

The Effect of Male Circumcision on Risky Sexual Behaviours of Men in Rwanda: A Comparative Analysis of RDHS 2005 and 2014/15

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ABSTRACT

Background: Rapid up-take of Voluntary Medical Male Circumcision (VMMC) in countries like Rwanda that implemented it as a national HIV prevention strategy since 2008, raised a public health concern of risk compensation. Risk compensation may occur if circumcised men increase their Risky Sexual Behaviours (RSB) because of the awareness of circumcision's 60% protection from heterosexual HIV/STIs transmission. The aim of this study was to assess the difference in RSBs among adolescent and adult circumcised men before and after the VMMC program implementation in Rwanda.

Methods: Data of 11,037 men aged 15-59 years from Rwanda DHS 2005 and 2014/15 were analyzed using STATA version 13.0. We estimated the prevalence of ever paid sex, extramarital sex, more than 3 total lifetime sex partners, condom use at paid sex, first sex below age 15 and most recent sex partner being casual/commercial; among circumcised and uncircumcised men and compared between surveys. Association of these behaviours with circumcision status was also determined using bivariate and multivariate logistic regression analysis in separate and in combined datasets.

Results: Men who reported being circumcised almost tripled from 11% (532) in 2005 to 29% (1821) in 2014/15. In all men, RSB prevalence was lower in 2014/15 than in 2005. Circumcised men were generally more likely to engage in RSB in both surveys than uncircumcised men but less likely in 2014/15 compared to 2005. Multivariate models revealed no association of circumcision with sex below 15 years in 2005 (AOR 0.89; CI: 0.65-1.19; P>0.05) and 63% protection in 2014/15 (AOR 0.63; CI: 0.51-0.76; P<0.01). In all men, while there were too few responses to determine a true difference in non-condom use, other RSB were significantly less likely whereas paid sex was significantly more likely in 2014/15 due to an increase among the uncircumcised (AOR 1.29; CI: 1.03-1.61).

Conclusion: The findings did not support risk compensation. However, more responses on condom use are needed to check its disinhibition among circumcised men. Ongoing VMMC campaigns should re-inforce pre-counseling to young men 15-24 in the provinces out of Kigali to delay sexual debut even after circumcision.

Keywords: Male circumcision; Risky sexual behaviours; HIV/STI prevention; Risk Compensation; Rwanda; Africa

INTRODUCTION

In 2007, the World Health Organization, the joint United Nations Programme on HIV/AIDS, WHO/UNAIDS and the Centers for Disease Control and Prevention (CDC) all released recommendations for scale up of adolescent and adult male circumcision as an HIV prevention strategy in countries with low uptake of circumcision and high HIV prevalence [1]. This recommendation resulted from three Randomized Control Trials (RCTs) done in Uganda, Kenya, and South Africa, on the effectiveness of male circumcision in preventing HIV infection in heterosexual men [24]. The RCTs demonstrated that Voluntary Medical Male circumcision (VMMC) reduces by approximately 60%, HIV acquisition by heterosexual men. This made it one of the most effective HIV prevention interventions. Fourteen

priority countries in East and Southern Africa were to expand circumcision services to reach 80% of their adult males within 5 years to be able to avert 3.4 million new HIV infections. VMMC programs began in these countries in 2008 and by end of 2014 were estimated to have done 8.9 million circumcisions [1-5].

Rwanda being one of the 14 priority countries earmarked by WHO, included VMMC in its national HIV/AIDS strategic plan of 2008-2012, and began a scale up in 2008 when the prevalence of male circumcision was just 12% [6]. The uptake increased and the prevalence of 2014/15 (30%) had almost tripled that of 2005 [7]. Although the rate didn't meet up with WHO's 80% target of adolescent and adult population by 2012, it was a considerable effort. The Rwanda MOH trained service providers and VMMC was provided by public and

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private health facilities. Mass campaigns in rural and urban districts, introduction and scale up of PrePex (bloodless adult male circumcision method) and task-shifting to nurses facilitated access of the services to a large number of people. By the end of 2012, 70% of health facilities had trained staff for circumcision [8-10].

Since the implementation of male circumcision for HIV prevention began, there had been public health concerns that following circumcision, adolescent and adult males may increase their risky sexual behaviors from the perception that they had been “fully protected” from HIV and other STIs thus compromising the benefits of the circumcision. This concept was described as risk compensation or sexual disinhibition [11-15]. Review of literature [16-18] showed that the major reason for the increasingly high demand for circumcision in Rwanda was its health benefit of HIV and STI prevention. Also the HIV prevalence in Rwanda had been stable for a decade (2005-2015) [9]. Why was it not declining despite all the strategies of HIV prevention? Could it be that the risk was being compensated? Maybe the adolescent and adult men who had undergone circumcision since the implementation of the national VMMC program, including those previously circumcised, had adopted riskier sexual behaviours compared to their uncircumcised counterparts thus compromising the gains of circumcision.

