**AIDS**

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**Title:** Self-selection of Male Circumcision Clients and Behaviors following Circumcision in a Service Program in Rakai, Uganda

**Running head:** Self-selection, Behaviors and Circumcision

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**Abstract**

**Objectives: S**ub-Saharan African countries have substantially scaled-up safe male circumcision (SMC) services. However, it is unclear whether services are reaching men most at risk of HIV and whether there is behavioral disinhibition after SMC. We compared characteristics of SMC acceptors and non-acceptors in Rakai, Uganda.

**Design:** Cohort design

**Methods:** Through the Rakai Community Cohort Study, baseline characteristics of 587 non-Muslim men who subsequently accepted SMC were compared to those of 4,907 uncircumcised non-Muslim men. Behaviors after SMC were compared with those of men who remained uncircumcised. Poisson multivariable regression was used to estimate adjusted prevalence rate ratios (aPRR) of behaviors in circumcised versus uncircumcised men.

**Results:** At baseline (pre-SMC), men subsequently circumcised were younger (mean=26.1 years), compared to the uncircumcised (mean=28.5 years, p<0.001), more likely to live in urban areas (21.1% versus 12.4%, p <0.001), less likely to have been currently or previously married (36.5 % versus 45.8%, p<0.001) and more likely to report multiple sexual partners (48.3% versus 41.6%, p=0.05) and genital discharge (7.4% versus 4.4% , p=0.03). At follow up (post-SMC), behaviors and genital discharge did not

differ between the groups. Genital ulcers were less reported among circumcised (6.8%) compared to uncircumcised men (10.5%) (aPRR=0.60, 95% CI=0.42-0.87, p=0.007)

**Conclusion**

In Rakai district, Uganda, the circumcision service program is attracting sexually active men at higher risk of HIV and we find no evidence of behavioral disinhibition following circumcision. The SMC program in this setting has the potential to reduce the HIV epidemic among men.

**Abstract word count=245**

**Key words:** Circumcision, Self-selection, Risk compensation, Rakai, Uganda



## Introduction

Efforts to scale-up safe male circumcision (SMC) for HIV prevention are underway in 14 priority countries in sub-Saharan Africa with a target of circumcising 80% of men aged 15-49 years, and sustaining it until 2025 in order to reduce new HIV infections by 22% [1]. However, the impact of SMC on HIV incidence will depend on whether circumcision is accepted by uncircumcised men at risk of HIV and whether circumcised men engage in higher risk behaviors (risk compensation) following SMC.

Few studies in sub-Saharan Africa have compared the characteristics and changes in sexual risk behaviors among men who accept or decline SMC services. Men who participated in SMC clinical trials in Uganda and Kenya did not show evidence of behavioral risk compensation after circumcision [2-7]. However, a South African trial found a higher number of sexual contacts in the first six months of follow up, which was not sustained with longer follow-up [8]. The trial participants received repeated intensive risk reduction education which would not be feasible in SMC service programs. Thus, risk compensation might be more pronounced among service SMC recipients compared to trial participants, due to less intensive health education and knowledge of the efficacy of SMC for HIV prevention. It is therefore necessary to assess behavioral risk compensation following circumcision in service programs.

Data from the demographic Health Survey in Tanzania indicated that circumcised men were younger, more educated, wealthier, and more likely to use condoms[9], suggesting self-selected circumcised men may be at lower risk of HIV. This cross-sectional study could not assess characteristics prior to SMC or temporal relationships between circumcision and subsequent risk behaviors. There is a need to characterize SMC acceptors and non-acceptors in SMC programs using data on characteristics and behaviors of men before circumcision.

Regarding changes in behavior following circumcision, a cohort study in Kenya among men who self-selected to be circumcised or to remain uncircumcised did not show

differences in behaviors after 12 months follow-up [7]. A cohort study in Kenya showed increased condom use among both SMC acceptors and non-acceptors over 12 months with greater improvements in condom use among the SMC acceptors [10]. However these cohort studies followed men every 3-6 months providing risk reduction counseling to men at each follow-up visit. With such intensity of follow-up, reported behaviors may partly be attributable to repeated risk reduction counselling.

We used data from a cohort in Rakai, Uganda to assess self-selection and risk behaviors among SMC acceptors before and after SMC, compared to characteristics and behaviors of uncircumcised men.

