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Changes in Male Circumcision Prevalence and Risk Compensation in the Kisumu, Kenya Population 2008–2013

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Abstract

Background—Three randomized controlled trials (RCT) showed that voluntary medical male circumcision (VMMC) reduces the risk of female to male HIV transmission by approximately 60%. However, data from communities where VMMC programs have been implemented are needed to assess changes in circumcision prevalence and whether men and women compensate for perceived reductions in risk by increasing their HIV risk behaviors.

Methods—Scale-up of free VMMC began in Kisumu, Kenya in 2008. Between 2009 and 2013 a sequence of three unlinked cross-sectional surveys was conducted. All individuals 15–49 years of age residing in randomly selected households were interviewed and offered HIV testing. MC status was confirmed by examination. Design adjusted bivariate comparisons and multivariable analyses were used for statistical inference.

Results—The prevalence of male circumcision increased from 32% (95% CI: 26–38%) in 2009 to 60% (95% CI: 56–63%) in 2013. The aPR of HIV and genital ulcer disease (GUD) in circumcised compared to uncircumcised men was 0.48 (95% CI: 0.36–0.66) and 0.51 (95% CI: 0.37–0.69), respectively. There was no association between circumcision status and sexual behaviors, HIV knowledge, or indicators of risk perception.

Conclusion—The conditions necessary for the VMMC program to have a significant public health impact are present in Kisumu, Kenya. Between 2009 and 2013, circumcision prevalence increased from 30% to 60%; HIV prevalence in circumcised men was half that of uncircumcised men, and there was no or minimal sexual risk compensation.

Keywords

Circumcision; Male; HIV Infections; Kenya; Sexual Behavior; Health Surveys; Risk Compensation

Introduction

Three randomized controlled trials (RCTs) showed that voluntary medical male circumcision (VMMC) reduces the risk of female-to-male HIV transmission by approximately 60%.¹⁻³ The results of these trials and of numerous observational studies provided the evidence for international normative agencies to endorse VMMC as an important component of a comprehensive program to reduce incidence of HIV in high prevalence regions where most infections are transmitted heterosexually.⁴ Since then, post-trial follow-up studies of participants in the Kenya and Uganda trials have demonstrated that the protective effect of VMMC is sustained and possibly strengthened during five years or more, and modeling of findings from Orange Farm, South Africa, indicate that, three years after scale-up of a VMMC program, HIV prevalence among males in the community would have been 19% higher had there been no VMMC program.⁵⁻⁷ Despite these findings, doubts remain whether implementation of a VMMC program will have a significant impact on the HIV epidemic outside of a clinical trial setting. There is concern that risk compensation (also referred to as behavioral disinhibition) will occur at levels sufficient to mitigate the biological protection conferred by VMMC.⁸⁻¹⁰ This is despite no or minimal evidence of risk compensation occurring in participants of the three RCTs,¹⁻³ in the post-trial follow-up studies,⁵⁻⁷ or in a longitudinal study designed specifically to compare sexual practices in circumcised and uncircumcised men in a programmatic setting.¹¹

In addition to risk compensation, concerns about the possibility that large-scale VMMC programs will not successfully reduce HIV prevalence at a population level are based on demographic health survey (DHS) data that show inconsistent associations between circumcision status and HIV prevalence in several countries.^{12,13} Such results may be explained by uncontrolled confounding, wide scale misclassification of circumcision status, and the problem of temporality (i.e., men getting circumcised after they are HIV infected).^{14,15} Therefore, quality monitoring and evaluation from communities where VMMC programs have been widely implemented are needed. Such an evaluation will also address question of whether sufficient numbers of men will accept a surgical procedure that may entail pain and time away from work, a six week period of sexual abstinence, and disruption of normal activities.¹⁶⁻¹⁸ Certainly, uptake of VMMC in some regions has lagged behind expectations, raising concern that the promise of VMMC as an effective HIV prevention program is limited.¹⁹

To evaluate whether a community-based scale-up of VMMC is to be successful, it will be necessary to demonstrate that at least three conditions prevail: that men and women do not increase their sexual risk behaviors from before the program is scaled up to after it achieves a significant proportion of men being circumcised; that circumcision is acceptable and significant numbers of men get circumcised; and that circumcision reduces the odds of HIV acquisition in such a community setting. Between 2008 and 2013, we conducted three random household surveys to assess VMMC uptake, changes in sexual risk behaviors and the association between VMMC and HIV infection in Kisumu, Kenya.