Longitudinal studies on risk compensation were done in Kenya, [11,19,20] Uganda, [14] and Zimbabwe [21]. They all found no significant differences in risky sexual engagement between circumcised and uncircumcised men following circumcision. However, they suggested a need for the same studies to be done in “real world” settings where participants were not within the confines of randomized control modalities. They admitted that within the randomized circumcision group, participants were constantly counseled for risk-reduction. This may have mitigated the risk compensation in their study. In the “real world” however, there may not be intense counseling and follow-up but instead promotional messages to increase demand for male circumcision. Thus results of a non-experimental operational research design were being awaited. Carrying out such a study in Rwanda was going to be a best-fit, being one of the fourteen priority countries that was chosen by WHO/UNAIDS to include VMMC as part of their HIV prevention package since 2008. Therefore, we used “real world” data of men in Rwanda who voluntarily chose to be circumcised in public and/or private health settings. We compared men’s data of Rwanda DHS 2005 with that of 2014/15 to assess the differences in RSBs among circumcised and uncircumcised men before and after the VMMC program implementation in Rwanda. The results will add to the evidences that have promoted male circumcision for HIV prevention and provide recommendations for best practices in this field.

METHODOLOGY

Study setting

This study was carried out in Rwanda. Geographically located in Central Africa between 1°04' and 2°51' south latitude, and between 28°45' and 31°15' East longitude, Rwanda is a land-locked country, bordered by Burundi in the South; Tanzania in the East; Uganda in the North, and the Democratic Republic of Congo in the West. The borders of Rwanda stretch up to 900 kilometers. The country’s administrative division counts for five provinces: Northern Province, Western Province, Southern Province, Eastern Province and the City of Kigali, which is the fifth province. Rwanda is divided into 30 districts (Uturere) which are further subdivided into 416 sectors (Imirenge), 2,148 cells (Utugari) and 14,837 villages (Imidugudu) (NISR, 2014).

The village is the smallest politico-administrative entity of the country (MINALOC, 2014).

The population of Rwanda is 10,515,973 residents, of which 52% are women and 48% men based on the 2012 Census. Since the 2002 Census, the population has increased by 2.4 million, which represents an average annual growth rate of 2.6%. The age pyramid of Rwanda has a large base, implying that the majority of the population is young. Around 50% (5.4 million) of the population is under 20. People aged 65 and above account for only 3% of the resident population. The population is essentially young with the mean age being 22.7 years. and mean female age than males (23.5% vs. 21.9%). The population is largely rural with almost 84 percent of the country’s residents living in rural areas. Among the total urban population, 49 percent live in Kigali City, the capital of the country [7,22].

Study design and sampling procedures

This study was a comparative data analysis of Rwanda Demographic and Health Surveys (RDHS) of 2005 and 2014/15. The RDHS 2005 was conducted before the recommendation, implementation and national scale up of the VMMC program in Rwanda as a strategy of HIV prevention thus serving as a good baseline data. The RDHS 2014/15 was conducted long after the scale-up of the VMMC. The number of years between the surveys allowed for real behaviour changes to be assessed because behaviour changes actually take long to happen.

The prevalence RSB of men aged 15–59 years who were circumcised was estimated from the surveys of 2005 and 2014/15, and then the ratios compared to an unmatched group of those who were uncircumcised during the same time periods.

Both surveys contained nationally representative data on demographic and health characteristics of the total population produced by using a two staged sampling techniques. The first stage involved creating clusters of the villages (Enumeration Areas; EAs) to represent rural and urban areas. The second stage involved systematic sampling of households, where male interviews were conducted in every second household interviewed. The RDHS 2005 had a total population sample of 16,141 with 4820 completed interviews for men aged 15-59 years and the RDHS 2014/15 had a total representative sample of 12,699 with 6217 completed interviews for men 15-59 years. (7,23). This study was a census of all data of completed interviews in the two surveys; 4820 in 2005 and 6217 in 2014/15, making a total sample size of 11037 men aged 15-59 years.

Data collection and variables

Secondary data was used for this study. A registration to the DHS program and an application to use the STATA format of the RDHS male datasets was made. Having been granted the dataset, the variables of interest were extracted in order to form a new dataset that would permit the response of the research questions.

The primary data were collected using validated questionnaires produced by MEASURE DHS. The questionnaires were produced in French and English and translated into Kinyarwanda. Effective trainings were conducted for the interviewers and the questionnaires were pretested before their use in the field. Detailed interviewer’s guide with other instructional manuals and field supervisors complemented the effectiveness of data collection [6,7].

The dependent variable was circumcision. It was indicated by responding yes or no to a question that asked if the respondent had ever been circumcised. Circumcision was described to them as the complete or partial removal of the foreskin of the penis. Those who

responded 'don't know' were considered uncircumcised for this study.

