HIV and Male Circumcision in Swaziland, Botswana and Lesotho: An Econometric Analysis

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Abstract

Over the past decade, a number of epidemiological studies have found a direct negative correlation between the practice of male circumcision (MC) and the prevalence of HIV in the general population. These studies were supported by three Randomised Control Trials in Kenya, Uganda and South Africa that found that MC can reduce the probability of female to male infection by between 51 and 60%. Given this, male circumcision is becoming an increasingly discussed addition to HIV prevention programmes in sub-Saharan Africa. Using DHS data from Swaziland and Lesotho and BAIS II data from Botswana this paper uses multivariate logistic regressions to assess the impact of MC on HIV. It further tests for any sample selection bias within the data as a result of non-response of HIV testing. The efficacy of MC in reducing the risk of HIV transmissions is dependent on circumcised men continuing to practice safe sex such as a single partner and condom use. To test for sexual risk a further logistic regression is run using condom use as the dependent variable to determine whether circumcised men engage in riskier sexual behaviour. After controlling for demographic, socio-economic and behavioural determinants of HIV, MC is found to be signicant in reducing the probability of being HIV positive in Botswana and Swaziland. In these two countries circumcised men do not appear to engage in riskier sexual behaviour. In Lesotho, despite the high prevalence of MC it does not appear significant in explaining HIV status. This may be explained in part by the fact that circumcised men have a lower probability of using condoms, increasing their risk and negating the effect of MC. Other factors which may explain this relationship in Lesotho is the possibility that traditional circumcision does not remove the entire foreskin and the age at which the circumcision is taking place. All these need to be considered if implementing a large scale MC programme.

Contents

1 Introduction

Sub-Saharan Africa is the epicentre of the HIV/AIDS global pandemic, accounting for more than two thirds (68%) of the world HIV prevalence. Southern Africa is particularly badly affected. In 2007, this sub region accounted for almost a third (32%) of all new HIV infections and AIDS-related deaths globally, with national adult HIV prevalence exceeding 15% in eight countries in 2005 (Botswana, Lesotho, Mozambique, Namibia, South Africa, Swaziland, Zambia and Zimbabwe)(UNAIDS 2007).

Currently there is no known cure or vaccine for AIDS; hence the need for alternative HIV prevention measures remains paramount. In Sub-Saharan Africa where 95% of infections are due to heterosexual transmission (Schmid et al, 2004), HIV prevention efforts have concentrated on reducing the risk of mother-to-child transmission, reducing risk factors such as number of sexual partners, commercial sex work and lack of condom use. More recently, male circumcision is becoming an increasingly discussed addition to HIV prevention programmes.

Over the past decade, a number of epidemiological studies have found a direct negative correlation between the practice of male circumcision (MC) and the prevalence of HIV infection in the general population (Auvert, et al., 2001). Figure 1 shows the relationship between MC and HIV prevalence in sub-Saharan Africa. In countries where fewer than 30% of men are circumcised, the median prevalence of HIV is 17% (9 countries); where more than 90% of men are circumcised it is 2.9% (13 countries) (Williams, et al., 2006). These results were supported by three randomised controlled trials (RCT) carried out to test the effectiveness of male circumcision in preventing HIV infection in Sub-Saharan Africa. The three trials were based in Orange Farm South Africa (Auvert, et al., 2005), Kisumu Kenya (Bailey, et al., 2007) and Rakai Uganda (Gray, et al., 2007). These studies found that MC can reduce the probability of female to male infection by between 51 and 60%.

Although Figure 1 shows a negative correlation between MC and HIV prevalence in Sub-Saharan Africa, within Southern Africa (represented in the green) this relationship does not appear to hold. There may be several reasons for this which will be discussed further later in the paper.

Proposed biological explanations for the apparent increase in susceptibility to HIV among

uncircumcised men include the ability of the internal foreskin to absorb HIV more efficiently due to the greater presence of Langerhans cells and other HIV target cells, and the greater susceptibility of the foreskin in uncircumcised men to tears, abrasions, and infections by STIs and subsequently HIV. Circumcision may increase keratinization of the glands (resulting in a shorter drying period after sexual contact thereby reducing the life expectancy of HIV on the penis after sexual contact with an HIV-positive partner) and the reduction of total surface of the skin of the penis and reduction of target cells which are numerous in the foreskin (Quinn, 2007). As well as the biological explanation for MC resulting in decreased HIV infection, it has also been reported that it makes condom use easier, which may result in greater condom use thereby adding to the efficacy of MC as an HIV prevention approach (Kebaabetswe, et al., 2003) (Bailey, Muga, Poulussen, & Abicht, 2002).

Given that MC is associated with a significantly reduced risk of HIV infection among men, government officials from Botswana, Lesotho, Swaziland, Tanzania, Kenya, Uganda and Zambia are in talks with UNAIDS about making it more accessible to men as part of HIV prevention efforts (UNAIDS/WHO, 2009). These efforts have been given financial support from other NGOs such as the Bill and Melinda Gates Foundation, Populations Services International (PSI) and US President's Emergency Plan for AIDS Relief (PEPFAR) in Kenya, Swaziland and Zambia [www.psi.org,www.pepfar.gov,www.gatesfoundation.org]. South Africa, is in the process of drafting a policy on MC,through the South African National AIDS (SANAC), apparently scheduled for release in mid 2009. The provision of safe services for MC in areas of Africa where men are not traditionally circumcised is being promoted and recommended by UNAIDS as an additional, important strategy for the prevention of heterosexually acquired HIV infection in men (UNAIDS & WHO, 2007). However they stress the importance of taking into account local socio-cultural, religious and traditional values to ensure acceptability by communities and to build on existing cultural practices.

Williams et al (2006) show that the impact of a MC intervention on the HIV epidemic depends crucially on the prevalence of HIV and the pre-existing coverage of MC. Using mathematical modelling the authors' show that based on the protective rates achieved in the South African (Orange Farm) trial, the greatest effect of MC coverage is predicted to be in Southern Africa, where circumcision rates are low and HIV prevalence is high. Williams and colleagues (2006) projected that if every man in sub-Saharan Africa was circumcised, assuming continued coverage of ARTs and that circumcised men do not engage in riskier

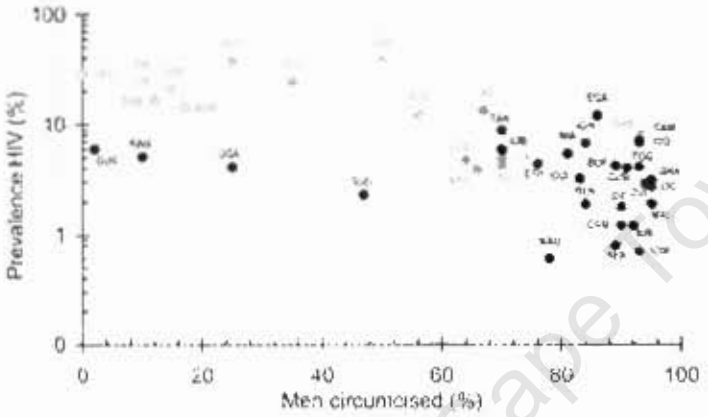

Figure 1. The Relationship between the Prevalence of H.V and MC in Sub-Saharan Africa

The percent prevalence of HIV [12] is plotted on a logarithmic scale against the estimated proportion of adult men who are circumcised [32,33].

Green, southern Africa; red, East Africa; orange, Central Africa; blue, West Africa.

C, Central Africa; E, East Africa; S, South Africa; W, West Africa.

ANG, Angola; BEN, Benin; BOT, Botswana; BUF, Burkina Faso; BUR, Burundi; CAM, Cameroon; CAR, Central African Republic; CHA, Chad; CON, The Congo; DJI, Djibouti; DRC, Democratic Republic of the Congo; EQA, Equatorial Guinea; ERI, Eritrea; ETH, Ethiopia; GAB, Gabon; GAM, Gambia; GHA, Ghana; GUB, Guinea Bissau; GUI, Guinea; IVO, Cote d'Ivoire; KEN, Kenya; LES, Lesotho; LIB, Liberia; MAL, Mali; MAU, Mauritania; MAW, Malawi; MOZ, Mozambique; NAM, Namibia; NIA, Nigeria; NIR, Niger; RWA, Rwanda; SEN, Senegal; SIE, Sierra Leone; SOA, South Africa; SOM, Somalia; SUD, Sudan; SWA, Swaziland; TAN, Tanzania; TOG, Togo; UGA, Uganda; ZAM, Zambia; ZIM, Zimbabwe.

Figure 1: Source(Williams, Lloyd-Smith, Gouws, Hankins, & Getz, 2006)

sexual behavior the potential impact would be about 2 million new HIV infections and 300,000 deaths averted over the next 10 years. Over the subsequent 10 years, an additional 3.7 million HIV infections and 2.7 million deaths could be averted (Williams, Lloyd-Smith, Gouws, Hankins, & Getz, 2006).

While it appears that MC reduces the probability of HIV infection, it does not provide complete protection and hence a MC strategy must be implemented together with other known methods of HIV prevention. Perhaps the biggest caveat with the circumcision approach to HIV prevention is the worry that it may result in false perceptions of security on the part of the newly circumcised men. MC is not a 'magic bullet' and does not provide full protection. If men erroneously perceive themselves to be fully protected then it could lead to an increase in risky sexual behaviour, including decreased condom use which would obviously reduce the beneficial effect of MC – perhaps even negating it entirely. Therefore when analysing the impact of MC on HIV, the assumption of no increase in risky behaviour needs to be interrogated carefully. Following the RCT in Kisumu, Kenya, a follow-up study was conducted to establish whether circumcision resulted in increased HIV risk behaviour. The study followed members of the RCT at baseline, 6 month and 12 month periods. They found that MC was not associated with increased HIV risk behaviour. (Mattson, Campbell, Bailey, Agot, Ndinya-Achola, & Moses, 2008)

Obviously it makes sense to circumcise men as early as possible – preferably before the age of sexual debut. A study in Uganda found, men who had been circumcised before the age of 12 had a significantly lower risk of being HIV positive than older circumcised men, and men who had been circumcised after the age of twenty were no more or less likely than non circumcised men to be HIV positive (Kelly et al, 1999).

Most of the evidence on the efficacy of MC in reducing HIV infections is based on epidemiological data and Randomised Controlled Trials (Orange Farm, Rakai and Kisumu) which have been conducted on small regional groups and may not be representative of the broader population. A few papers have used nationally representative cross-sectional data to assess the impact of MC on HIV. However the techniques used are often inconsistent and limited to a univariate analysis. As will be shown in Section 2 and 3 to ensure accurate conclusions on the relationship between MC and HIV multivariate analysis is necessary, including a range of variables that may contribute to the risk of being HIV positive.

