USAID
FROM THE AMERICAN PEOPLE

DHS WORKING PAPERS

Male Circumcision and HIV in Lesotho: Is the Relationship Real or Spurious? Analysis of the 2009 Demographic and Health Survey

Tiisetso Makatjane
Thandie Hlabana
Emmanuel Letete

2016 No. 125

DEMOGRAPHIC AND HEALTH SURVEYS

August 2016

This document was produced for review by the United States Agency for International Development.

Male Circumcision and HIV in Lesotho: Is the Relationship Real or Spurious? Analysis of the 2009 Demographic and Health Survey

Tiisetso Makatjane[1]

Thandie Hlabana[2]

Emmanuel M. Letete[3]

ICF International

Rockville, Maryland, USA

August 2016

[1] Department of Statistics and Demography
[2] Department of Sociology, Anthropology and Social Work
[3] Department of Economics
All three are based at the National University of Lesotho

Corresponding author: T. J. Makatjane, Department of Statistics and Demography, National University of Lesotho; E-mail: tj.makatjane@nul.ls or tjmakatjane@gmail.com

Acknowledgments

We would like to extend our heartfelt gratitude to ICF International and USAID for considering us for this opportunity and for funding us to be part of the 2016 DHS Fellows program. We are greatly indebted to our facilitators Dr. Wenjuan Wang, Dr. Shireen Assaf, Dr. Elizabeth Nansubuga, Simona Simona, and Damian Damian for their guidance and patience during this process. Our reviewer, Joy Fishel at ICF, is appreciated for valuable insights about this work. We are also grateful to our DHS Program co-fellows for their support, feedback, and humor. This has been an opportunity for growth, and we see ourselves as ambassadors of The DHS Program in Lesotho and beyond. We also want to extend our gratitude to our institution, the National University of Lesotho, Faculty of Social Sciences, for affording us the opportunity to participate in the 2016 DHS Fellows Program.

Editor: Bryant Robey
Document Production: Natalie La Roche

The DHS Working Papers series is a prepublication series of papers reporting on research in progress that is based on Demographic and Health Surveys (DHS) data. This research is carried out with support provided by the United States Agency for International Development (USAID) through The DHS Program (#AIDOAA-C-13-00095). The views expressed are those of the authors and do not necessarily reflect the views of USAID or the United States Government.

The DHS Program assists countries worldwide in the collection and use of data to monitor and evaluate population, health, and nutrition programs. For additional information about The DHS Program, contact DHS Program, ICF International, 530 Gaither Road, Suite 500, Rockville, MD 20850, USA. Phone: +1 301-407-6500; Fax: +1 301-407-6501; Email: reports@dhsprogram.com; Internet: www.dhsprogram.com.

Recommended citation:

Makatjane, T. J., T. Hlabana, and E. M. Letete. 2016. *Male Circumcision and HIV in Lesotho: Is the Relationship Real or Spurious? Analysis of the 2009 Demographic and Health Survey.* DHS Working Papers No. 125. Rockville, Maryland, USA: ICF International.

Abstract

Background. Lesotho has the second highest prevalence of HIV in the world, estimated at 23%. Compelling evidence from ecological studies, as well as from randomized clinical trials in Africa, suggests that male circumcision reduces the risk of heterosexually-acquired HIV infection in men. However, results from DHS surveys in Lesotho present contradictory evidence of high HIV prevalence among circumcised men (21%) compared with uncircumcised men (16%). The objective of this study is to analyze the relationship between HIV and male circumcision in Lesotho. In particular, the study seeks to assess whether it makes a difference if one is medically or traditionally circumcised, and if the differences in risky sexual behaviors could explain the contradictory evidence in Lesotho.

Data and Methods. The study used data from the 2009 Lesotho Demographic and Health Survey (LDHS). A weighted sample of 2,283 sexually active males age 15-59 was used for this analysis. Descriptive univariate, bivariate, and logistic regression analyses were used.

Results. Although 57% of sexually active men in Lesotho are circumcised, HIV infection is high among all men. When controlling for background and risky sexual behaviors, the study found that medically circumcised men had significantly lower odds of HIV infection than uncircumcised men. However, the odds of HIV infection among traditionally circumcised men were similar to those of uncircumcised men. When comparing the odds of HIV infection among circumcised men only, the study found that traditionally circumcised men had significantly higher odds of being HIV-positive compared with medically circumcised men.

Conclusion and Recommendations. The previously reported, apparent non-existence of protection offered by male circumcision occurs because traditional circumcision and medical circumcision were treated like the same procedure. However, medical circumcision provides the expected protection that traditional circumcision does not. There is need to engage with gatekeepers of initiation schools to ensure that traditional circumcision is as effective as medical circumcision. It is equally important that Lesotho continues to emphasize the importance of avoiding risky sexual behaviors if the war against the AIDS epidemic is to be won. Further research is needed to understand why HIV prevalence for medically and traditionally circumcised men in Lesotho is dissimilar to what prevails in other settings.

Keywords: HIV, Medical Circumcision, Traditional Circumcision, Risky Behaviors

1. Introduction

Lesotho has the second highest prevalence of HIV in the world, estimated at 23% (Ministry of Health Lesotho 2015). HIV infections in Lesotho are found within the general population, and heterosexual contact has been identified as the main mode of transmission (Ministry of Health Lesotho 2015). Indeed, prevention of new HIV infections is one of the biggest hopes in the fight against the HIV pandemic. While the ABCs (Abstinence, Be Faithful, and Correct Condom Use) have long been promoted as preventive strategies in Lesotho, the high HIV prevalence rate reflects the country's challenge in combating HIV infections.

In 2012 Lesotho launched voluntary male medical circumcision as an additional preventive strategy (Ministry of Health Lesotho 2015). It is noteworthy that the launch was not supported by local evidence, since both the 2004 and 2009 Lesotho Demographic and Health Surveys (LDHS) provided evidence that HIV prevalence was higher among circumcised men, suggesting no protection was offered by circumcision. For example, in 2009 HIV prevalence among circumcised men was 21% compared with 16% among uncircumcised men (Ministry of Health and Social Welfare (MOHSW) [Lesotho] and ICF Macro 2009). Rather, the notion that voluntary male medical circumcision should be rolled out as a public health intervention to protect against the transmission of HIV and other sexually transmitted infections was promoted by the World Health Organization (WHO) starting in 2007 based on evidence from ecological and randomized trail studies done in other countries in sub-Saharan Africa (WHO/UNAIDS 2007).

It is important to highlight the relationship between HIV and circumcision as an area of contested research. Epidemiological evidence from ecological studies in sub-Saharan African countries with heterosexually driven epidemics have shown that populations with a relatively high prevalence of male circumcision have relatively low HIV prevalence (Siegfried et al. 2002; Moses et al. 1990). Specifically, these findings have been used to explain the difference in HIV prevalence between Eastern and Southern African countries, which have high HIV prevalence but low male circumcision rates, compared with West African countries with low HIV prevalence and high circumcision rates. Furthermore, within-country research also has supported the inverse relationship between male circumcision and HIV prevalence. For example, in Western Kenya uncircumcised men had four times higher odds of being HIV positive compared with circumcised men (Auvert et al. 2005; Marum et al. 2004). A recent study (MacLaren et al. 2015) found that in regions of Papua New Guinea where male circumcision is ritually practiced, HIV seroprevalence was considerably lower than in areas where it is not practiced. Cameron and colleagues (1989) suggested a greater than eight-fold increased risk of HIV-1 infection for uncircumcised men. In a systematic review of literature on the relationship between HIV and male circumcision in sub-Saharan Africa, Weiss, Quigley, and Hayes (2000) concluded that male circumcision is associated with significantly reduced risk of HIV infection among men, especially men at high risk of infection. These findings are supported by the biological theory that the entry of HIV into host

cells is facilitated by CD4 and other HIV co-receptors present on the Langerhans' cells of the foreskin (Hussain and Lehner 1995).

The ecological studies that suggested the negative relationship between HIV and male circumcision prompted development of randomized controlled studies to test the efficacy of medical male circumcision. These randomized controlled trials (RCTs), conducted in South Africa, Kenya, and Uganda, indicated that medical circumcision reduces the risk of HIV acquisition by more than 60% among heterosexual men (Auvert et al. 2005; Bailey et al. 2007; Gray et al. 2007; Siegfried et al. 2005). Based on this evidence, Williams and colleagues (2006) estimated, using a simulation model, that increased coverage of male circumcision among men in Southern Africa could avert as many as 2 million HIV infections and 300,000 deaths over a 10-year period. This was further supported by Kahn, Marseille, and Auvert (2006), who suggested that the protective value of circumcision would be cost-saving. Therefore, these studies presented compelling evidence of a protective benefit of male circumcision against the spread of HIV.