The independent variables included Risky Sexual Behaviours (RSB) among sexually active circumcised and uncircumcised men:

- **Age at first sex <15:** Having the first sexual intercourse below the age of 15 was considered risky sexual behaviour. This was because the mean age of first sex in 2005 was 15 and 17 years in 2014/15 survey. The age of first sexual intercourse was categorized into two, those below 15 years and those 15 years and above.
- **Ever paid for sex:** This was comparable in both survey years. Men responded yes or no to the question if they ever gave money in exchange for sex in their lifetime.
- **Condom use at paid sex:** The only condom use that was comparable from both surveys was condom use every time the men had paid for sex. They responded yes or no to a question that asked if they always used a condom every time they gave money in exchange for sex. Risky sexual behaviour was defined by those who responded no.
- **Extramarital sex:** This was defined as having sex with a non-marital/non-cohabiting partner in the previous 12 months before the surveys. Respondents simply answered yes or no if in the previous 12 months they had had sex with someone who was not their spouse nor a live-in partner.
- **Having more than three lifetime number of sex partners:** This number was arrived at as the average lifetime number was approximately three. So going above the average was considered to be riskier.
- **Most recent sex partner was casual/commercial:** This indicator was derived from responses to a question that asked respondents to state their relationship with the most recent sex partner. Those whose most recent partners were casual and commercial were grouped together and considered risky sexual behaviour. Married/cohabiting partners, girlfriends and fiancée were considered non-risky.

Demographic and other variables

- **Age:** The ages of respondents were categorized into 5-year age groups for easy analysis; 15-19, 20-24, 25-29, 30-34, 35-39, 40-44, and 45-49.
- **Marital status:** The marital status was regrouped into married/living together, those divorced, separated or widowed formed another category and then those who had never married or lived with a partner.
- **Level of education:** Defined as the highest level of education attained. They were categorized into; no education, primary, secondary and higher.
- **Province:** The provinces were grouped according to the administrative divisions of Rwanda; Kigali, North, West, South and East. The twelve provinces of 2005 were regrouped to match 2015 divisions: Gitarama, Gikongoro and Butare were grouped as South province; Gisenyi, Cyangugu and Kibuye as West, Byumba and Ruhengeri as North, Umutara and Kibungu as East and Kigali and Kigali Ngali as Kigali province. This information was gotten from the current locations of these towns. (source: <http://www.statoids.com/urw.html>)
- **Residence:** The residence of the men were considered the way they were originally grouped into rural and urban dwellings.
- **Wealth index:** Wealth categories were left the way they were originally classified; Poorest, Poorer, Middle, Richer and Richest.
- **Occupation:** Occupation was also left the way they were originally classified;

- **Cigarette smoking:** the original categories were also used. Respondents answered yes or no to a question that asked if they smoked cigarettes or not.

Data analysis procedures

Using STATA version 13.0, variables of interest were first of all extracted to form two new datasets. The variables were each regrouped and re-named according to the operational definitions of the study and to make them comparable within and between the years of survey; 2005 and 2014/15. The statistical analyses were done separately and with combined datasets. Descriptive statistics were conducted and presented on tables and figures. To determine the association of circumcision status with risky sexual behaviour indicators, odd ratios of each risky sexual behaviour (ever paid sex, extramarital sex, more than 3 lifetime sex partners, sex before age 15, and most recent sex partner casual/commercial) were estimated for circumcised and uncircumcised men using bivariate logistic regression analysis, at a significance level of 0.05. In the multivariate analysis, the associations were adjusted for demographic and other health characteristics (age, marital status, level of education, province, residence, wealth index, occupation and cigarette smoking). Then, after combining the datasets, the difference of the RSBs for all men (circumcised and uncircumcised) were estimated between the survey years by conducting bivariate and multivariate logistic regression analysis as well. The final regression model of survey year were obtained by adjusting for circumcision and the demographic variables to determine other predictors of RSBs.

Data management and ethical considerations

The files containing the personal information of study participants were not requested from DHS Program when applying for the dataset. They remained secure with the DHS Program so that confidentiality and privacy of personal information was maintained. Moreso, the results have been presented as aggregated data and not as personal information. The raw and analyzed datasets were submitted to the University of Rwanda school of public health library archives.

Meanwhile, during the primary data collection, authorization to conduct the survey was given by the Rwanda Ministry of Health to the National Institute for Statistics (NISR). Ethics approval was granted by the National Ethics Committee of Rwanda and during data collection, consent was sought to participate in the survey. Special consent was gotten from the parents or guardians of children 0-59 years and for testing anemia and HIV. Personal information was not linked to HIV test samples. Further details can be found in the original RDHS 2005 and 2014/15 reports [7,23].

RESULTS

From characteristics of respondents

Data of a total of 11,037 men who completed interviews in both survey years were analyzed. The percentage of men who reported being circumcised in 2014/15 almost tripled those of 2005; from 11% (532) to 29% (1821). In both surveys majority of men were of the younger age groups and the percentage decreased as the population aged. The marital status was distributed in similar ways in 2005 and 2015, with half of the population reporting being married or living with a partner. Also two-thirds of the populations were of rural residence (76% in 2005 and 75% in 2014/15). There was an increase in the number of men reporting secondary and higher levels of education (9% and 3% increase respectively). The distribution of wealth was similar in both surveys (Table 1).

Prevalence of risky sexual behaviours in 2005 and 2015

Apart from ever paid sex and extramarital sex partners within the previous 12 months of survey that saw a total increase of about 2% the other risky sexual behaviours generally experienced a decrease from 2005 to 2015. There was a 5% decrease in having more than three lifetime sex partners as well as in having first sex below 15. Having a recent sex partner that was casual or commercial decreased by 4% while paying for sex without using condoms decreased by 2% (Table 2).

