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ABSTRACT

After a series of studies that revealed the protective effect of male circumcision against HIV infection, WHO/UNAIDS in 2007 recommended the adoption of safe male circumcision as one of the effective strategies in reducing heterosexually acquired HIV. To this effect, in 2010 the Ministry of Health in Uganda developed a circumcision policy, and circumcision was added to the strategy of abstinence, being faithful, and condom use (ABC) to protect against AIDS. Especially after the implementation of the safe male circumcision (SMC) policy, however, there has been a concern that some circumcised men may lead a more risky sexual lifestyle than non-circumcised men. This paper, therefore, examines the associations among circumcision status, age at circumcision, risky sexual behaviors, and HIV serostatus among men.

The paper uses data from the 2011 Uganda AIDS Indicator Survey, focusing on a subsample of 7,969 weighted cases of men age 15-59 who have ever had sex and who have received their HIV test results. The paper examines associations between risky sexual behaviors and circumcision status among all men, and associations between risky sexual behaviors and age at circumcision among circumcised men. At the multivariate level, the paper establishes the independent relationships between circumcision status and age at circumcision, risky sexual behaviors, and HIV serostatus.

Results show that 28% of men in Uganda have been circumcised, and the majority were circumcised before age 10. At the bivariate level, circumcision status is not independent of risky sexual behaviors. Results from the logistic regression models show that circumcised men are more likely to engage in risky sexual behaviors, while age at circumcision is not significantly associated with these behaviors. Circumcised men are also less likely to be HIV-positive.

The findings suggest a need to repackage the circumcision messages to account for the increased risky sexual behaviors among men who have been circumcised. Intensified, individual tailored counseling before and after SMC procedures may help to reduce these risky behaviors. Furthermore, qualitative research should explore the reasons for circumcision and the drivers for risky sexual behavior.

INTRODUCTION

Background

Male circumcision is the surgical removal of the intact foreskin of the human penis. Intact foreskin is one of the risk factors for HIV transmission from infected women to men (Wabwire-Mangen et al. 2009). Circumcision is undertaken worldwide for religious, cultural, and social as well as medical reasons (Government of Uganda MOH 2010). Randomized clinical trials, conducted in sub-Saharan Africa; Uganda (Gray et al. 2007); Kenya (Bailey et al. 2007) and South Africa (Auvert et al. 2005), showed that male circumcision protects against HIV as well as reduces the incidence of other sexually transmitted infections (STIs), including genital ulcers, human papilloma virus (HPV), and chlamydia in female partners of men. These studies showed that circumcision reduced the risk of heterosexual HIV transmission from an infected woman to a circumcised man by more than 60%. Due to such evidence, in 2007 WHO/UNAIDS recommended the adoption of male circumcision as part of the comprehensive strategy to reduce heterosexually-acquired HIV infection in countries with high HIV prevalence and low levels of male circumcision (WHO and UNAIDS 2007).

In 2010 Uganda launched the safe male circumcision (SMC) policy as part of the comprehensive strategy on HIV prevention, in addition to the existing strategy of abstinence, being faithful to one partner, and condom use (ABC). Prior to the launch of this policy, male circumcision was mainly practiced for socio-cultural reasons as a rite of passage from childhood to manhood among the Bagisu and Bakonjo ethnic groups; and also as a religious ritual among the Moslems. The goal of the SMC policy is to contribute to the reduction of HIV and other STIs through safe male circumcision services (Government of Uganda MOH 2010). In addition, one of the key objectives of this policy is to establish a research agenda focusing on male circumcision services for HIV prevention. This policy also recommends the integration of safe male medical circumcision services in the HIV prevention and sexual and reproductive health care services. The target population for this policy is all males, including neonates whose parents and guardians consent to the procedure, while the recommended age for circumcision is before puberty with a higher preference for age at circumcision below age 1, followed by age 2–9 and age 10–17, respectively (Government of Uganda MOH 2010).

As a result of the policy, several strategies including limited offer of free circumcision at public health facilities, community mobilization, and sensitization of the population have been put in place to scale up male medical circumcision in Uganda. Furthermore, in light of the research agenda of the policy, several studies (Galukande et al. 2012; Kitara et al. 2013) have been undertaken to provide evidence-based information useful for future implementation of circumcision programs or services in the country.

Although Uganda recorded a slight increase in the percentage of circumcised adult males age 15–59, from 25% in 2004 to 27% in 2011, the HIV prevalence rate increased from 6.4% to 7.3%, with male HIV prevalence increasing from 5.4% to 6.1% in the same period (MOH and ICF International 2012). The possible reasons for the increased HIV prevalence are twofold: first, as a result of the introduction of antiretroviral treatment leading to higher life expectancy among those infected, and second, as a result of complacency in HIV prevention efforts, especially among married people exhibiting risky sexual behavior, including concurrent multiple partnerships, non-consistent condom use with non-marital and non-cohabiting partners, and transactional sex (MOH and ICF International 2012).

This sexual behavior disinhibition, which undermines the great strides Uganda has achieved in reducing its HIV prevalence, may be explained by the behavior risk compensation theory. Behavior risk compensation is an observed effect where people tend to adjust their behavior in response to the perceived level of risk, usually behaving less cautiously where they feel more protected and more cautiously where they feel a higher level of risk. In the context where circumcision is viewed as a natural condom (Bonner 2001) against HIV transmission, there is a possibility of behavior risk compensation (Hedlund 2000; Adams and Hillman 2001; Riess et al. 2010) among circumcised men, leading them to engage in risky sexual behavior, including higher-risk sex with high-risk partners, non-condom use, and multiple sexual partners (Cassell et al. 2006; Eaton and Kalichman 2009). To date, there are still unanswered questions as to what difference circumcision will make in terms of risky sexual behavior and HIV infection.

There is also a growing need to establish the recommended age for circumcision in any given setting for individuals to enjoy the full public health benefits of male circumcision in the fight against HIV transmission. There are wide variations in the recommended age at

circumcision in different countries and study settings. While neonatal circumcision is highly preferred for various reasons, parents also differ in preference for the appropriate age at circumcision for their children (Bailey et al. 2002) . Therefore, this study examines whether age at male circumcision matters in terms of risky sexual behavior and HIV status in Uganda.

