	[4.329,11.240]	5.265***	[3.262,8.498]	2.514***	[1.879,3.363]
Christian	0.966	[0.819,1.138]	0.948	[0.809,1.111]	0.992	[0.857,1.149]
Moslem	1.966***	[1.563,2.472]	1.961***	[1.571,2.449]	1.634***	[1.350,1.979]
Quintile 2	1.171**	[1.015,1.350]	1.091	[0.946,1.257]	1.114	[0.971,1.278]
Quintile 3	1.308***	[1.132,1.512]	1.210***	[1.050,1.396]	1.131*	[0.986,1.296]
Quintile 4	1.464***	[1.260,1.700]	1.384***	[1.196,1.602]	1.415***	[1.234,1.623]
Quintile 5	1.987***	[1.646,2.400]	1.895***	[1.578,2.275]	1.746***	[1.484,2.055]
Age: 25-34	1.118*	[0.983,1.272]	1.190***	[1.049,1.351]	1.191***	[1.061,1.336]
Age: 35-44	1.097	[0.955,1.260]	1.170**	[1.021,1.341]	1.087	[0.961,1.230]
Age:45-54	0.998	[0.852,1.170]	1.010	[0.864,1.181]	1.002	[0.868,1.157]
Age: 55+	0.900	[0.745,1.088]	0.971	[0.807,1.168]	0.857*	[0.724,1.014]
Ever tested for HIV	1.343***	[1.167,1.546]	1.380***	[1.201,1.585]	1.211***	[1.068,1.373]
Northen region	0.341***	[0.299,0.389]	0.369***	[0.324,0.419]	0.532***	[0.472,0.599]
Central region	0.650***	[0.588,0.719]	0.690***	[0.625,0.760]	0.862***	[0.790,0.941]
N	13856		13864		13852	

Exponentiated coefficients; 95% confidence intervals in brackets

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

The results for the question of whether the respondents agreed or disagreed with the statement that men who are circumcised do not need to use condoms to protect themselves from HIV are in Table 3, column B. We found a difference between people working and those not working. In terms of being male, we observed that males were likely to disagree. Those who lived in urban areas, were more likely to disagree than the rural dwellers. In terms of wealth status, we found that being in quintile 3; quintile 4 and quintile 5, were more likely to disagree than those in quintile 1. Similar to the previous analysis, respondents who had had an HIV test were likely to disagree. These results are in Table 3, column B.

Apart from the above-narrated results, respondents were also asked their opinion about whether they agreed that male circumcision alone reduces the risk, or chance, of a man becoming infected with HIV completely, somewhat or not at all. Findings are reported in column C. Regarding gender, we observed that males were likely to indicate that circumcision partially protects from HIV. Those who lived in urban areas, were likely to indicate that circumcision somehow protects them. Respondents who had primary, secondary, and post-secondary education were more likely to disagree with the statement, than those without formal education. We found no statistical difference in terms of marital status or being a Christian. However, Muslims indicated that circumcision offers some protection from HIV compared to those with no religion. All the wealth status quintiles were significant at the 1% level, implying that those with some formal education were more likely to indicate that circumcision somewhat protects from HIV than those in quintile 1. Similar to the previous analysis, respondents who had had an HIV test were likely to say that circumcision offers partial protection from HIV. These results are in Table 3, column C.

We also analysed the outcomes in three level categories for all the results. Our results were consistent as the case in the findings from the binary variables above. The tables in the Appendix show the outcomes.

Discussion

Based on the existing evidence which suggests that VMMC has some preventive effect on HIV and other sexually transmitted diseases (Quinn *et al.*, 2000; Bailey *et al.*, 2007; Gray *et al.*, 2007; Feldacker *et al.*, 2020), many countries in SSA have scaled up the VMMC intervention. Current statistics indicate that by the end of 2017, around 18.5 million men in the priority countries had been medically circumcised. However, since 2011 when the intervention was introduced in Malawi (GoM and NAC, 2014), there has still been a low uptake of VMMC (Carrasco, Nguyen and Kaufman, 2018), which may, to a large extent, be an issue of understanding the

protective effect of VMMC. In this paper, we used nationally representative data from the MPHIA national survey to find out the association between socioeconomic factors and the various aspects of VMMC. Our salient findings are as follows.

We found that there is an understanding that circumcision offers partial protection. This is in line with a qualitative study conducted in Kenya (L’Engle *et al.*, 2014). At the same time, we also found that despite having the circumcision program implemented for an extended period in Malawi, some still think that it offers complete protection- a development that was quite worrisome. Nonetheless, others noted some similar outcomes in other countries (Mattson *et al.*, 2005; Figueroa and Jones-Cooper, 2010; Jones *et al.*, 2014; Grund *et al.*, 2019b; Mangombe and Kalule-Sabiti, 2019).