Methods

Study setting and design

Kenya's VMMC program began offering free medical circumcision services in November of 2008 with a gradual scale-up through 2009 as government strategies evolved.²⁰ Through 2013 the program had circumcised over 730,000 men, the majority within Nyanza province, and had reached over 85% of the goal of reaching 94% circumcision coverage nationwide.¹⁹

The Circumcision Impact Study (CIRCIS) was designed as a sequence of unlinked cross-sectional surveys designed to describe middle- and low-income Kisumu residents throughout maturation of Kenya's VMMC program. Kisumu municipality, Kenya's third largest urban area and an administrative capital and economic hub of Nyanza province,²¹ includes the urban center of Kisumu City, several large densely populated peri-urban settlements, and surrounding rural environs. Kisumu served as the site for one of the three RCTs of VMMC for HIV prevention,² and is a center for a large number of HIV research initiatives.

Survey methods and eligibility

Our 2013 survey was carried out between January and July and used the same methodology as the 2008–2009 baseline and 2011 survey, described previously.²² Briefly, 40 study clusters were randomly selected within the low- to middle-income areas of Kisumu municipality from pre-established non-overlapping areas comprising 50 to 150 households with selection probability proportional to the estimated underlying population as provided by the Kenya National Bureau of Statistics.²³ All households present in a cluster were identified and a simple random sample of approximately 38 households per cluster was selected. All households were considered for selection. At least three visits were made if no one was at home but no replacements were selected for absences or refusals.

All men and women aged 15 to 49 years sleeping in the house the night before the first study visit were eligible. Those who were contacted and agreed to participate were interviewed in the home or other private location, and a certified counselor completed rapid HIV testing. Participants consented to each activity separately and interviewers were sex matched to the participant.

The survey sample size was calculated for 80% power to obtain estimates with an acceptable level of precision (4% to 5% margin of error) with a confidence level of 95% and a response distribution of 50%. We assumed a design effect of 3.5, an average of 2 eligible residents per household, and a 70% participation rate.

HIV Testing

The HIV testing algorithm used adhered to the serial testing algorithm guidance by the Kenya National AIDS and STI Control Program (NASCOP) using test kits approved by the Kenya Ministry of Health (MoH).²⁴ Whole blood sample collected by finger prick was first tested using Determine (Abbott Laboratories, Japan) rapid testing kits. In 2011, samples testing positive were retested with Bioline 3rd generation (Standard Diagnosis, Korea). Negatives were considered negative for HIV infection. Concordant positive results were

considered positive for HIV infection. Discordant results were tested using Unigold rapid test kit (Trinity Biotech Plc, Ireland) with results considered final. Due to a change in Kenya's HIV testing algorithm, the Bionline test kits were not used in 2013. Instead, positive rapid results were confirmed with the Unigold rapid test kit and any discordant results resolved by enzyme-linked immunosorbent assay (ELISA) test performed at the local Kenya Medical Research Institute (KEMRI) laboratory. All participants were provided with pre- and posttest counseling according to Kenya national guidelines, and all individuals tested received their results.

Questionnaires

Study instruments were developed in English based on previous research addressing HIV knowledge, attitudes, and behaviors in the same general population^{2,25–28} and translated into the dominant local languages, Dholuo and Kiswahili. Data were collected on demographic, sexual, and other behavioral risk factors, and a basic sexual history including details on all spouses and up to three non-spousal partners within the last 12 months. All interviews and study activities were performed by specially trained research assistants with Kenya national HIV counseling and testing certification.²⁴ Questionnaire data were either entered in the field using a handheld computer and a digital form²⁹ or on paper. Data collected on paper were double entered into the database.