Uganda is facing challenges and setbacks in its implementation of the traditional HIV control and prevention strategies (the ABC strategy). With the recent addition of circumcision as part of Uganda's HIV prevention strategies, there is need for research-based evidence on the relationships among circumcision status, age at circumcision, sexual behavior and HIV status in the country. This paper specifically compares sexual behavior between circumcised and uncircumcised men; establishes the associations between circumcision and sexual behavior, circumcision status and HIV serostatus, age at circumcision and sexual behavior, and age at circumcision and HIV status. Results from this study will contribute to the safe male circumcision policy research agenda, in addition to strengthening promotion and use of safe male circumcision in the country. Furthermore, the results will also provide insights into when males should become circumcised if circumcision is to have a protective public health benefit in the fight against HIV/AIDS. This information will also be useful in designing strategies that can respond to the circumcision challenges and thus contribute to the attainment of MDG 6 (to combat HIV/AIDS, malaria, and other diseases) in Uganda.

Conceptual Framework

The conceptual framework for this study is shown in Figure 1. There is a link between circumcision status, age at circumcision, risky sexual behavior and HIV status. In developing countries, being circumcised is primarily influenced by religious and ethnic/cultural reasons in addition to other socio-demographic and economic factors, including but not limited to education, residence, region, wealth status, occupation, age, and marital status (Shaffer et al. 2007; WHO and UNAIDS 2007; Connolly et al. 2009). However, with increased sensitization about the hygienic and HIV-related benefits of safe male medical circumcision, the educated, employed, and urban populations are more likely than others to get circumcised. Although there is a positive relationship between education of parents and circumcision, particularly with reference to neonatal circumcision, a study in Central Uganda (Asiimwe 2010) showed

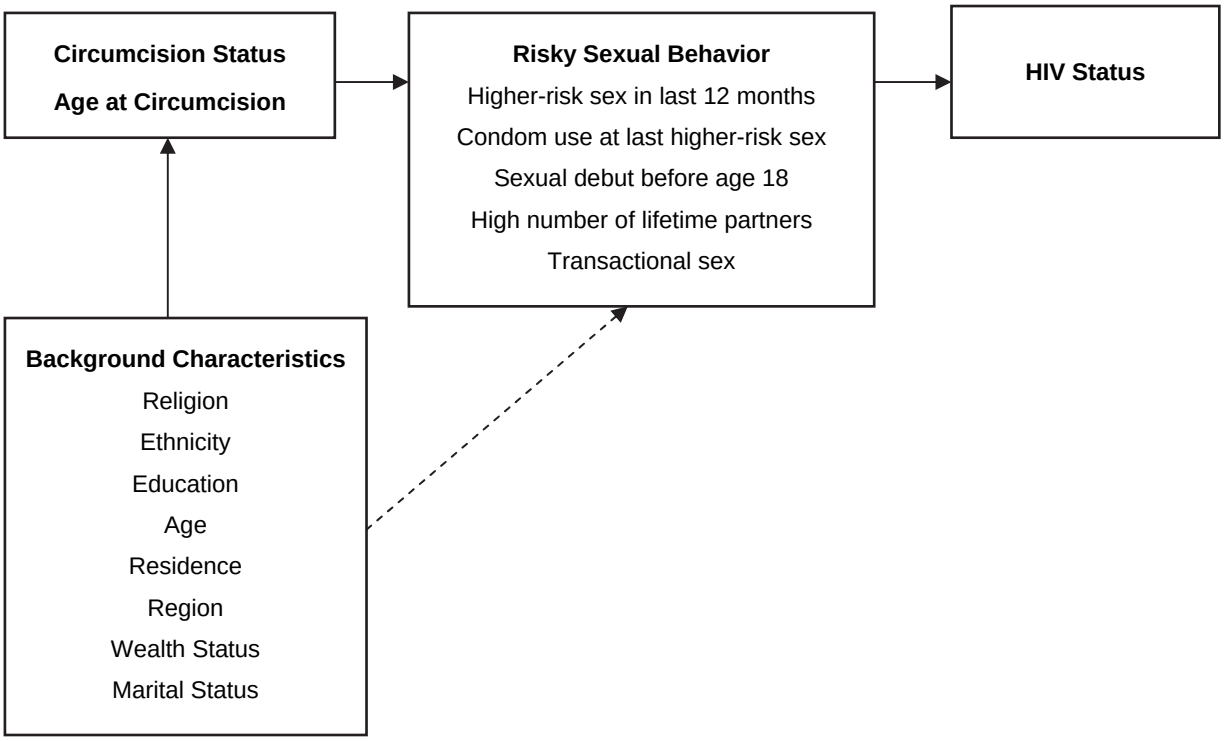
decreased personal willingness toward safe male circumcision among young men with increased educational attainment, which may partly reflect the limited knowledge on the public health benefits of circumcision.

Individual background characteristics not only affect men's circumcision status but also the age at which they are likely to be circumcised. Socio-demographic and economic factors play an important role in determining the age at circumcision. In Uganda most Moslems are circumcised during infancy or before age 10. In contrast, among the Bagisu culture, circumcision practiced as a transition from childhood to adulthood takes place from the onset of puberty, as early as age 12.

Men's circumcision status can influence their sexual behavior. Circumcised men may behave sexually differently from non-circumcised men. Circumcised men tend to engage in risky sexual behaviors, including but not limited to engaging in risky sex, concurrent partners, non-condom use during high-risk sex, transactional sex, age at first sex below age 18 and high number of lifetime partners. With the general belief that circumcision is an HIV vaccine, circumcised men tend to have unprotected sexual intercourse (Differding 2007). Such changes in sexual behavior are postulated in behavioral risk compensation theory, as observed in other studies (Differding 2007; Kalichman et al. 2007).