Our study also demonstrated that there are significant differences in the level of knowledge between men and women on the protective effect of circumcision. Males seem to have higher odds of knowing that circumcision offers partial protection and that men should use condoms despite being circumcised. The gender differences in understanding is an issue that should warrant more investigations, given that other studies have shown that women also have their preferences with regard to the circumcision of men (Westercamp *et al.*, 2012).

The findings on the effect of education on various perceptions towards circumcision mirror the results from other countries (Chikutsa and Maharaj, 2015; Mangombe and Kalule-Sabiti, 2019). Those with primary, secondary and higher education were likely to be associated with a likelihood of having much more knowledge regarding the correct effect of circumcision and also knowing that circumcised men ought also to use protection during sexual intercourse. The result is not so surprising given the emphasis placed on educating the masses through the radio and other means.

We found an encouraging result regarding having had an HIV test and perceptions of circumcision. We found that the HIV test is positively associated with having correct knowledge about circumcision than not having an HIV test. In Malawi, the HIV messages regarding circumcision have also been put out as part of the package during the counselling session of the HIV test. Although we found such a result, we found it difficult to compare with other studies in Malawi, given that this was one of the variables that was not considered in previous papers. Although the message is given as part of the counselling, those who do not go for HIV testing at facilities will not receive the message this way.

The role of wealth in our findings cannot go without mention. Our results point to a positive association between one’s wealth status and having correct knowledge regarding HIV and circumcision. As wealth status offers people different opportunities, such as access to information, it may help explain the positive

association observed. The role of wealth in socio-economic inequalities in HIV-related knowledge has been reported elsewhere (Ochako *et al.*, 2011; Chirwa, 2020). Regarding marital status, we found no significant correlation between marital status and the understanding of the protective effect of circumcision.

Our findings can be explained using a number of factors. First, there has been an improvement in the general HIV and AIDS messaging through radios and television; which, to some extent, may have contributed to the improvement in the HIV and AIDS knowledge (Chirwa, Sithole and Jamu, 2019; Chirwa, 2020). Second, the implementation of the intervention in 2011 has enabled people to obtain first-hand information and access to VMMC, which in one way or another, may have contributed to the proper understanding of the protective effect of VMMC. The interventions involved community outreach, plays and community workshops, where people in rural and urban areas would directly interact with the circumcision service providers. Furthermore, the role of NGOs to support the government initiative was also instrumental. Lastly, since some still consider it part of a culture which serves as a rite of passage (Parkhurst, Chilongozi and Hutchinson, 2015; Rennie *et al.*, 2015), they may find it difficult to link it to HIV prevention.

This study has some important limitations. Firstly, the findings from the study should not be interpreted as causal, given that our identification does not address endogeneity. Some of the variables may have a bi-directional effect on our dependent variables. Secondly, circumcision is a sensitive issue and is considered to be a custom among the Muslim and Yao ethnic groups in Malawi (Rennie *et al.*, 2015). Therefore, since we do not have control over ethnicity, we may potentially suffer the problem of omitted variable bias. In this regard, the results bear some important implications for future research in that there is a need to use other techniques such as instrumental variables to establish causality (Angrist and Pischke, 2008). In addition, it may also be of interest to assess socio-economic related inequality in having the correct information regarding circumcision. This may involve the use of concentration indices (O'Donnell *et al.*, 2008). As of now, it is not clear whether the poor and the rich in society have the same level of understanding regarding circumcision.

The results in this paper have some important implications for public health policy. The findings that correct information varies with wealth status suggest that there is a danger that people from poorer backgrounds are at a higher risk of catching HIV if they perceive that there is complete protection from the virus through circumcision than the wealthier ones. They may be susceptible to behaviour that may put them at a much higher risk of HIV infection due to an incomplete understanding. Hence, there is a need to intensifying information-sharing programmes targeting the poorer communities. Implementation of programmes aimed at improving the wealth status of the poor could also help increase their access to the correct information.

Furthermore, since those with no formal education are unlikely to have the correct information, there is a need to scale-up information regarding VMMC, beyond the education circle. It may be essential to use social media, especially to capture the attention of the youth, since circumcision is aimed at young people (Chikutsa and Maharaj, 2015).

Conclusion

In conclusion, this study has established that misconceptions regarding the protective effect of VMMC still exist and vary according to socio-economic factors. Thus, this remains a potential threat in the fight against HIV. The results, therefore, make us question the extent to which the interventions associated with VMMC messaging are working. The findings in this study suggest the need for designing and implementing strategies that address the misconceptions about male circumcision. This will help address misconceptions such as; if one is circumcised, there is no need to use a condom during sex, and that being circumcised is a licence to have multiple sexual partners since a circumcised penis has a “natural” condom or they consider it as a “bulletproof”. Clearing these misconceptions may lead to a good fight against HIV and AIDS in Malawi.