On the other hand, there were differences in the prevalence of risky sexual behaviours between the circumcised and uncircumcised men in both surveys that did not follow the pattern of the behaviour changes for all men. While paid sex increased among all men in 2015 by 2% (from 5.9% to 7.8%), there was a 2% decrease of this behaviour among the circumcised (from 13.2% to 11.5%). Also while first sex below sixteen decreased in all men, there was rather a 3% increase (from 35.0% to 38.3%) in circumcised men; from 35% to 38.3%. Another change in prevalence noted among circumcised and uncircumcised men was in ever paying for sex without using a condom. Circumcised men who were paying for sex without using condoms almost tripled between 2005 and 2015 (from 12.5% to 35.3%), while the uncircumcised reduced that risky behaviour by more than a half (from 40.0% to 24.1%). Having more than three total lifetime partner also decreased by 14% (from 37.6% to 23.4%).

In general, the prevalence of the different risky sexual behaviours were higher for the circumcised than the uncircumcised in both survey years except in using condoms when paying for sex and in sexual debut where the reverse is true in 2005.

Association of risky sexual behaviours and circumcision status of men in 2005 and 2014/15, Rwanda

After adjusting for demographic and other characteristics, circumcision status was significantly associated, both in 2005 and 2015, with ever paid sex (2005: AOR 1.92 (1.32-2.79), 2014/15; AOR 1.43 (1.07-1.91)), having more than 3 lifetime sex partners (2005: AOR 1.96 (1.53-2.52), 2014/15; AOR 1.39 (1.13-1.72)) and extramarital sex (2005: AOR 1.48 (1.10-2.00), 2014/15; AOR 1.32 (1.08-1.61)). Having the most recent sex partner being casual or commercial was also significantly higher among the circumcised in both surveys (2005; AOR 1.72 (1.12-2.64) 2014/15; AOR 1.91 (1.16-3.16)) but not so after controlling for demographic and other characteristics in both years. Whereas having first sexual intercourse below the age of fifteen seemed to be more likely in circumcised men in 2014/15 (OR 1.22 (95% CI 1.09-1.37)), after controlling for other variables, circumcision status was protective of early onset of sexual activity among the men (0.63 (95%CI 0.51-0.76)) as in 2005 (OR 0.77 (95%CI 0.63-0.92)) (Table 3).

The number of responses on condom use at each paid sex was not sufficient to predict a significant association between the circumcised

Table 1: Demographic characteristics of men 15-59 years by circumcision status, Rwanda 2005 and 2014/15.

Characteristics	RDHS 2005			RDHS 2014/15		
	Uncircumcised n(%)	Circumcised n(%)	Total n(%)	Uncircumcised n(%)	Circumcised n(%)	Total fn(%)
Age						
15-24	1837(42.84)	193(36.28)	2030(42.12)	1477(33.6)	803(44.1)	2280(36.67)
25-34	996(23.23)	166(31.2)	1162(24.11)	1273(28.96)	623(34.21)	1896(30.5)
35-44	750(17.49)	93(17.48)	843(17.49)	790(17.97)	238(13.07)	1028(16.54)
45-59	705(16.44)	80(15.04)	785(16.29)	856(19.47)	157(8.62)	1013(16.29)
Marital status						
never married	1957(45.64)	257(48.31)	2214(45.93)	1688(38.4)	1059(58.15)	2747(44.19)
married/living with partner	2222(51.82)	256(48.12)	2478(51.41)	2599(59.12)	728(39.98)	3327(53.51)
widowed/divorced	109(2.54)	19(3.57)	128(2.66)	109(2.48)	34(1.87)	143(2.30)
Residence						
urban	834(19.45)	296(55.64)	1130(23.44)	713(16.22)	894(49.09)	1607(25.85)
rural	3454(80.55)	236(44.36)	3690(76.56)	3683(83.78)	927(50.91)	4610(74.15)
Province						
Kigali City	707(16.49)	191(35.9)	898(18.63)	431(9.8)	451(24.77)	882(14.19)
South	1113(25.96)	39(7.33)	1152(23.9)	1353(30.78)	294(16.14)	1647(26.49)
West	652(15.21)	153(28.76)	805(16.7)	840(19.11)	513(28.17)	1353(21.76)
North	1066(24.86)	93(17.48)	1159(24.05)	756(17.2)	169(9.28)	925(14.88)
East	750(17.49)	56(10.53)	806(16.72)	1016(23.11)	394(21.64)	1410(22.68)
Highest educational level						
No education	771(17.98)	48(9.02)	819(16.99)	592(13.47)	67(3.68)	659(10.6)
Primary	3081(71.85)	276(51.88)	3357(69.65)	3178(72.29)	793(43.55)	3971(63.87)
Secondary	402(9.38)	164(30.83)	566(11.74)	555(12.63)	727(39.92)	1282(20.62)
Higher	34(0.79)	44(8.27)	78(1.62)	71(1.62)	234(12.85)	305(4.91)
Wealth index						
Poorest	799(18.63)	27(5.08)	826(17.14)	790(17.97)	108(5.93)	898(14.44)
Poorer	786(18.33)	33(6.2)	819(16.99)	896(20.38)	173(9.5)	1069(17.19)
Middle	876(20.43)	51(9.59)	927(19.23)	932(21.2)	247(13.56)	1179(18.96)
Richer	921(21.48)	91(17.11)	1012(21)	1025(23.32)	333(18.29)	1358(21.84)
Richest	906(21.13)	330(62.03)	1236(25.64)	753(17.13)	960(52.72)	1713(27.55)