Men's sexual behavior may also be influenced by their age at circumcision. Men who are circumcised later in life, after puberty or adolescence, are likely to be circumcised for health reasons, specifically for HIV protection. This is in light of the increased sensitization of the safe male circumcision programs by government and civil society, which offer free circumcision services, especially in government health facilities. Having been circumcised for health reasons and particularly for HIV prevention may influence these men's sexual behavior. Thus sexual behavior (risky or otherwise) is linked with HIV serostatus as an outcome. This study of data from Uganda focuses on the associations among circumcision status, age at circumcision, risky sexual behaviors, and HIV status among men who have ever had sex.

Figure 1. Conceptual framework showing relationship between male circumcision, age at circumcision, risky sexual behavior and HIV status



Research Questions

The study attempts to answer the following research questions:

i. Are there differences in sexual behavior among circumcised and uncircumcised men?
ii. Is age at circumcision associated with risky sexual behavior among circumcised men in Uganda?
iii. Is circumcision status associated with HIV status?
iv. Is age at circumcision associated with HIV status?

Hypotheses

In line with the research questions, the following hypotheses are tested:

i. The level of risky sexual behavior differs between circumcised and uncircumcised men.
ii. There is a relationship between age at circumcision and risky sexual behavior.
iii. Circumcised men are more likely to be HIV-negative compared with uncircumcised men.
iv. Men circumcised before age 10 are more likely to be HIV negative compared with men circumcised at age 10 or older.

DATA AND METHODS

Data

This study draws on data from the 2011 Uganda AIDS Indicator Survey (AIS). This survey dataset was chosen because it contains information on the background characteristics, circumcision status, age at circumcision, sexual behavior, and HIV serostatus of the target population. The target population for this study was men age 15–59 who were interviewed, had ever had sex, and had received HIV test results. The AIS uses a stratified two-stage cluster sampling methodology, which involves selecting clusters from each stratum at the first stage and, at the second stage, selecting households for interview. The strata were urban-rural and sub-regions of the country, while the clusters were enumeration areas updated from the 2010 Uganda National Household Survey.

The Individual Record (IR) and HIV Record (AR) data sets were downloaded, with permission, from the Measure DHS website. The two datasets were then merged to form a sample of 9,524 men who were interviewed and had valid HIV serostatus data. Out of 9,524 men, 7,969 men who ever had sex were considered for analysis and thus formed the sample size for this study.

Key Variables and Measurements

The study variables were categorized into dependent and independent variables. There were two dependent variables (HIV status, sexual behavior). HIV status was categorized as HIV-positive (code 1) or HIV-negative (code 0). The risky sexual behaviors considered for this study included having higher-risk sex in the last 12 months, transactional sex in the last 12 months, non-condom use at last higher-risk sexual encounter, age at first sex, and number of lifetime partners.

In this study higher-risk sex refers to sex with a non-marital or non-cohabiting partner in the 12 months immediately preceding the survey. Transactional sex means payment for sex or exchange of any gift items for sex in last 12 months prior to the survey. Non-condom use at last higher-risk sex refers to not using a condom the last time a respondent engaged in higher-risk

sex. These three variables (high-risk sex, transactional sex, non-condom use at last higher-risk sex) were coded as "0" for "no" and "1" for "yes". Given that the age of consent for sex, marriage, and adult decision making in Uganda is age 18, age at first sex was categorized as first sex at age 18 or older (code 0) or first sex before age 18 (code 1). This variable only applies to men who were age 18 or older at the time of the survey because those who were younger than age 18 were still at risk of having first sex before age 18. The variable on number of lifetime partners was organized into two categories: 1–3 lifetime partners and 4+ partners.

The key independent variables considered in the analysis were circumcision status and age at circumcision. Circumcision was categorized as circumcised (1, yes) and uncircumcised (0, no). Age at circumcision was recorded in one of four age groups; below 10, 10–14, 15–19, or age 20 or older. These categories were drawn partly because of the age at which circumcision is performed, especially for religious and cultural reasons and in relation to the onset of puberty. Circumcised men who did not know the age at which they were circumcised were grouped with those who were circumcised before age 10. This was done with the assumption that most likely they were circumcised in infancy. The first age group (below age 10) was to account for circumcisions in infancy or before puberty, while circumcision at age 10–14 and age 15–19 was to account for onset of puberty, sexual activity, and adolescence. The last category (age 20+) was primarily to account for those who were circumcised later in life, most probably for health reasons.

Men's demographic and socioeconomic characteristics were controlled for in multivariate analyses. These included residence, marital status, religion, education, wealth status, region, age, and ethnicity. Residence was categorized as rural-urban; marital status as never-married, currently married/cohabiting, and formerly married; religion as Moslem, Catholic, Anglican, Pentecostal, Seventh Day Adventist, other Christians, and other. Education was categorized as no education, primary, secondary, and higher education; wealth status as poorest, poorer, middle, richer, and richest. Region was categorized according to the major geographical locations of the country: Kampala, Central, Eastern, Northern, and Western regions. Age was categorized by five-year age groups, from ages 15 to 59. Ethnicity was categorized according to similarities in cultures among the different tribes. Also those that practice cultural circumcision, such as the Bagisu/ Sabiny and Bakonzo/Bakonjo, were grouped together.

Data Management and Statistical Analysis

Data management involved recoding of variables and computing new variables. HIV sample weights were applied to the data to adjust for complex surveys and non-response. At the bivariate level, chi-square tests were computed to examine the associations between outcomes and key independent variables. The bivariate analysis for age at first sex and number of sexual partners in lifetime was conducted with the full sample. The analysis for higher-risk sex and transactional sex was restricted to men who had sex in the past 12 months, while condom use at the last higher-risk sex included only men who had higher-risk sex.

At the multivariate level, logistic regressions were used to establish the adjusted effect of circumcision and age at circumcision on risky sexual behaviors and HIV status, respectively. To test the hypotheses, four groups of models were fitted to predict the effect of circumcision status on sexual behavior and on HIV status and the effect of age at circumcision on sexual behavior and HIV status. In the models with sexual behaviors as the outcomes, key background or socio-demographic and economic factors were controlled for. In the models predicting effects of circumcision and age at circumcision on HIV status, in addition to socio-demographic and economic factors, risky sexual behaviors were also controlled for. Odds ratios along with 95% confidence intervals for circumcision and age at circumcision from the models were reported.