The findings that a large proportion of respondents still have no clear understanding of the protective effect of male circumcision calls for more campaigns to disseminate correct information regarding circumcision. Furthermore, since we find education to be important, there may be a need to introduce topics in secondary school biology and social studies courses regarding the protective effect of circumcision. In addition to the above, colleges and universities, can use “Social Weekends” to share more information on VMMC during the health talks. Thus, if such messages are disseminated during that time, they may have long-lasting effects. Universities can also use HIV and AIDS-related activities organised during the university orientation weeks for freshers to share more information about VMMC (Chirwa, Sithole and Jamu, 2019). Making use of that time to disseminate information regarding circumcision may be helpful. Lastly, since we observed that the respondents from rural areas were less likely to have the correct information, there might be a need to intensify rural campaigns aimed at disseminating correct information.

References

- Angrist, J. D. and Pischke, J.-S. (2008) *Mostly harmless econometrics: An empiricist's companion*. Princeton university press.
- Assembly, T. G. (2016) 'General Assembly', 17020(June), pp. 1–26.
- Auvert, B. *et al.* (2005) 'Randomized, controlled intervention trial of male circumcision for reduction of HIV infection risk: the ANRS 1265 Trial', *PLoS medicine*. Public Library of Science, 2(11), p. e298.
- Bailey, R. C. *et al.* (2007) 'Male circumcision for HIV prevention in young men in Kisumu, Kenya: a randomised controlled trial', *The lancet*. Elsevier, 369(9562), pp. 643–656.
- Cameron, A. C. and Trivedi, P. K. (2010) *Microeconometrics using stata*. Stata press College Station, TX. Available at: <https://www.stata.com/stata-news/statanews.23.4.pdf> (Accessed: 28 December 2017).
- Carrasco, M. A., Nguyen, T. Q. and Kaufman, M. R. (2018) 'Low Uptake of Voluntary Medical Male Circumcision Among High Risk Men in Malawi', *AIDS and Behavior*, 22(2), pp. 447–453. doi: 10.1007/s10461-016-1633-1.
- Chikutsa, A. and Maharaj, P. (2015) 'Social representations of male circumcision as prophylaxis against HIV/AIDS in Zimbabwe', *BMC public health*. BioMed Central, 15(1), p. 603.
- Chirwa, G. C. (2020) "'Who knows more, and why?'" Explaining socioeconomic-related inequality in knowledge about HIV in Malawi', *Scientific African*, 7, p. e00213. doi: <https://doi.org/10.1016/j.sciaf.2019.e00213>.
- Chirwa, G. C., Sithole, L. and Jamu, E. (2019) 'Socio-economic Inequality in Comprehensive Knowledge about HIV in Malawi', *Malawi Medical Journal*. Medical Association of Malawi, 31(2), pp. 104–111.
- Feldacker, C. *et al.* (2020) 'Reducing Provider Workload While Preserving Patient Safety: A Randomized Control Trial Using 2-Way Texting for Postoperative Follow-up in Zimbabwe's Voluntary Medical Male Circumcision Program', *JAIDS Journal of Acquired Immune Deficiency Syndromes*, 83(1). Available at: https://journals.lww.com/jaids/Fulltext/2020/01010/Reducing_Provider_Workload_While_Preserving.3.aspx.
- Figueroa, J. P. and Jones-Cooper, C. (2010) 'Attitudes towards male circumcision among attendees at a sexually transmitted infection clinic in Kingston, Jamaica', *West Indian Medical Journal*, 59(4), p. 351.

- Filmer, D. and Pritchett, L. H. (2001) ‘Estimating Wealth Effects without Expenditure Data-or Tears: An Application to Educational Enrollments in States of India’, *Demography*. Springer, 38(1), pp. 115–132. doi: 10.2307/3088292.
- Galárraga, O. *et al.* (2018) ‘Cost and cost - effectiveness of voluntary medical male circumcision in street - connected youth : findings from an education - based pilot intervention in Eldoret , Kenya’, *AIDS Research and Therapy*. BioMed Central, pp. 1–7. doi: 10.1186/s12981-018-0207-x.
- GoM and NAC (2014) *Voluntary medical male circumcision strategy and national operations plan for scale up: 2015–2020*. Lilongwe, Malawi.
- Gray, R. H. *et al.* (2007) ‘Male circumcision for HIV prevention in men in Rakai, Uganda: a randomised trial’, *The lancet*. Elsevier, 369(9562), pp. 657–666.
- Grund, J. M. *et al.* (2019a) ‘Association of Male Circumcision with Women’s Knowledge of its Biomedical Effects and With Their Sexual Satisfaction and Function: A Systematic Review’, *AIDS and Behavior*, 23(5), pp. 1104–1114. doi: 10.1007/s10461-018-2313-0.
- Grund, J. M. *et al.* (2019b) ‘Association of Male Circumcision with Women’s Knowledge of its Biomedical Effects and With Their Sexual Satisfaction and Function: A Systematic Review’, *AIDS and Behavior*, 23(5), pp. 1104–1114. doi: 10.1007/s10461-018-2313-0.
- Hines, J. Z. *et al.* (2017) ‘Scale-Up of Voluntary Medical Male Circumcision Services for HIV Prevention—12 Countries in Southern and Eastern Africa, 2013–2016’, *MMWR. Morbidity and mortality weekly report*. Centers for Disease Control and Prevention, 66(47), p. 1285.
- ICF Macro (2018) *The DHS program-Wealth index construction*. Available at: <https://www.dhsprogram.com/topics/wealth-index/Wealth-Index-Construction.cfm>.
- Jones, D. *et al.* (2014) ‘Acceptability, knowledge, beliefs, and partners as determinants of Zambian men’s readiness to undergo medical male circumcision’, *AIDS and behavior*. Springer, 18(2), pp. 278–284.
- Kapumba, B. M. and King, R. (2019) ‘Perceived HIV-protective benefits of male circumcision: Risk compensatory behaviour among women in Malawi’, *PloS one*. Public Library of Science, 14(2), p. e0211015.
- L’Engle, K. *et al.* (2014) ‘Understanding partial protection and HIV risk and behavior following voluntary medical male circumcision rollout in Kenya’, *Health education research*. 2013/11/29. Oxford University Press, 29(1), pp. 122–130. doi: 10.1093/her/cyt103.