## Methods

### *Study population*

Data for the study were obtained from the Rakai Community Cohort Study (RCCS) conducted in Rakai district, Uganda [11, 12]. Briefly, the RCCS is an open population-based cohort of approximately 15,000 consenting participants aged 15-49 years who were interviewed in surveys conducted every 12-20 months since 1994. Participants provided interview information and blood samples for HIV serology. The data collected included sociodemographic variables, sexual behaviors, and service utilization including SMC. Institutional Review Board (IRB) approvals for RCCS were obtained

from Uganda Virus Research Institute's Science and Ethics Committee, Uganda National Council for Science and Technology and from the Western IRB in the U.S. We used data from three surveys conducted in 2006-2008, 2008-2009 and 2010-2011 when free SMC services were made available to the general population following completion of the circumcision trials. SMC services were offered through a RHSP central surgical facility, satellite clinics at government health centers and mobile circumcision camps in the communities. Services were supported by the President's Emergency Plan for AIDS Relief (PEPFAR) and followed WHO and Ugandan Ministry of Health guidelines [13, 14].

***Variables***

The population assessed were HIV-negative, initially uncircumcised, non-Muslim men. Muslim men were excluded because they are almost universally circumcised at infancy or childhood. Newly circumcised men and men who declined SMC were identified at the 2008-2009 and 2010-2011 surveys and their baseline characteristics prior to SMC were obtained from the 2006-2008 and 2008-2009 surveys, respectively. At baseline surveys circumcision prevalence among HIV-negative, non-Muslim men was about 20%.

We compared SMC acceptor's and non-acceptor's sociodemographic characteristics (age, marital status, education, urban-rural residence) and behaviors (any sexual partners in the past 12 months, number of sexual partners, condom use at last sex in

non-marital relationships, use of alcohol before sex, casual sex with non-regular/non-cohabiting partners, and acquisition of a new sexual partner in the 12 months prior to interview. Information was only collected on heterosexual relationships, and no questions were asked about relations between men. Symptoms of genital ulcer disease and genital discharge were also assessed as a surrogate for sexually transmitted infections.

***Statistical methods***

Among SMC acceptors, characteristics prior to SMC were compared to those of uncircumcised men at the same survey to assess self-selection in adoption of SMC. We then compared behaviors of newly circumcised and uncircumcised men at the follow-up surveys. We compared circumcised to uncircumcised men at the same time points, rather than a before and after comparison among the circumcised men, in order to control for possible secular trends in behaviors over time due to other risk reduction interventions. The median number of months between the baseline and follow-up surveys was 17.6 months (IQR= 15.2-20.6 months). Observations at each survey were the units of analysis. Some men were seen at more than two surveys and contributed multiple observations in the same or different comparison groups, so there was potential for correlation between observations due to clustering within individuals. We used multilevel models to adjust for the clustering. Multivariable modified Poisson regression [15, 16] was used to estimate adjusted prevalence rate ratios (aPRR) and 95

percent confidence intervals (95%CI) of characteristics and behaviors associated with circumcision status at baseline and follow-up. Comparisons of baseline and follow-up behaviors were adjusted for baseline sociodemographic characteristics. Analyses of genital ulceration and genital discharge were additionally adjusted for sexual behaviors including number of sexual partners, casual sex, and acquisition of a new sex partner in the 12 months prior to the survey.

We tested for time period effects by including an interaction term between circumcision status and a period variable to determine whether the association between circumcision status and behaviors was differential by period. The period variable was based on the time of the baseline visit; either before or after 2008. Since circumcisions occurred in the interval between two surveys some men were circumcised less than 12 months prior to the follow-up survey, but the reference period for behaviors was the previous 12 months, and thus could reflect behaviors before SMC. Therefore, we conducted sensitivity analyses to examine the robustness of our results by limiting analyses to men circumcised at least 12 months before the follow-up survey.

We used STATA 13.0 (StataCorp, College Station, TX) for statistical analyses. All tests of statistical significance were 2-sided with $\alpha<0.05$ and 95 percent confidence intervals.

## Results

There were a total of 4,907 observations of HIV-negative, non-Muslim men seen both at the baseline and a follow-up visit. A total of 578 men (11.8%) were circumcised in the intervals between the baseline and follow-up surveys, while 4,329 (88.2%) remained uncircumcised.

