Routledge
Taylor & Francis Group

Male circumcision, attitudes to HIV prevention and HIV status: A cross-sectional study in Botswana, Namibia and Swaziland

Neil Andersson[a]* and Anne Cockcroft[b]

[a]*Centro de Investigación de Enfermedades Tropicales, Universidad Autónoma de Guerrero, Acapulco, Mexico;* [b]*CIET Trust Botswana, Gaborone, Botswana*

In efficacy trials male circumcision (MC) protected men against HIV infection. Planners need information relevant to MC programmes in practice. In 2008, we interviewed 2915 men and 4549 women aged 15–29 years in representative cluster samples in Botswana, Namibia and Swaziland, asking about socio-economic characteristics, knowledge and attitudes about HIV and MC and MC history. We tested finger prick blood samples for HIV. We calculated weighted frequencies of MC knowledge and attitudes, and MC history and HIV status. Multivariate analysis examined associations between MC and other variables and HIV status. In Botswana, 11% of young men reported MC, 28% in Namibia and 8% in Swaziland; mostly (75% in Botswana, 94% – mostly Herero – in Namibia and 68% in Swaziland) as infants or children. Overall, 6.5% were HIV positive (8.3% Botswana, 2.6% Namibia and 9.1% Swaziland). Taking other variables into account, circumcised men were as likely as uncircumcised men to be HIV positive. Nearly half of the uncircumcised young men planned to be circumcised; two-thirds of young men and women planned to have their sons circumcised. Some respondents had inaccurate beliefs and unhelpful views about MC and HIV, with variation between countries. Between 9 and 15% believed a circumcised man is fully protected against HIV; 20–26% believed men need not be tested for HIV before MC; 14–26% believed HIV-positive men who are circumcised cannot transmit the virus; and 8–34% thought it was "okay for a circumcised man to expect sex without a condom". Inaccurate perceptions about protection from MC could lead to risk compensation and reduce women's ability to negotiate safer sex. More efforts are needed to raise awareness about the limitations of MC protection, especially for women, and to study the interactions between MC roll out programmes and primary HIV prevention programmes.

Keywords: male circumcision (MC); HIV status; HIV attitudes; Southern Africa

Background

Three randomised controlled efficacy trials indicated a benefit of male circumcision (MC) among young HIV-negative men who agreed to participate in the trials: MC could prevent one case of HIV for every 55, 107 and 29 men undergoing the procedure in South Africa (Auvert et al., 2005), Uganda (Gray et al., 2007a) and Kenya, respectively (Bailey et al., 2007). Several mathematical models have predicted the potential impact of widespread MC on the AIDS epidemic (Bollinger, Stover, & Musuka, 2009; Gray et al., 2007b; Nagelkerke, Moses, de Vlas, & Bailey, 2007; UNAIDS/WHO/SACEMA expert group, 2009). These models rely on assumptions about the sort of men who come forward for MC, their HIV status and what happens to their behaviour after the procedure. Evidence from the MC trials suggests the circumcised men did not adopt more risky sexual behaviour, such as using condoms less or having more partners, than the uncircumcised controls (Agot et al., 2007; Mattson et al., 2008). But all trial participants received intensive counselling about risky

sexual behaviours and the protective effect of MC was not well established at the time. It is still not clear whether or not men coming forward for MC in the context of mass roll-out of MC programmes would have risk compensation after the procedure.

Reduced condom use after MC and perhaps increasing number of sexual partners among circumcised men may have a negative effect on the epidemic, especially if a significant proportion of those undergoing MC are already HIV positive and given the evidence that MC does not reduce transmission from HIV-positive men (Wawer et al., 2009). The beliefs and attitudes of the potential female partners of circumcised men are also important (Women's HIV Prevention Tracking Project [WhiPT], 2010). For example, if women believe that HIV-positive men who are circumcised cannot transmit the infection, they will be less likely to press for condom use.

In 2008, we undertook the baseline survey for an HIV risk reduction randomised cluster controlled trial (RCCT) in Botswana, Namibia and Swaziland (ISRCTN register, 2008). This paper describes the

---

*Corresponding author. Email: andersson@ciet.org

MC rates across the three countries, examines the relationship between MC and HIV status in young men and examines levels and covariates of knowledge and attitudes about MC and HIV prevention among young men and women.