- Ledikwe, J. H. *et al.* (2014) ‘Scaling-up voluntary medical male circumcision - what have we learned?’, *HIV/AIDS (Auckland, N.Z.)*. Dove Medical Press, 6, pp. 139–146. doi: 10.2147/HIV.S65354.
- Mangombe, K. and Kalule-Sabiti, I. (2019) ‘Knowledge about male circumcision and perception of risk for HIV among youth in Harare, Zimbabwe.’, *Southern African journal of HIV medicine*, 20(1), p. 855. doi: 10.4102/sajhivmed.v20i1.855.
- Matoga, M. M. *et al.* (2022) ‘Uptake of voluntary medical male circumcision among men with sexually transmitted infections in Lilongwe, Malawi: a protocol for a pre-interventional and post-interventional study’, *BMJ Open*, 12(1), p. e057507. doi: 10.1136/bmjopen-2021-057507.
- Mattson, C. L. *et al.* (2005) ‘Acceptability of male circumcision and predictors of circumcision preference among men and women in Nyanza Province, Kenya’, *AIDS care*. Taylor & Francis, 17(2), pp. 182–194.
- Maughan-Brown, B. *et al.* (2015) ‘What Do People Actually Learn from Public Health Campaigns? Incorrect Inferences About Male Circumcision and Female HIV Infection Risk Among Men and Women in Malawi’, *AIDS and Behavior*, 19(7), pp. 1170–1177. doi: 10.1007/s10461-014-0882-0.
- MoH (2017) *Malawi Population-based HIV Impact Assessment (MPHIA) 2015-16: First Report*. Lilongwe, Malawi. Available at: http://phia.icap.columbia.edu/wp-content/uploads/2017/11/Final-MPHIA-First-Report_11.15.17.pdf.
- MPHIA (2019) *Malawi Population-based HIV Impact Assessment (MPHIA) 2015-16*. Available at: <https://phia-data.icap.columbia.edu/>.
- NAC (2020) *Malawi National Strategic Plan for HIV and AIDS, Lilon, Malawi: National AIDS Commission*.
- NSO and International, I. (2016) *Malawi Demographic and Health Survey 2015-16: Key Indicators Report*. Zomba, Malawi, and Rockville, Maryland, USA. Available at: <http://dhsprogram.com/pubs/pdf/PR73/PR73.pdf>.
- O’Donnell, O. A. *et al.* (2008) *Analyzing health equity using household survey data: a guide to techniques and their implementation*. Washington, D.C.: World Bank Publications.
- Ochako, R. *et al.* (2011) ‘Trends and determinants of Comprehensive HIV and AIDS knowledge among urban young women in Kenya’, *AIDS Research and Therapy*. BioMed Central, 8(1), p. 11. doi: 10.1186/1742-6405-8-11.