Analytic methods

Unless specified, all analyses incorporate sampling weights. Bivariate comparisons used design-adjusted statistical tests for categorical variables (i.e., Rao-Scott chi-square³⁰) with Wald-type 95% confidence intervals. Multivariable analyses used design-adjusted log-binomial regression techniques to provide aPR estimates.³¹ Estimated population totals are based on sampling weights post-stratified³² to age and gender population totals provided by the 2009 Kenya national census.²¹ All statistical analyses were done using the R statistical language and environment with the “survey package”.^{33,34}

All information, including circumcision status, STI treatment history, and symptoms, was based on self-report. Circumcision status was also assessed by genital exam. Agreement between self-report and visual exam was high: 98% (342/350) in 2009, 99% (1135/1140) in 2011, and 98% (933/949) in 2013. “Sexually active” was defined as reporting any lifetime history of vaginal or anal sex. Marriage/spousal relationships were defined inclusively as legal, religious, cultural, or informal unions in which a man and a woman regard themselves as married. Non-marital regular, casual, and transactional sexual partnerships were self-defined and categorized by the participant.

Ethical approval was obtained from the Kenyatta National Hospital Ethics and Research Committee and the Institutional Review Board of the University of Illinois at Chicago.

Results

For our 2009 baseline survey we randomly selected 1,120 households resulting in the identification of 1,361 eligible women and 1,210 eligible men with 1,087 (80%) women and 675 (56%) men located and agreeing to participate. In 2011, 1,633 households were selected

resulting in the identification of 1,671 eligible women and 1,540 eligible men with 1,540 (92%) women and 1,372 (89%) men participating. Finally, in 2013 we selected 1,513 households identifying 1,598 eligible women and 1,442 eligible men with 1,524 (95%) women and 1,309 (86%) men participating (Table 1).

Between 2009 and 2013, controlling for age, we observed no significant change in the HIV prevalence in male and female residents of Kisumu (Table 2). Over this period, however, the prevalence of several HIV risk factors did change. Educational attainment in female Kisumu residents in 2009 increased from 39% (95% CI: 33–44%) having secondary or higher education to 49% (95% CI: 45–54%) by 2013, a significant increase not seen among males. As the proportion of young women in school increased, age at marriage and age at sexual debut also increased. From 2009 to 2013, the proportion of women that had ever been married decreased significantly from 73% (95% CI: 68–77%) to 68% (95% CI: 64–72%), and the proportion of women reporting sexual debut at 15 years decreased by approximately 18% from 38% (95% CI: 34–43) to 31% (95% CI: 28–35%).

In men, there was a decrease in the proportion reporting two or more sex partners in the previous 12-months, from 23% (95% CI: 19–28%) in 2009 to 17% (95% CI: 14–19%) by 2013. No change was observed in women. Condom use at last sex with non-spousal partner increased significantly from 2009 to 2013 for both men and women, with women reporting a 59% (95% CI: 55–64%) increase and men a 50% (95% CI: 44–61%) increase (Table 2).

From 2009 to 2013, prevalence of MC increased steadily from 32% (95% CI: 26–38%) in 2009 to 49% in 2011 to 60% (95% CI: 56–63%) by 2013. Applying weighted estimates (see Methods), this increase in MC prevalence represents 30,106 (95% CI: 27,353–32,859) circumcisions between 2009 and 2013. The proportion of women reporting circumcised partners also increased significantly from 45% (95% CI: 41–50%) in 2011 to 54% (95% CI: 50–58%) in 2013. Partner circumcision status was not assessed in the 2009 survey. MC prevalence increased across all age groups of men: 88% in men 15–19 years of age, 84% (20–24 years), 82% (25–29 years), and 61% in men 30–49 years of age (Table 3). As MC prevalence increased in the population, signs and symptoms of STI decreased. Compared to 2009 (23%; 95% CI: 20–27%), fewer sexually active men reported a history of STI treatment in both the 2011 and 2013 (20%; 95% CI: 17–22%) surveys. Additionally, fewer sexually active men reported genital ulcer disease (GUD) in the last 12 months (Table 2).