Despite the evidence from ecological studies and RCTs of a protective effect of circumcision, some national surveys have failed to support this effect consistently in sub-Saharan Africa. For example, Garenne (2008) argued that data from 13 African DHS surveys did not support a protective effect. Using DHS data from 18 countries, Mishra and Assche (2009) also showed that circumcision status was not correlated with lower HIV prevalence rate in 10 countries, including Lesotho. An HIV survey in South Africa also showed no relationship between male circumcision and HIV status (Connolly et al. 2008). It was only in pooled DHS data that the protective effect of circumcision once again emerged, with the odds of having HIV four times higher for uncircumcised men than circumcised men, and the effect was more pronounced once sexual behavior and other co-variates were included in the regression analysis (Gebremedhin 2010). In fact, some authors, such as Warren (2010), argue that the protective effect of male circumcision may occur mainly because circumcision is associated with safer sexual behavior and hence lower rates of HIV infection, as was the case in Botswana and Swaziland, though not in Lesotho. Circumcision has also been found to facilitate condom use, thereby increasing the efficacy of male circumcision (Kebaabetswe et al. 2003; Bailey et al. 2007). Talbott (2007) posited that male circumcision is not significantly associated with lower HIV prevalence once commercial sex-worker patterns are controlled for. These contradictory findings on the effect of male circumcision on HIV infection suggest that male circumcision alone is not sufficient in explaining HIV prevalence in sub-Saharan Africa.

Risk compensation theory can also be used to explain the contradictory effect of male circumcision. According to the theory, people adjust their behavior based on their perceived level of risk. Thus as the perceived risk of HIV is reduced, a person may adopt riskier sexual behaviors (Eaton and Kalichman 2007). For example, some studies have shown that men who are circumcised tend to think they are protected against or immune to HIV infection (Westercamp et al. 2012; Green et al. 2008). Using Uganda DHS data, Kibira and colleagues (2014) found that

circumcised men were more likely to engage in risky sexual behaviors. Consequently, risky sexual behaviors may undermine the effects of male circumcision. Nevertheless, Chikutsa, Ncube, and Mutsau (2014) found that in Zimbabwe it was uncircumcised men who were more likely to practice risky sexual behaviors. These mixed results have prompted further questions on the relationship between HIV and circumcision.

Notwithstanding available research on the subject, a number of studies on the relationship between male circumcision and HIV fail to address questions associated with circumcision within traditional contexts. First, they do not differentiate between traditional and medical circumcision, which is likely to mediate outcomes within the circumcision and HIV literature. The sociocultural factors surrounding circumcision are important in unearthing the myth behind differences in HIV protective efficacy between traditional and medical male circumcision. For instance, MacLaren and colleagues (2015) have shown that the HIV protective effect of male circumcision is not limited to medical procedures, as other traditional foreskin cuttings showed similar results in Papua New Guinea. Second, it is important to understand whether traditionally circumcised men have different sexual behaviors compared with medically circumcised men, which might offset the protective effect of circumcision in specific settings. These issues have become more pressing in the context of Lesotho, where traditional circumcision has remained a common practice that defines manhood even today, and yet HIV prevalence remains among the highest in the region. Thus, the peculiarity of the situation in Lesotho calls for more scientific interrogation that might help explain the relationship between circumcision and HIV.

2. Background

Circumcision in Lesotho is embedded within Sesotho culture. Historically, male circumcision has been part of an "initiation" process known as "lebollo," culturally practiced as a rite of passage from adolescence into adulthood (Gayle et al. 2007). Initiation became part of life in Lesotho culture after the settlement of the Sotho tribe in the Caledon River Valley and Maluti Mountain (Warren 2010). Initiation schools were attended by boys and girls who had reached puberty, and were held in secret locations. Although the curriculum of traditional initiation schools is unclear, Ashton (1952) asserted that in Lesotho this type of school has always been associated with virility. Nevertheless, discussion of initiation remains taboo in the Sesotho culture; as such, information on initiation school practices is based on anecdotal evidence. This evidence only suggests that traditional male circumcision is performed in different ways, and that it may be incomplete by biomedical standards, with perhaps only a small incision cut into the foreskin (Corno and de Walque 2007). Thus, biomedical concerns about safety have contributed to the marginalization of traditional male circumcision. In addition, the timing of traditional male circumcision often takes place after sexual debut, and this is a concern because of its effect on HIV prevention. In Lesotho, age at circumcision was reported to be between 16 and 20 (Ministry of Health and Social Welfare Government of Lesotho 2008).

Nonetheless, traditional male circumcision remains a common practice even today in Lesotho and continues to carry a symbolic meaning of manhood in the Sesotho culture (Skolnik et al. 2014). It appears that young men circumcised under traditional circumcision far out-number those circumcised in the health care system (Warren 2010). It is estimated that about 10,000 initiates are circumcised each year by traditional "healers and elders" compared with between 4,000 and 5,000 men circumcised in the formal health sector (National AIDS Commission 2009). Targeting traditional male circumcision would be a better strategy on the basis of large numbers, not to mention that traditional male circumcision is mainly voluntary. It is important to engage with traditional practitioners in order to effectively roll out voluntary male medical circumcision as a public health intervention. However, historical beliefs and practices around traditional male circumcision will affect the take-up of voluntary male medical circumcision, public health messaging, and broader HIV prevention strategies.

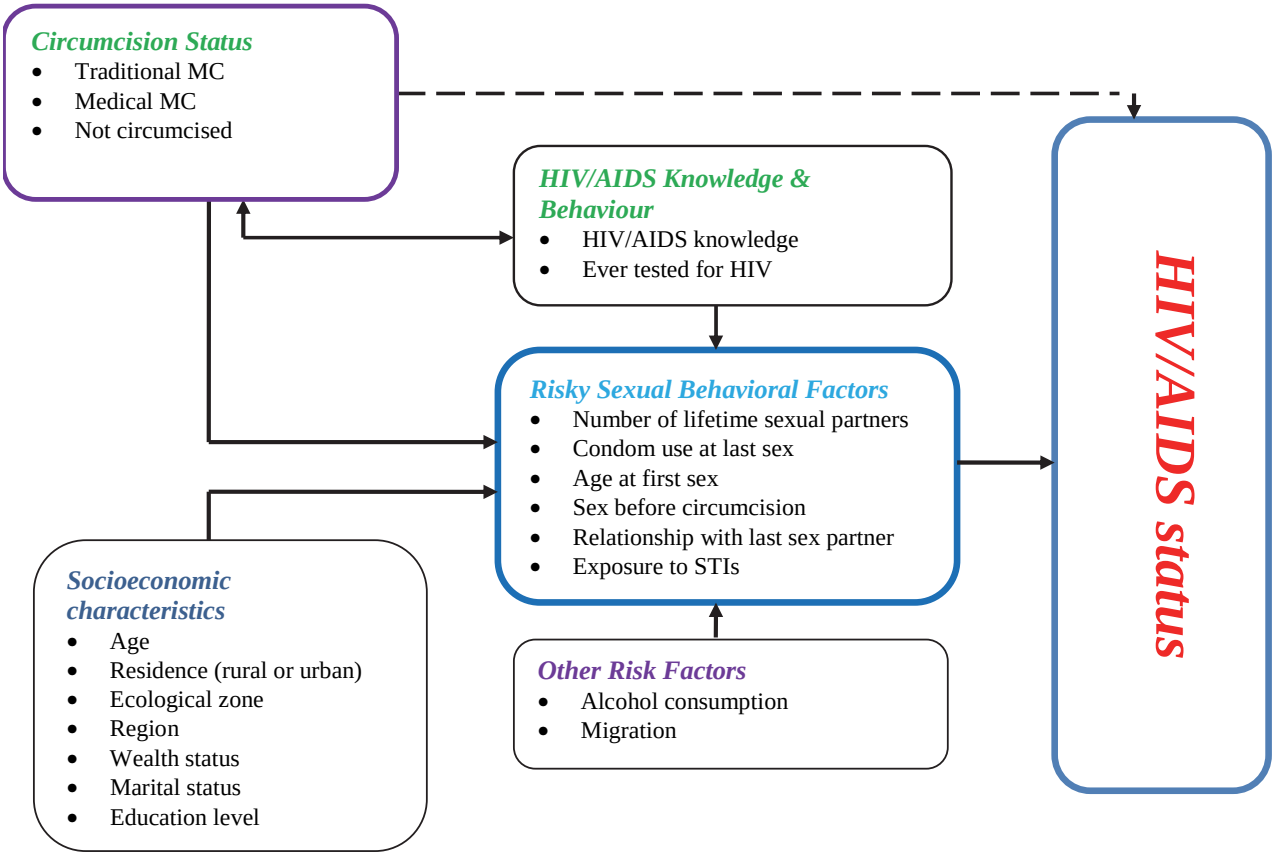
2.1. Conceptual Framework

This paper is based on the conceptual framework illustrated in Figure 1. The framework identifies HIV status as the outcome variable. Based on previous research referenced above, there is a direct link between HIV status and circumcision status. However, the framework identifies this link to be weak (denoted by broken lines in Figure 1) given the unique context of Lesotho in which men who are circumcised present higher HIV prevalence compared with uncircumcised men (Ministry of Health and Social Welfare (MOHSW) [Lesotho] and ICF Macro 2009). The framework divides circumcision status into three categories: traditional circumcision, medical circumcision, and no