- Parkhurst, J. O., Chilongozi, D. and Hutchinson, E. (2015) ‘Doubt, defiance, and identity: Understanding resistance to male circumcision for HIV prevention in Malawi’, *Social Science & Medicine*, 135, pp. 15–22. doi: <https://doi.org/10.1016/j.socscimed.2015.04.020>.
- Prodger, J. L. and Kaul, R. (2017) ‘The biology of how circumcision reduces HIV susceptibility: broader implications for the prevention field’, *AIDS Research and Therapy*, 14(1), p. 49. doi: 10.1186/s12981-017-0167-6.
- Quinn, T. C. *et al.* (2000) ‘Viral Load and Heterosexual Transmission of Human Immunodeficiency Virus Type 1’, *New England Journal of Medicine*. Massachusetts Medical Society, 342(13), pp. 921–929. doi: 10.1056/NEJM200003303421303.
- Rennie, S. *et al.* (2015) ‘Perceptions of voluntary medical male circumcision among circumcising and non-circumcising communities in Malawi’, *Global public health*. 2015/01/29, 10(5–6), pp. 679–691. doi: 10.1080/17441692.2015.1004737.
- Tapera, R. *et al.* (2017) ‘Factors associated with uptake of voluntary medical male circumcision among University of Botswana undergraduate male students’, *International Journal of Health Promotion and Education*. Routledge, 55(5–6), pp. 333–342. doi: 10.1080/14635240.2017.1394796.
- Westercamp, M. *et al.* (2012) ‘Circumcision preference among women and uncircumcised men prior to scale-up of male circumcision for HIV prevention in Kisumu, Kenya’, *AIDS Care*. Taylor & Francis, 24(2), pp. 157–166. doi: 10.1080/09540121.2011.597944.
- WHO (2019) *Male circumcision for HIV prevention*. Available at: <https://www.who.int/hiv/topics/malecircumcision/en/>.
- Wooldridge, J. M. (2012) *Introductory Econometrics: A morden Approach*. fifth Edit. South-Western, USA: Cengage Learning. Available at: [file:///C:/Users/USER/AppData/Local/Mendeley Ltd./Mendeley Desktop/Downloaded/Wooldridge - 2012 - Introductory Econometrics A morden Approach.pdf](file:///C:/Users/USER/AppData/Local/Mendeley%20Ltd./Mendeley%20Desktop/Downloaded/Wooldridge%20-%202012%20-%20Introductory%20Econometrics%20A%20morden%20Approach.pdf).
- World Medical Association (2008) ‘Declaration of Helsinki. Ethical principles for medical research involving human subjects’, <http://www.wma.net/e/policy/b3.htm>.

APPENDIX

Appendix 1 - Does male circumcision alone reduce the risk, or chance, of a man getting HIV

Explanatory Variables	A		B		C	
	β	95%CI	β	95%CI	β	95%CI
Protect completely						
work status	1.207**	[1.026,1.420]	1.198**	[1.017,1.410]	1.203**	[1.022,1.417]
Sex of respondent	1.498***	[1.272,1.764]	1.397***	[1.183,1.650]	1.411***	[1.194,1.668]
Residence	1.275**	[1.015,1.601]	1.373***	[1.151,1.638]	1.280**	[1.020,1.606]
Marital status	1.039	[0.868,1.243]	1.083	[0.906,1.295]	1.051	[0.878,1.258]
Christian	1.041	[0.818,1.326]	1.043	[0.819,1.327]	1.026	[0.806,1.306]
Moslem	2.112***	[1.524,2.926]	2.228***	[1.607,3.089]	2.193***	[1.582,3.041]
Quintile 2	1.140	[0.921,1.413]			1.113	[0.898,1.379]
Quintile 3	1.314**	[1.059,1.630]			1.267**	[1.021,1.573]
Quintile 4	1.407***	[1.132,1.750]			1.315**	[1.055,1.638]
Quintile 5	1.410**	[1.075,1.849]			1.276*	[0.966,1.684]
Age: 25-34	1.077	[0.894,1.298]	1.113	[0.923,1.341]	1.098	[0.910,1.323]
Age: 35-44	0.856	[0.701,1.046]	0.942	[0.771,1.152]	0.916	[0.747,1.122]
Age:45-54	0.704***	[0.560,0.887]	0.810*	[0.643,1.021]	0.777**	[0.614,0.982]
Age: 55+	0.696***	[0.531,0.911]	0.817	[0.622,1.073]	0.787*	[0.597,1.037]
Ever tested for HIV	1.418***	[1.143,1.759]	1.391***	[1.121,1.726]	1.388***	[1.118,1.723]
Northern region	0.236***	[0.193,0.289]	0.229***	[0.187,0.281]	0.224***	[0.183,0.275]
Central region	0.444***	[0.383,0.515]	0.426***	[0.367,0.493]	0.436***	[0.375,0.505]
Primary education			1.481***	[1.212,1.809]	1.441***	[1.178,1.763]
Secondary education			1.988***	[1.518,2.603]	1.858***	[1.406,2.454]
Post secondary education			0.902	[0.449,1.812]	0.828	[0.409,1.678]
Protect Somewhat						
work status	1.290***	[1.145,1.454]	1.207***	[1.069,1.363]	1.210***	[1.071,1.367]
Sex of respondent	2.843***	[2.520,3.207]	2.415***	[2.139,2.727]	2.500***	[2.212,2.826]