Table 4 shows changes between 2009 and 2013 in sexual behavior, HIV knowledge, and risk perception comparing circumcised and uncircumcised men. Between 2009 and 2013, adjusted for survey period and age, circumcised men were significantly less likely than uncircumcised men to be HIV positive (aPR = 0.48; 95% CI: 0.36–0.66). They were also less likely to report GUD in the last 12 months (aPR = 0.51; 95% CI: 0.37–0.69). Over this period, there were no differences observed between circumcised and uncircumcised men in sexual behaviors, including number of sexual partners, condom use, and history of non-ulcerative STI, or in knowledge about HIV or indicators of HIV risk perception (Table 4).

In order to assess possible risk compensation in men who were circumcised under the VMMC program, we restricted the 2013 sample to all men who were ever sexually active

and compared those who were uncircumcised to men who reported being circumcised in a clinical setting between 2007–2013. The men circumcised under the VMMC program were much younger than the uncircumcised men (median 22 years versus 29 years) and consequently less likely to be married (35% versus 65%), a difference that is not significant after adjusting for age (Table 5). The age-adjusted prevalence ratio (aPR) comparing the HIV prevalence in men circumcised under VMMC to those remaining uncircumcised (aPR = 0.50; 95% CI: 0.24–1.05; Table 5) was similar to the aPR observed for all circumcised men (aPR = 0.48; 95% CI: 0.36–0.66; Table 5), although not statistically significant ($p=0.08$) due to the smaller sample size. The protective effect of circumcision observed for GUD remained strong and significant in the 2013 sub-sample analysis (aPR = 0.30; 95% CI: 0.15–0.61). Unlike men circumcised outside the VMMC program (Table 4), men circumcised under VMMC were more likely to have two or more partners (aPR=1.43; 95% CI: 1.00–2.02). Otherwise, there were no differences in sexual risk behaviors or beliefs about circumcision and HIV risk that would indicate risk compensation (Table 5).

Discussion

While three RCTs of medical male circumcision have demonstrated the protective effect of male circumcision against HIV incidence, little information is available from communities after VMMC program scale-up. We conducted three randomized household surveys in Kisumu, Kenya over five years to assess uptake of medical male circumcision, whether circumcision is associated with reduced prevalence of HIV, and whether behavioral risk compensation has occurred after years of promotion and uptake of VMMC. Between 2009 and 2013 the prevalence of circumcision among men ages 15–49 years in Kisumu rose from 32% in 2009 to 60% in 2013. This represents approximately 30,000 additional men circumcised over this four year period, indicating that uptake of circumcision was substantial, and that Kisumu was well on its way to achieving the 80% target set for the region by the NASCOP³⁵ and by the World Health Organization (WHO) and the Joint United Nations Programme on HIV/AIDS (UNAIDS) for high HIV prevalence regions of sub-Saharan Africa.³⁶ Regarding the age distribution of circumcision, models indicate that circumcising men who have not started sexual activity leads to the greatest population-level benefit in the long term, whereas circumcising 20 to 34 year-olds has the biggest benefit over the following 10 years.³⁷ The results of our surveys show that the Kisumu VMMC program is achieving a close to optimal age distribution of circumcisions with the greatest increases in prevalence among 15–19 year-olds (from 22% to 68%), 20–24 year-olds (35% to 64%), and 25–30 year-olds (35% to 63%), with lower MC prevalence among 30–49 year-olds (53% in 2013) (Table 3).

Concerns about the possibility that large-scale VMMC programs will not successfully reduce HIV prevalence at a population level are based on national cross-sectional DHS data that show inconsistent associations between circumcision status and HIV prevalence in several countries,^{12,13} although not in Kenya.³⁸ The results of our cross-sectional surveys in Kisumu found that the association of circumcision with lower HIV prevalence is intact and similar to the protective effect shown by the three RCTs. In the Kisumu population the adjusted prevalence ratio (aPR) of circumcision and HIV was 0.48 (95% CI 0.36–0.66) with just 4% HIV prevalence in circumcised men compared to 12% in uncircumcised men in

2013. Restricting analyses to men circumcised only since the scale up of VMMC, the HIV prevalence is just 3% compared to 12% in uncircumcised men (aPR=0.50; 95% CI 0.24–1.05). Similarly, prevalence of GUD is significantly less in the clinically circumcised versus uncircumcised men (aPR=0.30; 95% CI 0.15, 0.61).