A study using the Nelson Mandela/HSRC Survey (2002) in South Africa found that MC has no protective effect against HIV infection among men. This was attributed in part to the age at which circumcision took place (40% of men where circumcised after their sexual debut) and to the fact that a high proportion of circumcisions took place outside of a hospital setting increasing the risk of inadequate infection control and possibly increasing the risk of HIV infection (Connolly, et al., 2008). One of the drawbacks of this study was that multivariate analysis was not always used and where it was several key variables such as wealth and sexual behaviour variables were not included.

Another study using cross-sectional data to examine the relationship between MC and HIV was conducted by Garenne (2008) using 13 Demographic and Health Surveys conducted in sub-Saharan Africa. He finds that in eight countries (Burkina Faso, Cote d'Ivoire, Ethiopia, Ghana, Niger, Rwanda, Tanzania and Zimbabwe) there was no significant difference in HIV status between circumcised and uncircumcised men. In two countries (Kenya and Uganda) HIV prevalence was significantly lower among circumcised men and in three countries (Cameroon, Lesotho and Malawi) circumcised groups showed a higher HIV prevalence. He concludes from this that on the continent as a whole there is no evidence to support the belief that MC reduces the levels of HIV sero-prevalence in a national population (Garenne, 2008). There may be a number of reasons for these results that were not explored in this paper such as the age of circumcision, type of circumcision (in some African countries traditional circumcision does not remove the entire foreskin) as well as risk compensation. Furthermore it appeared that this conclusion was based on a univariate analysis, casting doubt on its reliability. This paper will re-create the results found by Garenne and expand on them to show some of the pitfalls in his argument using data from Lesotho.

This paper uses a nationally representative sample to assess the impact of MC on HIV status. The paper focuses on three hyper-epidemic countries, namely Swaziland, Botswana and Lesotho. These three countries represent the highest HIV prevalence rates in the world. The aim of the paper is to determine the characteristics of men who are circumcised as well as to analyse the conditional effect of MC on HIV prevalence in men in these countries. This is done by including MC as an explanatory variable in a multivariate logistic regression on HIV status controlling for a variety of HIV risk factors which have been set out in Section 3. It further determines whether those that are circumcised have a higher sexual risk profile in comparison to uncircumcised men. Finally it gives an indication of the characteristics of

circumcised men which may guide policy makers about which groups should be targeted for MC.

2 Methodology

The data used in this study comes from the 2006 Swaziland Demographic and Health Survey (DHS), the 2004 Botswana AIDS Impact Survey (BAIS II) and the 2004 Lesotho DHS. HIV testing was done using dried blood spot (DBS) samples collected on a special filter paper using capillary blood from a finger prick. Participation in HIV testing was voluntary and, before collecting blood samples for HIV testing, each selected participant was asked to provide informed consent to the testing (Mishra, et al., 2007). The results of the HIV test were linked to each respondent in the data. When analysing the effect of MC on HIV status it is important to use a multivariate analysis. Univariate analysis fails to allow for interactions with other risk factors and can thus produce misleading results.

The main concern in this paper will be the estimation of the following equation:

$$Y_i^* = \beta X_i + u_{1i} \tag{1}$$

This is the latent equation with Y_i^* being the unobserved HIV status of individual i, β is a vector of unknown parameter, X_i is a vector of the exogenous variables which includes male circumcision and $u_{1i} \sim N(0,1)$.

$$Y_i = 1 \text{ if } Y_i^* > 0$$

$$Y_i = 0 \text{ if } Y_i^* \leq 0 \tag{2}$$

Y_i is the observed HIV status of individual i. The conditional expected value of Y_i always falls within the $[0,1]$ interval and may be interpreted as the probability that the individual, given the values, of the exogenous variables is HIV positive. Choosing which variables should

be included in the vector X_i is based on previous literature (explored in Section 3) on the determinants of being HIV positive within the context of Sub-Saharan Africa.

One of the problems with using these data sets is that circumcision status is self reported. There is often confusion in Southern Africa about circumcision and initiation. During the Orange Farm study men were asked to report on whether or not they were circumcised. Inspection after self reported circumcision found that 45% of men who believed they were circumcised still had an intact foreskin and were not clinically circumcised (Auvert, et al., 2009). HIV prevalence among these men was similar to that of uncircumcised men. This shows substantial bias with self-reported circumcision status, as the effectiveness of MC stems from the full removal of the foreskin rather than cultural initiation practices. In all the data sets used for this paper circumcision is self-reported. The potential effect of this is discussed further in the paper.

A further issue that needs to be addressed is that of non-response bias. In both the DHS and the BAIS II the selected participants are asked to provide informed voluntary consent to an HIV test. With the DHS surveys a written statement describing the procedure to be used in testing and the potential benefits and risks are read to each respondent. The respondent then makes a decision on whether or not they agree to be tested (Mishra, et al., 2006). This has the potential to create bias in the analysis of the determinants of HIV if those that choose not to be tested are systematically different from those that agree to be tested. Refusing to be tested may be associated with a higher or lower risk of HIV infection compared with those who agree to be tested. Selection bias occurs because non-participation is rarely random; instead, bias is often correlated with variables that are also related to the dependent variable, in this case HIV status (Cuddeback, et al., 2004). If a sample is based in part on values taken by a dependent variable, parameter estimates may be inconsistent unless corrective measures are taken. To ensure that the results presented are unbiased the data is tested for sample selection bias before any HIV regressions are run. This is done using a binomial probit with selection model. This is an extension of the sample selection model developed by Heckman (Heckman, 1979). This model was extended for a probit analysis by Van de Ven & Van Praag, (1981). The behaviour of respondents with regards to being tested can be analysed by means of a probit analysis. Y_i^* is the latent equation that was described above.

$$Y_i^* = \beta X_i + u_{1i} \tag{3}$$

Y_i in Equation 2 is the observed HIV status, and this is only observed if $I_i = 1$. I_i^* is the unobserved propensity to participate in HIV testing. I_i^* can be estimated with the following binary regression model:

$$I_i^* = \alpha Z_i + u_{2i} \tag{4}$$

$$I_i = 1 \text{ if } I_i^* > 0$$

$$I_i = 0 \text{ if } I_i^* \leq 0 \tag{5}$$

Where I_i^* is an unobserved index of response propensity, Z is a vector of exogenous variables associated with the participation in HIV testing and $u_{2i} \sim N(0,1)$. Because there are some common terms in both the selection equation and the HIV equation the error terms in both probit equations might contain some common omitted variables. There is a potential correlation (ρ) between the errors of the two equations. The inconsistency of the estimates of β based on the tested sub-sample arises when the correlation coefficient ρ, between u_{1i} and u_{2i} is not equal to zero. This is analogous to the omitted variable bias in which the conditional mean of u_{1i} given X_i and $I_i = 1$ is omitted from the regression. This can be modelled using the Heckman probit[1]. If there is some sample selection bias then we should expect ρ to be significantly different from zero. If however we cannot reject the null and find that ρ is equal to zero we can conclude that sample selection is not a problem and using the sub-sample of only those that agreed to HIV tests will give consistent and unbiased estimates.

UNAIDS has given a guideline of variables that may show variation in non-response that might affect HIV prevalence estimates (UNAIDS/WHO, 2005). These include geographical area (HIV prevalence is likely to be lower in rural areas), age (men 30–35 years old have the highest prevalence rates), marital status (single people could be at higher risk if they have

[1] command "heckprob" in Stata 10

multiple partners, and widowed or remarried people have higher prevalence), socioeconomic status, educational levels, mobility history and a variety of sexual behaviour (such as condom use, multiple concurrent partners and engaging with commercial sex workers who considered to be a high risk group)[2]. The probit selection model shows how these characteristics differ between those who refuse testing and those who do not and the relative contributions of each of the characteristics on non-response. If there is found to be no sample selection bias in the data then further analysis will be conducted using logistic regressions for ease of interpretation.

Once the possibility of selection bias has been analysed and the main logistic regression has been modelled, a second regression is done to determine whether being circumcised results in a greater sexual risk profile. As mentioned earlier, the efficacy of MC in reducing the risk of HIV transmission is dependent on individuals not engaging in risk compensation (i.e. where circumcised men engage in riskier behaviour). The regression performed uses as its dependent variable condom use during last sexual encounter. Lack of use of condoms has been identified as behaviour that greatly contributes to increased risk of HIV transmission. Although this is a crude estimation of sexual risk, it gives an indication of the risk profile of circumcised men. Again it is important that multivariate analysis is used so that other factors that affect sexual risk behaviour are controlled for. Logistic regressions will also be used to examine this relationship with a similar form to that of the main regression equation:

$$Y_i^* = \beta X_i + u_{1i} \tag{6}$$

3 HIV Risk Factors

Johnson and Budlender (2002) identify some of the major risk factors for HIV after reviewing relevant literature on South Africa. They identify the major demographic, socioeconomic, biomedical and behavioural determinants of HIV risk. Typically HIV rates are found to be higher among women than among men. This, however, is not relevant to the analysis presented here as it is restricted to men. In South Africa, male HIV prevalence tends to

[2]Variables included for selection equation were: age, location, education, wealth, marital status, travel in last 12 months, STD in last 12 months, multiple concurrent partners, condom use and engaging in commercial sex in the past 12 months.

peak between the ages of 30 and 35. This may be due to men acquiring greater sexual buying power with age as they enter employment and acquire greater socio-economic status (Johnson & Budlender, 2002, p. 28). Age is therefore an important variable that should be included as part of a multivariate analysis to explain HIV prevalence.

Southern Africa, which is the hardest hit in terms of the HIV epidemic, is also the most economically advanced area in Sub-Saharan Africa. On average, Southern African countries have higher levels of education. A review of the association between educational attainment and HIV in developing countries conducted by Hargreaves and Glynn (2002) found that in Africa, countries with higher educational attainment are often associated with a greater risk of HIV infection. However the pattern of new infections may be changing with relatively higher rates of HIV incidence more predominant in less educated nations for example Uganda and Zambia. On the other hand in Tanzania there was little change in the association over time (Hargreaves & Glynn, 2002). Gregson et al (2001) argue that more educated populations typically have pre-existing patterns of sexual behaviour that provide greater vulnerability to rapid HIV transmission, however once the effects of HIV on morbidity and mortality become recognised, more educated populations respond more speedily in terms of behaviour change and so over time one would expect to see reduced HIV in educated populations (Gregson, Waddell, & Chandiwana, 2001). Thus these authors are suggesting that as the epidemic progresses the risk of HIV will shift from higher educated groups to those that are less educated. This shift is expected where more educated people are the first to modify their behaviour (Gregson, Waddell, & Chandiwana, 2001). Given this hypothesis they find that the age pattern of HIV risk shifts from a convex shape to a more concave shape as young adults entering the education system are the first to modify their behaviour. In order to test this, age and age squared are included in the logistic regression (to establish whether it takes on a convex or concave shape), furthermore education is added into the regressions to assess which socio-economic groups are most affected by the disease. Given that the data is fairly recent and that the AIDS epidemic is by no means new to the countries analysed, one would expect to find those with poorer education disproportionately affected, given the above hypothesis.