Religion						
Christian	4151(96.81)	436(81.95)	4587(95.17)	4256(96.93)	1609(88.36)	5865(94.41)
Muslim	26(0.61)	86(16.17)	112(2.32)	27(0.61)	172(9.45)	199(3.2)
Others/no religion	111(2.59)	10(1.88)	121(2.51)	108(2.46)	40(2.2)	148(2.38)
Total	4288(100)	532(100)	4820(100)	4396(100)	1821(100)	6217(100)

Table 2: Prevalence of risky sexual behaviours among men 15-59 years by circumcision status in 2005 and 2014/15, Rwanda.

Risky sexual behaviours	RDHS 2005			RDHS 2014/15		
	Uncircumcised Frequency(%)	Circumcised Frequency(%)	Total Frequency(%)	Uncircumcised Frequency(%)	Circumcised Frequency(%)	Total Frequency(%)
Ever paid for sex						
No	2862(95.1)	362(86.8)	3224(94.1)	2676(93.5)	893(88.5)	3569(92.2)
Yes	147(4.89)	55(13.2)	202(5.9)	186(6.5)	116(11.5)	302(7.8)
Total lifetime number of sex partners >3						
No	2437(80.3)	267(62.4)	2704(78.1)	2855(86.0)	1001(76.6)	3856(83.3)
Yes	598(19.7)	161(37.6)	759(21.9)	465(14.0)	306(23.4)	771(16.7)
Extramarital sex						
No	3946(92.1)	446(83.8)	4392(91.2)	4022(91.6)	1500(82.4)	5522(88.9)
Yes	339(7.91)	86(16.2)	425(8.8)	370(8.4)	320(17.6)	690(11.1)
Condom used at each paid sex						
No	6(40)	1(12.5)	7(30.4)	7(24.1)	6(35.3)	13(28.3)
Yes	9(60)	7(87.5)	16(69.6)	22(75.9)	11(64.7)	33(71.7)
Most recent sex partner was casual/commercial						
No	2317(94.8)	297(91.4)	2614(94.4)	2829[98.6]	986[97.4]	3815[98.3]
Yes	127(5.2)	28(8.6)	155(5.6)	39[1.36]	26[2.6]	65[1.7]
Age at first sex <15						
No	2520(58.8)	346(65.0)	2866(59.5)	2913(66.3)	1123(61.7)	4036(65.0)
Yes	1768(41.2)	186(35.0)	1954(40.5)	1481(33.7)	697(38.3)	2178(35.0)
Total	4288(100)	532(100)	4820(100)	4396(100)	1821(100)	6217(100)

NB: Ever paid sex was considered comparable since 2005 data didn't have paid sex in last 12 months.

Table 3: Unadjusted and adjusted associations of risky sexual behaviour and circumcision status of men aged 15-59 years in 2005 and 2014/15, Rwanda.

Risky sexual behaviours	Unadjusted or (95% CI)		Adjusted or (95% CI)	
	RDHS 2005	RDHS 2014/15	RDHS 2005	RDHS 2014/15
Ever paid for sex				
Uncircumcised	1.0	1.0	1.0	1.0
Circumcised	2.96**(2.13-4.11)	1.87**(1.46-2.39)	1.92**(1.32-2.79)	1.43*(1.07-1.91)
Number of Men	3426	3871	3424	3864
Total lifetime number of sex partners >3				
Uncircumcised	1.0	1.0	1.0	1.0
Circumcised	2.46**(1.98-3.05)	1.88**(1.60-2.21)	1.96**(1.53-2.52)	1.39**(1.13-1.72)
Number of men	3463	4627	3450	4622
Had extramarital sex				
Uncircumcised	1.0	1.0	1.0	1.0
Circumcised	2.24**(1.74-2.90)	2.32**(1.97-2.72)	1.48*(1.10-2.00)	1.32**(1.08-1.61)
Number of men	4817	6212	4807	6202
Most recent sex partner was casual/commercial				
Uncircumcised	1.0	1.0	1.0	1.0
Circumcised	1.72*(1.12-2.64)	1.91*(1.16-3.16)	1.42(0.83-2.42)	1.62(0.94-2.78)
Number of men	2769	3880		
Age at first sex <15				
Uncircumcised	1.0	1.0	1.0	1.0
Circumcised	0.77**(0.63-0.92)	1.22**(1.09,1.37)	0.89 (0.65-1.19)	0.63**(0.51-0.76)
Number of men	4820	6214	4789	6209
Condom used at each paid sex				
Uncircumcised	1.0	1.0		
Circumcised	4.67(0.45-48.26)	0.58(0.16-2.16)		
Number of men	23	46		

Note: *p<0.05, **p<0.01, ***p<0.001.

Table 4: Unadjusted and adjusted odd ratios of risky sexual behaviours among all men, aged 15-59 years between 2005 and 2014/15, with combined data, Rwanda.