Risk compensation or sexual disinhibition after VMMC could mitigate or even negate the protective effect of VMMC in reducing HIV infection if men and women increase risk in response to perceiving themselves at less risk of infection due to increases in the proportion of men circumcised in the community.⁸ We found no evidence of risk compensation occurring among men and women in Kisumu during the five years of our surveys. To the contrary, we found that men and women reduced their sexual risk behaviors. The proportion of men having sex with two or more partners declined significantly as did the proportion reporting a history of STI treatment, and condom use with last non-spousal sex partner increased significantly among both men and women. The only indication of possible risk compensation was among men who had been circumcised in a clinic since VMMC scale-up: a greater proportion (17% versus 14%) reported two or more sex partners in the last year — a difference that is statistically significant, but unlikely to have a significant impact on the protective effect of circumcision against HIV infection as indicated by the aPR of HIV of 0.50 among these circumcised men.

Our results showing no or minimal risk compensation are consistent with previous findings. Large cohort studies using data from RCT participants in Kenya,^{39,40} data from initial VMMC program implementation in Kenya,¹¹ and RCT follow-up data from Uganda^{6,41} suggest that risk compensation after VMMC is absent or negligible, and is not likely to undermine the impact of circumcision on HIV prevention. In the Orange Farm, South Africa, RCT there was a significant increase in the number of sexual contacts in the VMMC group,³ but the protective effect of VMMC was unchanged after adjusting for differences in sexual behavior. In Kenya, Agot et al., found no increases in risky sexual behavior in VMMC or control subjects at the end of a one-year cohort study. A one-year follow-up study of over 1,300 RCT participants in Kenya by Mattson et al., also found no evidence of risk compensation after VMMC. Risk behaviors decreased over time in both the circumcision and control groups, and no differences in the incidence of gonorrhea, chlamydia, or trichomoniasis were found between the two groups. The most comprehensive study of risk compensation in a non-trial, VMMC scale-up setting was conducted by Westercamp et al.. Despite significant increases in sexual activity in the youngest age group and decreases in HIV risk perception in the circumcision group, no evidence was found for risk compensation after VMMC: all risk behaviors decreased over time in both groups. Notably, condom use increased significantly in both groups, with much larger increases in the VMMC group.¹¹ Studies in Uganda by Kong et al. and Gray et al. in post-trial follow-up of participants in Rakai also found no evidence of risk compensation.^{6,41}

Limitations

We evaluated cross-sectional, representative population data sampled serially over time. This is not equivalent to longitudinal trajectories of individuals, but is appropriate for answering our broader question of how a population exposed to a VMMC program has changed over

time. The possibility of reporting bias due to reliance on self-reported information was minimized through the use of questionnaires developed specifically for this population, extensive training of study staff, and visual confirmation of circumcision status. In 2009, our inability to locate selected individuals and overlap with other community HIV testing initiatives impacted participation. Post-stratification weighting based on well-established population parameters was used to help adjust for suboptimal participation; however, selection bias may have been introduced if specific groups were systematically excluded. The use of cellular phones to contact participants and coordination with community HIV testing programs improved participation in subsequent rounds.

Mathematical modeling of other data by Nagelkerke et al. suggests that our 5-year post-trial surveillance period is likely not sufficient to observe population-level reduction in HIV prevalence attributable to a VMMC program⁴². Therefore, some proportion of the decreased HIV prevalence among circumcised men observed may be due to self-selection of HIV-negative or lower-risk men for the procedure. Additional study at further time points and the inclusion of HIV recent infection assays or refined mathematical modeling incorporating our findings would be helpful in directly attributing population changes in HIV incidence to VMMC initiatives.