circumcision. It assumes that individuals within these three categories might exhibit different sexual behaviors and come from different socioeconomic backgrounds. In particular, traditional circumcision is a “rite of passage” into manhood and not necessarily intended as protection against HIV/AIDS. Manhood in this case is associated with family formation and sexual activity, whereas medical circumcision is associated with protection against HIV and other sexually transmitted infections (STIs). Therefore, conceptualization of circumcision between these two groups is different, with different implications for sexual behaviors.

In Lesotho, HIV is mainly transmitted through heterosexual intercourse (Ministry of Health Lesotho 2015). To account for this, the framework posits that risky sexual behaviors mediate the relationship between circumcision and HIV status. For example, Kibira and colleagues (2014) found that in Uganda circumcised men were more likely to engage in risky sexual behaviors, while Chikutsa, Ncube, and Mutsau (2014) had contradictory results in their study of Zimbabwe. In our study, risky sexual behaviors are defined as number of lifetime sexual partners, age at first sex, non-use of condom at last sex, and relationship with last sex partner. Moreover, risky sexual behaviors could be influenced by other factors such as HIV comprehensive knowledge, STI experience in the past 12 months, and exposure to alcohol consumption. The conceptual framework assumes that men who have comprehensive HIV knowledge would behave differently from those without this knowledge. For instance, some research has found that men with comprehensive HIV knowledge are less likely to engage in unprotected sexual intercourse (Wang and Alva 2012). In the same manner, prior experience of bacterial and viral STIs is associated with risk of acquisition and transmission of HIV infection (Ward and Rönn 2010). Individuals who consume alcohol are likely to make risky sexual decisions while under the influence of alcohol—for example, engaging in sexual intercourse without using a condom (Kalichman et al. 2007). Similarly, individuals who have ever tested for HIV/AIDS have different attitudes and sexual behavior compared with those who have never tested (Kalichman and Simbayi 2003). Moreover, Lurie and colleagues (2003) showed that in South Africa migrant men were twice as likely to be HIV-infected as nonimmigrant men. Thus in mobile societies like Lesotho, migration is an important independent risk factor for HIV infection.

Figure 1: Conceptual framework



2.2. Research Questions

The main research question of the study is why do circumcised men in Lesotho have higher HIV prevalence than uncircumcised men?

Specifically:

- Does it make a difference if one is medically or traditionally circumcised?
- Do differences in risky behavior provide the answer?

3. Data and Methods

3.1. Data

The study used data from the Lesotho 2009 Demographic and Health Survey for the analysis. This was a nationally representative sample. The survey used a stratified, two-stage cluster sampling strategy. At the first stage, clusters were selected from the 2006 Lesotho Population and Housing Census list of enumeration areas (EAs), with probability proportional to size. At the second stage, a complete listing of households within selected clusters was done. From the household listing, systematic sampling was used to select 10,000 households (Ministry of Health and Social Welfare (MOHSW) [Lesotho] and ICF Macro 2009). The survey collected information on sociodemographic characteristics (age, marital status, highest educational level, survey region, residence, ecological zone, and work status), sexual behavior, and self-reported circumcision status. Based on household assets, a wealth index variable was generated. HIV status information was obtained from blood samples collected during interviews from consenting respondents.

In all, 3,317 records were available from the data file for men. Of the total, 3,075 men performed an HIV test. Since the study included variables linked to risky behavior, only men who had been sexually active in the past 12 months were included in the study. Excluding respondents who were not sexually active in the past 12 months and those with missing information on variables of interest reduced the sample size to 2,283. There were 1,432 circumcised men (118 medically circumcised and 1,314 traditionally circumcised) and 851 not circumcised. Based on these figures the weighted distribution of the sample is 58% circumcised men (51% traditional and 6% medical) and 42% uncircumcised.

3.2. Key Variables and Measurements

HIV status was the main outcome variable in this research. The variable was based on blood samples collected from respondents consenting to HIV testing. The variable was categorized into HIV negative and HIV positive. Circumcision status was also a key variable, since the study was interested in the relationship between circumcision and HIV. Based on two questions, “Are you circumcised (self-report)” and “where circumcision was performed,” the variable was categorized into medical male circumcision, traditional male circumcision, and uncircumcised.

Factors related to risky sexual behavior were another set of variables of interest. Included in this group was total number of lifetime sexual partners, age at first sex, age at circumcision, relationship with the last sex partner, condom use at last sexual intercourse, and exposure to STIs. Other risky behavior factors included alcohol consumption, categorized into never drank alcohol, never got drunk, and ever got drunk.

Testing for HIV was categorized into never tested for HIV and ever tested for HIV. Comprehensive HIV knowledge was a computed variable. According to the 2009 DHS report for Lesotho, respondents had to know the correct answers to three questions about protection against AIDS and two questions about local myths. The myth questions were coded as 1 for correct responses and 0

for incorrect responses. An HIV knowledge variable was computed by adding the responses of the 5 variables. The knowledge variable was categorized into "Yes" for respondents with a score of 5, indicating comprehensive HIV knowledge, and "No" for those with a score of less than 5, indicating lack of comprehensive HIV knowledge. Being away from home for more than one month was used as a proxy for migration. The variable was categorized as away for less than one month, away for more than one month, and not away, meaning the individual had never left home.

Background or control variables included region/district, residence, ecological zone (lowlands and highlands), age (15-24, 25-34, 34-44, and 45-59), marital status (never married and ever married), educational level (no education, primary, and secondary and above) and wealth index (poor, middle, and rich).

3.3. Statistical Methods

At the univariate level, the distribution of background/control variables was presented using circumcision status as the unit of comparison.

At the bivariate level, a comparison of risky behaviors by circumcision status was presented, as well as a comparison of HIV status by circumcision status. Chi square tests were used to test for presence of statistically significant associations.

At the multivariate level, four regression models were run on the association between HIV prevalence and circumcision status:

Model 1: circumcision status

Model 2: circumcision status and risky behaviors

Model 3**:** circumcision status and background characteristics

Model 4: circumcision status, risky behaviors, and background characteristics

To fully answer the research question "Does it make a difference if one is medically or traditionally circumcised?" two comparisons were made. In the first comparison, uncircumcised men were the reference category and compared with medically circumcised men and traditionally circumcised men. This comparison included all men in the survey sample. A second comparison was made among circumcised men only, with medical circumcision as the reference category.

To account for the survey sampling methodology, the analysis took into consideration the sample stratification design and sampling weights. Permission to use the data was obtained from ICF International.

4. Results

4.1. Background Characteristics

Table 1 shows the characteristics of the study population by circumcision status. Overall, nearly three-fourths of respondents (72%) live in rural areas, and 14% of respondents have no education. Sixty percent live in the lowlands, and the largest proportions are age 15-24 (37%) and age 25-34 (31%). Ever-married respondents are in the majority (58%), and 43% of respondents reside in rich households. Over two-thirds of the men (69%) are currently working.

Comparing respondents by circumcision status, 74% of medically circumcised men reside in urban areas; in contrast, 87% of traditionally circumcised men and 59% of uncircumcised men reside in rural areas. Medically circumcised men and uncircumcised men are comparatively well educated-84% and 56%, respectively, have completed secondary education or better compared with only 16% of traditionally circumcised men. Most medically circumcised men (84%) and uncircumcised men (74%) live in the lowlands compared with less than half of traditionally circumcised men (46%). Uncircumcised men and traditionally circumcised men show a younger age distribution than medically circumcised men, who are concentrated between ages 25-34 and 35-44. Almost half of uncircumcised men (49%) have never been married compared with 32% of medically circumcised men and 38% and traditionally circumcised men. Eighty-six percent of medically circumcised men and 60% of uncircumcised men reside in rich households, while 50% of traditionally circumcised men reside in poor households. There are only marginal differences in work status among respondents by circumcision status.