Methods

Ethics committees in Botswana, Namibia and Swaziland approved the RCCT, including the baseline and impact surveys.

The survey

We stratified census enumeration areas (EAs) in each country into capital, urban and rural; a random sample of EAs in each stratum produced 78 clusters (28 in Namibia and 25 each in Botswana and Swaziland).

In November 2008, field teams interviewed men and women aged 15–29 years in each cluster. The administered questionnaire documented individual characteristics, HIV and gender-related attitudes and practices and knowledge and attitudes about MC. The interviewers asked young men if they had been circumcised, at what age and in what setting. They asked young women if their partners had been circumcised. The 55 question interview took 20–30 minutes. We did not provide any incentives for participation in the survey.

Blood samples and laboratory analysis

Following signed, informed consent, interviewers collected finger prick samples to produce dried blood spots (DBS) using a safety auto-retracting lancet. Young people who did not agree to the finger prick blood sample for anonymous HIV testing were not interviewed. For young people below 18 years old in Botswana and Swaziland and below 16 years old in Namibia, the interviewers obtained signed consent from a parent or guardian. The National Institute for Communicable Diseases in Johannesburg analysed the DBS specimens, with confirmatory ELISA testing (Veronostika) of specimens HIV positive on the initial screening ELISA test (Genscreen).

Analysis

Operators entered data twice using Epi Info, with validation to eliminate keystroke errors. Analysis relied on CIETmap open-source software (Andersson & Mitchell, 2006) which incorporates an interface to the widely used public domain R statistical software.

We calculated weights to reflect any differences between the urban and rural proportions in the sample and the population in each country. We analysed MC history of male respondents and of sexual partners of female respondents, and HIV and MC knowledge and attitudes of all respondents. Multivariate analysis used the Mantel-Haenszel (1959) procedure to examine associations between knowledge and attitude outcomes and independent variables of sex, age, marital status, education, employment status, food sufficiency, education relative to partner, earnings relative to partner and urban or rural residence. Initial models included those variables associated with the outcomes in bivariate analysis and those considered a priori as likely to be associated with the outcomes. We used a step-down approach to produce final models with all remaining variables significantly associated with the outcome. We calculated adjusted Odds Ratios (ORs) and 95% confidence intervals (CI). We adjusted the CI for clustering (CIca), using a method described by Gilles Lamothe (2011) based on a variance estimator to weight the Mantel Haenszel OR for cluster-correlated data (Bieler & Williams, 1995; Williams, 2000).

Results

A total of 12,441 young women and men aged 15–29 years were identified as eligible for the study. Of these, 2459 (20%) declined to participate, 2518 (20%) were absent, or for those under the national age of consent their parent or carer was absent and 7464 (60%) gave a finger prick blood sample and completed an interview, 2915 men and 4549 women. We determined HIV status for 7303 young men and women (97.8% of those 7464 that gave a blood sample and completed a questionnaire). The few missing HIV results were because of unusable samples or sample numbering problems.

Table 1 shows characteristics of the participating youth in each country. More than half were women, most had above primary education, most had enough to eat in the last week and few were married or cohabiting.

Male circumcision (MC) rates and intentions

Table 2 shows the reported MC status of the young men who gave information about this. Overall, about one in six said they were circumcised. The higher rate in Namibia is partly explained by the nearly universal circumcision of the OtjiHerero speaking young men. Most of those circumcised had the procedure as infants or children. Some women did not know if

Table 1. Characteristics of the participating youth aged 15–29 years in each country.