Risky sexual behaviours	Unadjusted or (95% CI)	Adjusted or (95% CI)	Number of men (N)
Ever paid for sex			
2005	1.0	1.0	
2014/15	1.35**(1.12,1.62)	1.29*(1.03,1.61)	7296
Total lifetime number of sex partners >3			
2005	1.0	1.0	
2014/15	0.71*** (0.64,0.80)	0.46*** (0.38,0.55)	8074
Had Extramarital sex partners in past 12months			
2005	1.0	1.0	
2014/15	1.29*** (1.14,1.47)	0.79** (0.67,0.94)	11009
Most recent sex partner was casual/commercial			
2005	1.0	1.0	
2014/15	0.29*** (0.21,0.39)	0.15*** [0.10,0.23]	6641
Age at first sex <15			
2005	1.0	1.0	
2014/15	0.79*** (0.73,0.86)	1.16 (0.98,1.39)	11025
Condom used at each paid sex			
2005	1.0		
2014/15	1.11 (0.37,3.32)		69

Note: *p<0.05, **p<0.01, ***p<0.001.

and uncircumcised men in both years (Table 4).

Using the combined dataset to compare the RSBs between surveys, Table 4 shows that in all men, circumcised or not, total number of sex partners greater than 3, having extramarital sex in the previous 12 months and having a most recent sex partner who is commercial was less likely in 2014/15 compared to 2005, after adjusting for demographic characteristics and circumcision status. Men were more than 50% less likely (AOR 0.46, 95%CI 0.38-0.55) to have more than three lifetime number of sex partners in 2014/15 compared to 2005. Respectively, the probability to engage in extramarital sex or have a most recent sex partner being casual/commercial in 2014/15 were 21% (AOR 0.79, 95%CI 0.67-0.94) and 85% (AOR 0.15, 95%CI 0.10-0.23) less likely than in 2005. However, having ever paid for sex was more likely (AOR 1.29, (1.03-1.61)) in all men in 2014/15 than in 2005. Again the difference in likelihood of condom use every time the men paid for sex could not be detected both survey years due to too few subject responses.

Other contributing factors associated with risky sexual behaviours of men

All demographic characteristics and other health factors influenced risky sexual behaviours either positively or negatively and there wasn't much difference in the group of factors that influenced specific risky behaviours between 2005 and 2015.

Age, marital status, cigarette smoking and having ever been tested for HIV were the four factors that were associated with all risky sexual behaviours of men in at least one survey. Age affected all the behaviours in the same way; increasing age increased the behaviours every time except first sex where ages 15-24 were those more at risk. Marital status was not associated with paid sex in 2005. Being married was generally protective of risky behaviours while being divorced

or widowed posed significantly higher risks for having more than 3 lifetime partners in 2005 (AOR 1.7 (1.04,2.68) and in 2014/15 AOR 1.8 (1.17,2.84)) and having extramarital sex (AOR 2.2 (1.33,3.59) in 2005). Smoking Cigarettes doubled all RSBs except first sex below 15 and it was not associated with having more than 3 lifetime sex partners in 2015. Interestingly, having ever tested for HIV was instead positively associated with all risky sexual behaviours, except in early sexual debut where it was 50% protective in both surveys.

While living in Kigali posed the highest risk of ever paid sex and more lifetime partners in 2014/15, it was protective of early commencement of sexual intercourse. Living out of Kigali was the only factor that positively influenced first sex below age fifteen in both surveys. The risks almost doubled compared to Kigali (West (AOR 1.8 (1.36, 2.51) in 2005; 1.9 (1.42, 2.57) in 2014/15), North (AOR 1.4 (1.07, 1.93) in 2005; 1.8 (1.29, 2.45) in 2014/15), South (AOR 1.5 (1.13, 1.97) in 2005; 1.7 (1.31, 2.29) in 2014/15).

Increasing education also significantly increased the probability to pay for sex and have more partners but was protective of engaging in early sex. Being in the richest wealth index doubled the risk of extramarital sex (AOR 1.9 (1.38, 2.65)) in 2014/15 compared to being in the poorest index.

Also religion contributed to extramarital sex and having more lifetime sex partners in 2014/15; being Muslim was 60% more likely to contribute to these behaviours. Lastly, having any kind of occupation was protective of early sexual debut but generally provoked more partners and extramarital sex with the army being the highest (Table 5).

- RDHS2005 had no occupation categories of Household and Domestic Services while RDHS 2014/15 had no category for Army.

Table 5: Logistic regression models showing other variables significantly associated with risky sexual behaviours of men in 2005 and 2014/15, Rwanda.