Table 1. Characteristics of the study population by circumcision status

		Circumcision Status			
Variable	**Labels**	**Medical Circumcision**	**Traditional Circumcision**	**Not Circumcised**	**Total**
Residence	urban	74.4	13.1	41.1	28.5
	rural	25.6	86.9	58.9	71.5
Education	no education	2.1	22.7	4.5	13.8
	primary	14.4	61.2	39.9	49.4
	secondary+	83.5	16.1	55.5	36.7
Zone	lowlands	83.9	46.1	73.6	59.9
	high lands	16.1	53.9	26.4	40.1
Age	15-24	20.8	35.6	40.9	37.0
	25-34	35.0	30.9	29.4	30.6
	35-44	26.2	18.1	14.1	16.9
	45-59	18.0	15.3	15.6	15.6
Marital status	never married	31.7	38.0	49.2	42.3
	ever married	68.3	62.0	50.8	57.7
Wealth index	poor	6.8	49.6	21.5	35.2
	middle	6.8	25.6	18.4	21.4
	rich	86.4	24.8	60.1	43.3
Respondent currently working?	no	23.7	29.2	34.7	31.2
	yes	76.3	70.8	65.3	68.8
N (weighted)		135	1163	947	

4.2. Risky Behaviors

As Table 2 shows, the majority of Basotho men (56%) experience sex for the first time between the ages of 15 and 19, while more than half (54%) report four or more lifetime sexual partners. For almost all respondents (94%), the last sexual partner was the usual partner, and the majority (53%) did not use a condom at last sex. Half of the respondents have never tested for HIV, and almost all respondents (96%) did not experience an STI in the past 12 months. Close to three-fourths of respondents (73%) lack comprehensive HIV knowledge, while 52% say they have never been drunk. More than half of men have been away from home for at least once, but only 9% have been away for more than one month.

There are differences in migration by circumcision status. Among medically circumcised men, one-third (34%) have never been away from home compared with 46% of traditionally circumcised men and 42% of uncircumcised men. There are no substantial differences between respondents by circumcision status with respect to age at first sex, STIs, drunkenness, number of lifetime sexual partners, and relationship with last sex partner. However, traditionally circumcised men are less likely to have ever tested for AIDS or to have used a condom at last sex compared with medically circumcised men and uncircumcised men. Fifty-nine percent of medically circumcised men and 57% of uncircumcised men used a condom at last sex compared with only 37% of traditionally circumcised men. Only 41% of traditionally circumcised men have ever tested for AIDS compared with 50% of uncircumcised men and 65% of medically circumcised men.

Among circumcised men overall, close to two-thirds (63%) were circumcised between ages 15 and 19, while only 10% were circumcised before age 15. Among traditionally circumcised men, however, two-thirds (67%) were circumcised between ages 15 and 19. In contrast, among medically circumcised men, about half (47%) were circumcised at age 20 or older.

Table 2. Risky behaviors by circumcision status

Variable	Labels	Circumcision Status				Chi-square p value
		Medical Circumcision	Traditional Circumcision	Not Circumcised	Total	
Age at circumcision	< 15	25.6	7.6	na	9.5	0.000
	15-19	27.6	66.8	na	62.7	
	20+	46.8	25.6	na	27.8	
	not circumcised	na	na	na	na	
Age at first sex	< 15	15.3	12.4	16.6	14.3	0.221
	15-19	52.1	56.5	56.9	56.4	
	20+	27.7	26.6	23.1	25.2	
	don't know	4.9	4.5	3.4	4.0	
Number of lifetime sexual partners	1	8.8	9.4	11.2	10.1	0.145
	2-3	20.4	30.1	31.8	30.2	
	4+	61.4	55.3	51.8	54.2	
	don't know	9.3	5.2	5.3	5.5	
Relationship with the last sex partner	usual partner	94.6	94.3	94.2	94.3	0.987
	casual acquaintance	5.4	5.7	5.8	5.7	
Was condom used during last sex?	no	40.8	63.1	42.8	53.3	0.000
	yes	59.2	36.9	57.2	46.7	
Ever tested for AIDS?	no	35.5	54.6	46.5	50.0	0.000
	yes	64.5	40.8	49.6	45.9	
	does not know about AIDS	0.0	4.6	(3.9)	4.0	
Had STIs in the past 12 months?	no	96.1	96.1	95	95.7	0.606
	yes	3.9	3.9	5	4.3	
Comprehensive HIV knowledge?	no	45.6	85.6	61.9	73.3	0.000
	yes	54.4	14.4	38.1	26.7	
Ever got drunk?	no	16.2	11.8	12.5	12.3	0.557
	yes	50.5	46.8	48.4	47.7	
	never drank	33.4	41.4	39.1	40.0	
Away from home	not away	33.8	46.3	41.8	43.6	0.021
	away for less than a month	49.7	46.4	48.2	47.4	
	away for more than a month	16.5	7.3	1.0	9.0	
N (weighted)		135	1163	947		

4.3. HIV Prevalence and Risky Behavior

Of the risky behavior variables, including circumcision status, suggested to be associated with HIV prevalence by the conceptual framework, only six are significantly associated with HIV prevalence. As Table 3 shows, age at first sex, number of lifetime sexual partners, ever tested for AIDS, STIs experience in the past 12 months, drunkenness experience, and being away from home are significantly associated with HIV prevalence ($p<0.05$). Circumcision status, age at circumcision, relationship with the last sex partner, condom use during the last sex, and comprehensive HIV knowledge are not significantly associated with HIV prevalence.

According to Table 3, HIV prevalence increases with increasing age at first sex and with increasing number of lifetime sexual partners. Table 3 further shows that respondents who have either ever tested for HIV or experienced STIs in the past 12 months have the highest HIV prevalence. Respondents who have experienced drunkenness or been away from home for more than a month have the highest prevalence among their groups.

Table 3. HIV prevalence by circumcision status and risky behaviors

Variable	Labels	HIV Prevalence	N	Chi-square p value
Circumcision status	medical circumcision	15.1	141	0.260
	traditional circumcision	21.9	1,217	
	not circumcised	20.7	981	
Age at first sex	< 15	10.5	335	0.000
	15-19	19.7	1,320	
	20+	27.4	590	
	don't know	36.8	94	
Age at circumcision	< 15	21.8	129	0.144
	15-19	19.0	852	
	20+	26.1	377	
	not circumcised	20.7	981	
Number of lifetime sexual partners	1	13.5	237	0.000
	2-3	16.5	706	
	4+	23.8	1,268	
	don't know	32.0	128	
Relationship with the last sex partner	usual partner	20.6	2,205	0.121
	casual acquaintance	27.7	134	
Was condom used at last sex?	no	20.0	1,246	0.335
	yes	22.1	1,093	
Ever tested for HIV/AIDS?	no	16.3	1,170	0.000
	yes	26.7	1,074	
	does not know about AIDS	13.9	94	
Had STIs in the past 12 months?	no	19.9	2,238	0.000
	yes	45.3	101	
Comprehensive HIV knowledge?	no	20.9	1,713	0.858
	yes	21.3	625	
Away from home	not away	20.2	1,020	0.015
	away for less than 1 month	20.0	1,108	
	away for more than a month	30.2	211	
Ever got drunk?	no	22.4	289	0.006
	yes	23.9	1,116	
	never drank	17.1	935	

4.4. Factors Associated with HIV Prevalence

At the univariate level there are differences in the distribution of respondents based on circumcision status. There are also differences in risky behavior based on circumcision status. According to our conceptual framework, the relationship between circumcision and HIV could be operating through risky behaviors. Bivariate analysis shows six variables to be significantly

associated with HIV prevalence. To establish the existence of the relationship suggested by the chi-square statistics in Table 3, and to answer the research question of the study (Are differences in risky behaviors the answer?), multivariate analysis was conducted. Four models were run regressing circumcision status and HIV status, as indicated in the statistical methods.