RESULTS

Description of the Respondents

Table 1 shows a summary of the background characteristics of all men studied and of circumcised men. Overall, out of the 7,969 respondents, the majority resided in rural areas (81%), had primary education (57%), were currently married/ cohabiting (72%), and primarily belonged to the Baganda (17%) ethnic group, followed by the Langi/Acholi ethnic group (11%). Over 75% of respondents were Catholic or Anglican, while 13% were Moslems. Almost equal proportions of respondents lived in the four main geographic locations of Uganda (Eastern, Western, Northern, and Central).

Table 1. Background characteristics of all men and circumcised men

	All men			Circumcised men		
	Weighted		Unweighted	Weighted		Unweighted
Background characteristics	%	N	N	%	N	N
Age						
15-19	9.3	742	746	10.3	230	236
20-24	15.0	1,198	1,170	17.1	380	390
25-29	16.6	1,326	1,293	17.9	399	392
30-34	14.2	1,134	1,126	13.9	309	330
35-39	14.0	1,118	1,091	13.0	290	300
40-44	11.1	883	868	9.8	218	227
45-49	9.0	720	723	6.8	153	163
50-54	6.5	519	516	7.1	158	162
55-59	4.1	329	340	4.1	91	97
Place of residence						
Urban	19.1	1,520	1,504	27.1	604	593
Rural	80.9	6,449	6,369	72.9	1,624	1,704
Region						
Central	22.4	1,784	1,528	22.0	491	423
Kampala	7.1	568	779	9.6	215	308
Eastern	21.3	1,701	1,738	39.6	882	906
Northern	25.1	1,999	2,289	9.0	201	294
Western	24.0	1,916	1,539	19.7	439	366
Highest education level						
No education	7.2	570	543	6.4	143	156
Primary	56.8	4,526	4,490	52.3	1,166	1,219
Secondary	27.0	2,155	2,128	31.3	697	699
Higher	9.0	718	712	10.0	222	223

(Continued...)

Table 1. – *Continued*

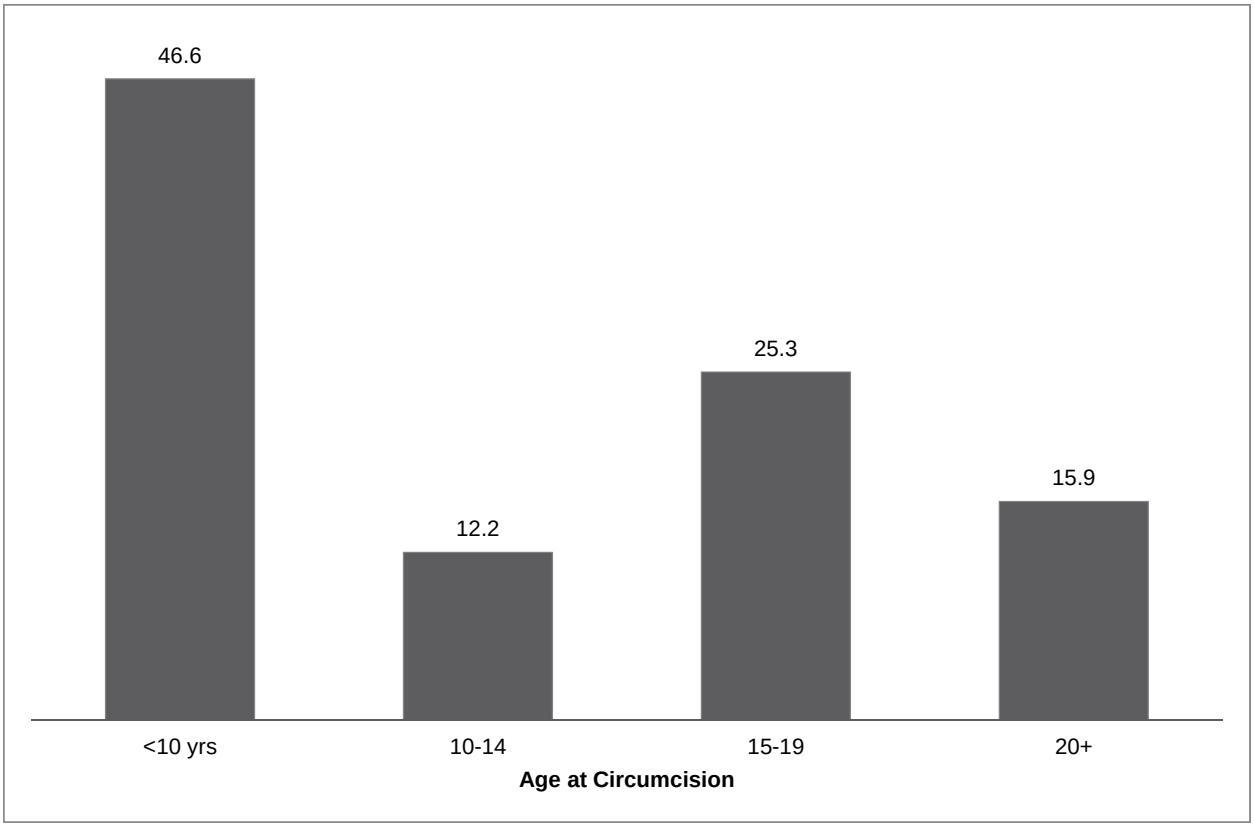
Background characteristics	All men			Circumcised men		
	Weighted		Unweighted	Weighted		Unweighted
	%	N	N	%	N	N
Marital status						
Never married	20.7	1,649	1,638	23.5	523	523
Currently married	71.7	5,710	5,614	68.9	1,534	1,587
Formerly Married	7.6	609	621	7.7	171	187
Ethnicity						
Baganda	16.6	1,321	1,297	18.0	400	419
Banyakore	10.0	794	643	4.9	109	98
Iteso/Karimojong	9.2	730	739	2.9	64	58
Lugbara/Madi/Alur/Japadhola	9.8	783	1,046	8.4	186	259
Basoga	9.0	716	719	14.1	314	319
Langi/Acholi	11.2	896	878	0.9	19	23
Bakiga	5.4	427	353	1.9	42	37
Bagisu/Sabiny/Bakonzo/Bakonjo	8.5	680	694	29.0	646	656
Banyoro/Batooro	8.5	680	588	7.4	164	141
Bafumbira	2.1	165	130	1.1	24	20
Bagwere/Samia	3.5	280	276	4.4	99	96
Others	6.2	497	510	7.3	163	171
Religion						
Catholic	42.2	3,365	3,354	21.5	478	484
Anglican	34.4	2,741	2,621	24.4	543	547
SDAs	1.5	116	103	1.6	36	32
Pentecostal	5.6	449	418	3.8	85	83
Moslems	13.0	1,038	1,105	46.1	1,026	1,087
Other Christians	2.4	191	201	2.1	46	51
Others	0.9	69	71	0.6	14	13
Circumcision status						
No	72.0	5,741	5,576			
Yes	28.0	2,228	2,297			
Total	**100.0**	**7,969**	**7,873**	**100.0**	**2,228**	**2,297**