***Baseline comparisons of newly circumcised versus uncircumcised men***

Baseline comparisons of circumcised men prior to SMC and men who remained uncircumcised at follow up are shown in Table 1. Men who were subsequently circumcised were younger (mean = 27.8 years (SD=9.4) than uncircumcised men 26.1 years (SD=8.7), p<0.001), more likely to live in urban areas (21.1% versus 14.3%, p <0.001) and more likely to have never been married (45.8 % versus 36.7 %, p <0.001). Among sexually active men, those who later became circumcised were more likely to report multiple sexual partners in the previous 12 months (48.3 %) compared to men who remained uncircumcised (41.6% p=0.05) and were more likely to report genital discharge (7.4 % versus 4.4 %, p=0.03). The two groups did not differ significantly with respect to level of education, condom use at last non-marital sex, casual sex, and acquisition of any new partners in the past 12 months. No period effects were observed in the association between baseline characteristics and circumcision (results not shown).

*Comparisons of post-SMC behaviors to behaviors among uncircumcised men*

Comparisons of post-SMC behaviors and behaviors of uncircumcised at follow up are shown is table 2. There were no statistically significant differences between post-SMC behaviors and those of uncircumcised men at follow up.

Genital ulceration was lower among circumcised men (6.8%) compared to uncircumcised men (10.5%) (aPRR=0.60, 95 % CI=0.42-0.87, p=0.007), but the prevalence of genital discharge did not differ significantly between the groups. No period effects were observed in the associations between baseline characteristics and circumcision. In the sensitivity analysis where we excluded men who were circumcised less than 12 months prior to the post-SMC follow-up survey, results did not differ from those in the main analysis (results not shown).

## Discussion

Men who accepted SMC services in Rakai, Uganda were younger, more likely to live in urban areas, to have never been married, to report multiple sexual partnerships and to report genital discharge before they were circumcised. This suggests that the SMC clients were self-selected with a higher representation of younger men with higher risk profiles who were potentially more vulnerable to HIV. These findings differ from those in a Tanzanian study [9] which found that circumcision programs in Tanzania were attracting lower risk men. However, the Tanzanian study was based on cross-sectional

data and it was difficult to determine whether self-reported behaviors were modified by circumcision-related health education. The present study findings are based on baseline comparisons before men became circumcised or chose to remain uncircumcised, and therefore do not reflect behavioral modifications due to SMC related health education. To the best of our knowledge, no other study in sub-Saharan Africa has compared characteristics and behaviors prior to SMC to those of men who later declined SMC. Our results show no evidence of risk compensation among circumcised men and are consistent with findings from Kenyan programs [7, 10]. Our observation of a lower prevalence of genital ulcers among circumcised men post-SMC, reflects the protective effect of SMC against genital ulceration as reported in earlier studies[3, 17-19]. We also observed attenuation of differentials in self-reported multiple sex partnerships, casual partnerships and genital discharge between circumcised and uncircumcised men at the follow-up visits, relative to the baseline visit. A previous study conducted in this setting did not show a protective effect of circumcision against genital discharge [3]. The reductions in self-reported sexual partners, casual sex and genital discharge between baseline and post-SMC visits may be due to health education provided by the circumcision programs.

## Conclusions

In Rakai district, Uganda, the circumcision service program is attracting sexually active men at risk of acquiring HIV and we find no evidence of behavioral risk compensation following circumcision.


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**Table 1: Baseline characteristics of men who subsequently were circumcised and men who remained uncircumcised, Rakai, Uganda (2006-2008)**