Characteristic	Weighted percentage (fraction) with characteristic		
	Botswana	Namibia	Swaziland
Age			
15–19 years	26.3 (653/2510)	51.4 (1379/2676)	40.6 (917/2278)
20–24 years	43.0 (1081/2510)	30.8 (819/2676)	33.0 (758/2278)
25–29 years	30.7 (776/2510)	17.9 (478/2676)	26.4 (603/2278)
Female	65.0 (1629/2510)	60.8 (1633/2676)	56.3 (1287/2278)
Above primary education	87.0 (2176/2501)	80.9 (2181/2664)	71.7 (1623/2227)
Had enough food in last week	70.9 (1775/2500)	83.8 (2244/2671)	68.6 (1564/2257)
Married or cohabiting	20.1 (509/2502)	16.0 (408/2672)	22.0 (490/2262)

their main sexual partner was circumcised or not. Grouping these "don't know" responses with negative responses, the rates of partner circumcision reported by young women were still higher than the rates of circumcision reported by young men (Table 2).

The main reason given by 376 young men for why they were circumcised was "for cultural or religious reasons" (43.9%). Other common reasons included "arranged by parents" (25.5%) and "for hygiene reasons" (22.9%). Common reasons given by 2203 uncircumcised young men included: "not interested" (31.4%), "afraid" (16.5%), "not enough information about it" (14.1%), "don't know where to go for MC" (10.8%) and "cultural or religious reasons" (10.0%).

Among uncircumcised young men, nearly half said they planned to be circumcised (Table 3). The proportion planning MC was lowest in Namibia

(34.9%). Similar proportions of young women with uncircumcised partners planned to ask them to be circumcised. Around two-thirds of the young men and women respondents planned to have their sons circumcised. The highest proportions planning circumcision for themselves, their partners or their sons were in Swaziland.

HIV status and MC

Overall, 6.5% (189/2844) of men aged 15–29 years old were HIV positive: 8.3% (72/871) in Botswana, 2.6% (28/1014) in Namibia and 9.1% (89/959) in Swaziland. Taking into account country by stratification, circumcised men were as likely as uncircumcised men to be HIV positive (OR 0.96, 95% CIca 0.55–1.67).

Table 2. Reported rates of MC among young men aged 15–29 years.

Reported by	Weighted percentage (fraction)	
	Had MC	Those with MC who had MC as infant or child
Young men		
All three countries	15.8 (450/2895)	85.0 (341/406)
Botswana	11.0 (97/878)	74.6 (65/88)
Namibia	27.6 (273/1035)	93.6 (226/243)
OtjiHerero speaking	96.3 (76/79)	100 (64/64)
Speaking other languages	22.0 (197/952)	91.4 (162/179)
Swaziland	7.8 (80/982)	67.7 (50/75)
Young women[a] (reporting about main sexual partner)		
All three countries	20.0 (758/3816)	
Botswana	14.6 (217/1473)	
Namibia	32.9 (387/1218)	
OtjiHerero speaking	95.2 (101/106)	
Speaking other languages	26.9 (285/1109)	
Swaziland	13.4 (154/1125)	

[a]The young women reported on the circumcision status of their main sexual partner. Some 11.2% (423/3816) of young women did not know the circumcision status of their main sexual partner. The table shows the proportions of young women who were definite that their partner was circumcised, among those who had a partner. Those who did not know the MC status of their partner were grouped with those that said their partner was not circumcised. Many women who said their main partner was circumcised could not say at what age he had been circumcised.

Table 3. Intentions about male circumcision among young men and women aged 15–29 years.

	Weighted percentage (fraction) of respondents			
	Botswana	Namibia	Swaziland	All countries
Uncircumcised young men who plan to have MC	46.0 (358/780)	34.9 (267/764)	51.2 (465/901)	44.7 (1090/2445)
Young women with uncircumcised partners who plan to ask partners to have MC	48.3 (610/1258)	41.3 (357/868)	50.2 (503/1005)	47.1 (1470/3131)
Young men who plan to have sons circumcised	63.5 (552/865)	65.5 (668/1026)	70.9 (692/965)	66.8 (1912/2856)
Young women who plan to have sons circumcised	60.8 (969/1592)	62.2 (986/1598)	75.7 (936/1234)	65.7 (1533/4424)

MC and HIV knowledge and attitudes

Table 4 shows the proportion of respondents with inaccurate beliefs and unhelpful views about MC and HIV across the three countries. More than 10% of respondents thought a circumcised man is fully protected against HIV infection. Nearly a quarter thought men need not be tested for HIV before MC. About 18% believed that HIV-positive men who are circumcised cannot transmit HIV; respondents in Swaziland were more likely to think this than those in Botswana and Namibia (OR 1.84, 95% CIca 1.52–2.24). Overall, around one in six thought it was ''okay for a circumcised man to expect sex without a condom''; in Swaziland, however, men and women were more likely to think this than those in Botswana and Namibia (OR 3.21, 95% CIca 2.62–3.93). Fully one-third of men in Swaziland reported the view that a circumcised man could expect sex without a condom.