Characteristics	Risky sexual behaviours							
	Ever paid for sex		Lifetime sex partners >3		Had extramarital sex		First sex <16 years	
	DHS 2005	DHS 2014/15	DHS 2005	DHS 2014/15	DHS 2005	DHS 2014/15	DHS 2005	DHS 2014/15
Circumcision status								
Uncircumcised	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Circumcised	1.92***	1.43*	1.96***	1.39**	1.48*	1.32**	0.9	0.63***
Age								
15-24	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
25-34	1.4	1.5	2.0***	1.7***	1.8***	1.98***	0.3***	0.3***
35-44	2.5***	2.1**	4.1***	2.3***	2.2***	1.4	0.4***	0.2***
45-59	2.3**	3.1***	5.2***	4.5***	1.7*	1.3	0.3***	0.3***
Marital status								
Never married		1.0	1.0	1.0	1.0	1.0	1.0	1.0
Married/living with Partner		0.39***	0.8	0.7**	0.2***	0.1***	0.05***	0.05***
Widowed/divorced		1.6	1.6*	1.8**	2.2**	1.5	0.08***	0.05***
Residence								
Urban	1.0			1.0	1.0			
Rural	0.6**			0.6***	0.7*			
Province								
Kigali City		1.0		1.0			1.0	1.0
South		0.46***		0.7*			1.5**	1.7***
West		0.57**		1.1			1.8***	1.9***
North		0.39***		0.8			1.4*	1.8***
East		0.56**		0.9			1.2	1.4*
Highest educational level								
No Education	1.0	1.0		1.0				1.0
Primary	1.4	3.26**		1.6***				0.7
Secondary	1.8*	3.63***		1.8**				0.8
Higher	2.5*	2.87**		2.1**				0.5*
Wealth index								
Poorest			1.0		1.0	1.0	1.0	1.0
Poorer			1.3		0.8	1.1	1.3	0.7
Middle			1.2		0.8	1.1	1.5*	0.8
Richer			1.1		0.7*	1.1	1.0	0.7*
Richest			1.6**		0.9	1.9***	1.0	0.6**
Religion								
Christian				1.0		1.0		
Muslim				1.6*		1.6*		
Others/No religion				1.7*		0.8		
Smokes cigarettes								
No	1.0	1.0	1.0		1.0	1.0	1.0	1.0
Yes	2.1***	1.70**	1.9***		2.0***	1.99***	0.7**	0.7*
Ever tested for HIV								
No	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Yes	1.4*	0.52**	1.4***	1.8***	1.8***	1.7***	0.50***	0.53***
Occupation								
Not working			1.0	1.0	1.0	1.0	1.0	1.0
Professional/technical			1.2	1.7	1.6	2.8***	0.7	0.48**

Clerical	1.8	2.1	2.2	0.8	1.0	0.17*		
Sales	1.8**	1.3	3.5***	3.2***	0.3***	0.26***		
Agriculture-self-employed	1.2	1.4	2.3***	2.2***	0.8*	0.40***		
Agriculture-employee	1.0	1.0	33.9*	1.99***	12.4	0.49***		
Household and domestic	-	1.6	-	1.7*	-	0.49**		
Services	-	2.2**	-	3.6***	-	0.24***		
Skilled manual	1.4*	2.0**	2.3***	3.3***	0.3***	0.34***		
Unskilled manual	1.7	1.5	1.8**	2.2***	0.7*	0.37***		
Army	9.5***	-	5.8**	-	0.4	-		
N	3424	3864	3450	4622	4807	6202	4789	6209

Note: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

- The shaded areas represent factors that were not part of the models for the specific risky sexual behaviours.

DISCUSSION

Increases in risky sexual behaviours as a result of decrease in perceived risk in men who are circumcised have been one of the public health concerns since the rapid uptake of male circumcision as an HIV prevention intervention [4,12,24,25]. The research design for the investigation of risk compensation shifted from randomized controlled trials due to possible influences of the strict routine HIV counseling sessions, undergone by trial participants, on the research results. Results from real world settings have since been sought to show whether risk compensation can occur in men who undergo circumcision under less strict HIV prevention counseling conditions [13,20] and a longer time-span for observation of sexual behavioral changes following circumcision [11].

This study analyzed two nationally representative surveys of Rwandan men aged 15-59 years over a ten-year time-span, to compare men's sexual risk behaviours before and after the national scale up of the VMMC programme in 2008. The hypothesis was that if risk compensation had occurred in Rwanda, the prevalence of risky sexual behaviours among men who reported being circumcised in 2014/15 would be significantly higher than those of 2005 and there may be no change among the uncircumcised. Thus the prevalence-ratios of RSBs between the circumcised and uncircumcised men will be higher in 2014/15 than in 2005.

Firstly, the prevalence of most of the risky sexual behaviours studied decreased over time among all men, showing a general shift towards safer behaviours. This decrease was observed in total lifetime number of sex partners, non-condom use, most recent sex with a casual/commercial partner and first sex below age 15. The only risky behaviour with a general increase was in ever paid sex largely driven by an increase among uncircumcised men. Non-condom use drastically increased (23% increase) among circumcised men in 2014/15. Extramarital sex was more or less stable although higher for the circumcised between surveys. The circumcised men generally had a higher prevalence than the uncircumcised for most of the behaviours in both surveys.

Similar findings of general shifts towards safer behaviours were obtained in Uganda [26] for multiple partnerships, and extramarital sex and in Kenya [20] for paid sex, most recent sex with casual partner, more than 2 partners and non-condom use for both groups over a 2-year timespan.

The increase in non-condom use among circumcised men has been one of the greatest public health and community concerns of promoting increasing uptake of MC/VMMC program [16,27-29]. Our study found the prevalence of non-condom use at every paid sex to have tripled from 2005-2014/15 whereas that of the uncircumcised decreased by more than a half. These findings differ with the Kenyan longitudinal study where condom use was reported to increase among the circumcised over time [20]. Other prospective studies however did not find any significant difference in condom use among men who had been circumcised compared to their partners who chose not to be circumcised in Uganda [2,13,14], Kenya [11,20] and Zimbabwe [21]. However the recent Ugandan comparative analysis of men's data before and after VMMC showed a significant 13% increase in prevalence of this risky behaviour [26].