Table 1 also shows that more than one-quarter of respondents (28%) were circumcised. The percentage of circumcised men increases by age from age 15 to 34, and then decreases. Almost-three quarters (73%) of the circumcised men resided in rural areas, while 40% were from Eastern region, 22% were from Central region, and 20% were from Western region. Over half (52%) had primary education, and over two-thirds (69%) were married or living together at the time of the survey. Twenty-nine percent were either Bagisu/Sabiny or Bakonjo, the ethnic groups in Uganda that practices cultural circumcision, while a considerable percentage were either Baganda (18%) or Basoga (14%). Even though Moslems were a small percentage of all men

compared with Catholics and Anglicans, they were 46% of circumcised men, having been circumcised for religious reasons.

Figure 2 shows that almost half of the respondents (47%) were circumcised before reaching age 10, while 25% were circumcised between ages 15 and 19, 16% were circumcised at age 20 or older, and 12% at age 10-14.

Figure 2. Percentage distribution of circumcised men by age at circumcision

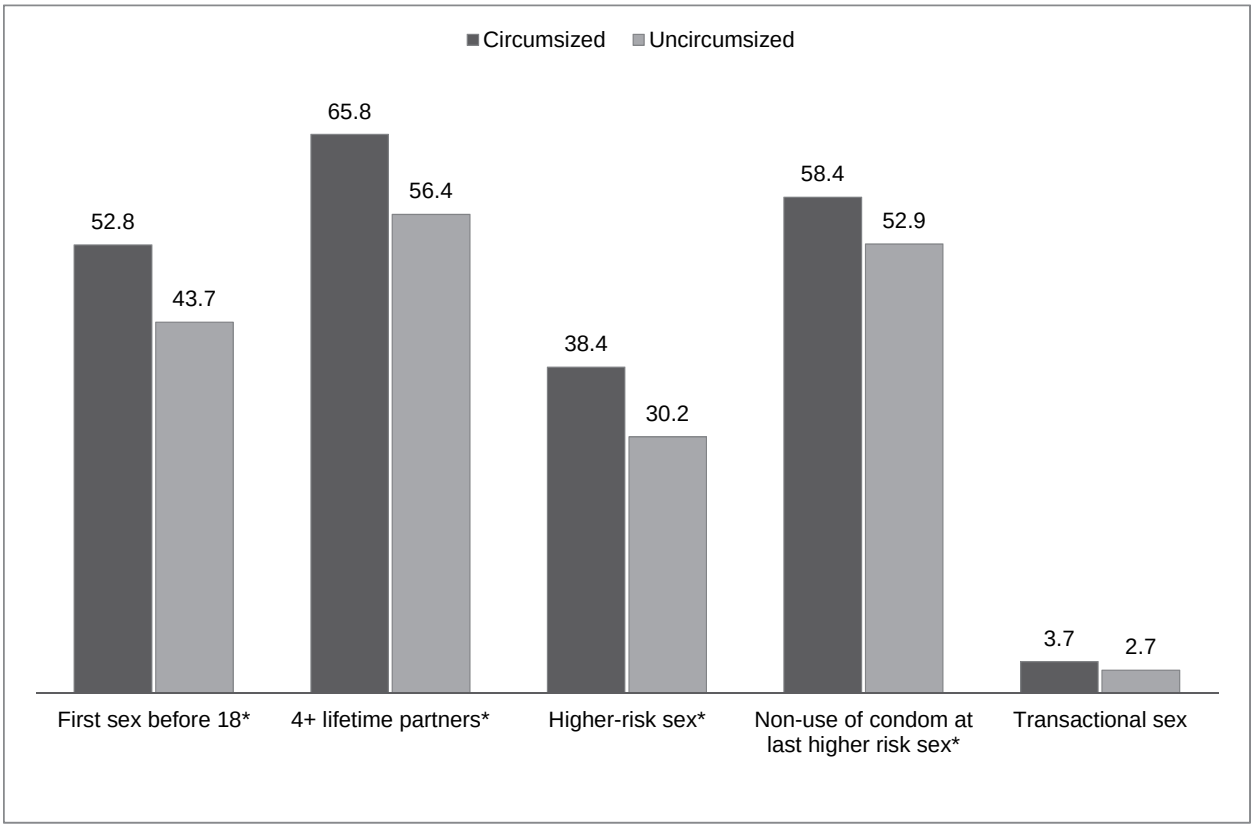


Comparison of Sexual Behavior between Circumcised and Uncircumcised Men

Bivariate analysis (Figure 3) shows the association between circumcision status and risky sexual behaviors. Overall, the percentages of circumcised men who engaged in various risky sexual behaviors were higher compared with the percentages of uncircumcised men. Circumcision status is significantly associated with four of the five risky sexual behaviors studied: higher-risk sex, number of lifetime sexual partners, age at first sex, and non-condom use

at last higher-risk sex. However, no association was found to exist between circumcision status and transactional sex in the last 12 months.