Table 5 summarises the final models from the multivariate analysis of the factors related to the beliefs and attitudes of the young people about MC and HIV. Respondents with enough food in the last week and those with above primary education were more likely to know that MC confers only partial protection against HIV infection. Male respondents, younger respondents and those who were married or cohabiting were more likely to think that men were fully protected after MC. Those who were married or cohabiting were more likely to think men should be tested for HIV before MC, while those with more education were *less* likely to think this. Taking other factors into account, respondents in Botswana and Namibia were nearly twice as likely to know that HIV-positive men can transmit HIV after circumcision, compared with respondents in Swaziland. Men, those who had enough food in the last week, and those with above primary education were also more likely to have this knowledge. However, those earning the same or more than their partner (or with no partner) were less likely to know men can still transmit HIV after circumcision.

The factors related to the view that ''it's okay for a circumcised man to expect sex without a condom''

differed between Botswana and Namibia (together) and Swaziland (Table 5). In Botswana and Namibia, more educated respondents were more likely to disagree with this proposition, while younger respondents and those earning the same or more than their partner (or with no partner) were more likely to agree with it. In Swaziland, education was not a factor, but respondents with enough food in the last week were more likely to disagree, while male and younger respondents were more likely to agree.

Discussion

MC and HIV status

Our findings confirm that MC was not common in these three countries in 2008. MC is a cultural norm only among the Herero in Namibia. In 2008, an MC rollout campaign had begun in Swaziland and was about to begin in Botswana. In all countries, nearly all the circumcised young men, including Herero, had the procedure as infants or young children. Since the time of the survey, campaigns are under way in Swaziland and Botswana. According to a recent WHO report, some 6180 MC procedures were carried out in Botswana between January 2009 and March 2010, and some 9309 in Swaziland between 2006 and March 2010 (World Health Organisation & UN-AIDS, 2010).

We did not find a significant association between MC and HIV status among the young men in this survey, when stratifying for country; nearly all those who were circumcised had the procedure as children or infants, before any would be likely to have contracted HIV. Similarly, Connolly, Simbayi, Shanmugam, and Nqeketo (2008) did not find an association between MC and HIV status among South African men surveyed in 2002. The lack of association between MC and HIV status in our study persisted when we took into account a number of known risk factors for HIV infection in a multivariate analysis. We have reported elsewhere that, among both men and women, those who were choice disabled (unable to make and implement HIV protective choices) were

Table 4. Knowledge and attitudes of young men and women about MC and HIV.

Belief/attitude	Weighted percentage (fraction) of respondents with belief or attitude							
	Botswana		Namibia		Swaziland		All countries	
	Male	Female	Male	Female	Male	Female	Male	Female
A circumcised man is fully protected against HIV infection	10.8 (92/867)	9.1 (146/1589)	14.7 (154/1030)	10.7 (173/1581)	13.0 (126/973)	11.0 (136/1229)	13.0 (372/2870)	10.2 (455/4399)
Men need not be tested for HIV before being circumcised	25.7 (225/878)	23.8 (385/1629)	25.3 (263/1041)	21.9 (355/1631)	19.8 (196/988)	21.5 (272/1282)	23.4 (684/2907)	22.4 (1012/4542)
HIV positive men who are circumcised cannot transmit HIV	15.8 (136/881)	14.2 (228/1625)	13.8 (146/1043)	16.2 (265/1632)	22.8 (221/990)	26.4 (336/1286)	17.6 (503/2914)	18.5 (829/4543)
It's okay for a circumcised man to expect sex without a condom	12.0 (105/881)	7.6 (122/1629)	16.0 (159/1043)	14.5 (238/1632)	34.0 (334/989)	28.6 (360/1285)	21.2 (598/2913)	16.3 (720/4546)

more likely to be HIV positive (Andersson & Cockcroft, 2011).