Residence	1.371***	[1.160,1.620]	1.828***	[1.603,2.085]	1.342***	[1.134,1.588]
Marital status	0.974	[0.850,1.117]	1.052	[0.919,1.204]	0.989	[0.862,1.135]
Christian	1.026	[0.857,1.229]	1.011	[0.845,1.211]	0.974	[0.813,1.167]
Moslem	2.188***	[1.685,2.843]	2.407***	[1.852,3.127]	2.322***	[1.786,3.019]
Quintile 2	1.212**	[1.032,1.424]			1.173*	[0.998,1.378]
Quintile 3	1.415***	[1.202,1.666]			1.303***	[1.106,1.535]
Quintile 4	1.871***	[1.588,2.205]			1.610***	[1.364,1.900]
Quintile 5	2.962***	[2.423,3.622]			2.050***	[1.668,2.520]
Age: 25-34	1.263***	[1.095,1.456]	1.330***	[1.153,1.535]	1.283***	[1.111,1.481]
Age: 35-44	0.946	[0.815,1.098]	1.150*	[0.991,1.336]	1.068	[0.918,1.242]
Age:45-54	0.785***	[0.662,0.930]	1.043	[0.879,1.237]	0.947	[0.796,1.128]
Age: 55+	0.644***	[0.527,0.788]	0.898	[0.733,1.099]	0.811**	[0.660,0.997]
Ever tested for HIV	1.444***	[1.237,1.685]	1.353***	[1.161,1.577]	1.355***	[1.161,1.582]
Northern region	0.305***	[0.265,0.350]	0.293***	[0.255,0.337]	0.279***	[0.242,0.321]
Central region	0.597***	[0.534,0.666]	0.567***	[0.507,0.633]	0.591***	[0.529,0.661]
Primary education			1.665***	[1.432,1.937]	1.558***	[1.338,1.814]
Secondary education			4.168***	[3.414,5.087]	3.428***	[2.796,4.204]
Post secondary education			5.984***	[3.880,9.230]	4.401***	[2.841,6.818]
Does not protect at all						
Work status	1.435***	[1.196,1.722]	1.335***	[1.109,1.607]	1.347***	[1.119,1.622]
Sex of respondent	3.435***	[2.855,4.132]	3.039***	[2.519,3.667]	3.098***	[2.566,3.740]
Urban residence	1.701***	[1.314,2.204]	1.989***	[1.635,2.419]	1.678***	[1.294,2.176]
Marital status	1.192	[0.929,1.530]	1.253*	[0.978,1.606]	1.199	[0.935,1.538]
Christian	0.913	[0.682,1.223]	0.898	[0.671,1.203]	0.875	[0.653,1.171]
Moslem	1.220	[0.792,1.879]	1.316	[0.857,2.021]	1.283	[0.833,1.974]
Quintile 2	1.182	[0.875,1.597]			1.148	[0.850,1.550]
Quintile 3	1.643***	[1.234,2.188]			1.544***	[1.159,2.056]
Quintile 4	1.533***	[1.142,2.058]			1.366**	[1.016,1.836]

Quintile 5	2.255 ^{***}	[1.615,3.148]			1.644 ^{***}	[1.164,2.323]
Age: 25-34	1.284 [*]	[0.999,1.652]	1.316 ^{**}	[1.024,1.690]	1.289 ^{**}	[1.002,1.657]
Age: 35-44	0.964	[0.739,1.257]	1.104	[0.845,1.441]	1.054	[0.808,1.377]
Age:45-54	0.977	[0.726,1.313]	1.188	[0.881,1.603]	1.114	[0.825,1.504]
Age: 55+	0.905	[0.644,1.271]	1.134	[0.805,1.598]	1.072	[0.760,1.512]
Ever tested for HIV	1.188	[0.932,1.514]	1.124	[0.882,1.431]	1.128	[0.884,1.439]
Northern region	0.350 ^{***}	[0.273,0.447]	0.334 ^{***}	[0.261,0.428]	0.326 ^{***}	[0.254,0.418]
Central region	0.625 ^{***}	[0.522,0.748]	0.596 ^{***}	[0.498,0.714]	0.619 ^{***}	[0.517,0.742]
Primary education			1.566 ^{***}	[1.184,2.072]	1.499 ^{***}	[1.132,1.985]
Secondary education			2.967 ^{***}	[2.120,4.151]	2.624 ^{***}	[1.861,3.701]
Post secondary education			5.865 ^{***}	[3.335,10.317]	4.862 ^{***}	[2.737,8.638]
<i>N</i>	13852		13852		13852	

Exponentiated coefficients; 95% confidence intervals in brackets

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

Appendix 2 - Men who are circumcised do not need to use condoms to protect themselves from HIV