Table 4a presents the results of this analysis. According to Model 1 there is no statistically significant association between circumcision status and HIV prevalence in Lesotho. Controlling for risky behaviors in Model 2, however, the odds of being HIV positive are 0.5 for medically circumcised men and 1.1 for traditionally circumcised men relative to uncircumcised men, but the odds are not statistically significant. After controlling for background characteristics in Model 3, medically circumcised men have significantly lower odds of being HIV-positive compared with uncircumcised men (AOR =0.4; 95% CI: 0.2 - 0.8), while there is no statistical difference between traditionally circumcised men and uncircumcised men. When controlling for both risky behavior and background characteristics in Model 4, medically circumcised men continue to have significantly lower odds of being HIV-positive relative to uncircumcised men (AOR = 0.4; 95% CI: 0.2 - 0.8). The results of Models 3 and 4 are similar, suggesting that risky behaviors have no effect, since the odds do not change between controlling for background characteristics alone and controlling for both background and risky behaviors.

Table 4a. The odds that a circumcised man Is HIV positive, for all sexually active men in the last 12 months

Circumcision Status	Model 1	Model 2	Model 3	Model 4
Medical circumcision	0.7	0.5	0.4**	0.4**
Traditional circumcision	1.0	1.1	1.1	1.1
Not circumcised (RC)	1	1	1	1
Controls				
Risky behaviors		√		√
Background characteristics			√	√
No. of Observations	2283	2283	2283	2283

*** p<0.001, ** p<0.01, * p<0.05
Note: The complete results for each model are in Appendix 1

To fully answer the question “whether it makes a difference if one is medically or traditionally circumcised,” modeling similar to that in Table 4a is repeated, but this time among circumcised men only rather than all men who were sexually active in the last 12 months. Table 4b presents the results of this modeling. According to Model 1 in Table 4b, there is no association between HIV status and circumcision. In contrast to Model 2 in Table 4a, Model 2 in Table 4b shows that after controlling for risky behavior, traditionally circumcised men have significantly higher odds (AOR = 2.1; 95% CI: 1.1 - 3.9) of being HIV-positive compared with medically circumcised men. Controlling for background characteristics brings a change in the odds, but after controlling for both background characteristics and risky behaviors, the odds are similar to those found after

controlling for background characteristics alone. The odds that a traditionally circumcised man is HIV-positive increases from 2.1 in Model 2, when risk behaviors alone are controlled for, to 2.9 (95% CI: 1.4 – 6.0) in Model 3, when background characteristics are controlled for. As was the case in Table 4a, controlling for both risky behavior and background characteristics does not bring a change in the odds, as indicated in Model 4 of Table 4b.

Table 4b. The odds that a traditionally circumcised man Is HIV positive, for circumcised sexually active men in the last 12 months

Type of Circumcision	Model 1	Model 2	Model 3	Model 4
Medical circumcision	1	1	1	1
Traditional circumcision	1.6 (0.9–2.8)	2.1* (1.1–3.9)	2.9** (1.4–6.0)	2.9** (1.4-6.1)
Controls				
Risky behaviors		√		√
Background characteristics			√	√
No. of Observations	1432	1432	1432	1432

*** p<0.001, ** p<0.01, * p<0.05
Note: The Complete results for each model are in Appendix 2

For Model 2 in both Tables 4a and 4b, age at first sex, STI experience, number of lifetime sexual partners, and experience of testing for HIV are important factors significantly associated with HIV status, as shown in Appendix 1 and Appendix 2. Drunkenness experience and migration are only significant when comparing uncircumcised men with circumcised men. In both scenarios age, marital status, and region are significant factors after controlling for background characteristics only as well as after controlling for both background characteristics and risky behaviors. When controlling for both risky behaviors and background characteristics, however, only condom use at last sex and STI experience are significantly associated with HIV status. Both are associated with increased odds of HIV infection.

5. Discussion

The distribution of the study sample was such that 58% of the study population reported being circumcised (52% traditional and 6% medical). In terms of background characteristics, among uncircumcised men and medically circumcised men the majority resided in lowlands, urban areas, and in rich households relative to traditionally circumcised men. Traditionally circumcised men were less schooled compared with either uncircumcised or medically circumcised men. Thus, traditionally circumcised men tend to have a lower socioeconomic status compared with other men in the study population.

All men demonstrated similar risky behavior practices irrespective of their circumcision status, except in a few cases. There were no significant differences among Basotho men by circumcision status in the number of lifetime sexual partners, relationship with the last sex partner, age at first sex, experience of STIs, and alcohol consumption. However, uncircumcised men and medically circumcised men had a higher percentage using a condom at last sex, as well as having ever tested for HIV relative to traditionally circumcised men. Medically circumcised men had higher comprehensive HIV knowledge (54%) than traditionally circumcised men (14%) and uncircumcised (38%) men. Among medically circumcised men, a higher percentage were circumcised at age 20 or older (44%), while among traditionally circumcised men the majority (68%) were circumcised between the ages of 15 and 19.

Risky sexual behaviors were associated with HIV status-age at first sex, number of lifetime sexual partners, ever tested for AIDS, experience of STIs, and drunkenness. There was no direct association between circumcision status and HIV status, but after controlling for risky behaviors in a sample restricted to only circumcised men, traditionally circumcised men had significantly higher odds of being HIV-positive compared with medically circumcised men. The odds increased when controlling for background characteristics, but no increase was observed after controlling for both background characteristics and risky behaviors. Medically circumcised men had significantly lower odds of being HIV positive relative to uncircumcised men only after controlling for background characteristics for all men in the sample. Thus, in Lesotho traditional circumcision does not seem to offer the same protection from HIV. This is contrary to reports on traditional circumcision in Papua New Guinea (MacLaren et al., 2015). However, medical circumcision in Lesotho provides protection, as shown by randomized control trials (Auvert et al. 2005; Bailey et al. 2007; Gray et al. 2007; Siegfried et al. 2005).

6. Conclusion

The study set out to understand the relationship between male circumcision and HIV prevalence in Lesotho. The apparent nonexistence of the protection offered by medical circumcision found in previous studies is due to treating traditional circumcision and medical circumcision the same versus treating them separately. In our study, medical circumcision provides protection against HIV, but traditional circumcision does not. When modeling among circumcised men only, medical circumcision protects against HIV relative to traditional circumcision. While medical circumcision provides expected protection when comparing this group with either traditionally circumcised or uncircumcised men, risky behaviors-particularly condom use at last sex and STI experience in the past 12 months—are only important when comparing medical and traditional circumcision. This finding is supported by Skolnik and colleagues (2014), who found that 73% of voluntary medical circumcision clients in Lesotho highlighted protection against HIV as their main reason for circumcision, suggesting that medically circumcised men are conscious of HIV infection, while the motivation for traditional circumcision is manhood (Ashton 1952). It is noteworthy, though, that since this is a cross-sectional study we cannot know if the medical circumcision is what protected the men from HIV or whether they went for medical circumcision because they were more aware of protection offered by medical circumcision against HIV.

Coburn, Okano, and Blower (2013) had also attempted to separate traditional circumcision and medical circumcision in testing for the efficacy of circumcision in HIV prevention in Lesotho. They used data from the 2009 DHS and found partially significant evidence ($p=0.053$) of the effect of circumcision on HIV after controlling for background characteristics and risky behaviors. These findings differ from those of the present study. These differences may be due to differences in the group of respondents included in the analysis. While their study analyzed all men in the sample, the current study included only men who were sexually active in the past 12 months. Moreover, our study went further to look at the efficacy differences among the circumcised men. This approach was particularly insightful in providing strong evidence of the efficacy of medical circumcision.

The importance attached to traditional circumcision could lead to false self-reporting of circumcision status, thus confounding the association between circumcision and HIV. For instance, Thomas and colleagues (2011) in a study in Lesotho found that physical examinations revealed that 23% of military male applicants who reported themselves as circumcised showed no evidence of circumcision. This suggests that self-reporting of circumcision could confound the results of the present study. Moreover, only 28% of men who reported traditional circumcision could be classified as fully circumcised (Thomas et al. 2011), suggesting that not all traditional circumcision should be ruled out in protecting against HIV. Along similar lines, Maclaren and collegues (2013) found that, partial or not, circumcision protected against HIV infection in Papua New Guinea.

What remains in question is (1) why sexual risk behavior makes no difference once background characteristics are controlled for and (2) why background characteristics make a difference even when sexual risk behaviors are controlled for. While the present analysis does not provide a clue, it is probable that, because medical circumcision is currently low (6%), men in this group are a special self-selecting group with lower HIV risk for some reason that is better reflected by background characteristics than by risky behaviors. Also, if voluntary medical circumcision is publicized as a means to reduce risk of HIV acquisition for men, perhaps men who already know they are HIV-positive would be highly unlikely to get the procedure. In fact "compulsory" HIV testing has been highlighted as one of the concerns hindering voluntary medical circumcision uptake in Lesotho (Skolnik et al. 2014).