A UN report on AIDS and poverty cites mobility as a contributor to the spread of HIV/AIDS (United Nations, 2005, p. 13). According to a South African study of the interactions between mobility, sexual behaviour, HIV and sexually transmitted infections in the province

of Kwa-Zulu Natal, the impact of migration is dependent on sexual risk behaviour in that migration influences the spread of HIV by increasing high-risk sexual behaviour rather than by connecting areas of low and high risk (Coffee, Lurie, & Garnett, 2007). Johnson and Budlender (2002) argue that migration increases the extent of sexual networking, facilitating the swift spread of HIV/AIDS. The living conditions of migrant workers in South Africa are conducive to higher risk sexual behaviour (Johnson & Budlender, 2002). Many migrant workers are in the mining industry where they live in single-sex accommodation, often engaging in casual sexual relationships and interacting with commercial sex workers. To account for mobility, an explanatory variable for mobility is included in the regression. The variable used is the number of times the respondent has travelled away from his home and slept away. For the Botswana data a dummy variable was used indicating whether the respondent had travelled away from home for a period greater than one month.

HIV has been described as an epidemic of poverty. Some argue that poverty is the driving factor of Africa's HIV/AIDS pandemic because it is associated with lower levels of education, vulnerability to other diseases and generally poorer health status making the poor more susceptible to HIV infections. It facilitates transactional sex, other non-monogamous sexual activity, the spread of other sexually transmitted diseases, and the lack of condom use (Philipson & Posner, 1995; Poku, 2001;Stillwaggon, 2002). However at a country level there is evidence of a positive relationship between national wealth and HIV prevalence across countries in sub-Saharan Africa. Prevalence is higher in the wealthier countries of Southern Africa (Gillespie, Kadiyala, & Greener, 2007). Nattrass (2009) uses cross-country regressions to explore the effect of poverty on national epidemics and finds that income variables (such as per capita income and calories per capita) are insignificant in explaining prevalence rates. Rather, it is regional differences that have strong explanatory power (Nattrass, 2009).

While some argue that poverty is the driving force of the spread of HIV, others argue that wealthier groups are at just as great a risk of infection if not more. Wealthier individuals are more likely to be found in urban areas where there is wider sexual networks available and greater access to high-risk behaviours such as commercial sex (Dyson, 2003). The relationship between income and HIV may differ between men and women. Men may use their higher socio-economic status to acquire sexual partners to a greater extent than is the case for women. If so, this would suggest that male HIV prevalence may peak at higher levels of income for men than for women (Johnson & Budlender, 2002). A study using eight national

surveys within sub-Saharan Africa between 2003 and 2005 was done to assess the relationship between household wealth and HIV sero-prevalence. The study found that contrary to evidence for other infectious diseases, HIV prevalence does not disproportionately affect the poor. In all eight countries adults in the wealthiest quintiles had a higher HIV prevalence than those in poorer quintiles. However this association is diminished when other factors such as education, residency, community wealth, condom use and male circumcision are taken into account (Mishra et al, 2007). This does not negate the importance of poverty reduction to improve health and combat the HIV epidemic. The relationship between poverty and HIV is a complex one; an income variable should be included in the logistic analysis to explore this relationship in the context of the three countries being studied as well as a dummy variable for urban residency.

DHS surveys do not include direct questions on income or expenditure, but collect information on several items that measure household ownership of consumer durables (such as ownership of assets like a television or a bicycle; materials used for housing construction; and availability of amenities such as electricity, source of drinking water, and type of toilet facility) which can be used to provide an indicator of household wealth status. Using these survey items, Filmer and Pritchett (2001) developed a standard procedure to construct a wealth index to quantify differences in household economic status. This index was constructed out of these variables using a principal components analysis to determine the weights for an index of the asset variables. It is a technique for extracting from a large number of variables those few orthogonal linear combinations of the variables that best capture the common information. The first principal component is the linear index of variables with the largest amount of information common to all variables (Filmer & Pritchett, 2001). It is a composite measure of the cumulative living standard of a household, which places individual households on a continuous scale of relative wealth. The wealth index is divided into population quintiles, with the lowest quintile representing the poorest 20 percent and the highest quintile representing the wealthiest 20 percent households within each country (Mishra, et al., 2007). This wealth index has already been created in the DHS data sets. The BAIS II data did not include any wealth index and so using the same principles components method this was created (refer to Appendix for construction of wealth index). The wealth quintiles created are used as a proxy for income which is to be included in the HIV regressions. An employment status dummy was included as an additional socio-economic variable in all models.

A further contributing risk factor in the transmission of HIV in Africa is that many Africans are already infected with other sexually transmitted diseases, increasing the infectivity of HIV (Philipson & Posner, 1995; Johnson & Budlender, 2002). To control for this, a dummy variable is included if the respondent has reported having had an STD in the last 12 months. However, as both HIV and STDs are sexually transmitted, the presence of an STD probably captures increased biological vulnerability to HIV infection and the fact that the individual is engaging in unsafe sex.

A study in rural southwest Uganda found a positive association between a history of alcohol consumption and being HIV sero-positive (Mbulaiteye et al, 2000). Alcohol consumption increases the likelihood of interaction with sex workers and other risky sexual behaviours. In South Africa alcohol has been identified as a determinant of HIV transmission (Johnson & Budlender, 2002). To control for this in the logistic regression a dummy variable was included indicating whether the respondent had consumed alcohol during their last sexual encounter.

As mentioned before, HIV in Africa is mostly transmitted via heterosexual intercourse. Therefore sexual behaviour and risk is an important determinant of HIV status. Lack of condom use and multiple concurrent partnerships have been identified as high risk sexual behaviour, increasing the probability of being HIV positive (Morris & Kretzschmar,1997;UNAIDS & WHO, 2007). Concurrent partners exponentially increase the number of infected individuals and the growth rate of the epidemic during its initial phase (Morris & Kretzschmar, 1997). Using multivariate analysis it was found that in three geographic areas in the Rakai District of Uganda, age, residence and number of sex partners were significant in explaining HIV infections (Serwadda et al, 1992). However condom use and multiple concurrent partners cannot directly be added into a multivariate analysis because of the possibility of reverse causality or endogeneity. For example condom use could prevent HIV infections (negative association), but on the other hand HIV-positive people may be choosing to use condoms in order to protect their sexual partners (positive association) (de Walque, 2006). The same could be found with multiple concurrent partners where those who have more than one partner are more likely to use condoms. To avoid any endogeneity bias, age of sexual debut and number of lifetime partners are used as proxies for sexual behaviour.

The final HIV risk factor that was included in the analysis was marital status. Although one may assume that marriage implies monogamy and married partners are relatively safe

from transmitting the virus, a study amongst couples in rural Uganda finds that men are twice as likely as women to bring home HIV infection, presumably through extra-marital sexual behaviour (Coffee, Lurie, & Garnett, 2007).

Based on the above review the following variables, where available were included in the multivariate analysis: Age, age squared, dummy variable for urban residency (rural being reference category), wealth quintile, educational attainment, marital status, travel in the last 12 months, number of lifetime partners, age of sexual debut, alcohol consumption during last sexual encounter, currently working, had an std in the last 12 months, circumcised and age of circumcision (See Appendix for questions used to create these variables).

The efficacy of male circumcision in preventing HIV transmission is dependent on circumcised men not engaging in greater sexual risky behaviour. Condoms are an important input into safe sex and so are used as a proxy for sexual risk in a simple logistic regression. The question used is a dummy variable whether or not the respondent used a condom during their last sexual encounter. Male circumcision is included in the regression to assess whether being circumcised results in men being less likely to use condoms, therefore decreasing the efficacy of male circumcision in reducing the probability of HIV transmission. A univariate analysis would not be sufficient in testing this hypothesis and a multivariate analysis is necessary. Again it is important to choose variables to include in the multivariate logistic regression that contribute to condom use, using existing literature and empirical work.

Several factors have been identified as determining the use of condoms in Africa. Philipson and Posner (1995) stress the importance of the price of condoms relative to income. They predict that the demand for condoms is positively correlated with income. Therefore to control for the relative cost of condoms, wealth is included in the regression to assess their affordability. Schooling and education has been identified as an important predictor of protective behaviour such as condom use. Condom use is associated with higher levels of education (Buve, et al., 2002; de Walque, 2006). Marital status is also a predictor of condom use. A study of four African countries found that more married men report using a condom in marriage than married women (de Walque, 2006). The UN found that condom use outside marriage is increasing (United Nations, 2005). There are some religious groups that do not advocate the use of condoms. Most notably the Catholic church and Muslim religion have been publicly vocal about their disapproval of the use of condoms (de Walque, 2006). Where possible a dummy variable for Catholic has been added to the regression on

condom use to assess whether this has any effect on condom use in the countries presented. The United Nations (2005) conclude that in the developing world rural and uneducated youth and adults that tend to be relatively poor are less likely to use condoms. A final variable included in the analysis is consumption of alcohol during last sexual encounter which is often associated with inconsistent condom use (Johnson & Budlender, 2002).

4 Swaziland

4.1 Background

Swaziland has the highest prevalence rate in the world, with adult (15-49 years) HIV prevalence of 26% (UNAIDS 2007). UNAIDS (2007) find that while there is little difference in HIV prevalence between regions there is a stark contrast between men and women. The prevalence among adult women is estimated at 31%, compared to 20% among adult men. HIV infection levels in men peak in older age groups; 44% of men aged 30.34 years and 45% of those aged 35.39 years were HIV-positive. Unusually high HIV prevalence is found also among older age groups, with about a quarter (28% of men and 24% of women) aged 50.54 years found to be HIV-positive. While knowledge about HIV is high, just under half of adult men and adult women who reported more than two sexual partners, reported not to have used condoms the last time they had sex (UNAIDS, 2007).

Historically traditional MC was practised in Swaziland until it was banned by King Mswati II in the late 1800s for fear that recovering from surgery would distract young warriors (Marwick, 1966). Given the evidence about the protective effect of MC, the Swaziland Ministry of Health and Social Welfare is currently preparing a MC policy. The health ministry backed a workshop in January 2009 to train 60 doctors and nurses to perform circumcision, responding to what it called a surge in demand. The Family Life Association of Swaziland (FLAS) has been a leading NGO in promoting MC through advertising as well as providing free MCs at their clinic in Mbabane. There has been a surge in the demand for circumcisions with the Mbabane Clinic performing 10 circumcisions weekly, up from less than one a month before the project was implemented (Zwane, 2009)[3].