Conclusions

The conditions necessary for the VMMC program in Kisumu, Kenya, to have a significant public health impact over the next 10–20 years were present in 2013. Between 2009 and 2013, circumcision prevalence increased from 30% to 60%; the adjusted HIV prevalence in circumcised men was half that of uncircumcised men; and no sexual risk compensation was exhibited. Based on these results and considering that Kenya's successful VMMC program has been sustained,⁴³ we should expect significant declines in HIV prevalence to be demonstrable in this population within the next few years.

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Table 1

Sample profile by post-trial surveillance period — 2009, 2011, and 2013: Kisumu, Kenya

	2009		2011		2013	
	Households sampled With eligible members					
	Women	Men	Women	Men	Women	Men
	1,120 1,033 (92%)		1,633 1,558 (95%)		1,513 1,462 (97%)	
Eligible individuals	1,361	1,210	1,671	1,540	1,598	1,442
Located individuals (%) *	1,141 (84)	733(61)	1,648 (99)	1,523 (99)	1,578 (99)	1,419 (98)
Refused interview (%) **	53 (5)	55 (8)	101 (6)	142 (9)	48 (3)	109 (8)
Removed for data quality	1	3	7	9	6	1
Final sample size (%) **	1,087 (95)	675 (92)	1,540 (93)	1,372 (90)	1,524 (97)	1,309 (92)

* Percent of eligible individuals

** Percent of located individuals

Prevalence of HIV, selected HIV risk factors, and socio-demographic characteristics by post-trial surveillance period — 2009, 2011 and 2013: Kisumu, Kenya

Table 2

	Female			Male		
	2009 N (%)#	2011 N (%)#	2013 N (%)#	2009 N (%)#	2011 N (%)#	2013 N (%)#
Total (age 15–49 years)	1,087 (100)	1,540 (100)	1,524 (100)	675 (100)	1,372 (100)	1,309 (100)
Age: Median (IQR)	24 (20–31)	24 (20–31)	26 (21–33) **, †	24 (20–31)	26 (21–33) *	27 (22–34) **, †
HIV Prevalence						
HIV negative	330 (87.6)	1,078 (87.1)	1,024 (84.9)	267 (90.0)	937 (93.0)	862 (92.8)
HIV positive	50 (12.4)	158 (12.9)	186 (15.1)	31 (10.0)	70 (7.0)	67 (7.2)
Ethnic Group						
Non-Luo	191 (17.9)	317 (20.5)	296 (17.9)	124 (18.9)	265 (19.2)	228 (17.6)
Luo	896 (82.1)	1222 (79.5)	1255 (82.1)	551 (81.1)	1,107 (80.8)	1,081 (82.4)
Education						
Primary or less	678 (61.4)	857 (55.8)	782 (50.9) **	299 (43.5)	541 (39.5)	514 (38.8)
Secondary or greater	408 (38.6)	677 (44.2)	742 (49.1) **	376 (56.5)	829 (60.5)	795 (61.2)
Marriage						
Single	278 (27.0)	423 (27.5)	481 (31.9) **, †	343 (51.8)	549 (39.9) *	565 (43.3) †
Ever married	808 (73.0)	1,116 (72.5)	1,043 (68.1) **, †	331 (48.2)	822 (60.1) *	744 (56.7) †
Sexual partners in last 12 months						
0 partners (ref)	267 (26)	428 (29)	445 (29)	167 (25)	396 (30)	342 (27)
1 partner	758 (70)	1008 (67)	1,000 (66) **	350 (51)	773 (57)	714 (56)
2+ partners	38 (4)	62 (4)	72 (5)	153 (23)	175 (13) *	213 (17) **
Condom use at last sex with non-spousal partner[‡]						
Did not use condom	579 (83.5)	635 (83.6)	522 (73.2) **, †	338 (62.5)	472 (60.6)	337 (42.9) **, †
Used condom	113 (16.5)	125 (16.4)	190 (26.8) **, †	198 (37.5)	307 (39.4)	449 (57.1) **, †
Condom use at last sex with current spouse^{‡‡}						