Knowledge and attitudes about MC

Most studies about MC attitudes have focused on acceptability of MC among populations where MC is not a cultural norm. In our study, nearly half the uncircumcised young men actually planned to have MC and nearly half the young women with uncircumcised partners planned to ask their partners to have MC, while about two-thirds of the young men and women planned to have their sons circumcised. A review of 13 studies in sub-Saharan Africa by Westercamp and Bailey (2007) noted that MC was acceptable to about two-thirds of men (range 29–87%) and rather more women (range 47–79%). In this review, on average 71% of men (50–90%) and 81% of women (70–90%) were willing to have their sons circumcised, even though the studies included took place before the publicity about MC following the efficacy trials. Because we asked about actual plans for MC, rather than general acceptability or willingness for the procedure, this might explain why we found relatively fewer men and women planning for MC, even though our study took place after widespread publicity about the benefits of MC for HIV prevention demonstrated in the three efficacy trials (Auvert et al., 2005; Bailey et al., 2007; Gray et al., 2007a). We did not collect details about the "plans" for MC and social desirability bias might explain some of the positive responses to this question, although only Swaziland had a campaign for MC in place at the time of our data collection.

The beliefs and attitudes of young men in the target age for MC and of young women who are their potential partners will affect the way MC roll out programmes contribute to HIV prevention in practice. However, there is little published quantitative evidence of knowledge and attitudes about MC, beyond studies of its acceptability. WHO and UN-AIDS have identified as a research priority the need to "document changes in HIV-related individual and community perceptions and behaviours as a result of the expansion of male circumcision services" (Clearinghouse on male circumcision for HIV prevention, 2011). It is encouraging that we found quite high levels of accurate knowledge and helpful attitudes about MC and HIV in the three countries of this study. But the minority with inaccurate knowledge and unhelpful attitudes raise concerns.

The individual average protection after MC in HIV-negative young men, based on the complement of the OR, is around 60% (Auvert et al., 2005; Bailey et al., 2007; Gray et al., 2007a). Belief in an

Table 5. Factors related to beliefs and attitudes about MC and HIV among young women and men, from final models of multivariate analysis.

Factors in final model	Unadjusted OR	Adjusted OR (95% CIca)
Do *not* think that a circumcised man is *fully* protected against HIV infection		
Had enough food in last week	1.27	1.19 (1.02–1.38)
Above primary education	2.32	2.09 (1.65–2.63)
Sex (male)	0.77	0.77 (0.66–0.91)
Age (15–19)	0.74	0.74 (0.63–0.87)
Married or cohabiting	0.78	0.72 (0.59–0.88)
Agree that 'men should be tested for HIV before being circumcised'		
Married or cohabiting	1.28	1.24 (1.06–1.45)
Above primary education	0.65	0.66 (0.55–0.79)
Do *not* agree that 'HIV-positive men who are circumcised cannot transmit HIV'		
Country (Botswana and Namibia)	1.87	1.83 (1.43–2.34)
Sex (male)	1.08	1.23 (1.04–1.46)
Had enough food in last week	1.31	1.18 (1.01–1.38)
Above primary education	1.75	1.56 (1.29–1.89)
Earn the same or more than partner	0.93	0.83 (0.69–0.99)
Do *not* agree that 'It's okay for a circumcised man to expect sex without a condom'		
Botswana, Namibia		
Above primary education	2.10	1.92 (1.45–2.55)
Age (15–19)	0.70	0.83 (0.69–0.99)
Earn the same or more than partner	0.61	0.70 (0.57–0.85)
Swaziland		
Had enough food in last week	1.28	1.36 (1.16–1.61)
Sex (male)	0.77	0.76 (0.61–0.95)
Age (15–19)	0.77	0.76 (0.61–0.96)

Note: All the initial models included sex, age group (15–19 vs. 20–29), marital status (married or cohabiting vs. single), food sufficiency in the last week (had enough food vs. did not have enough food), earnings relative to partner (more, same as partner or no partner vs. less than partner), education (above primary vs. primary or less), urban/rural residence and country (Botswana and Namibia vs. Swaziland).