It is equally plausible that our study did not properly capture risk behavior (and thus did not truly control for increased exposure to HIV), either due to reporting issues, or not asking the right questions. For example, we lacked comprehensive data on coital frequency with various partners and comprehensive measures for condom use. Also, while we had reasonable measures of the number of sexual partners, we did not have a good way of measuring the likelihood that someone's partners were HIV-positive. In a population with high prevalence of HIV, like Lesotho, this could make a big difference. For example, living in a high-prevalence area and selecting sexual partners from a high-prevalence area would increase the risk of HIV acquisition per partner.

Recommendations

Based on the results of the study, the following recommendations are put forward:

- There is need to engage with gatekeepers of traditional circumcision to ensure that their practice of circumcision is as effective as medical circumcision.

- The current voluntary medical male circumcision targeting uncircumcised men should be expanded to include traditionally circumcised men. To avoid resistance among traditionally circumcised men, health professionals who have undergone traditional circumcision should be used in performing the procedure for correcting circumcision among traditionally circumcised men.

- Health professionals who have undergone traditional circumcision should be used to transfer medical circumcision skills to those who perform traditional circumcision.

- It is equally important that Lesotho emphasize risky behaviors if the war against the AIDS epidemic is to be won. HIV prevalence among medically circumcised men in Lesotho is very high by any standards, despite the protective effect of circumcision. Without behavior change, the effect of circumcision will not bring HIV prevalence to levels observed elsewhere among medically circumcised men.

- Further research is needed to understand why HIV prevalence for medically and traditionally circumcised men in Lesotho is not similar to what prevails in other settings.

Limitations of the Study

The study is based on cross-sectional survey data, and thus causality cannot be inferred. Although DHS data are nationally representative, subdividing circumcised men into medical and traditional groups might have introduced problems of precision, because the proportion of medically circumcised men is quite low.

References

Ashton, H. 1952. *The Basuto*. Oxford University Press: London.

Auvert, B., D. Taljaard, E. Lagarde, J. Sobngwi-Tambekou, R. Sitta, and A. Puren. 2005. "Randomized, Controlled Intervention Trial of Male Circumcision for Reduction of HIV Infection Risk: the ANRS 1265 Trial." *PLoS Medicine* 2(11):1112-22.

Bailey, R., S. Moses, C. B. Parker, K. Agot, I. Maclean, J. N. Krieger, C. F. Williams, R.T. Campbell, and J.O. Ndinya-Achola. 2007. "Male Circumcision for HIV Prevention in Young Men in Kisumu, Kenya: A Randomised Controlled Trial." *The Lancet* 369:643-656.

Cameron, D., L. D'Costa, G. Maitha, M. Cheang, P. Piot, J. Simonsen, A. Ronald, et al. 1989. "Female To Male Transmission of Human Immunodeficiency Virus Type 1: Risk Factors for Sero Conversion in Men." *The Lancet* 334(8660):403-407.

Chikutsa, A., A. Ncube, and S. Mutsau. 2014. "Male Circumcision and Risky Sexual Behavior in Zimbabwe: Evidence from the 2010-11 Zimbabwe Demographic and Health Survey."*African Population Studies* 28(2):1057-1071.

Coburn, B., J. Okano, and S. Blower. 2013. "Current Drivers and Geographic Patterns of HIV in Lesotho: Implications for Treatment and Prevention in Sub-Saharan Africa." *BMC Medicine* 11: 224.

Connolly, C., L. Simbayi, R. Shanmugam, and A. Nqeketo. 2008. "Male Circumcision and Its Relationship to HIV Infection in South Africa: Results of a National Survey in 2002." *South African Medical Journal = Suid-Afrikaanse Tydskrif Vir Geneeskunde* 98(10):789-94.

Corno, L., and D. de Walque. 2007. "The Determinants of HIV Infection and Related Sexual Behaviors : Evidence from Lesotho." Policy Research Working Papers, World Bank Group.

Eaton, L., and S. Kalichman. 2007. "Risk Compensation in HIV Prevention: Implications for Vaccines, Microbicides, and Other Biomedical HIV Prevention Technologies." *Current HIV/AIDS Reports* 4(4):165-172.

Garenne, M. 2008. "Long-Term Population Effect of Male Circumcision in Generalised HIV Epidemics in Sub-Saharan Africa." *African Journal of AIDS Research* 7(1):1-8.

Gayle, M., L. Bollinger, T. Pandit-Rajani, R. Nkambula, and J. Stover. 2007. "Costing Male Circumcision in Swaziland and Implications for the Cost Effectiveness of Circumcision as an HIV Intervention." Swaziland Mbabane. USAID/Health Policy Initiative, Task Order 1, USA.

Gebremedhin, S. 2010. "Assessment of the Protective Effect of Male Circumcision from HIV Infection and Sexually Transmitted Diseases: Evidence from 18 Demographic and Health Surveys in Sub-Saharan Africa." *East African Journal of Public Health* 7 (4):295-299.

Gray, R., G. Kigozi, D. Serwadda, F. Makumbi, S. Watya, F. Nalugoda, N. Kiwanuka, et al. 2007. "Male Circumcision for HIV Prevention in Men in Rakai, Uganda: A Randomised Trial." *The Lancet* 369 (9562): 657-666.

Green, L., R. McAllister, K. Peterson, and J. Travis. 2008. "Male Circumcision Is Not the HIV 'Vaccine' We Have Been Waiting For!" *Future HIV Therapy* 2(3):193-199.

Hussain, L., and T. Lehner. 1995. "Comparative Investigation of Langerhans' Cells and Potential Receptors for HIV in Oral, Genitourinary and Rectal Epithelia." *Immunology* 85(3):475-484.

Kahn, J., E. Marseille, and B. Auvert. 2006. "Cost-Effectiveness of Male Circumcision for HIV Prevention in a South African Setting." *PLoS Med* 3(12):e517.

Kalichman, S., and L. Simbayi. 2003. "HIV Testing Attitudes, AIDS Stigma, and Voluntary HIV Counselling and Testing in a Black Township in Cape Town, South Africa." *Sexually Transmitted Infections* 79(6):442-447.

Kalichman, S., L. Simbayi, M. Kaufman, D. Cain, and S. Jooste. 2007. "Alcohol Use and Sexual Risks for HIV/AIDS in Sub-Saharan Africa: Systematic Review of Empirical Findings." *Prevention Science* 8(2):141-151.

Kebaabetswe, P., S. Lockman, S. Mogwe, R. Mandevu, I. Thior, M. Essex, and R. Shapiro. 2003. "Male Circumcision: An Acceptable Strategy for HIV Prevention in Botswana." *Sexually Transmitted Infections* 79(3):214-219.

Kibira, S., E. Nansubuga, N. Tumwesigye, L. Atuyambe, and F. Makumbi. 2014. "Differences in Risky Sexual Behaviors and HIV Prevalence of Circumcised and Uncircumcised Men in Uganda: Evidence from a 2011 Cross-Sectional National Survey." *Reproductive Health* 11:25.

Lesotho National AIDS Commission. 2009. *HIV Prevention Response and Analysis of Modes of HIV Transmission Studies*. Government Printers, Maseru 100: Lesotho.

Lurie, M., B. Williams, K. Zuma, D. Mkaya-Mwamburi, G. Garnett, A. Sturm, M. Sweat, J. Gittelsohn, and S. Abdool Karim. 2003. "The Impact of Migration on HIV-1 Transmission in South Africa A Study of Migrant and Nonmigrant Men and Their Partners." *Sexually Transmitted Diseases* 30(2):149-156.

MacLaren, D., W. McBride, G. Kelly, R. Muller, R. Tommbe, J. Kaldor, and A. Vallely. 2015. "HIV Prevalence Is Strongly Associated with Geographical Variations in Male Circumcision and Foreskin Cutting in Papua New Guinea: An Ecological Study." *Sexually Transmitted Infections* 91(7):502-505.

MacLaren, D., R. Tommbe, T. Mafile, C. Manineng, F. Fregonese, M. Redman-Maclaren, M. Wood, et al. 2013. "Foreskin Cutting Beliefs and Practices and the Acceptability of Male Circumcision for HIV Prevention in Papua New Guinea." *BMC Public Health* 13:818.

Marum, L., J. Muttunga, F. Munene, and B. Cheluget. 2004. "HIV Prevalence and Associated Factors." Kenya Demographic and Health Survey, 217-232. Maryland: Calverton, Macro International Maryland.