	Female			Male		
	2009 N (%)#	2011 N (%)#	2013 N (%)#	2009 N (%)#	2011 N (%)#	2013 N (%)#
Did not use condom	574 (84.5)	820 (86.3)	693 (81.3) [†]	273 (88.3)	681 (88.1)	573 (82.6) ^{**†}
Used Condom	103 (15.5)	129 (13.7)	161 (18.7) [†]	35 (11.7)	90 (11.9)	121 (17.4) ^{**†}
Sexual debut[†]						
>15 years	566 (61.6)	835 (62.9)	898 (68.5) ^{**†}	363 (61.8)	764 (65.1)	729 (67.3)
15 years	358 (38.4)	492 (37.1)	419 (31.4) ^{**†}	219 (38.2)	410 (34.9)	357 (32.7)
Circumcision status of self or spouse						
Not circumcised	NA	520 (54.6)	392 (45.9) [†]	460 (68.2)	702 (51.4) [*]	527 (40.1) ^{**†}
Circumcised	NA	430 (45.4)	463 (54.1) [†]	215 (31.8)	669 (48.6) [*]	781 (59.9) ^{**†}
STI treatment history — Ever[§]						
No prev. STI treatment	908 (90.3)	1257 (89.8)	1248 (91.7)	476 (76.8)	979 (79.8) [*]	933 (80.2) ^{**}
Any prev. STI treatment	96 (9.7)	142 (10.2)	114 (8.3)	143 (23.2)	246 (20.2) [*]	234 (19.8) ^{**}
Genital ulcers in last 12-months[§]						
No genital ulcer	943 (94.0)	1,344 (96.1) [*]	1,293 (94.9)	564 (90.8)	1,164 (94.9) [*]	1,093 (93.6)
Any Genital ulcer	57 (6.0)	55 (3.9) [*]	69 (5.1)	56 (9.2)	61 (5.1) [*]	74 (6.4)

Differences between survey years account for survey design and control for age

#N = Non-weighted sample size; %: sample weighted percent

* Findings in 2011 significantly different than 2009 controlling for age (p 0.05)

** Findings in 2013 significantly different than 2009 controlling for age (p 0.05)

[†] Findings in 2013 significantly different than 2011 controlling for age (p 0.05)

[‡] Restricted to participants reporting at least one non-spousal partners

^{‡‡} Restricted to participants currently married

[§] Restricted to sexually active participants

Table 3

Percent of men circumcised by age group over post-trial surveillance periods, Kisumu, Kenya, 2009 – 2013

	2009 % (95% CI)	2011 % (95% CI)	2013 % (95% CI)
All ages	31.8 (25.7–37.8)	48.6 (44.3–52.9)	59.9 (56.4–63.3)
15–19 years	21.9 (14.4–29.3)	52.4 (44.8–59.9)	68.2 (60.8–75.5)
20–24 years	35.2 (27.3–43.1)	58.3 (52.4–64.2)	64.6 (57.4–71.7)
25–29 years	34.8 (24.5–45.0)	46.3 (40.3–52.4)	63.2 (56.2–70.1)
30–49 years	32.7 (25.4–40.0)	42.9 (37.5–48.3)	52.7 (46.9–58.4)

CI = Confidence Interval

Changes in sexual behavior, HIV knowledge, and risk perception over post-trial surveillance periods among circumcised and uncircumcised men, Kisumu, Kenya, 2009 – 2013