exaggerated protective effect of MC for young men who are HIV negative might lead to risk compensation after MC. In our study, 13% of young men and 10% of young women held the misconception that MC provides full protection against HIV infection for uninfected men. Despite the campaign about MC having begun in Swaziland at the time, the misconception was no less common there than in Botswana and Namibia. Youth with less education and without enough food in the last week were more likely to hold this misconception. The current campaign materials in both Botswana and Swaziland state clearly that MC is only partially protective for men who are HIV negative. A study in Uganda, in a population where more than a third of the male participants were circumcised, found that more than three-quarters had heard that MC "reduced the risk of contracting HIV" and this awareness was higher in those with more education (Wilcken, Miiro-Nakayima, Hizaamu, Keil, & Balaba-Byansi, 2010). However, the study did not ask about the perceived degree of protection from MC; some respondents may have believed MC provided complete protection. A small study of sexually active men in a district of Zambia suggested that the misconception of full protection after MC was common. They reported that 94% of the men knew what MC was, of these 64% said it reduced the chances of HIV infection, and of these 72% believed there was no need to use a condom if circumcised (Ndopu & Gilbert, 2009).

Nearly one quarter of young people in our study thought it unnecessary for men to be tested for HIV before MC. In neither Botswana nor Swaziland is testing for HIV insisted upon prior to MC in their programme roll out. The current MC campaign materials in Botswana state that MC is not recommended for HIV-positive men, but do not state that men need to test for HIV prior to MC. In Swaziland, the materials state that if a man is not tested for HIV he can still be circumcised, "although it is not always recommended". The proportion of young people considering it unnecessary to test for HIV prior to MC might be expected to rise with exposure to the MC campaign materials. It is clear that many men are having MC without prior HIV testing. In Swaziland during 2008, 70% (385/549) of men coming forward

to one provider for MC agreed to have an HIV test; 8% (31/385) of those tested were HIV positive (B. Mziyako, personal communication, September 23, 2008).

MC does not reduce transmission from HIV-positive men (Wawer et al., 2009). It is of concern that around 18% of respondents thought HIV-positive men cannot transmit infection after MC. Women were more likely to believe this than men; this may reduce their likelihood of protecting themselves when having sex with circumcised men. Respondents with above primary education and with enough food in the last week were more likely to have correct knowledge on this point. In the WhiPT (2010) study of 494 women, mostly HIV positive, in Kenya, Namibia, South Africa, Swaziland and Uganda, with questionnaires and focus groups, overall 46% of the respondents thought women would be protected from HIV infection by MC, some of them holding the misconception that MC was directly protective for women, or even that men who are circumcised are by definition HIV negative. In our study, the misconception that circumcised men cannot transit HIV infection was significantly more common in Swaziland, despite the mention in the MC campaign materials that HIV-positive men who are circumcised can transmit HIV. Stronger efforts are needed to raise awareness that MC does not directly protect women, that circumcised men may be HIV positive, and that HIV positive circumcised men can transmit the infection at least as readily as non-circumcised men (Wawer et al., 2009).

The belief that HIV-positive men cannot transmit infection after MC might make it more difficult for women to insist that circumcised men should use condoms. Across the three countries we found that one in five young men and one in six young women believed it was "okay for a circumcised man to expect sex without a condom". Again, this belief was more prevalent in Swaziland, where it was held by a third of men and more than a quarter of women. If the misconceptions about the protection provided by MC persist, mass MC programmes might be expected further to limit women's negotiating power for protecting themselves from HIV infection. The WhiPT (2010) study also highlighted concerns of the women respondents that MC might reduce women's sexual negotiating power; over half believed that MC programmes would lead to an increase in gender based violence (GBV). Insistence on unprotected sex is a form of GBV. A belief among men that after MC it is "safe" for them to have unprotected sex with whoever they choose, might reinforce attitudes about masculinity that are related to GBV in the region (Wood & Jewkes, 1997). GBV is an important driver of the HIV epidemic (Andersson, Cockcroft & Shea, 2008), so an increase in GBV might be expected to counteract some of the predicted reduction in HIV rates from mass MC programmes.