| | Uncircumcised | | Circumcised | | | | |
|---|---|---|---|---|---|---|---|
| **Characteristics** | **Number/ Mean** | **Percent/ (SD)** | **Number/ Mean** | **Percent/SD** | **[‡]PRR (95% CI)** | **[‡‡]aPRR (95% CI** | **p-value** |
| **All** | 4,328 | 100 | 578 | 100 | | | |
| **Demographics** | | | | | | | |
| **Mean Age ( SD)** | 28.5 | (9.1) | 26.1 | (8.7) | | | <0.001 |
| **Marital status** | | | | | | | |
| Married | 2,498 | 57.7 | 289 | 50.0 | | | <0.001 |
| Separated | 243 | 5.6 | 24 | 4.2 | | | |
| Never married | 1,588 | 36.7 | 265 | 45.8 | | | |
| **Education** | | | | | | | |
| Primary/No education | 2,965 | 68.5 | 375 | 64.9 | | | 0.080 |
| Post primary | 1,364 | 31.5 | 203 | 35.1 | | | |
| **Location** | | | | | | | |
| Rural | 3,793 | 87.6 | 456 | 78.9 | | | <0.001 |
| Trading center | 536 | 12.4 | 122 | 21.1 | | | |
| ***Sexual behaviors** | | | | | | | |
| Any sexual partner in past 12 months | 3,404 | 78.6 | 431 | 74.6 | 0.95 (0.86-1.05) | 1.01 (0.92-1.12) | 0.766 |
| *More than one partner in past 12 months | 1,416 | 41.6 | 208 | 48.3 | 1.16 (1.00-1.34)) | 1.15 (1.00-.33) | 0.050 |
| *Casual partner in past 12 months | 311 | 9.1 | 53 | 12.3 | 1.34 (1.00-1.80) | 1.18 (0.87-1.56) | 0.301 |
| **Used condom at last non-marital sex | 967 | 57.1 | 148 | 56.7 | 0.99 (0.84-1.18) | 0.97 (0.82-1.16) | 0.751 |
| *Acquired a new sexual partner in previous 12 months | 1,582 | 46.5 | 242 | 56.2 | 1.20 (1.05-1.38) | 1.07 (0.94-1.23) | 0.280 |
| *Used alcohol before sex | 1,537 | 45.1 | 175 | 40.6 | 0.90 (0.77-1.05) | 0.97 (0.83- 1.14)) | 0.772 |
| *Genital ulcer in past 12 months | 440 | 12.9 | 63 | 14.6 | 1.11 (0.87-1.44)) | 1.10 (0.84-1.44) | 0.486 |
| *Genital discharge | 149 | 4.4 | 32 | 7.4 | 1.69 (1.14-2.52) | 1.55 (1.04-2.31 | 0.03 |

*Only among the sexually active: 3,404 among uncircumcised and 431 among circumcised, **only among those who had non-marital relationships, 1,694 among uncircumcised and 261 among the circumcised, [‡]using uncircumcised as the reference group, [‡‡]Adjusted for socio-demographics including age, marital status, education, rural-urban residence status. In addition to these variables, analyses on genital ulcers and genital discharge were adjusted for behaviors including number of sexual partners, casual partners and acquisition of a new sex partner in past 12 months.

**Table 2: Behaviors following circumcision and behaviors of uncircumcised men at follow up, Rakai, Uganda (2008-2011)**

| | Uncircumcised | | Circumcised | | ±PRR (95 % CI) | ±±aPRR (95% CI) | p-value |
|---|---|---|---|---|---|---|---|
| **All** | **4,329** | **100** | **578** | **100** | | | |
| Any sexual partner in past 12 months | 3,562 | 82.3 | 453 | 78.3 | 0.95 (0.86-1.05) | 1.00 (0.903-1.10) | 0.929 |
| *More than one sex partner in past 12 months | 1,381 | 38.8 | 196 | 43.3 | 1.11 (0.96-1.30) | 1.02 (0.87-1.19) | 0.797 |
| *Had a casual sex partner in past 12 months | 270 | 7.6 | 33 | 7.3 | 0.96 (0.67-1.38) | 0.88 (0.59-1.31) | 0.519 |
| **Used condom at last non-marital sex | 940 | 55.2 | 150 | 59.8 | 1.08 (0.91-1.29) | 1.13 (0.91-1.39) | 0.267 |
| *Acquired a new sexual partner in previous 12 months | 1,532 | 43.0 | 232 | 51.2 | 1.19 (1.04-1.37) | 1.07 (0.92-1.24) | 0.408 |
| *Used alcohol before sex with any partner | 1676 | 47.1 | 183 | 40.4 | 0.86 (0.74-1.00) | 0.95 (0.81-1.11) | 0.489 |
| *Genital ulcers in the past 12 months | 375 | 10.5 | 31 | 6.8 | 0.66 (0.47-0.94) | 0.60 (0.42-0.87) | 0.007 |
| *Genital discharge in the past 12 months | 153 | 4.0 | 20 | 4.6 | 1.15 (0.71-1.87) | 1.00 (0.63-1.62) | 0.973 |

*Only among sexually active 3,404 among uncircumcised and 431 among circumcised, **only among those who had non-marital relationships, 1,694 among uncircumcised and 261 among the circumcised, ±using uncircumcised as the reference group, ±±Adjusted for socio-demographics including age, marital status, education, rural-urban residence status. In addition to these variables, analyses on genital ulcers and genital discharge were adjusted for behaviors including number of sexual partners, casual partners and acquisition of a new sex partner in past 12 months.