Figure 3. Percentage of men who had risky sexual behavior by circumcision status



* p-value from the chi2 test is less than 0.05

Half of the circumcised men had first sex before age 18 compared with 42% of uncircumcised men. Two-thirds of the circumcised men had four or more lifetime sexual partners compared with 56% of uncircumcised men. Thirty-eight percent of circumcised men engaged in higher-risk sex in the last 12 months before the survey compared with 30% of uncircumcised men. More than half of the respondents, whether circumcised or not, did not use condoms the last time they had higher-risk sex.

Age at Circumcision and Sexual Behavior

Table 2 shows the results from bivariate analysis for age at circumcision and risky sexual behavior. Among the risky sex behaviors studied, only age at first sex and having higher-risk sex are associated with age at circumcision. With the exception of men circumcised at age 20+ years, more than half of all circumcised men had sex before age 18. Men circumcised between ages 10 and 14 had the highest percentage (48%) engaging in higher-risk sex, followed by men circumcised before age 10 (42%).

Men circumcised at age 20 or older had the highest percentage (72%) with four or more lifetime sexual partners, while 4% engaged in transactional sex. Men circumcised between ages 15 and 19 had the highest proportion not using condoms during their last higher-risk sex (65%).

Table 2. Among circumcised men, the percentage who reported various risky sexual behaviors, by age at circumcision

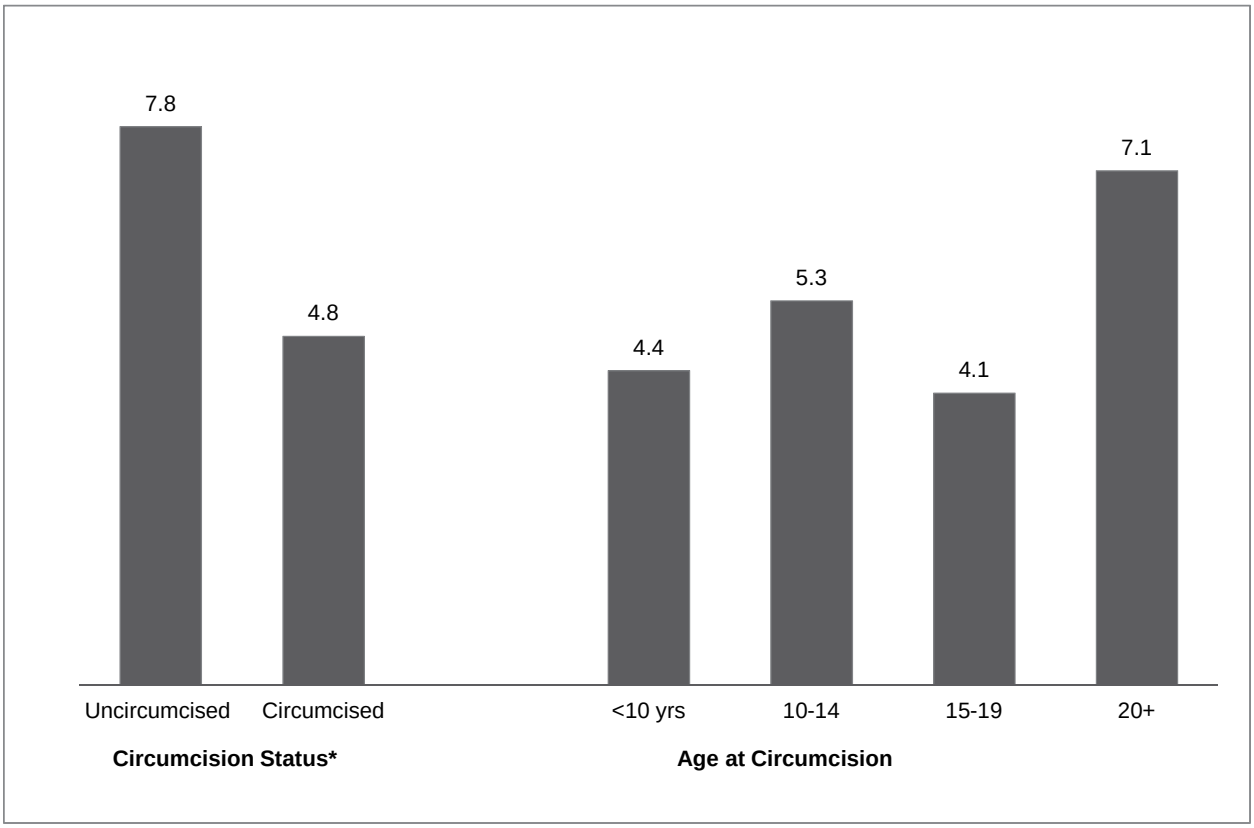
	Age at circumcision (years)				
	< age 10	10-14	15-19	20+	
Sexual behavior	%	%	%	%	Total
First sex below age 18*	52.1	52.4	52.7	41.7	50.6
Four or more lifetime sexual partners	62.8	68.0	66.6	71.8	65.8
Had transactional sex in last 12 months	3.9	2.5	3.7	4.3	3.7
Had higher-risk sex in the last 12 months*	42.0	47.7	34.1	28.2	38.4
Did not use a condom at last higher-risk sex	56.3	60.5	65.4	50.9	58.4

* p-value from the chi2 test is less than 0.05

HIV Results by Circumcision Status and Age at Circumcision

Figure 4 shows a bivariate analysis for HIV serostatus by circumcision status and by age at circumcision, for men who were circumcised. HIV prevalence was lower among the circumcised men (5%) compared with uncircumcised men, and the association is significant. Among circumcised men, those who were circumcised at age 20 or older had a higher HIV prevalence (7%) compared with other age groups. However this association is not significant.

Figure 4. HIV prevalence by circumcision status and age at circumcision



*p-value from the chi2 test is less than 0.05

Adjusted Associations among Circumcision Status, Age at Circumcision, and Sexual Behaviors

Table 3 shows adjusted associations between risky sexual behaviors and circumcision status. The table contains five models, one for each of the selected sexual behaviors, comparing circumcision status and controlling for key background characteristics including age, ethnicity, residence, wealth status, marital status, region and education. Overall, circumcision status is significantly associated with number of lifetime sexual partners, age at first sex, higher-risk sex, and condom use at last higher-risk sex. However, transactional sex is not associated with circumcision status.