Limitations

Some 20% of those approached for the study declined to participate. Most people who declined did so because they did not want to have a finger-stick, while a few did not want to be tested anonymously. We have no information about the possibility that non-response could have been related to MC status or to likely views about MC.

We relied on self-reported MC status. Some 11% of young women did not know the circumcision status of their partners and the higher reported rate by women than men may also reflect confusion among the women about what MC looks like. Some of the men may have incorrectly reported their MC status, especially if they were circumcised as young children. There is evidence that even clinical examination sometimes records men as circumcised on one occasion and not on a subsequent occasion (Weiss et al., 2008).

Conclusions

Male circumcision (MC) was rare in 2008 in Botswana, Namibia and Swaziland, and MC was unrelated to HIV status. Inaccurate knowledge and perceptions about the protection from MC held by some young people could lead to risk compensation after MC, reduce women's ability to negotiate safer sex and lead to an increase in GBV. Governments undertaking MC roll out programmes need to make more efforts to raise awareness about the limitations of MC protection, especially for women. Study of the potentially negative interactions between MC roll out programmes and primary HIV prevention programmes should be a research priority.

Acknowledgements

References

Agot, K.E., Kiarie, J.N., Nguyen, H.Q., Odhiambo, J.O., Onyango, T.M., & Weiss, N.S. (2007). Male circumcision in Siaya and Bondo districts, Kenya: Prospective cohort study to assess behavioral disinhibition following circumcision. *Journal of Acquired Immune Deficiency Syndrome, 44*, 66–70.

Andersson, N., & Cockcroft, A. (2011). Choice-disability and HIV infection: A cross sectional study of HIV status in Botswana, Namibia and Swaziland. *AIDS and Behavior*. doi: 10.1007/s10461-011-9912-3

Andersson, N., Cockcroft, A., & Shea, B. (2008). Gender-based violence and HIV: Relevance for HIV prevention in hyperendemic countries of southern Africa. *AIDS*, (Suppl. 4), S73–S86.

Andersson, N., & Mitchell, S. (2006). Epidemiological geomatics in evaluation of mine risk education in Afghanistan: Introducing population weighted raster maps. *International Journal of Health Geographics, 5*, 1. doi: 10.1186/1476-072X-5-1

Auvert, B., Taljaard, D., Lagarde, E., Sobngwi-Tambekou, J., Sitta, R., & Puren, A. (2005). Randomized, controlled intervention trial of male circumcision for reduction of HIV infection risk: The ANRS 1265 Trial. *PLoS Medicine, 2*(11), E298. doi:10.1371/journal.pmed.0020298

Bailey, R.C., Moses, S., Parker, C.B., Agot, K., Maclean, I., Krieger, J.N., & ... Ndinya-Achola, J.O. (2007). Male circumcision for HIV prevention in young men in Kisumu, Kenya: A randomised controlled trial. *Lancet, 369*(9562), 643–656.

Bieler, G.S., & Williams, R.L. (1995). Cluster sampling techniques in quantal response teratology and developmental toxicity studies. *Biometrics, 51*, 764–776.

Bollinger, L., Stover, J., & Musuka, G. (2009). The cost and impact of male circumcision on HIV/AIDS in Botswana. *Journal of the International AIDS Society, 12*, 7.

Clearinghouse on male circumcision for HIV prevention. (2011). Retrieved January 31, 2011, from http://www.malecircumcision.org/index.html

Connolly, C., Simbayi, L.C., Shanmugam, R., & Nqeketo, A. (2008). Male circumcision and its relationship to HIV infection in South Africa: Results of a national survey in 2002. *South African Medical Journal, 98*(10), 789–794.

Gray, R.H., Kigozi, G., Serwadda, D., Makumbi, F., Watya, S., Nalugoda, F., & ... Wawer, M.J. (2007a). Male circumcision for HIV prevention in men in Rakai, Uganda: A randomised trial. *Lancet, 369*(9562), 657–666.