[3] Unpublished Masters Dissertation

4.2 Data and Summary Statistics

HIV data is available for 3602 out of a total of 4156 male respondents in the 2006 Swaziland DHS. This gives a response rate of 86.7%. As outlined in the methodology section a probit with sample selection is used to test whether there is any sample selection bias as a result of some men refusing to give blood for an HIV test. Table 1 show the results from the selection model using the variables suggested by UNAIDS (UNAIDS/WHO, 2005). Due to lack of availability the variable on sex with a commercial worker was excluded from the selection equation. Rho has a value of 0.84 with a p-value of 0.03, the null hypothesis that $\rho = 0$ is therefore rejected. Sample selection appears to be a concern in this data set. When reporting the results of the empirical analysis the probit model from the Heckman selection will be used. Age, urban residency, STDs and condom use all significantly determine whether someone chooses to agree to an HIV test or not. Wealthier quintiles and those with higher levels of education are less likely to consent to HIV testing.

Table 2 shows HIV prevalence according to demographic and socio-economic characteristics. It also gives the p-value of a t-test to determine whether HIV prevalence is statistically different within each category, where the null hypothesis is that they are equal. Overall prevalence for this all male sample is 19.5%, which is very close to the UNAIDS estimate for adult male prevalence. HIV prevalence is much higher in urban areas than in rural areas and this difference is statistically significant. Education appears to play a role with the highest prevalence among those that have no education. HIV prevalence does not appear to differ across wealth categories. HIV prevalence is slightly higher for circumcised men than uncircumcised men; however the difference is not statistically significant. Prevalence is also more concentrated in older age groups.

As mentioned in Section 1 the age at which circumcision takes place has important consequences for the effectiveness of MC. A cohort study done in Uganda by Kelly et al (1999) found that MC is most effective as an HIV prevention factor if performed before the age of 20. In Swaziland, HIV prevalence among circumcised men increases as the age at which circumcision was performed increases. Prevalence is 16.5% for those circumcised at infancy or below 13 years old and goes up to 32% for those circumcised after 20 years old.

Table 1: Heckman Sample Selection Probit - Selection Model

	Probit Sample Selection	**Standard Error**
Age	-0.076	[0.033]**
Age squared	0.001	[0.000]**
Rural	Ref	
Urban	-0.195	[0.082]
No Education	Ref	
Primary Education	-0.004	[0.131]
Secondary Education	-0.059	[0.126]
Higher Education	-0.293	[0.150]*
Poorest	Ref	
Poor	-0.190	[0.155]
Middle	-0.326	[0.144]**
Rich	-0.322	[0.144]**
Richest	-0.275	[0.154]
Never Married	Ref	
Married	-0.178	[0.095]*
Formerly Married	0.120	[0.254]
Times away from home	-0.002	[0.002]
No STD	Ref	
STD	0.380	[0.143]***
No MCP	Ref	
Multiple Concurrent Partners	-0.233	[0.184]
No Condom	Ref	
Condom	-0.310	[0.072]***
Constant	2.900	[0.531]***
Observations		2238
Censored Observations		360
Rho		0.838
P-Value		0.029

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

Table 2: HIV Prevalence by Selected Characteristics

	HIV Prevalence	**P-value**
Age		
15 -24	5.8%	
25 -49	35.2%	0.000
Location		
Urban	25.0%	
Rural	17.0%	0.000
Education		
No Education	30.5%	
Primary	18.3%	
Secondary	18.2%	
Post Secondary	21.9%	
Wealth Quintile		
Poorest Quintile	19.0%	
Poor	19.8%	
Middle	17.3%	
Rich	20.6%	
Richest Quintile	20.4%	
Marital Status		
Never Married	9.8%	
Married	35.5%	
Formerly Married	61.3%	
Circumcision		
Circumcised	20.8%	
Uncircumcised	19.4%	0.567
Age of Circumcision		
Below age 13	16.5%	
13-19 years old	25.0%	
20 or more years old	32.2%	
TOTAL	**19.5%**	

Table 3: Male Circumcision Prevalence and Logistic Results

	Total Sample	Circumcised	MC Prevalence	OR
Age Group				
15-24	2135	112	5.3%	Ref
25-49	2020	244	12.1%	2.004***
Residence Type				
Rural	2714	163	6.0%	Ref
Urban	1441	193	13.4%	1.724***
Wealth				
Poorest	585	32	5.5%	Ref
Poorer	639	42	6.6%	1.196
Middle	787	44	5.6%	0.929
Richer	921	77	8.4%	1.139
Richest	1223	161	13.2%	1.394
Education				
No Education	332	31	9.3%	Ref
Primary	1428	98	6.9%	0.979
Secondary	2017	165	8.2%	0.966
Higher	378	62	16.4%	1.254
TOTAL	4155	356	8.6%	4155
Prob > Chi2				0.000
Pseudo R squared				0.046

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

Table 3 shows the distribution of characteristics and socio-economic factors for circumcised men compared to the entire sample. The prevalence of MC in Swaziland is relatively low with only 8.6% of men reporting to be circumcised. It also includes a logistic regression reported in terms of the odds ratio to determine the variables that significantly influence the probability of being circumcised. The logistic regression shows that age and type of residence are the only statistically significant determinants of circumcision. Those that are in a higher age category and live in urban areas are more likely to be circumcised. Circumcision appears to be more prevalent among the very wealthy, those living in urban areas and those above 25 years old.

One of the factors that determine the efficacy of MC in preventing female to male HIV transmission is the age at which the circumcision took place. Circumcision should ideally be performed before the sexual debut of young men. Table 4 shows the mean age of sexual

Table 4: Age of Sexual Debut compared to Age of Circumcision

Age at Circumcision	N (%)	Mean Age of Sexual Debut
Below age 13	227 (65%)	19
13-19 years old	49 (14%)	18.7
20 or more years old	73 (21%)	19.7

debut amongst circumcised men. The majority of circumcised men were circumcised before the age of 13, which is the ideal age. On average men who were circumcised over the age of 20 had already become sexually active.

Of the 356 men who were circumcised 51 (14%) had their sexual debut before being circumcised. Eighty-seven percent of circumcised men were circumcised by a health professional, implying that traditional circumcision does not play a big role in Swazi culture. Eighty percent of respondents cited the reason they chose to be circumcised was for health and hygiene purposes. Of those who were not circumcised 43% said they would like to be circumcised, again the overwhelming majority citing health and hygiene as the primary reason (96%). Of those that did not want to be circumcised 52% cited pain as the primary deterring factor and 10% said for religious/traditional reasons.

Because most of the circumcisions were performed by health professionals, it can safely be assumed that reported circumcision probably refers to the removal of the entire foreskin. This gives greater validity to the interpretation of the results.

4.3 Empirical Analysis

Table 5 shows three models of the determinants of being HIV positive among Swazi men. The first model is a probit model corrected for sample selection. The probit model is interpreted differently from odds ratio and generally the coefficient is trickier to interpret. A one unit increase in a variable results in a coefficient β standard deviation increase/decrease in the predicted probit index. A positive β indicates an increase in the probability of being HIV positive while a negatively signed coefficient decreases the probability of being HIV positive. Models 2 and 3 are restricted to the sub-sample who consented to HIV tests and are reported in terms of logistic regression odds ratios but are not corrected for sample selection. The coefficient shows the probability of the dependent variable scoring 1 (HIV positive) over

the probability of it scoring 0 (HIV negative). A coefficient greater than one indicates a greater probability of being HIV positive than HIV negative when the explanatory variable increases by one unit. Comparing the results of the probit and logistic model they do not differ greatly despite the logistic model not accounting for sample selection bias.

Age and age squared are significant showing a quadratic relationship with the turning point being at 36 years old. This is consistent with the concave relationship between HIV and AIDS that was dicussed in Section 3. Post Secondary education contributes to lower infection relative to those that have no education, while living in urban areas increases the probability of infection. Men who have formerly been married (widowed and divorced) have higher odds of infection than those that have never been married. Wealth, migration and travel have no significance in determining HIV status. The regression indicates that after controlling for other potential determinants of HIV infection, MC has a large significant effect in reducing the odds of being HIV positive.

Instead of using a simple MC dummy in Model 3, circumcised men were grouped according to the age categories at which they were circumcised. The reference group is still uncircumcised men. It finds that if circumcision takes place after the age of 20 it is not significant in determining HIV prevalence. However for those that are circumcised before the age of 20, circumcision is effective in reducing the odds of being HIV positive. Being circumcised between the ages of 13 and 19 years old appears to have the greatest impact on the reducing the risk of having HIV. This in contrast to the findings of the study conducted by Kelly et al (1999) which found that circumcision below the age of 12 was the most effective in HIV risk reduction. Assessing the marginal effects at the mean of all the independent variables, being circumcised reduces the probability of being HIV positive by approximately 7.5%. This remains the same even when sample selection is accounted for. This is much lower than the 50-60% reduction in transmission found by the Randomised Control Studies. For those that are circumcised before the age of 13 there is a 7% reduced probability of being HIV positive, and a 14% reduction for those circumcised between the ages of 13 and 19.

The efficacy of MC for HIV prevention is dependent on circumcised men continuing to practice safe sexual behaviour such as condom use and having only one sexual partner. Table 6 shows a logistic model that determines whether MC can be associated with risky sexual behaviour, based on whether the respondent used a condom during their last sexual encounter as a proxy for risky sexual behaviour. MC is insignificant in determining condom

Table 5: HIV Probit and Logistic Regressions

	Model 1		Model 2		Model 3	
HIV	**Probit**	**SE**	**OR**	**SE**	**OR**	**SE**
Age	0.361	[0.036]***	2.001	[0.131]***	2.010	[0.132]***
Age squared	-0.005	[0.001]***	0.991	[0.001]***	0.990	[0.001]***
Rural	Ref		Ref		Ref	
Urban	0.151	[0.083]*	1.467	[0.215]***	1.464	[0.215]***
No Education	Ref		Ref		Ref	
Primary Education	0.061	[0.111]	1.110	[0.218]	1.112	[0.218]
Secondary Education	0.065	[0.110]	1.169	[0.230]	1.161	[0.228]
Higher Education	-0.376	[0.145]***	0.584	[0.154]**	0.580	[0.153]**
Poorest	Ref		Ref		Ref	
Poor	0.130	[0.123]	1.381	[0.302]	1.364	[0.299]
Middle	-0.019	[0.119]	1.100	[0.234]	1.088	[0.232]
Rich	-0.083	[0.123]	0.973	[0.216]	0.963	[0.214]
Richest	-0.208	[0.132]	0.766	[0.183]	0.756	[0.180]
Unemployed	Ref		Ref		Ref	
Employed	-0.075	[0.076]	0.868	[0.123]	0.868	[0.123]
Never Married	Ref		Ref		Ref	
Married	0.088	[0.085]	1.211	[0.180]	1.205	[0.180]
Formerly Married	0.576	[0.198]***	2.713	[0.931]***	2.708	[0.931]***
Times Away from Home	-0.003	[0.002]	0.996	[0.004]	0.996	[0.004]
No Alcohol	Ref		Ref		Ref	
Alcohol	0.138	[0.112]	1.238	[0.256]	1.250	[0.259]
Lifetime Sexual Partners	0.008	[0.003]**	1.015	[0.006]**	1.015	[0.006]**
Age at First Intercourse	-0.037	[0.010]***	0.932	[0.017]***	0.931	[0.017]***
No STD	Ref		Ref		Ref	
STD	0.524	[0.104]***	2.239	[0.405]***	2.257	[0.409]***
Uncircumcised	Ref		Ref			
Circumcised	-0.245	[0.102]**	0.636	[0.120]**		
Below Age 13					0.647	[0.156]*
13 - 19 years old					0.354	[0.176]**
20 or more years					0.797	[0.279]
Constant	-6.238	[0.572]***				
Observations		2238		1878		1878
Censored Observations		360				
Prob > Chi2				0.000		0.000
Pseudo R Squared				0.145		0.146