Moreover, our study found circumcision status to be significantly associated with all risky sexual behaviours in both surveys except condom use that had the least number of observations. Circumcision status was positively associated with paying for sex, having more lifetime partners and extramarital sex, while being protective of sexual intercourse before age fifteen after controlling for demographic and other factors. The strength of the associations significantly reduced from 2005 to 2014/15 rejecting the hypothesis of significant increase in risky sexual behaviours among the circumcised and thus no behavioral disinhibition.

Similar results were obtained in Uganda where sex with non-marital partners, multiple sexual partners and condom use were all significantly associated with circumcision status in the survey before and after the safe circumcision program. The strength of the associations also decreased with time [26]. Longitudinal studies in Kenya also found decrease in risk behaviours over time in both groups [20] and among the circumcised arm of the cohort [11].

Chikutsa, et al. [21] however found no association between risky sexual behaviours and circumcision status in Zimbabwe after about two years of circumcision programme implementation. Gray, et al. [2] also found no difference in a post-trial follow up study in Uganda suggesting that longer time-spans are needed to observe behavioural changes.

Our findings showed that increasing age, education and wealth increased the probability of engaging in more than 3 lifetime partners, paying for sex or having extramarital partners. Having extramarital partners however declined from age 35-39. Being Muslim positively affected having more lifetime partners and extramarital sex. Also, apart from province that positively influenced having first sex below 15 years, all other demographic and health factors were protective of

this behaviour; all provinces out of Kigali had almost a double risk of having first sex below age 15 than Kigali.

Similar results have ensued from Malawi [30], where secondary education, age, Muslim religion, and work-related migration influence number of partners and condom use positively while those with more household wealth were less likely to pay for sex. Being of younger age, having primary education and above and being unmarried was also found to predict risky sexual behaviour among adolescents in Tanzania [31]. To also support our finding of no difference in the way age affected first sex below age fifteen in both surveys, an analysis of sexual behaviour data from 59 countries by WHO [32], did not show any universal trends towards earlier sexual intercourse.

In our study, having tested for HIV interestingly increased the risk of risky sexual behaviours except early sexual debut. A qualitative study in Tanzania [33] however found no evidence that adolescent sexual behaviour was affected by HIV/AIDS awareness. On the contrary, a quantitative study [34], found an increase in risky behaviours following an HIV test in East Africa.

That cigarette smoking increased all risky behaviours except starting sex early can be understood as the younger age groups with the most probability of starting sex earlier are restrained by law in Rwanda not to smoke [34-36].

CONCLUSION

The study showed that the prevalence of risky sexual behaviour among circumcised men did not significantly increase 7-8 years after the VMMC programme program implementation in Rwanda. On the contrary, there was a general decrease in probabilities to engage in these behaviours among the circumcised and the uncircumcised. Other demographic and health factors played significant roles in the outcome of each man's sexual behaviour, other than his circumcision status. We conclude by saying that this study found no risk compensation in the HIV high-risk behaviours of paying for sex, increased lifetime number of sex partners, extramarital sex and having casual partners among men in the era of increasing uptake of male circumcision in Rwanda. However, more subjects on condom use are needed to determine a true relationship between condom use and circumcision. Also investigation of sexual debut in young people out of Kigali are needed to ascertain their compromise by the male circumcision program for HIV prevention.

VMMC packages should intensify counselling on safer sex, particularly regarding correct and consistent use of male and/or female condoms especially at higher risk sex and for men who are circumcised. Also, to intensify HIV counseling to the adolescents and younger adults, 15-24, undergoing circumcision especially in the provinces out of Kigali and in the lower wealth index to know that circumcision does not provide them full protection against HIV/STIs.

DECLARATIONS

Ethics approval and consent to participate

During the primary data collection, ethics approval was granted by the National Ethics Committee of Rwanda and during data collection, consent was sought to participate in the survey. Special consent was gotten from the parents or guardians of children 0-59 years and for testing anemia and HIV. Personal information was not linked to HIV test samples. Further details can be found in the original RDHS 2005 and 2014/15 reports.

In the current analysis, the files containing the personal information

of study participants were not requested from DHS Program when applying for the dataset. They remained secured with the DHS Program so that confidentiality and privacy of personal information was maintained. More so, the results have been presented as aggregated data and not as personal information.

CONSENT FOR PUBLICATION

Not applicable

AVAILABILITY OF DATA AND MATERIALS

The datasets analyzed during the current study are available in the DHS Program repository, [<https://dhsprogram.com/data/new-user-registration.cfm>]

COMPETING INTERESTS

The authors declare that they have no competing interests.

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AUTHOR'S CONTRIBUTIONS

CPN conceived and designed the study, applied for and extracted the data, conducted analysis and interpretation of data and drafted the manuscript. JN assisted the study design, data interpretation, critically reviewed the manuscript. All authors read and approved the final manuscript.

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