Model 1 shows that circumcision status is significantly associated with number of lifetime sexual partners ($p < 0.01$). The odds of having four or more lifetime partners are 1.47 times higher among the circumcised men compared with uncircumcised men. Model 2 also

shows the odds of circumcised men having first sexual intercourse before age 18 to be 1.25 times higher than among uncircumcised men ($p<0.01$). Having higher-risk sex (model 3) and using a condom at last higher-risk sex (model 4) also are significantly associated with circumcision status ($p<0$ .05). The odds of circumcised men having higher-risk sex in the last 12 months are 1.25 times higher compared with uncircumcised men, while the odds of having used a condom during the last higher-risk sex are 20% lower among circumcised men.

Table 3. Adjusted odds ratios for risky sexual behaviors comparing circumcised and uncircumcised men

	(1)	(2)	(3)	(4)	(5)
	Number of lifetime partners	**Age at first sex below age 18**	**Had higher-risk sex in the last 12 months**	**Condom use at last higher-risk sex**	**Transactional sex in last 12 months**
	ORs (95% CI)	**ORs (95% CI)**	**ORs (95% CI)**	**ORs (95% CI)**	**ORs (95% CI)**
Circumcision status					
Uncircumcised	1.00	1.00	1.00	1.00	1.00
Circumcised	1.47** (1.28-1.68)	1.25** (1.09-1.44)	1.25* (1.03-1.50)	0.80* (0.63-1.00)	1.22 (0.83-1.80)
Background characteristics					
Age	**	**	**	**	*
Ethnicity	**	**	**	**	*
Residence	**		**	**	
Wealth status	**		**	**	
Marital status	**	*	**		*
Region	*	*	*	**	
Education	**	*		**	
Number of men	**7,969**	**7,661**[¥]	**7,114**	**2,313**	**7,109**

* p<0.05, ** p<0.01, Background characteristics were controlled for in all five models. [¥]based on only men who were age 18+ years.

Table 4 shows adjusted associations between risky sexual behaviors and age at circumcision, with separate models for each of the five selected risky sexual behaviors and age at circumcision, controlling for background characteristics, as in Table 3. In Table 4, however, age was not controlled for because it was highly correlated with age at circumcision. In Table 4 only model 3 (having higher-risk sex in the last 12 months) shows a strong significant relationship with age at circumcision. Men who were circumcised between ages 10 and 14 were 56% more likely to have had higher-risk sex in the last 12 months preceding the survey compared with men

circumcised before age 10. However circumcision after age 15 is not associated with higher-risk sex. None of the other four risky sexual behaviors is significantly associated with age at circumcision.

Table 4. Adjusted odds ratios for risky sexual behaviors comparing age at circumcision

	(1)	(2)	(3)	(4)	(5)
	Number of lifetime partners	**First sex below age 18**	**Had higher-risk sex in the last 12 months**	**Condom use at last higher-risk sex**	**Transactional sex in the last 12 months**
	ORs (95% CI)	**ORs (95% CI)**	**ORs (95% CI)**	**ORs (95% CI)**	**ORs (95% CI)**
Age at circumcision					
Below 10 years	1.00	1.00	1.00	1.00	1.00
10-14	1.30 (0.99-1.72)	1.05 (0.75-1.48)	1.56* (1.02-2.39)	1.05 (0.59-1.87)	0.57 (0.21-1.55)
15-19	1.10 (0.80-1.52)	1.05 (0.78-1.39)	0.96 (0.66-1.40)	1.16 (0.67,2.02)	1.10 (0.51-2.35)
20+	1.10 (0.76-1.61)	0.82 (0.61-1.10)	1.03 (0.70-1.52)	1.50 (0.84-2.68)	1.13 (0.51-2.52)
Background characteristics					
Ethnicity	**		*	*	
Residence					
Wealth status	**		*		
Marital status	**		**		
Region	*		*		
Education				*	
Number of circumcised men	**2,228**	**2,125**[¥]	**2,053**	**766**	**1,997**

* p<0.05, ** p<0.01, Background characteristics were controlled for in all five models, [¥]based on only men who were aged 18+ years

Adjusted Associations between Circumcision Status, Age at Circumcision, and HIV Status

Table 5 shows the adjusted association between HIV status and circumcision status (model 1), controlling for background characteristics including age, ethnicity, residence, wealth status, marital status, region, and education. Model 2 shows the adjusted association between HIV status and circumcision status, controlling for both background characteristics and risky sexual behaviors. In model 1 the odds of being HIV positive among circumcised men are 32% lower compared with uncircumcised men, after controlling for background characteristics, while in model 2 the odds of being HIV-positive among circumcised men are 35% lower compared

with uncircumcised men, after controlling for both background characteristics and risky sexual behaviors. The protective effect of circumcision seems to even be stronger after controlling for risky sexual behaviors, although the confidence intervals in the two models overlap. Among the risky sexual behaviors that were controlled for in the model, number of lifetime partners and transactional sex are significantly associated with HIV status.

Table 5. Adjusted odds ratios for HIV positive comparing circumcised and uncircumcised men

	(1)	(2)
	HIV status, adjusted for background characteristics	**HIV status, adjusted for background characteristics and risky sexual behaviors[¥]**
	ORs (95% CI)	**ORs (95% CI)**
Circumcision status		
Uncircumcised	1.00	1.00
Circumcised	0.68*	0.65*
	(0.48-0.95)	(0.46-0.92)
Background characteristics		
Age	**	**
Ethnicity	*	**
Residence	*	
Wealth status		
Marital status	**	*
Ethnicity	*	
Region		**
Education	*	
Number of lifetime partners		
Less than four		1.00
Four or more		1.68**
		(1.33-2.12)
Age at first sex		
Below age 18		1.00
Age 18 and above		0.95
		(0.77-1.16)
Transactional sex in last 12 months±		
Did not pay for sex		1.00
Paid for sex		2.17**
		(1.26-3.74)
Number of men	**7,969**	**7,969**

* p<0.05, ** p<0.01

[¥] Higher-risk sex and condom use at higher-risk sex were omitted because of collinearity.