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

Table 6: Logistic Regression Assessing Sexual Risk Behaviour

Condom	**OR**	**SE**
Age	0.979	[0.007]***
Rural	Ref	
Urban	1.245	[0.141]*
Poorest	Ref	
Poor	1.051	[0.197]
Middle	1.192	[0.210]
Rich	1.336	[0.238]
Richest	1.714	[0.329]***
No Education	Ref	
Primary Education	1.094	[0.191]
Secondary Education	1.647	[0.281]***
Higher Education	1.539	[0.324]**
Never Married	Ref	
Married	0.215	[0.026]***
Formerly Married	0.685	[0.198]
Other Religion	Ref	
Catholic	1.531	[0.307]**
No Alcohol	Ref	
Alcohol	0.574	[0.101]***
Uncircumcised	Ref	
Circumcised	1.112	[0.164]
Observations		2443
Prob > Chi2		0.00
Pseudo R Squared		0.143

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

use during last sexual encounter. Although this is a crude estimation of sexual risk it suggests that circumcised men do not engage in greater risky sexual behaviour than uncircumcised men. The wealthy and those with higher levels of education are more likely to use condoms. This is consistent with the hypothesised determinants of condom use that were discussed in Section 3. Contrary to expectations Catholics in Swaziland appear to be more likely to use condoms than those from other religious groups. The base category for this dummy was made predominantly of other Christian denominations, as well as a few from other religions.

Male Circumcision appears to have a protective effect against the risk of HIV infections in Swaziland, especially for those that are circumcised below the age of 20 years. If male circumcision does not result in increased sexual risk as the above results appear to show, then it should be an effective HIV prevention mechanism in Swaziland.

5 Botswana

5.1 Background

UNAIDS estimated that the adult (15-49 years old) HIV prevalence in 2007 was 23.9%. This is the second highest HIV prevalence rate in the world. The government of Botswana has actively been pursuing policies in an attempt to curb the epidemic. These range from prevention, testing and counselling as well as antiretroviral (ARV) treatment. Botswana was one of the first countries to offer free ARV treatment to HIV positive patients. With the recent studies showing that MC has the potential to reduce female to male transmission of HIV by between 30 and 60% more countries are including MC as part of their HIV prevention policy. Botswana is no exception. They recently conducted a study into the acceptability of MC in Botswana. The study found that MC appears to be highly acceptable in Botswana (Kebaabetswe, et al., 2003).

MC was traditionally practised in Botswana as part of initiation schools. The male initiation schools, known as bogwera lasted approximately three months and details were kept secret. The boys were circumcised at the camp, they were taught about tradition and customs as well as sex. Boys were taught the physiology of sex relations, duty of procreation and conduct in married life and dangers of promiscuous intercourse with unclean women (Schapera, 1977).

The arrival of Christian missionaries into Botswana would change the fate of traditional initiation schools. Many tribal chiefs in Botswana became Christian and so were influenced by the missionaries. The missionaries regarded it as immoral and did their best to eliminate the practice. It was frowned upon by the Administration of Bechuanaland Protectorate without actually being forbidden. Proclamation No.41 of 1917 made it a penal offence for anybody to subject a young person (under the age of 16) to enter bogwera or bojale (female initiation school) without the consent of the child's parents or guardians. Progressive Chiefs felt that the practice interfered with the advancement of European religion and education (Schapera, 1977).

Although there was pressure on the Administration in 1931 from missionary bodies and others to prohibit circumcision rites, most chiefs had already suppressed these ceremonies. The administration was reluctant to prohibit bogwera rather they preferred for chiefs to deal with it themselves (Schapera, 1970).

Despite this over the years the popularity and importance of bogwera has gone through periods of decline and resurgence. Schapera (1977) reports in 1977 that bogwera was still practiced among the Tlokwa, Balete, Bakgatla and Kwena tribes. However this depended on the chief at that time and so went through several periods of being banned then re-introduced. In 1996 it appeared that it was being practised only among the Balete of Ramotswa and Bakgatla ba Kgafela of Mochudi (Molefi, 1996). Every time the institution was revived; it was modified to meet the recommendations set both by the government and the church (Mosothwane, 2001). In the early 1960s Kgosi Lincwe II re-introduced bogwera once again to the Bakgatla tribe. Nobody was forced to enrol but once they did circumcision was compulsory. However it was not done by the traditional rrathipana (man with the knife), it was performed at the Deborah Retief Hospital run by the Dutch Reform church. In later initiation ceremonies students from the Medical University of South Africa were invited to help because of staff shortages (Mosothwane, 2001). This fact is important in establishing that circumcision was done in medical settings, which leads to the assumption that it was the full removal of the foreskin. Also it shows how traditional initiation rites are able and willing to adapt to current concerns.

After interviews with the tribal houses of the various tribes in Botswana all report that they are not practicing any sort of initiation ceremony. However the current chief of the Bakgatla

tribe of Mochudi wants it to be re-introduced in the near future[4].

5.2 Data and Summary Statistics

The analysis presented here was conducted on the 2004 nationally representative Botswana AIDS Impact survey (BAIS II). The survey focuses on issues related to HIV prevention and the impact of HIV/AIDS. The survey finds the HIV prevalence in Botswana for all those above 18 months to be 17.1 % (19.8% for females and 13.9% for males) (NACA, CSO, ACHAP, & UNDP, 2004). For those between the ages of 10 and 64 HIV prevalence is 20.2% and prevalence amongst men is 17% as compared to 24.3% amongst women.

The overall survey had a 60% success rate in obtaining blood samples from those who were eligible. This leads to some concerns about non response bias. Using the full data set Levinsohn and McCrary (2009) find although opting out of testing is non-random it does not affect the prevalence rates and prevalence rates corrected for self selection are only moderately less than the naive rate. Using only the sub-sample of men between the ages of 10 and 64 non-response biases was tested for using the Heckman probit selection method described above. Of the 6838 men eligible for testing only 4331 agreed to HIV tests giving a response of 63%. Table 7 reports the results of the selection equation.

The BAIS II data did not include a derived wealth index and so this was constructed using principal components analysis as with the DHS wealth index. Eight variables were included about household ownership of certain consumer durables (radio, television, telephone, cell phone, car, tractor, motorcycle and bicycle) and variables describing characteristics of household's dwelling (type of toilet, source of water and quality of housing materials). A wealth score was created following the guidelines of Filmer and Pritchett(2001) and divided into quintiles to create five wealth categories. The variable "paid for sex" was phrased slightly differently in this data and asked whether the respondent had exchanged gifts or money for sex during the last 12 months.

The p-value for the hypothesis that $\rho = 0$ is 0.57. We therefore cannot reject the null hypothesis and conclude that $\rho = 0$ and sample selection does not result in any bias in this

[4]Telephonic interviews conducted with tribal houses in January 2009

Table 7: Heckman Sample Selection Probit - Selection Model

	Probit Sample Selection	**Standard Error**
Age	-0.012	[0.017]
Age Squared	0.000	[0.000]
Rural	Ref	
Urban	2.453	[0.076]***
No Education	Ref	
Primary Education	0.845	[0.109]***
Secondary Education	0.693	[0.117]***
Higher Education	0.770	[0.127]***
Poorest	Ref	
Poor	-0.499	[0.099]***
Middle	-0.619	[0.100]***
Rich	-0.789	[0.101]***
Richest	-1.105	[0.109]***
Never Married	Ref	
Married	0.057	[0.075]
Formerly Married	0.288	[0.252]
Times Away from Home	0.174	[0.070]**
No STD	Ref	
STD	0.209	[0.098]**
No MCP		
Multiple Concurrent Partners	0.203	[0.088]**
No Condom	Ref	
Condom	0.090	[0.068]*
Paid Sex	0.301	[0.320]
Constant	-0.471	[0.331]
Observations		3168
Censored Observations		1287
Rho		0.28
P-Value		0.574

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

data set. Therefore the proceeding regressions will be reported as logistic regressions using only the subsample of those that agreed to HIV tests. The results should remain unbiased.

Wealth plays a very significant role in determining whether or not men decide to agree to HIV tests. Surprisingly those who are at higher risk (multiple concurrent partners and reported having an STD in the past 12 months) are more likely to agree to test. Of the 4658 (with HIV results) men in the sample 9.32% reported themselves to be circumcised. This is relatively low in comparison to countries in Eastern and Western Africa. Given the virtual abolition of MC in Botswana, one would expect low levels of circumcised men. HIV prevalence amongst this sample was 17%, HIV prevalence among circumcised men was slightly higher at 21% as compared to 17% among uncircumcised men. A t-test shows that this difference is significant at 5%. The data does not give any information about the age at which respondents were circumcised or where they were circumcised.

Because circumcision is protective against sexually transmitted HIV, the HIV prevalence between circumcised and uncircumcised men was compared among only those that reported to have ever had sexual intercourse. For this sub-population, HIV prevalence was higher among the uncircumcised, which is in line with expectations. However the difference in HIV prevalence amongst non virgin circumcised and uncircumcised men is not statistically significant, implying that prevalence is the same between the two groups. These results as well as HIV prevalence by other socio-economic and demographic characteristics are reported in Table 8. Levels of HIV prevalence vary across education levels. Those with no education have higher prevalence rates than those with Primary education or higher.

Table 9 reports the associations between various socio-demographic characteristics and MC. It also reports the Odds Ratio of a logistic regression determining which socio-economic and demographic characteristics are significant in determining the probability that a man is circumcised.