Variables	A		B		C	
	β	95%CI	β	95%CI	β	95%CI
Agree						
Work status	1.173*	[0.979,1.406]	1.193*	[0.997,1.429]	1.179*	[0.984,1.413]
Sex of respondent	1.426***	[1.184,1.719]	1.449***	[1.205,1.742]	1.426***	[1.182,1.721]
Urban residence	1.429***	[1.164,1.754]	1.487***	[1.150,1.924]	1.498***	[1.160,1.935]
Marital status	1.283**	[1.046,1.574]	1.259**	[1.024,1.549]	1.265**	[1.029,1.556]
Primary education	1.137	[0.919,1.405]			1.125	[0.908,1.394]
Secondary education	1.196	[0.885,1.617]			1.187	[0.867,1.624]
Post secondary education	1.322	[0.521,3.352]			1.371	[0.535,3.514]
Christian	0.831	[0.637,1.084]	0.827	[0.634,1.080]	0.825	[0.632,1.077]
Moslem	1.012	[0.694,1.475]	0.983	[0.675,1.433]	1.005	[0.689,1.464]
Age: 25-34	1.002	[0.816,1.231]	0.997	[0.811,1.225]	1.000	[0.813,1.230]
Age: 35-44	0.803*	[0.643,1.002]	0.785**	[0.629,0.979]	0.795**	[0.636,0.995]
Age:45-54	0.628***	[0.484,0.815]	0.607***	[0.469,0.785]	0.619***	[0.475,0.806]
Age: 55+	0.547***	[0.400,0.749]	0.525***	[0.385,0.716]	0.542***	[0.395,0.745]
Ever tested for HIV	1.161	[0.918,1.468]	1.164	[0.920,1.472]	1.159	[0.915,1.466]
Northern region	0.178***	[0.142,0.224]	0.181***	[0.144,0.227]	0.177***	[0.141,0.223]
Central region	0.359***	[0.304,0.423]	0.367***	[0.311,0.433]	0.363***	[0.308,0.428]
Quintile 2			1.069	[0.849,1.346]	1.058	[0.840,1.333]
Quintile 3			1.208	[0.957,1.524]	1.200	[0.950,1.516]
Quintile 4			1.213	[0.953,1.542]	1.185	[0.929,1.512]
Quintile 5			1.000	[0.736,1.357]	0.974	[0.710,1.338]
Disagree						
Work status	1.166**	[1.026,1.324]	1.254***	[1.106,1.421]	1.169**	[1.029,1.329]
Sex of respondent	2.689***	[2.364,3.058]	3.180***	[2.798,3.614]	2.773***	[2.435,3.158]
Urban residence	2.432***	[2.093,2.826]	1.870***	[1.555,2.250]	1.847***	[1.531,2.227]

Marital status	1.044	[0.908,1.200]	0.973	[0.845,1.120]	0.989	[0.858,1.139]
Primary education	1.753 ^{***}	[1.505,2.042]			1.656 ^{***}	[1.420,1.932]
Secondary education	4.685 ^{***}	[3.801,5.774]			3.939 ^{***}	[3.179,4.882]
Post secondary education	7.981 ^{***}	[4.655,13.684]			5.988 ^{***}	[3.477,10.311]
Christian	0.909	[0.753,1.099]	0.931	[0.770,1.125]	0.880	[0.728,1.063]
Moslem	2.024 ^{***}	[1.535,2.668]	1.837 ^{***}	[1.394,2.420]	1.959 ^{***}	[1.485,2.584]
Age: 25-34	1.231 ^{***}	[1.061,1.429]	1.173 ^{**}	[1.011,1.360]	1.192 ^{**}	[1.026,1.385]
Age: 35-44	1.152 [*]	[0.984,1.348]	0.945	[0.808,1.105]	1.080	[0.921,1.266]
Age:45-54	0.935	[0.783,1.117]	0.701 ^{***}	[0.588,0.836]	0.860	[0.718,1.030]
Age: 55+	0.872	[0.706,1.076]	0.622 ^{***}	[0.505,0.765]	0.800 ^{**}	[0.646,0.991]
Ever tested for HIV	1.437 ^{***}	[1.227,1.683]	1.536 ^{***}	[1.311,1.801]	1.440 ^{***}	[1.228,1.689]
Northern region	0.220 ^{***}	[0.190,0.255]	0.234 ^{***}	[0.203,0.270]	0.211 ^{***}	[0.182,0.244]
Central region	0.447 ^{***}	[0.398,0.503]	0.472 ^{***}	[0.420,0.531]	0.465 ^{***}	[0.413,0.523]
Quintile 2			1.156 [*]	[0.983,1.358]	1.113	[0.946,1.310]
Quintile 3			1.407 ^{***}	[1.194,1.657]	1.287 ^{***}	[1.091,1.518]
Quintile 4			1.732 ^{***}	[1.465,2.049]	1.469 ^{***}	[1.239,1.741]
Quintile 5			2.796 ^{***}	[2.268,3.448]	1.879 ^{***}	[1.514,2.332]
<i>N</i>	13864		13864		13864	

Exponentiated coefficients; 95% confidence intervals in brackets

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

Appendix 3- Men who are circumcised can have multiple sexual partners and not be at risk for HIV