[±]To utilize the full sample (all men who ever had sex) in the analysis, men who did not have sex in the last 12 months were grouped in a separate category for the variable, transactional sex in the last 12 months.

Table 6 shows, among the circumcised men, the adjusted association between HIV status and age at circumcision (model 1), controlling for background characteristics. Model 2 shows the adjusted association between HIV status and age at circumcision, controlling for both background characteristics and risky sexual behaviors. In both models, HIV status is not significantly associated with age at circumcision.

Table 6. Adjusted odds ratios for HIV positive comparing age at circumcision

	(1)	(2)
	HIV status, adjusted for background characteristics	**HIV status, adjusted for background characteristics higher-risk sexual behavior**
	ORs (95% CI)	**ORs (95% CI)**
Age at circumcision		
Below age 10	1.00	1.00
10-14	1.21 (0.55-2.67)	1.16 (0.52-2.60)
15-19	1.11 (0.43-2.84)	1.04 (0.40-2.73)
20+	1.35 (0.70-2.61)	1.32 (0.68-2.57)
Background characteristics		
Ethnicity		
Residence	*	
Wealth status		
Marital status	**	**
Ethnicity		
Region	**	
Education		
Number of lifetime partners		
Less than four		1.00
Four or more		1.41 (0.78-2.53)
Age at first sex		
Below age 18 years		1.00
Age 18 and above		0.79 (0.52-1.19)
Transactional sex in last 12 months		
Did not pay for sex		1.00
Paid for sex		0.83 (0.29-2.36)
Number of circumcised men	**2,228**	**2,228**

* p<0.05, ** p<0.01

DISCUSSION

The findings show that circumcised men have higher odds of having four or more lifetime partners, having first sex before reaching age 18, engaging in higher-risk sex, and non-condom use at last higher-risk sex compared with uncircumcised men in Uganda. This is consistent with findings from other studies (Bailey et al. 1999; Differding 2007), which have shown that circumcision often gives circumcised men more leeway to have unprotected sex and to have many sexual partners. This is often the case when men view circumcision as an HIV "vaccine" and thus believe that they are protected from acquiring HIV.

Some studies attribute such unexpected differences in sexual behavior to behavior risk compensation, where men change their sexual behaviors for the worse with the knowledge that their risk of infection is reduced (Kalichman et al. 2007; Eaton and Kalichman 2009; Riess et al. 2010). In the study by Riess and colleagues, some men stopped using condoms temporarily after undergoing male circumcision as part of the new program in Kisumu, Kenya, while others increased their number of sexual partners. In the three randomized clinical trials that gave rise to the circumcision recommendation by UNAIDS in 2007, the South African study showed evidence of risk compensation. In that trial, circumcised men reported more sexual partners than uncircumcised men at the 4-12 month and 13-21 month recall periods (Auvert et al. 2005). Given this evidence, promotion of the Safe Male Contraception (SMC) policy without increased education and counseling among men may hinder progress in further HIV reduction (Sidler et al. 2008), as circumcised men engage in risky sexual behaviors. This may undermine the efforts in the fight against HIV/AIDS, or even reverse the gains made in reducing HIV incidence.

Another possible explanation could be that men who already practice risky sexual behaviors may decide to undergo circumcision to reduce their chances of HIV infection. Their risk-taking may not change after circumcision.

In relation to circumcision and HIV status, multivariate results show that circumcised men are more likely to be HIV-negative compared with uncircumcised men. These findings are consistent with some randomized controlled studies (Auvert et al. 2005; Bailey et al. 2007; Gray et al. 2007) that have shown a protective effect of circumcision against heterosexual HIV infection from infected women to men. These results were observed even though the odds of risky sexual behaviors were higher among the circumcised men. This could mean that the effect

of risk compensation in the Ugandan context may be small compared with the fundamental benefits of the SMC interventions in this population.

The relationship between age at circumcision and sexual behavior, in both bivariate and multivariate analysis, is inconsistent, except for engaging in higher-risk sex in the last 12 months. The likelihood of having higher-risk sex was higher among men circumcised at age 10–14 than among men circumcised before age 10. However, these results need to be interpreted with caution. We found no literature to explain why circumcision at age 10–14 may increase the odds of having higher-risk sex compared with circumcision before age 10. In addition, age at circumcision is not significantly associated with HIV status among men, consistent with findings from other studies (Connolly et al. 2009). Hence, more studies need to be done to explore the relationship between age at circumcision and sexual behavior and HIV serostatus.

Conclusions

There is a strong association between circumcision and risky sexual behavior. Even given this strong association, however, circumcised men are less likely than uncircumcised men to be HIV-positive, which could mean that the benefits of circumcision outweigh the behavior risk compensation that could result. Age at circumcision is not significantly associated with men's sexual behavior or HIV serostatus.

Recommendations

The findings suggest a need to repackage Uganda's circumcision messages to account for the increase in risky sexual behaviors among circumcised men. Intense, individualized counseling before and after SMC procedures may help to reduce these risky behaviors. More sensitization at the population level, in health service provision, and at institutions on the advantages of circumcision needs to be done to encourage more men to get circumcised. This sensitization should be detailed enough to show that circumcision is part of the comprehensive HIV prevention package, and not a replacement for the ABC strategy.

Future Research

There is need for qualitative studies to understand the motivation for circumcision among men who seek circumcision services. This could help determine if messages about protective effects of male circumcision have been sufficiently disseminated and correctly interpreted. Furthermore, there is a need for more research on the possible connection of the roll out of SMC and the increased risky sexual behaviors among circumcised men. A comparison of the surveys before and after the launching of the SMC policy would fill in some of the gaps in knowledge.

Limitations of the Study

The study is based on data from a cross-sectional survey design. Therefore, while the analysis shows associations, it is not possible to establish causality using such data. In addition, recall bias among respondents for some of the risky sexual behaviors may have affected the study results. Also, it is difficult to ascertain whether respondents got infected before circumcision or after circumcision.

Another limitation is the failure to establish the mode of HIV transmission for respondents. Some men could have been infected from other modes, such as mother-to-child transmission. Finally, the Uganda AIDS Indicator Survey did not collect data on the reasons for circumcision that would have been helpful addressing some of the issues in the analysis.

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