The BAIS II survey did not specifically ask which tribe respondents belonged to. However the district that respondents reside in can be used as an indication of the tribe they belong to. A dummy variable for respondents tribe was created based on the district they resided in, where the reference category was districts which were made up of towns and cities where there is no predominant tribe. Other districts (mostly rural) were categorised into the predominant tribal group in that area. Of all the tribes that have had any resurgence of

Table 8: HIV Prevalence by Selected Characteristics

	HIV Prevalence	P-value
Age		
10-14	3.6%	
15-24	5.9%	
25-49	31.3%	
50-64	17.0%	
Location		
Urban	18.0%	
Rural	16.2%	0.135
Education		
No Education	24.6%	
Primary	17.6%	
Secondary	14.3%	
Post Secondary	17.0%	
Wealth Quintile		
Poorest Quintile	17.5%	
Poorer	17.6%	
Middle	19.6%	
Rich	18.0%	
Richest Quintile	14.1%	
Marital Status		
Never Married	11.6%	
Married	27.8%	
Formerly Married	29.8%	
Circumcision		
Circumcised	20.8%	
Uncircumcised	17.0%	0.060
Circumcision (Sexually Active)		
Circumcised	22.2%	
Uncircumcised	24.6%	0.308
TOTAL	17.3%	

Table 9: Male Circumcision Prevalence and Logistic Results

	Total	Circumcised	MC Prevalence	OR
Age Group				
10-14	1138	24	2.1%	Ref
15-24	2104	110	5.2%	2.218***
25-49	2852	401	14.1%	6.041***
50-64	629	108	17.2%	9.242***
Location				
Rural	4146	374	9.0%	Ref
Urban	2577	269	10.4%	1.073
Tribal Regions				
Mixed	3369	358	10.6%	Ref
Ngwaketse	532	38	7.1%	0.791
Barolong	148	6	4.1%	0.429**
Batlokwa/Balete+	260	26	10.0%	0.815
Bakwena+	873	58	6.6%	0.642***
Bakgatla+	312	52	16.7%	1.728***
Bangwato	957	70	7.3%	0.750**
Batawana	272	35	12.9%	1.337
Education				
No Education	953	100	10.5%	Ref
Primary	2201	154	7.0%	1.105
Secondary	2635	206	7.8%	1.191
Higher	926	183	19.8%	2.217***
Religion				
Christian	5111	478	9.4%	Ref
Muslim	51	20	39.2%	4.252***
Hindu	33	3	9.1%	0.401
Badimo (Traditional)	381	42	11.0%	1.097
Other	67	10	14.9%	1.619
No religion	1069	90	8.4%	0.900
TOTAL	6715	410	9.6%	6704
Prob > Chi2				0.000
Pseudo R Squared				0.087

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

+ tribes that had a revival of initiation and circumcision after the 1930s

initiation schools and circumcision over the last 100 years only the Kgatla tribe significantly increases the probability of being circumcised. The Kwena, Barolong and Bangwato tribes have significantly lower odds of being circumcised when compared to non-tribal regions. This is interesting given that the Kwena tribe was one of the tribes that had revived the practice of bogwera and circumcision. Looking at the prevalence of circumcision across age groups, it increases as age increases. There is a jump in circumcision prevalence in the age group 25 to 49 from a low of 2.1 and 5.2% for age groups 10-14 and 15-24 respectively, to 14.1%.It can be inferred from this that circumcision in Botswana takes place later on life that is post puberty. This could hinder the efficacy of MC in reducing the risk of HIV transmission. MC is more prevalent in urban areas and the odds of being circumcised are significantly positive for those living in urban areas. Other characteristics that significantly increase the odds of being circumcised are being Muslim and having higher education.

5.3 Empirical Analysis

Further analysis is reported in Table 10 which shows the results of a logistic regression determining variables that are associated with HIV status among sexually active men in Botswana. Number of lifetime partners was excluded from the explanatory variables due to unavailability of this information in the data.

The results of the model show that HIV status has a quadratic relationship with age where the turning point is 39.6 years old. The variable English is a dummy variable indicating which language the participant understands best. This was added because a cultural study conducted by MacDonald (1996) showed that in Botswana there was a possible linguistic and cultural confusion regarding some of the information and messages regarding HIV and AIDS. He gives an example of the Setswana word for condom, *sekausu* is the same as that for sock and stories emerged of men carrying socks in their pockets or wearing them during sex. Because of possible high collinearity between language and education model 2 excludes education as an explanatory variable and only uses language. In the second model being primarily an English speaker is significant in reducing the probability of being HIV positive.

In the case of Botswana circumcision is significant in explaining decreased odds of being HIV positive at a 10% significance level only in the second model where education is excluded. In the first model however circumcision is significant at a 15% significance level. The age

Table 10: HIV Logistic Regressions

	Model 1		Model 2	
HIV	**OR**	**SE**	**OR**	**SE**
Age	1.613	[0.070]***	1.605	[0.068]***
Age Squared	0.994	[0.001]***	0.994	[0.001]***
Rural	Ref		Ref	
Urban	1.272	[0.176]*	1.276	[0.175]*
No Education	1.498	[0.381]		
Primary Education	1.322	[0.350]		
Secondary Education	0.818	[0.236]		
Higher Education	Ref		Ref	
English	0.880	[0.143]	0.766	[0.120]*
Poorest	Ref		Ref	
Poor	1.043	[0.225]	1.027	[0.221]
Middle	1.024	[0.220]	0.989	[0.209]
Rich	0.812	[0.180]	0.753	[0.163]
Richest	0.612	[0.148]**	0.494	[0.112]***
Unemployed	Ref		Ref	
Employed	2.339	[2.647]	2.182	[2.459]
Never Married	Ref		Ref	
Married	1.007	[0.127]	0.998	[0.126]
Formerly Married	1.642	[0.579]	1.622	[0.568]
Travelled more than one Month	0.907	[0.121]	0.891	[0.118]
No Alcohol	Ref		Ref	
Alcohol	1.015	[0.175]	1.024	[0.175]
Age at First Intercourse	0.986	[0.016]	0.986	[0.016]
No STD	Ref		Ref	
STD	1.716	[0.275]***	1.713	[0.272]***
Uncircumcised	Ref		Ref	
Circumcised	0.784	[0.134	0.760	[0.130]*
Observations		2115		2119
Prob > Chi2		0.000		0.000
Pseudo R Squared		0.111		0.106

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

at which circumcision takes place may be relevant in explaining why MC is not significant in the first model. As indicated earlier the distribution of circumcised males across age groups suggests that circumcision generally takes place post puberty in Botswana. Despite this there is still evidence to suggest that MC is significant in reducing the risk of HIV transmission in Botswana. Wealth is significant in explaining HIV prevalence with wealthier groups less likely to be HIV positive. This is in contrast to Swaziland where education was a key determinant of HIV status and wealth was insignificant. The marginal effects of circumcision on HIV status, holding all other explanatory variables constant at their mean shows a reduction in the probability of men in Botswana being HIV positive by 4%.

Table 11 reports the results of a logistic regression to assess the risk profile of circumcised men in Botswana. In order for MC to be an effective HIV prevention tool it must not be coupled with risk compensation. This regression is a binary logistic regressions where the dependent variable is whether respondents used a condom during the last sexual encounter. Using this measure of behavioural risk circumcision does not appear to be significant in explaining condom use. It can therefore be concluded that being circumcised does not appear to be associated with greater risky sexual behaviour.

Education and wealth are significant predictors of condom use, with the wealthiest quintiles and the more educated more likely to use condoms (as expected). BAIS II did not have information on specific Christian groups, rather it grouped all Christian faiths together. Botswana is quite a religiously diverse country (in comparison to Lesotho and Swaziland) and the reference category includes non-religious, Hindu and traditional beliefs. The regression shows that being Christian or Muslim is not significant in explaining condom use. The variable alcohol is the number of time per week the respondent drinks alcohol. The probability of having used condoms during their last sexual encounter decreases with the number of times per week the respondent drinks alcohol.

In Botswana MC appears to be effective in reducing the risk of HIV transmission. Circumcised men do not appear to engage in riskier sexual behaviour; however the age at which they are circumcised could be crucial in its efficacy as a HIV prevention strategy. A 2003 study (Kebaabetswe, et al., 2003) in Botswana assessed the acceptability of circumcision in Botswana before and after an informational session about the risks and benefits of circumcision. Before the informational session, 68% responded that they would definitely or probably circumcise a male child if circumcision was offered free of charge in a hospital setting; this

Table 11: Logistic Regression Assessing Condom Use

Condom	**OR**	**SE**
Age	0.944	[0.006]***
Rural	Ref	
Urban	0.975	[0.105]
Poorest	Ref	
Poor	2.016	[0.338]***
Middle	2.350	[0.416]***
Rich	3.064	[0.558]***
Richest	3.064	[0.590]***
No Education	Ref	
Primary Education	1.432	[0.236]**
Secondary Education	2.177	[0.382]***
Higher Education	1.855	[0.375]***
Never Married	Ref	
Married	0.835	[0.093]
Formerly Married	0.659	[0.225]
Other Religions	Ref	
Christian	0.851	[0.093]
Islam	1.031	[0.669]
Alcohol	0.911	[0.023]***
Uncircumcised	Ref	
Circumcised	0.796	[0.112]
Observations		2153
Prob > Chi2		0.000
Pseudo R Squared		0.166

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

number increased to 89% after the informational session. Among 238 uncircumcised men, 61% stated that they would definitely or probably get circumcised themselves if it were offered free of charge in a hospital setting; this increased to 81% after the informational session. Most participants (55%) felt that the ideal age for circumcision is before 6 years, and 90% of participants felt that circumcision should be performed in the hospital setting. MC is not only effective in Botswana as a HIV prevention strategy, but is also highly acceptable.

6 Lesotho

6.1 Background on HIV/AIDS

Lesotho is a small country with a population of less than 2 million, 75% of whom live in rural areas. UNAIDS (2007) estimates adult (15-49 years) HIV prevalence in Lesotho to be 23% making it the third highest prevalence rate in the world. Infection rates are disproportionately higher in urban areas. UNAIDS (2007) find that knowledge about HIV in Lesotho is poor and the spread of infection is characterised by early sexual debut, migration and reluctance to use condoms. Further research has shown that education appears to be an important aspect of preventing HIV infection and adopting less risky behaviours (Corno & de Walque, 2007). Migration may play a particularly important role in Lesotho. In 2008 it was estimated that more than 53 000 Basotho were employed in mines in South Africa (Bureau of Statistics, 2008).

Initiation schools have been a part of rural life in Lesotho since the Sotho tribe settled in the Caledon River Valley and Maluti Mountains. Such schools were attended by boys and girls who had reached puberty and were held in secret locations. Circumcision in Lesotho is still practiced today as part of male initiation (Sunal & Mutua, 2007). An estimated 8 000 young men are circumcised by traditional healers every year, outnumbering those that are performed by the healthcare system (Sawires, et al., 2007). The subject of initiation schools is taboo in Sotho culture and so most of the information on initiation school practices is based on anecdotal evidence. Although the DHS data has no information on who performed the circumcision it is likely that the majority of circumcisions were performed by traditional healers during initiation.

