A Comparison of the Prevalence of Sexually Transmitted Infections Among Circumcised and Uncircumcised Adult Males in Rustenburg, South Africa: A Cross-Sectional Study

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Abstract

Background South Africa has a persistent burden of sexually transmitted infections (STIs). Male circumcision has been shown to be effective in preventing HIV, and STIs but data are scarce on the protective effect of circumcision in high-risk populations such as migrant miners. The objective of this study was to assess the effect of medical and traditional circumcision on the prevalence of STIs after adjusting for other risk factors in Rustenburg, a mining town in North West Province, South Africa.

Methods This cross-sectional study used baseline data collected from a cohort study. Adult males in a mining town were assessed for STIs (gonorrhea, chlamydia, and trichomoniasis) using syndromic assessment. Data on circumcision status and other risk factors for STIs were collected using an interviewer-administered questionnaire. Multiple logistic regression analysis was used to assess the independent effect of circumcision on STI presence after adjusting for confounders.

Results A total of 339 participants with a median age of 25 years (IQR 22-29) were included in the study, of whom 116 (34.2%) were circumcised. The overall STIs prevalence was 27.4% (95% CI 22.8% to 32.6%) and was lower in the circumcised participants compared with those who were uncircumcised (15.5% vs 33.6%, respectively, p<0.001). Both medical (OR 0.57, 95% CI 0.34-0.95, p = 0.030) and traditional circumcision (OR 0.34, 95% CI 0.13-0.86, p = 0.022) were strongly associated with a lower risk of STIs after adjustment for employment and condom use.

Conclusion

In this high-risk population, with a relatively high prevalence of STIs, and 34% circumcision, both medical and traditional circumcision appear to be protective against STIs.

Background

Despite improvements in prevention, screening, and treatment, the global burden of sexually transmitted infections (STIs) remains high (1). Worldwide, more than a million people acquire sexually transmitted infections every day, 499 million new cases of treatable STIs (gonorrhea, chlamydia, syphilis, and trichomoniasis) arise each year, and 536 million people are estimated to be living with none curable herpes simplex virus type 2 (HSV-2) (2). In South Africa, the prevalence of STIs in men was 5% for chlamydia and 17% for herpes simplex virus type 2 between October 2016 and January 2017 (3). A home-based prevalence survey conducted in rural KwaZulu Natal, South Africa, among young man and women aged between 15–24 years old found a weighted prevalence of treatable STIs; 1.8% for gonorrhea, 0% and 0.4% for active syphilis, 0.6% and 4.6% for trichomoniasis (3). There is a need to both promote and evaluate existing interventions to improve the effectiveness of prevention of STIs.

STIs have varying consequences on sexual and reproductive health. Syphilis in pregnancy leads to an estimated 305 000 adult and new-born deaths and leaves 215 000 babies at high risk of losing their life from prematurity, low birth weight or congenital disease each year in the world (2). Gonorrhea and chlamydia are risk factors for infertility, and untreated genital infection may be the cause of up to 85% of sterility of women seeking infertility treatment (2). As a result of an understanding of the persistent problem f STIs, as well as the effects on health, the World Health Organization (WHO) Global Health Sector strategy on STI 2016–2021 (4) has outlined the goals and targets for global STIs prevention and control. Among these targets is to collect information on STI prevalence and incidence across representative populations (4). In South Africa, the government is promoting voluntary male circumcision and condom use (6) and has sentinel surveillance in place across the nine provinces (5). However, the burden of STIs remains high and this may require combining the biological and behavioral interventions.