Explanatory variable	A		B		C	
	β	95%CI	β	95%CI	β	95%CI
Agree						
Work status	1.235**	[1.023,1.492]	1.236**	[1.024,1.492]	1.242**	[1.029,1.500]
Sex of respondent	1.777***	[1.463,2.160]	1.797***	[1.484,2.177]	1.787***	[1.468,2.175]
Urban residence	1.452***	[1.160,1.817]	1.435**	[1.082,1.903]	1.452***	[1.099,1.920]
Marital status	1.119	[0.905,1.385]	1.092	[0.879,1.355]	1.099	[0.886,1.364]
Primary education	1.167	[0.931,1.463]			1.151	[0.917,1.444]
Secondary education	1.072	[0.770,1.491]			1.040	[0.739,1.464]
Post secondary education	0.446*	[0.173,1.150]			0.439*	[0.169,1.142]
Christian	0.870	[0.659,1.150]	0.859	[0.649,1.136]	0.863	[0.653,1.141]
Moslem	0.927	[0.621,1.384]	0.901	[0.604,1.344]	0.919	[0.616,1.371]
Age: 25-34	1.066	[0.854,1.332]	1.052	[0.842,1.314]	1.061	[0.849,1.326]
Age: 35-44	0.908	[0.716,1.152]	0.883	[0.697,1.120]	0.894	[0.703,1.138]
Age:45-54	0.661**	[0.499,0.876]	0.638***	[0.481,0.846]	0.646***	[0.485,0.861]
Age: 55+	0.531***	[0.377,0.747]	0.509***	[0.364,0.712]	0.522***	[0.369,0.738]
Ever tested for HIV	1.061	[0.833,1.352]	1.058	[0.830,1.348]	1.059	[0.831,1.350]
Northern region	0.182***	[0.142,0.233]	0.183***	[0.142,0.234]	0.180***	[0.140,0.231]
Central region	0.375***	[0.315,0.446]	0.387***	[0.324,0.461]	0.380***	[0.319,0.454]
Quintile 2			1.045	[0.821,1.332]	1.035	[0.812,1.319]
Quintile 3			1.221	[0.956,1.560]	1.221	[0.955,1.562]
Quintile 4			1.165	[0.901,1.506]	1.157	[0.892,1.500]
Quintile 5			1.017	[0.732,1.414]	1.070	[0.764,1.499]
Disagree						
Work status	1.134*	[0.996,1.291]	1.219***	[1.073,1.385]	1.139*	[1.000,1.297]
Sex of respondent	2.578***	[2.263,2.938]	3.065***	[2.692,3.489]	2.662***	[2.333,3.037]

Urban residence	2.481 ^{***}	[2.129,2.892]	1.874 ^{***}	[1.553,2.260]	1.850 ^{***}	[1.530,2.237]
Marital status	1.076	[0.935,1.239]	0.995	[0.862,1.148]	1.012	[0.877,1.169]
Primary education	1.775 ^{***}	[1.523,2.069]			1.668 ^{***}	[1.429,1.946]
Secondary education	4.846 ^{***}	[3.911,6.004]			4.022 ^{***}	[3.228,5.010]
Post secondary education	7.633 ^{***}	[4.420,13.181]			5.594 ^{***}	[3.224,9.708]
Christian	0.946	[0.782,1.146]	0.966	[0.797,1.171]	0.914	[0.754,1.107]
Moslem	1.950 ^{***}	[1.480,2.570]	1.768 ^{***}	[1.342,2.329]	1.886 ^{***}	[1.431,2.486]
Age: 25-34	1.183 ^{**}	[1.019,1.373]	1.126	[0.970,1.306]	1.143 [*]	[0.984,1.328]
Age: 35-44	1.137	[0.972,1.331]	0.927	[0.792,1.084]	1.061	[0.904,1.244]
Age:45-54	0.956	[0.801,1.141]	0.710 ^{***}	[0.595,0.846]	0.872	[0.728,1.044]
Age: 55+	0.819 [*]	[0.663,1.010]	0.578 ^{***}	[0.469,0.713]	0.746 ^{***}	[0.602,0.924]
Ever tested for HIV	1.355 ^{***}	[1.155,1.589]	1.449 ^{***}	[1.235,1.702]	1.357 ^{***}	[1.155,1.594]
Northern region	0.215 ^{***}	[0.186,0.249]	0.228 ^{***}	[0.198,0.264]	0.205 ^{***}	[0.176,0.238]
Central region	0.439 ^{***}	[0.390,0.495]	0.466 ^{***}	[0.414,0.525]	0.458 ^{***}	[0.406,0.516]
Quintile 2			1.230 ^{**}	[1.046,1.446]	1.186 ^{**}	[1.008,1.395]
Quintile 3			1.524 ^{***}	[1.292,1.796]	1.395 ^{***}	[1.181,1.646]
Quintile 4			1.813 ^{***}	[1.533,2.146]	1.537 ^{***}	[1.297,1.823]
Quintile 5			3.031 ^{***}	[2.449,3.751]	2.039 ^{***}	[1.637,2.539]
<i>N</i>	13856		13856		13856	

Exponentiated coefficients; 95% confidence intervals in brackets

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