Ministry of Health and Social Welfare (MOHSW) [Lesotho] and ICF Macro. 2009. *Lesotho Demographic and Health Survey of 2009.* Maryland: Calverton, Macro International Maryland.

Ministry of Health and Social Welfare Government of Lesotho. 2008. *Male Circumcision in Lesotho: Situation Analysis Report.* Human Resource Research Council (HSRC), Cape Town, South Africa.

Ministry of Health Lesotho. 2015. Global AIDS Response Progress Report 2015 Lesotho Country Report, Follow-Up to the 2011 Political Declaration on HIV/AIDS: Intensifying Efforts to Eliminate HIV/AIDS." Government of Lesotho, Maseru 100, Lesotho.

Mishra, V., and S. Bignami-Van Assche. 2009. *Concurrent Sexual Partnerships and HIV Infection : Evidence from National Population-Based Surveys*. DHS Working Paper No.62. Calvaton. Maryland: Macro International Inc.

Moses, S., J. Bradley, N. Nagelkerke, A. Ronald, J. Ndinya-Achola, and F. Plummer. 1990. "Geographical Patterns of Male Circumcision Practices in Africa: Association with HIV Seroprevalence." *International Journal of Epidemiology* 19:693-697.

Quigley M., R. Hayes, and H. Weiss. 2000. "Male Circumcision and Risk of HIV Infection in Sub-Saharan Africa: A Systematic Review and Meta-Analysis." *AIDS* 14:2361-2670.

Siegfried, N., M. Muller, J. Deeks, J. Volmink, M. Egger, N. Low, S. Walker, and P. Williamson. 2005. "HIV and Male Circumcision—a Systematic Review with Assessment of the Quality of Studies." *The Lancet Infectious Diseases* 5(3):165-173.

Siegfried, N., M. Muller, J. Deeks, and J. Volmink. 2002. "Male Circumcision for Prevention of Heterosexual Acquisition of HIV in Men." *Cochrane Database of Systematic Reviews* 5: 1-27.

Skolnik, L., S. Tsui, T. Adamu Ashengo, V. Kikaya, and M. Lukobo-Durrell. 2014. "A Cross-Sectional Study Describing Motivations and Barriers to Voluntary Medical Male Circumcision in Lesotho." *BMC Public Health* 14 (1): 1119.

Talbott, J. 2007. "Size Matters : The Number of Prostitutes and the Global HIV/AIDS Pandemic." *PLoS ONE* 2 (6).

Thomas, A, B. Tran, M. Cranston, M. Brown, R. Kumar, and M. Tlelai. 2011. "Voluntary Medical Male Circumcision : A Cross-Sectional Study Comparing Circumcision Self-Report and Physical Examination Findings in Lesotho." *PLoS ONE* 6(11):1-6.

Wang, W., and S. Alva. 2012. *HIV-Related Knowledge and Behavior in Eight High HIV Prevalence Countries in Sub-Saharan Africa.* DHS Analytical Studies, No.29. Calverton, Maryland, USA: ICF International.

Ward, H., and M. Rönn. 2010. *The Contribution of STIs to the Sexual Transmission of HIV." Current Opinion in HIV and AIDS 5 (4): 305-310.*

Warren, K. 2010. HIV and Male Circumcision in Swaziland, Botswana and Lesotho: An Econometric Analysis. CSSR Working Paper no 273. Centre for Social Science Research, University of Cape Town.

Westercamp, M., K. Agot, J. Ndinya-Achola, and R. Bailey. 2012. “Circumcision Preference among Women and Uncircumcised Men Prior to Scale-up of Male Circumcision for HIV Prevention in Kisumu, Kenya.” *AIDS Care* 24(2):157-166.

WHO/UNAIDS. 2007. “New Data on Male Circumcision and HIV Prevention: Policy and Programme Implications.” Geneva: World Health Organization.

Williams, B., J. Lloyd-Smith, E. Gouws, C. Hankins, W. Getz, J. Hargrove, I. De Zoysa, C. Dye, and B. Auvert. 2006. “The Potential Impact of Male Circumcision on HIV in Sub-Saharan Africa.” *PLoS Medicine* 3 (7): e262.

Appendix I:
Modeling Circumcision Status and HIV Status

Model 1. Circumcision status and HIV: No controls

Variables	Labels	Odds (95% CI)
Circumcision status	medical circumcision traditional circumcision not circumcised	0.7 (0.4 - 1.2) 1.1 (0.8 - 1.4) 1.0
Constant		0.3***
Observations		2,283

*** p<0.001, ** p<0.01, * p<0.05

Model 2. Circumcision status and HIV: Controlling for risky sexual behaviors

Variables	Labels	Odds (95% CI)
Circumcision status	medical circumcision traditional circumcision not circumcised	0.5 (0.3 - 1.0) 1.1 (0.9 - 1.5) 1.0
Age at first sex	< 15 15-19 20+ don't know	1.0 2.2** (1.3 - 3.5) 3.8*** (2.3 - 6.2) 5.0*** (2.5 - 10.1)
Was condom used at last sex?	yes no	1.2 (1.0 - 1.6) 1.0
Relationship with last sex partner	usual partner casual acquaintance	1.0 1.4 (0.8 - 2.3)
Had STIs in the past 12 months?	no yes	1.0 2.9*** (1.8 - 4.5)
Number of lifetime sexual partners	1 2-3 4+ don't know	1.0 1.3 (0.7 - 2.2) 2.0** (1.2 - 3.2) 2.7** (1.4 - 5.2)
Comprehensive HIV knowledge?	no yes	1.0 1.0 (0.7 - 1.3)
Ever tested for HIV/AIDS?	no yes does not know about AIDS	1.0 1.6** (1.2 - 2.1) 1.0 (0.5 - 1.7)
Ever got drunk	no yes never drank	1.0 1.3 (0.8 - 1.9) 1.4* (1.1 - 1.8)
Away from home?	away for less than 1 month away for more than a month not away	0.9 (0.7 - 1.2) 1.6* (1.0 - 2.4) 1.0
Constant		0.0***
Observations		2,283

*** p<0.001, ** p<0.01, * p<0.05

Model 3. Circumcision status and HIV: Controlling for background characteristics

Variables	Labels	Odds (95% CI)
Circumcision status	medical circumcision	0.4** (0.2 - 0.8)
	traditional circumcision	1.2 (0.9 - 1.6)
	not circumcised	1.0
Age	15-24	1.0
	25-34	6.1*** (3.8 - 9.9)
	35-44	8.8*** (5.1 - 15.1)
	45-59	4.4*** (2.5 - 7.9)
Wealth index	poor	1.0
	middle	1.5* (1.0 - 2.1)
	rich	1.4 (0.9 - 2.0)
Education	no education	1.0
	primary	1.0 (0.7 - 1.4)
	secondary+	1.2 (0.7 - 1.8)
Marital status	never married	1.0
	ever married	1.8** (1.2 - 2.7)
Rural urban residence	urban	1.0
	rural	0.9 (0.6 - 1.4)
Ecological zone	lowlands	1.0
	highlands	1.0 (0.7 - 1.6)
District	Botha-Bothe	1.0
	Leribe	2.3* (1.2 - 4.4)
	Berea	2.0* (1.1 - 3.8)
	Maseru	2.3* (1.2 - 4.3)
	Mafeteng	2.4* (1.2 - 4.7)
	Mohale’s Hoek	2.2* (1.1 - 4.4)
	Quthing	1.9 (0.9 - 3.9)
	Qacha’s-Nek	1.8 (0.9 - 3.8)
	Mokhotlong	1.6 (0.8 - 3.3)
	Thaba-Tseka	1.9 (1.0 - 3.9)
Constant		0.0***
Observations		2,283

*** p<0.001, ** p<0.01, * p<0.05

Model 4. Circumcision status and HIV: Controlling for risky sexual behaviors and background characteristics