Male circumcision is one of the oldest and most common surgical procedures worldwide and is accepted for many reasons including religious, cultural, social and medical (7). Circumcision decreases the entry of pathogens through abrasions in the thinly keratinized inner mucosal surface of the foreskin and eliminates the moist environment under the foreskin, which may favor pathogen persistence and reproduction (4). From an efficacy point of view, there is conclusive evidence that male circumcision reduces the risk of HIV and STI infection risk is conclusive. Three randomized controlled trials (RCTs), a meta-analysis of the 3 RCTs, and several cohort studies have shown consistent benefits and the WHO now recommends voluntary medical male circumcision (VMMC) as one of the key HIV and STI prevention strategies (9). The first RCT was conducted in Johannesburg, South Africa, from October 25, 2005, including 3274 uncircumcised men of 18–24 years old, reported that male circumcision reduced risk of HIV infection by60% (8). The same authors found a 58% reduction in risk of incident *Trichomonas vaginalis* in women with circumcised partners, compared to those with uncircumcised partners, in a prospective study conducted in Kenya (10). Another RCT found that male circumcision decreased *Trichomonas vaginalis* infection among men (OR 0.49, p = 0.030, AOR 0.41, p = 0.030 (11) among men aged 18–24 years, in Orange farm in South Africa. A systematic review of 57 observational studies also found that females were at a decreased risk of STIs when their male partners were medically circumcised (12). Another systematic review and meta-analysis of global data from April 2019 of 62 observational studies including 119248 men who have sex with men (MSM) found that circumcision was associated with 23% reduced odds of HIV infection among MSM (OR 0.77, 955 CI 0.67–0.89) (13). In controlled settings and the general population, male circumcision is effective in reducing the risk of STIs in both men and women.

Although data from clinical trials and several observational studies show the efficacy of VMMC in reducing the risk of STDs, several questions remain unanswered. This may have an unintended effect in that circumcised men expose themselves more, in the belief that they will not get STIs (19). Behavioral risk compensation is not limited to men only as women may change their behavior in the belief that VMMC protects them. In one study in South Africa, women who were aware of the benefits believed that VMMC reduced the need to worry about HIV and were less likely to use condoms with circumcised men (20). STIs tend to be diagnosed late in women and commercial sex workers may act as reservoirs of infection and increase the risk of incident cases and re-infection (21). Further, resumption of sexual activity before 6 weeks post circumcision wound healing period increases the risk of STIs (19). How these factors affect the risk of STIs in a setting where high-risk sexual activity is prevalent such as migrant mining communities found in certain parts of South Africa is not known (22). Further, many traditional communities practice circumcision as a rite of passage to manhood (23). Available data suggest that traditional circumcision may increase the risk of STI through a lack of health education, incomplete skin removal and higher risk sexual behaviors such as multiple partners and lower condom use (23). More research is needed to investigate how all these factors affect the efficacy of interventions for the reduction of STI risk, such as male circumcision.

This study compares the prevalence of STIs between men who are circumcised and those who are not, in an observational setting, where high-risk sexual behaviors are prevalent. Further, we compared the prevalence of STIs between males who were traditionally circumcised and those medically circumcised. Lastly, we assessed the effect of circumcision on the risk of STIs, after adjusting for established risk factors for STIs.

Methods

We used baseline cross-sectional data on men collected from a previous study - The International AIDS Vaccine initiation (IAVIB) study at Aurum institute Rustenburg, Bojanala district, Rustenburg. The parent study was a cohort study that aimed to measure the incidence of HIV infection (14).

Setting

Rustenburg city is in the Bojanala Platinum District in the North West province, 173 kilometers from Johannesburg. The Tshwane ethnicity and diverse internal and external migrants are the predominant populations in this community (14). The migration population is due to the mining industry which attracts many people seeking employment. Also, this industry attracts many sex workers (15). This may increase the prevalence of STIs in the population.

Sample Size and power

The baseline data on 339 men collected over 6 months were available for analysis. The prevalence of STIs in the total population was estimated at 30%, with an estimated prevalence of circumcision at 34%. Among those circumcised, we estimated that approximately 15% will have STIs while the prevalence will be double in the uncircumcised group. A sample size of 339 had 84.8% power to detect a difference given these assumptions.

Data collection

Data were collected using interviewer-administered questionnaires. Data collected included socio-demographic data, risky sexual behavior and circumcision status and assessment of STIs. The questionnaire used for the assessment of risky sexual behavior was previously validated in this population while the checklist used for assessing STIs was also validated (14).