6.2 Data and Summary Statistics

The data for the analysis presented here was drawn from the Lesotho DHS (2004). It comprises 2,797 men between the ages of 15 and 59, of which HIV test results are available for 2,234 giving a response rate of 79.9%. Table 12 gives the results of the sample selection equation from the Heckman probit. The null hypothesis that $\rho = 0$ is not rejected (p-value of 0.461) indicating that sample selection bias is not a problem. Logistic regressions will

therefore be used for further analysis. In contrast to Botswana and Swaziland those in urban areas of Lesotho are less likely to agree to participate in HIV tests. Most sexual behaviour variables are insignificant in predicting the decision to test except for the variable paid for sex in the last 12 months, which reduces the probability of being tested.

Table 13 shows the HIV prevalence of men in the DHS by selected characteristics. The data shows that HIV prevalence is higher in urban areas, a t-test comparing prevalence in rural and urban areas shows that this difference is statistically significant. Education also seems to play a role with HIV prevalence declining as education levels increase. The data also challenges a common misconception that HIV is a poor man's disease, with higher HIV positive rates in the third and fourth wealth quintiles. An unexpected result is that HIV rates are statistically significantly higher among circumcised men than uncircumcised men, which appears to fly in the face of the general African pattern presented earlier. Even after restricting the data to non-virgins only, there is still a larger HIV prevalence among circumcised men, although this difference is no longer significant at a 5% significance level. This still goes against what one would expect which is statistically significant lower HIV prevalence amongst circumcised men. However, as this could be reflecting confounding factors, it is useful to explore the data more carefully.

The prevalence of circumcision among the men interviewed by the DHS was relatively high with just over 51% of respondents reporting themselves to be circumcised. However these results should be treated with caution as self-reporting of circumcision can be unreliable.

Table 14 summarises prevalence of circumcision by certain characteristics. It also includes the results of a logistic regression determining the characteristics that determine the probability of being circumcised in Lesotho; reported in terms of an odds ratio. Age, location, wealth, education and religion are all significant in explaining the probability of being circumcised. Circumcision appears to be predominant in rural areas, which may be explained by greater likelihood of attending initiation schools for those living in rural areas. Although HIV prevalence is greater among circumcised men overall, the picture changes when the country is divided by region: in urban areas there is a higher HIV prevalence where prevalence of MC is lower; and in rural areas there is lower HIV prevalence where there is greater MC. MC is more probable among the poor and amongst people living in rural (as opposed to urban) areas. The odds of being circumcised declines as education increases. Compared to the reference category of Roman Catholic, most other religions have an increased prob-

Table 12: Heckman Sample Selection Probit - Selection Model

	Probit Sample Selection	**SE**
Age	-0.032	[0.022]
Age squared	0.000	[0.000]
Rural	Ref	
Urban	-0.272	[0.092]***
No Education	Ref	
Primary Education	0.025	[0.100]
Secondary Education	-0.026	[0.126]
Higher Education	-0.649	[0.204]***
Poorest	Ref	
Poor	-0.104	[0.123]
Middle	-0.204	[0.123]*
Rich	-0.287	[0.129]**
Richest	-0.319	[0.140]**
Never Married	Ref	
Married	0.011	[0.105]
Formerly Married	-0.117	[0.239]
Times Away from Home	0.012	[0.008]
No STD	Ref	
STD	0.087	[0.206]
No MCP	Ref	
Multiple Concurrent Partners	-0.006	[0.201]
No Condom	Ref	
Condom	-0.031	[0.089]
Paid Sex	-0.267	[0.139]*
Constant	1.710	[0.361]***
Observations		1698
Censored Observations		378
Rho		-0.680
P-Value		0.461

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

Table 13: HIV Prevalence by Selected Characteristics

	HIV Prevalence	**P-value**
Age		
15-24	5.9%	
25-49	32.6%	
50-59	16.9%	
Location		
Urban	23.1%	
Rural	17.4%	0.005
Education		
No Education	23.6%	
Primary	17.3%	
Secondary	17.6%	
Post Secondary	12.1%	
Wealth		
Poorest	17.9%	
Poorer	16.5%	
Middle	21.3%	
Richer	20.8%	
Richest	16.3%	
Marital Status		
Never Married	7.9%	
Married	28.5%	
Formerly Married	24.5%	
Circumcision		
Circumcised	22.2%	
Uncircumcised	14.6%	0.000
Circumcision (Sexually Active)		
Circumcised	23.5%	
Uncircumcised	20.0%	0.078
Total Sample	**18.6%**	

Table 14: Male Circumcision Prevalence and Logistic Results

	Total	Circumcised	MC Prevalence	OR
Age Group				
15-24	1258	460	36.6%	Ref
25-49	1230	784	63.7%	2.961***
50-59	302	189	62.6%	2.137***
Residence Type				
Rural	2096	1192	56.9%	Ref
Urban	694	241	34.7%	0.630***
Wealth				
Poorest	538	386	71.8%	Ref
Poorer	553	332	60.0%	0.795
Middle	550	279	50.7%	0.685***
Richer	567	249	43.9%	0.641***
Richest	582	187	32.1%	0.485***
Education				
No Education	545	440	80.7%	Ref
Primary	1509	784	52.0	0.379***
Secondary	665	185	27.8%	0.176***
Higher	71	24	33.8%	0.204***
Religion				
Roman Catholic	1254	596	47.5%	Ref
Lesotho Evangelical Church	560	272	48.6%	1.222*
Methodist	44	23	52.3%	1.266
Anglican Church	264	136	51.5%	1.363**
Seventh Day Adventist	9	4	44.4%	1.358
Pentecostal	92	57	62.0%	1.838**
Other Christian	377	216	57.3%	1.335**
No Religion	182	123	67.3%	1.584**
TOTAL	2790	1433	51.4%	2782
Prob > Chi2				0.000
Pseudo R Squared				0.151

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

ability of being circumcised. Those that reported not to belong to any religion, also had greater odds of being circumcised compared to Roman Catholics.

An important feature of circumcision in Lesotho is how it is distributed over age categories. After the age of 25 the prevalence of circumcision increases to over 63% compared to a much lower prevalence of 37% in the age group 15 -24. This might suggest that circumcision happens after the age of 25 for Sotho men. Although this cannot be tested, as the questionnaire fails to ask the age at which the men were circumcision it does give an indication that the age at which circumcision happens is likely to be post puberty.

6.3 Empirical Analysis

Logistic regression analysis was used to analyse the determinants of being infected with HIV. Again regressions are expressed in terms of an odds ratio. First an oversimplified model is tested using just circumcision as an explanatory for HIV status amongst all the men in the population, non-virgins and those that reported they have never had sexual intercourse. Using this simple univariate analysis circumcision emerges as a predictor of increased risk of HIV. This conforms to the findings of Garenne (2008) indicating that his results were not based on a multivariate analysis (reported in Table 16). However when the same regression is performed on a sub-sample excluding virgins, circumcision is no longer significant in explaining risk of HIV.

Brewer et al (2007) found that circumcised male virgins were substantially more likely to be HIV infected than uncircumcised virgins in Lesotho. They concluded from this that HIV transmission may occur through circumcision related blood exposures. Using the same data (Lesotho DHS 2004) this relationship was tested and reported in Table 15.

It is restricted to all those who reported themselves to have never had sexual intercourse and lie between the ages of 15 and 59. The logistic regression finds similar results to those of Brewer et al (2007) that circumcision may be contributing to greater odds of being HIV positive. However there could be other factors that are not included in this crude model which may be significant in explaining HIV status among virgins. After controlling for age, location and education circumcision is no longer significant in explaining HIV status among virgins. Higher education was excluded because of lack of observations for this

Table 15: Logistic Regressions Assessing Impact of MC on HIV

HIV	**Total Sample**		**Non-Virgins**		**Virgins [OR]**		**Virgins [OR]**	
	OR	**SE**	**OR**	**SE**	**OR**	**SE**	**OR**	**SE**
Circumcised	1.67	[0.187]***	1.21	[0.145]	4.82	[1.747]***	1.43	[0.611]
Age							1.602***	[0.165]***
Age Squared							0.994***	[0.001]***
Urban							1.015	[0.618]
Primary Education							1.297	[0.576]
Secondary Education							0.635	[0.481]
Observations		2231		1737		494		493
Prob > Chi2		0.000		0.108		0.000		0.000
Pseudo R Squared		0.100		0.001		0.077		0.241

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

variable within the restricted sample. This casts doubt over the hypothesis that the actual circumcision procedure in Lesotho contributes to higher HIV transmission.

Table 16 shows a model of drivers of HIV amongst men in Lesotho. Age and age squared are both significant in explaining HIV prevalence and have a quadratic relationship of odds of being infected increasing with age and then at a turning point of approximately 38 years old begins to decline.

Those in the middle and rich wealth quintile are more likely to be HIV positive compared to the poorest quintile (the reference group). This is shows the importance of knowing your local epidemic as the reverse was true for Swaziland and Botswana. Education variables are insignificant predictors of HIV status. Married men have greater odds of being infected compared to those that have never been married. MC is not significant and appears to have no impact on the odds of being HIV positive once other factors are controlled for. This, in turn, indicates that the initial positive relationship between MC and HIV is spurious and once other factors are controlled for, it falls away. Interestingly, though, the relationship does not switch over the other way .i.e. controlling for other factors does not result in the negative correlation between HIV prevalence and MC. As mentioned before there could be several confounding factors that might be able to explain this result one of which is if circumcised men have a false sense of security and engage in riskier sexual behaviour once they have been circumcised.