Variables	Labels	Odds (95% CI)
Circumcision status	medical circumcision	0.4** (0.2 - 0.8)
	traditional circumcision	1.2 (0.8 - 1.6)
	not circumcised	1.0
Age	15-24	1.0
	25-34	5.3*** (3.2 - 8.7)
	35-44	7.6*** (4.3 - 13.4)
	45-59	3.8*** (2.0 - 7.1)
Wealth index	poor	1.0
	middle	1.4 (1.0 - 2.0)
	rich	1.2 (0.8 - 1.8)
Education	no education	1.0
	primary	1.0 (0.7 - 1.4)
	secondary+	1.1 (0.7 - 1.7)
Marital status	never married	1.0
	ever married	2.0*** (1.3 - 3.0)
Rural urban residence	urban	1.0
	rural	1.0 (0.7 - 1.5)
Ecological zone	lowlands	1.0
	highlands	1.1 (0.7 - 1.7)
District	Botha-Bothe	
	Leribe	2.4** (1.3 - 4.6)
	Berea	1.9 (1.0 - 3.6)
	Maseru	2.0* (1.1 - 3.9)
	Mafeteng	2.4* (1.2 - 4.8)
	Mohale's Hoek	2.1* (1.0 - 4.2)
	Quthing	1.7 (0.8 - 3.5)
	Qacha's-Nek	1.7 (0.8 - 3.6)
	Mokhotlong	1.5 (0.7 - 3.1)
	Thaba-Tseka	1.9 (0.9 - 4.0)
Age at first sex	< 15	1.0
	15-19	1.4 (0.8 - 2.3)
	20+	1.4 (0.8 - 2.5)
	don't know	2.1 (1.0 - 4.4)
Was condom used at the last sex?	no	1.0
	yes	1.7*** (1.3 - 2.3)
Relationship with last sex partner	usual partner	1.0
	casual acquaintance	1.6 (0.9 - 3.0)
Had STIs in the past 12 months?	no	1.0
	yes	2.5*** (1.6 - 4.1)
Number of lifetime sexual partners	1	1.0
	2-3	1.0 (0.5 - 1.8)
	4+	1.3 (0.7 - 2.3)
	don't know	1.5 (0.7 - 3.1)
Comprehensive HIV knowledge?	no	1.0
	yes	0.9 (0.7 - 1.3)
Ever tested for HIV/AIDS?	no	1.0
	yes	1.3 (0.9 - 1.7)
	does not know about AIDS	1.2 (0.7 - 2.2)
Ever got drunk?	no	1.0
	yes	1.2 (0.8 - 1.9)
	never drank	1.0 (0.6 - 1.5)
Away from home?	away for less than 1 month	1.0 (0.7 - 1.3)
	away for more than a month	1.4 (0.9 - 2.1)
	not away	1.0
Constant		0.0***
Observations		2,283

*** p<0.001, ** p<0.01, * p<0.05

Appendix II:

Modeling Circumcision Status Based on Where Circumcision Was Performed (Circumcised Men Only)

Model 1. Circumcision status and HIV: No controls

Variables	Labels	Odds (95% CI)
Circumcision status	medical circumcision traditional circumcision	1.0 1.6 (0.9 - 2.8)
Constant		0.2***
Observations		1,432

*** p<0.001, ** p<0.01, * p<0.05

Model 2. Circumcision status and HIV: Controlling for risky sexual behaviors

Variables	Labels	Odds (95% CI)
Circumcision status	medical circumcision traditional circumcision	1.0 2.1* (1.1 - 3.9)
Age at first sex	<15 15-19 20+ don't know	1.0 1.7 (1.0 - 3.0) 2.4** (1.3 - 4.4) 4.2*** (1.9 - 9.3)
Was condom used during the last sex?	no yes	1.0 1.2 (0.9 - 1.7)
Relationship with last sex partner	usual partner casual acquaintance	1.0 1.1 (0.6 - 2.2)
Had STIs in the past 12 months?	no yes	1.0 2.4** (1.3 - 4.6)
Number of lifetime sexual partners	1 2-3 4+ don't know	1.0 1.7 (0.8 - 3.7) 2.8** (1.3 - 5.7) 4.1** (1.6 - 11.0)
Comprehensive HIV knowledge?	no yes	1.0 0.9 (0.6 - 1.3)
Ever tested for HIV/AIDS?	no yes does not know about AIDS	1.0 1.8*** (1.3 - 2.4) 1.1 (0.5 - 2.2)
Ever got drunk?	no yes never drank	1.0 0.8 (0.5 - 1.3) 0.6 (0.4 - 1.0)
Away from home?	away for less than 1 month away for more than a month not away	1.0 (0.7 - 1.3) 1.6 (1.0 - 2.6) 1.0
Constant		0.0***
Observations		1,432

*** p<0.001, ** p<0.01, * p<0.05

Model 3. Circumcision status and HIV: Controlling for background characteristics

Variables	Labels	Odds (95% CI)
Type of circumcision	medical circumcision	1.0
	traditional circumcision	2.9** (1.4 - 6.0)
Age	15-24	1.0
	25-34	6.5*** (3.6 - 11.8)
	35-44	9.7*** (5.2 - 18.0)
	45-59	4.6*** (2.3 - 8.9)
Wealth index	poor	1.0
	middle	1.3 (0.9 - 2.0)
	rich	1.2 (0.7 - 2.0)
Education	no education	1.0
	primary	0.9 (0.6 - 1.4)
	secondary+	1.2 (0.7 - 2.1)
Marital status	never married	1.0
	ever married	1.9* (1.1 - 3.1)
Rural urban residence	urban	1.0
	rural	0.9 (0.5 - 1.5)
Ecological zone	lowlands	
	highlands	1.2 (0.7 - 2.0)
District	Botha-Bothe	1.0
	Leribe	2.3* (1.1 - 4.9)
	Berea	2.0 (1.0 - 4.0)
	Maseru	1.9 (0.8 - 4.2)
	Mafeteng	2.2* (1.1 - 4.8)
	Mohale’s Hoek	1.9 (0.9 - 4.0)
	Quthing	1.4 (0.6 - 3.1)
	Qacha’s-Nek	1.3 (0.6 - 2.9)
	Mokhotlong	1.5 (0.7 - 3.1)
	Thaba-Tseka	1.7 (0.8 - 3.6)
Constant		0.0***
Observations		1,432

*** p<0.001, ** p<0.01, * p<0.05

Model 4. Circumcision status and HIV: Controlling for risky sexual behaviors and background characteristics

Variables	Labels	Odds (95% CI)
Circumcision status	medical circumcision	1.0
	traditional circumcision	2.9** (1.4 - 6.1)
Age	15-24	1.0
	25-34	6.0*** (3.2 - 11.1)
	35-44	8.9*** (4.4 - 18.0)
	45-59	4.5*** (2.1 - 9.3)
Wealth index	poor	1.0
	middle	1.2 (0.8 - 1.8)
	rich	1.0 (0.6 - 1.8)
Education	no education	1.0
	primary	0.9 (0.6 - 1.3)
	secondary+	1.1 (0.6 - 1.9)
Marital status	never married	1.0
	ever married	2.1** (1.3 - 3.4)
Rural urban residence	urban	1.0
	rural	1.0 (0.6 - 1.8)
Ecological zone	lowlands	1.0
	highlands	1.2 (0.7 - 2.1)
District	Botha-Bothe	1.0
	Leribe	2.5* (1.2 - 5.4)
	Berea	1.9 (0.9 - 4.1)
	Maseru	1.7 (0.8 - 4.0)
	Mafeteng	2.3* (1.0 - 4.9)
	Mohale's Hoek	1.7 (0.8 - 3.7)
	Quthing	1.3 (0.6 - 2.8)
	Qacha's-Nek	1.2 (0.5 - 2.8)
	Mokhotlong	1.3 (0.6 - 3.0)
	Thaba-Tseka	1.6 (0.7 - 3.7)
Age at first sex	<15	1.0
	15-19	1.0 (0.5 - 1.9)
	20+	0.9 (0.4 - 1.8)
	don't know	1.7 (0.7 - 4.3)
Was condom used during last sex?	no	1.0
	yes	1.6** (1.1 - 2.2)
Relationship with last sex partner	usual partner	1.0
	casual acquaintance	1.2 (0.6 - 2.7)
Had STIs in the past 12 months?	no	1.0
	yes	2.8** (1.4 - 5.3)
Number of lifetime sexual partners	1	1.0
	2-3	1.4 (0.6 - 3.2)
	4+	2.0 (1.0 - 4.2)
	don't know	2.8 (1.0 - 7.7)
Comprehensive HIV knowledge?	no	1.0
	yes	0.8 (0.5 - 1.3)
Ever tested for HIV/AIDS?	no	1.0
	yes	1.4 (1.0 - 1.9)
	does not know about AIDS	1.4 (0.6 - 2.9)
Ever got drunk?	no	1.0
	yes	0.9 (0.6 - 1.5)
	never drank	0.8 (0.5 - 1.4)
Away from home?	away for less than 1 month	1.0 (0.7 - 1.4)
	away for more than a month	1.6 (1.0 - 2.7)
	not away	1.0
Constant		0.0***
Observations		1,432

*** p<0.001, ** p<0.01, * p<0.05