Gray, R.H., Li, X., Kigozi, G., Serwadda, D., Nalugoda, F., Watya, S., & ... Wawer, M. (2007b). The impact of male circumcision on HIV incidence and cost per infection prevented: A stochastic simulation model from Rakai, Uganda. *AIDS, 21*, 845–850.

ISRCTN register. (2008). *Acquired immune deficiency syndrome (AIDS) prevention through reduced choice disability*. Retrieved from http://www.controlled-trials.com/ISRCTN28557578

Lamothe, G. (2011). Adjusting the Mantel Haenszel test statistic and Odds Ratio for cluster sampling. Statistical annex to: Andersson, N., & Lamothe, G. Clustering and meso-level variables in cross sectional surveys: An example of food aid during the Bosnian crisis. *BMC Health Services Research* (in press).

Mantel, N., & Haenszel, W. (1959). Statistical aspects of the analysis of data from retrospective studies of disease. *Journal of the National Cancer Institute, 22*, 719–748.

Mattson, C.L., Campbell, R.T., Bailey, R.C., Agot, K., Ndinya-Achola, J.O., & Moses, S. (2008). Risk compensation is not associated with male circumcision in Kisumu, Kenya: A multi-faceted assessment of men enrolled in a randomized controlled trial. *PLoS ONE, 3*(6), e2443. doi: 10.1371/journal.pone.0002443

Nagelkerke, N.J.D., Moses, S., de Vlas, S.J., & Bailey, R.C. (2007). Modelling the public health impact of male circumcision for HIV prevention in high prevalence areas in Africa. *BMC Infectious Diseases, 7*, 16. doi: 10.1186/1471-2334-7-16

Ndopu, S., & Gilbert, S. (2009). Knowledge, attitudes and practices (KAP) of sexually active men towards circumcision as a preventive measure against HIV infection in Kitwe district, Zambia. *Journal of Acquired Immune Deficiency Syndromes, 51*. doi: 10.1097/01.qai.0000351174.86961.1e

UNAIDS/WHO/SACEMA expert group on modelling impact and cost of male circumcision for HIV prevention. (2009). Male circumcision for HIV prevention in high HIV prevalence settings: What can mathematical modelling contribute to informed decision making? *PloS Medicine, 6*(9), e1000109. doi:10.1371/journal.pmed.1000109

Wawer, M.J., Makumbi, F., Kigozi, G., Serwadda, D., Watya, S., Nalugoda, F., ... Gray, R.H. (2009). Circumcision in HIV-infected men and its effect on HIV transmission to female partners in Rakai, Uganda: A randomised controlled trial. *Lancet, 374*, 229–237. doi: 10.1016/S0140-6736(09)60998-3

Weiss, H.A., Plummer, M.L., Changalucha, J., Mshana, G., Shigongo, Z.S., Todd, J., & ... Ross, D.A. (2008). Circumcision among adolescent boys in rural north-western Tanzania. *Tropical Medicine and International Health, 13*(8), 1054–1061.

Westercamp, N., & Bailey, R.C. (2007). Acceptability of male circumcision for prevention of HIV/AIDS in Sub-Sarahan Africa: A review. *AIDS and Behavior, 11*, 341–355. doi: 10.1007/s10461-006-9169-4

Wilcken, A., Miiro-Nakayima, F., Hizaamu, R.N.B., Keil, T., & Balaba-Byansi, D. (2010). Male circumcision for HIV prevention – a cross-sectional study on awareness among young people and adults in rural Uganda. *BMC Public Health, 10*, 209. doi:10.1186/1471-2458-10-209.

Williams, R.L. (2000). A note on robust variance estimation for cluster-correlated data. *Biometrics, 56*, 645–646.

Women's HIV Prevention Tracking Project (WhiPT). (2010). Making medical male circumcision work for women. December 2010. Retrieved January 31, 2011,

from http://www.avac.org/ht/a/GetDocumentAction/i/31646

Wood, K, & Jewkes, R. (1997). Violence, rape, and sexual coercion: Everyday love in a South African township. *Gender and Development*, *5*, 41–46.

World Health Organisation and UNAIDS. (2010). *Progress in male circumcision scale-up: Country implementation and research report*. WHO and UNAIDS. http://www.malecircumcision.org/documents/MC_country_June 2010.pdf