Table 16: HIV Logistic Regression

HIV	OR	SE
Age	1.578	[0.088]***
Age Squared	0.994	[0.001]***
Rural	Ref	
Urban	1.205	[0.242]
No Education	Ref	
Primary Education	0.887	[0.168]
Secondary Education	0.779	[0.196]
Higher Education	0.383	[0.239]
Poorest	Ref	
Poor	1.291	[0.304]
Middle	1.776	[0.422]**
Rich	1.948	[0.503]***
Richest	1.288	[0.380]
Unemployed	Ref	
Employed	1.049	[0.160]
Never Married	Ref	
Married	1.567	[0.323]**
Formerly Married	1.149	[0.556]
Times Away from Home	1.006	[0.016]
No Alcohol	Ref	
Alcohol	1.253	[0.291]
Number of Lifetime Partners	1.014	[0.006]**
Age at First Intercourse	0.975	[0.021]
No STD	Ref	
STD	1.717	[0.590]
Uncircumcised	Ref	
Circumcised	1.001	[0.167]
Observations		1351
Prob > Chi2		0.000
Pseudo R Squared		0.132

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

Table 17: Logistic Regression Assessing Condom Use

Condom	**OR**	**SE**
Age	0.965	[0.008]***
Rural	Ref	
Urban	1.394	[0.223]**
Poorest	Ref	
Poor	1.205	[0.291]
Middle	1.469	[0.351]
Rich	2.441	[0.585]***
Richest	2.784	[0.722]***
No Education	Ref	
Primary Education	1.547	[0.353]*
Secondary Education	3.997	[1.002]***
Higher Education	6.461	[2.424]***
Never Married	Ref	
Married	0.197	[0.034]***
Formerly Married	0.549	[0.238]
Other Religion	Ref	
Catholic	0.862	[0.109]
No Alcohol	Ref	
Alcohol	1.079	[0.252]
Uncircumcised	Ref	
Circumcised	0.766	[0.101]**
Observations		1890
Prob > Chi2		0.00
Pseudo R Squared		0.269

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

In order to see if the insignificance of MC can be explained by greater risky behaviour a further regression is run. The logistic regression reported in Table 17uses condom use during last sexual encounter as a measure of sexual risk. Although this is a crude measure of the risk profile of Sotho men, it will give an indication of whether circumcision can explain sexual behaviour.

The results of the logistic regression show that age, wealth and education are significant in explaining condom use. Lack of education and poverty appear to contribute to lower condom use. Married men are less likely to use condoms. Circumcision is significant in explaining condom use, where circumcised men are less likely to have used condoms during their last sexual encounter. Condom use in Lesotho is generally very low, but among circumcised men it is even lower.

Although Lesotho has a high prevalence of circumcision it does not appear to have a protective effect in terms of HIV status. Rather the drivers of HIV infection in Lesotho are wealth, a lack of education and greater infection rates among married men. Wealth may contribute as wealthier men are in a position to negotiate transactional sex or sex for gifts. The insignificance of MC as a driver for HIV was surprising, but its insignificance may be linked to the fact that circumcised men appear to be engaging in riskier behaviour.

The apparent lack of efficacy of MC in preventing HIV can also be explained to some extent by the type of circumcision that is being performed. Both in terms of the possibility of unsanitary circumcisions which are causing HIV and the fact that traditional circumcision often does not involve the full removal of the foreskin. Furthermore, circumcision may be taking place when men are much older, reducing its effectiveness as protection against HIV transmission. However these issues needs to be investigated further.

7 Discussion

The data analysis for Swaziland and Botswana supports the hypothesis that MC is an effective method for reducing the risk of HIV transmission. In these countries the way that circumcision is already practiced appears to be effective in reducing the risk of being HIV positive, however the age of circumcision may be of particular concern in Botswana.

Although there are no signs of risk compensation among these populations, circumcision roll outs should target men and boys from as early an age as possible and care must be taken to ensure that people understanding that MC is not fully protective or a cure for AIDS and that condom use and other risk reduction strategies are necessary. The results from these two data sets confirm what has been found in observational studies as well as randomised controlled trials. Although marginal effects show a much lower reduction in the probability of being HIV positive (between 4 and 14%) it must be considered that this compares a circumcised male (who is an average of all explanatory variables) with a similair uncircumcised male sharing the same X values. The effect of MC may be more or less when comparing different sub-populations, with different values of X. Age at which circumcision takes place in Botswana may be contributing to the particularly low marginal effect of MC in that country.

At first glance it would appear to policy makers that a MC policy in Lesotho would not be helpful as MC does not appear to contribute to lower HIV prevalence. In fact in his paper, Garenne (2008) comes to this conclusion. He concludes that "little may be expected from voluntary circumcision programmes in advanced generalised epidemics" (Garenne, 2008, p. 6). However there may be several factors that may have contributed to this result. Firstly as seen above risk compensation may be contributing to this, which means that any circumcision roll out needs to be accompanied with education on continued condom use. Another contributing factor may be over-reporting of circumcision. Garenne (2008) dismisses the relevance of this factor stating that "the reported effect of MC in clinical trials is basically the same as in observational studies, and also in general populations after controlling for confounding factors, which reinforces the value of the demographic information" (Garenne, 2008, p. 6). The type of circumcision that is practised in Lesotho cannot be ignored as contributing factor to explaining the inefficacy of MC in reducing the risk of HIV transmission. The circumcision that is performed in Lesotho is a different type of circumcision. MC is the surgical removal of the entire prepuce (foreskin) of the penis (Quinn, 2007). In Lesotho circumcision is not performed in early childhood, but during adolescence while boys are sent to "initiation schools". Generally, it does not involve a complete removal of the foreskin but rather a more symbolic cut (Corno & de Walque, 2007). Therefore circumcision is likely to be over-reported as Basotho men think they are circumcised according to their own definition, but this is not a medically defined circumcision. In the Orange Farm study they found that 59% of Sotho men said they were circumcised but upon inspection found

that entire foreskin had not been removed[5]. Therefore the reporting of circumcision in this data set may be highly unreliable. This may also contribute to the insignificance of MC in explaining reduced HIV prevalence. Finally the age at which circumcision takes place may also contribute to these results. If circumcision is taking place post-puberty as the data suggests then this would also contribute to the insignificance of MC as an HIV prevention strategy.

These results do not necessarily mean that circumcision as an HIV prevention policy in Lesotho would be ineffective; it just means that in the case of Lesotho more needs to be done to ensure the full removal of the foreskin, that circumcision takes place before sexual debut and that men are educated about continued use of condoms and safe sexual practices. All these factors need to be considered if Lesotho is considering a wider MC coverage.

Traditional initiation schools are very closely linked to the practice of circumcision. In Sesotho the term for MC and initiation rites is the same: *lebollo*. Lesotho needs to consider how they can incorporate safe circumcisions that are of a medical standard into traditional initiation practices. At the moment initiation schools in Lesotho are not influenced in any way by government, but if Lesotho wants to implement MC as part of its HIV prevention strategy they will need to collaborate with traditional leaders.

Such efforts have been undertaken in the Eastern Cape Province in South Africa. Traditional surgeons are now required by law to be officially recognized and registered with the provincial Department of Health. The Eastern Cape Legislature promulgated a law, known as Application of Health Standards in Traditional Circumcision Act No. 6 of 2001, which regulates traditional MC (Peltzer, Nqeketo, Petros, & Kanta, 2008). Traditional surgeons and nurses must undergo a five day training session. However it has been found that a five day training programme for traditional surgeons and nurses is not sufficient and that more training is needed in the surgical procedure, the control of sepsis, post-operative wound care, recognition of complications, and referral to hospital would also be beneficial (Peltzer, Nqeketo, Petros, & Kanta, 2008). This is a lesson that can be learnt by Lesotho if they choose to implement some type of regulation into their own initiation schools.

MC has the potential to change the spread of HIV and AIDS in African countries. Serious consideration needs to be taken before implementing such a strategy to ensure that it is

[5]Unpublished Auvert, 2009

implemented safely, at the right age (before sexual debut) and with the body of knowledge that it is not a cure and needs to be implemented in conjunction with other preventative methods such as condom use. There also needs to be an understanding about how this can be incorporated into traditional circumcision methods, in supporting certain aspects such as no sex before circumcision, as well as ensuring the safety of circumcision procedures.

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9 Appendix

9.1 Construction of Wealth Index

The first step in constructing the wealth index using the BAIS II data was choosing the indicator variables to be included based on those used in the DHS (Rutstein & Johnson, 2004) and Filmer and Pritchett (2001). Almost all household assets and utility servicesare included. Assets included were ownership of radio, television, telephone, cell phone, car, tractor, motorbike and bicycle. Also added was the type of toilet, material used for housing (door and roof), number of rooms, source of water and sources of energy for light and cooking. A weighted sum of these indicator variables is constructed using principles components analysis (PCA). When PCA is used only the first principle component is retained and this becomes the proxy measure of wealth or living standards. Once this wealth index is created it is divided into quintiles. The following stata commands were used to create the wealth index:

global assets radio - bicycle rooms piped open other_wat flush pit no_toilet

light_elec coal high_q low_q

pca $assets

predict wscore

xtile wealth=wscore,nq(5)

label define wealth 1"Poorest" 2 "Poorer" 3 "Middle" 4 "Richer" 5 "Richest"

9.2 Questions used to Create Variables

9.2.1 Swaziland

Q104: In the last 12 months, on how many occasions have you travelled away from your home community and slept away?

Q107: How old were you at your last birthday?

Q109: What is the highest level of school you attended: primary, secondary or higher?

Q118: What is your religion?

Q401: Are you currently married or living with a woman as if married?

Q402: Have you ever been married or lived together with a woman as if married?

Q414: How old were you when you had sexual intercourse for the very first time?

Q423: The last time you had sexual intercourse with last sexual a partner, was a male condom or female condom used?

Q431: The last time you had sexual intercourse with this person did you or this person drink alcohol or used any other intoxicating substance?

Q435: In total, with how many different people have you had sexual intercourse in your lifetime?

Q601: Are you currently working?

Q738: During the last 12 months, have you had a disease which you got through sexual contact?

Q801: Are you circumcised?

Q802: At what age where you circumcised?

9.2.2 Botswana

Q102: How old are you in completed years?

Q105: What is the highest level of school you attended: primary, secondary, or higher?

Q110: In the last 12 months, have you been away from your home community for more than one month at one time?

Q115: What is your current occupation?

Q116: What is your religious denomination or Church you go to?

Q117: What language do you speak most often at home?

Q201: Are you currently married or living together with a woman as if you were married?

Q205: Do you have more than one sexual partner?

Q302: At what age did you first have sex?

Q311: The last time you had sex with your most recent partner; did you or this partner use a condom?

Q313: The last time you had sex with your most recent partner; did you or this partner drink alcohol?

Q319: In the last 12 months have you exchanged gifts or money for sex?

Q401: Have you been circumcised?

Q408: During the last 12 months have you had a genital discharge or genital ulcer?

9.2.3 Lesotho

Q105: In the last 12 months, on how many occasions have you travelled away from your home community and slept away?

Q108: How old were you at your last birthday?

Q110: What is the highest level of school you attended: primary, secondary or higher?

Q122: Are you currently working?

Q132: What is your religion?

Q401: Are you currently married or living with a woman as if married?

Q407: Have you ever been married or lived together with a woman as if married?

Q416: How old were you when you had sexual intercourse for the very first time?

Q419: What method of contraception/protection was used the last time you had sex?

Q423A: The last time you had sexual intercourse with this person did you or this person drink alcohol?

Q445: In total, with how many different people have you had sexual intercourse in your lifetime?

Q449: Have you ever paid for sex?

Q739: During the last 12 months, have you had a disease which you got through sexual contact?

Q748: Are you circumcised?