Table 4

	Circumcised N = 1,665 [#]			Uncircumcised N = 1,689 [#]			Circumcised vs. Uncircumcised aPR* [95% CI]
	2009 %	2011 %	2013 %	2009 %	2011 %	2013 %	
Ever married	50.5	56.3	51.4	47.1	63.6	64.5	0.88 [0.69–1.12]
HIV Prevalence							
HIV positive	7.5	4.1	4.1	10.9	9.7	11.8	0.48 [0.36–0.66]
Sexual partners in last 12 months							
0 partners (not sexually active)	23.1	32.0	29.4	26.5	27.3	23.3	1.01 [0.94–1.08]
1 partner	50.2	56.0	52.4	52.0	58.8	62.5	0.96 [0.90–1.01]
2+ partners	26.8	12.1	18.1	21.5	14.0	14.2	1.14 [0.98–1.33]
Condom used at last sex with a non-spousal partner[^]	39.6	43.0	57.8	36.5	36.3	56.3	1.13 [0.92–1.38]
Treated for an STI in the last 12 months[^]	4.7	1.8	2.9	4.5	2.2	2.3	1.04 [0.65–1.67]
Treated for an STI ever[^]	20.0	18.5	17.6	24.8	21.7	23.0	0.90 [0.78–1.03]
Genital ulcer in the last 12 months[^]	7.2	3.2	3.9	10.2	6.8	10.0	0.51 [0.37–0.69]
HIV knowledge: Answered correctly							
Condoms reduce risk of HIV	84.8	87.5	96.2	84.7	91.5	96.6	0.99 [0.97–1.00]
HIV infection is for life	82.6	83.3	86.6	81.2	86.4	89.2	0.98 [0.95–1.01]
Agreement with statements reflecting potential for risk compensation: Now that MC is available...							
I am less worried about becoming HIV infected	13.2	10.2	14.2	14.5	10.4	12.5	0.99 [0.82–1.20]
I am more willing to take a chance of getting infected or infecting someone else	6.3	4.2	2.4	7.6	2.6	2.5	1.06 [0.72–1.55]
I am more likely to have sex without a condom	11.6	4.5	3.0	9.2	4.2	3.3	1.13 [0.78–1.64]

Table displays the weighted proportion estimates of factors by survey period

[#] Non-weighted sample size

aPR* = Adjusted Prevalence Ratio: aPR is adjusted for age and surveillance period

CI = Confidence Interval

[^] Restricted to those ever sexually active

Changes in sexual behavior, HIV knowledge, and risk perception among men circumcised since VMMC scale-up and uncircumcised men, Kisumu, Kenya, 2013

Table 5

	<u>Circ. (VMMC), N = 352[#]</u>	<u>Uncircumcised, N = 527[#]</u>	<u>Circ. (VMMC) vs. Uncircumcised</u>
	2013 %	2013 %	aPR* [95% CI]
Age: Median (IQR)	22 (19–28)	29 (23–35)	--
Ever married	35.4	64.5	0.74 [0.49–1.11]
HIV Prevalence			
HIV positive	3.3	11.8	0.50 [0.24–1.05]
Sexual partners in last 12 months			
0 partners (not sexually active)	42.7	23.3	0.97 [0.85–1.10]
1 partner	40.3	62.5	0.86 [0.74–1.01]
2+ partners	17.0	14.2	1.42 [1.00–2.02]
Condom used at last sex with a non-spousal partner*	64.4	56.3	1.30 [0.87–1.94]
Treated for an STI in the last 12 months*	2.4	2.3	1.03 [0.45–2.36]
Treated for an STI ever*	14.4	23.0	0.94 [0.69–1.29]
Genital ulcer in the last 12 months*	2.8	10.0	0.30 [0.15–0.61]
HIV knowledge: Answered correctly			
Condoms reduce risk of HIV	97.3	96.6	1.02 [1.00–1.03]
HIV infection is for life	86.6	89.2	0.99 [0.94–1.05]
Agreement with statements reflecting potential for risk compensation: Now that MC is available...			
I am less worried about HIV infected	14.7	12.5	1.03 [0.67–1.57]
I am more willing to take a chance of getting infected or infecting someone else	1.7	2.5	0.5 [0.18–1.36]
I am more likely to have sex without a condom	3.2	3.3	1.01 [0.53–1.92]

Table displays weighted proportion estimates of factors for the third (2013) survey period

Circ (VMMC): Circumcised after 2007 in medical or clinical settings

aPR* = Adjusted Prevalence Ratio — Adjusted for age and surveillance

[#]Non-weighted sample size

CI = Confidence Interval

* Restricted to those ever sexually active

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