Assessment of circumcision

This was done using an interviewer-administered questionnaire. Participants were asked whether they were circumcised and if so, whether they were circumcised culturally or medically (14).

Assessment of STIs

Syndromic assessment and management of sexually transmitted infections were done in the parent study, brief physical examination including vital signs, weight, height, examination external genital, and rectal examinations for relevant symptoms (14). Inconsistent condom use as was categorized as never, frequently, or sometimes using condoms with partners in the last three months, while consistent condom use was always using a condom with all partners. Clinicians conducted a genital exam and STIs were diagnosed syndromically and treated according to national guidelines (14).

Data analysis

All analyses were performed using SPSS version 25 (IBM Corp. Released 2017. IBM SPSS Statistics for Windows, Version 25.0. Armonk, NY: IBM Corp.), and the level of significance was set at $p < 0.05$. Data from the primary study were imported into SPSS for analysis. Numerical data were presented using mean and standard deviation (SD) when variables were normally distributed, otherwise median and inter-quarter ranges (IQR) were reported. Frequencies and percentages were used to summarize categorical variables.

Numerical data were compared between participants with and without STIs using independent samples t-tests or Wilcoxon rank-sum test (where data were not normally distributed), and categorical outcomes compared using chi-squared or Fisher's exact tests. The prevalence of STIs overall (gonorrhea, chlamydia, and trichomoniasis) was presented with 95% confidence intervals and by age group. The association between risk factors including circumcision and STI prevalence was assessed initially using chi-square tests and univariate logistic regression analysis reporting crude odds ratios and 95% confidence intervals. Circumcision as well as the other risk factors which were found to show an association with STIs at <= 0.2 level of significance were included in the predictive multivariable logistic regression analysis model. Backward selection based on likelihood ratios was used to arrive at a final model. The magnitude of the association between identified factors and outcomes was summarized using adjusted odds ratios and 95% confidence intervals. Both crude and adjusted odds ratios with 95% confidence intervals are presented.

Ethics considerations

The study was approved by the Health Research Ethics Committee at Stellenbosch University, (Reference No: S19/07/134), with a waiver of informed consent, as no new data were collected from participants. Permission to use the data was obtained from the Arum Institute.

Results

Table 1 shows the demographics of the participants by circumcision status. Baseline data on 339 participants were included in the study. In total 116 (34.2%) of the participants were circumcised. The majority (68%) were medically circumcised while the remainder were culturally circumcised. Their median age was 25 years, with an inter-quartile range from 22 to 29 years. The mean total years of schooling was 12 years with a standard deviation of 2 years. Most of the participants were Black, married and without a partner. Demographics did not vary by circumcision status.

Table 1: Demographics of participants by circumcision status

		Circumcised	Uncircumcised	Total
Enrolment Age	Median	25	25	25
	Percentile 25	23	22	22
	Percentile 75	31	28	29
Total years of schooling (years)	Mean	12.1	12.4	12.28
	standard deviation	1.8	1.9	1.9
Race: n (%)	Black	116 (34.5%)	220 (65.5%)	336 (99.1%)
	White	0	1 (100%)	1 (0.3%)
	Other	0	2 (100%)	2 (0.6%)
Marital status: n (%)	Single	106 (33%)	215 (66.9%)	321 (94.7%)
	Divorced	2 (100%)	0	2 (0.6%)
	Married	8 (50%)	8 (50%)	16 (4.7%)
Does your partner live with you: n (%)	No	91 (35.1%)	168 (65.6%)	259 (76.4%)
	Yes	19 (34.5%)	36 (65.5%)	55 (16.2%)
	Not applicable	6 (24%)	19 (76%)	25 (7.4%)
Employment	Unemployed	56 (33.7%)	110 (66.3%)	166 (49%)
	Self employed	7 (30.4%)	16 (69.6%)	23 (6.8%)
	Student	10 (38.5%)	16 (61.5%)	26 (7.7%)
	Employed	43 (35.2%)	79 (64.7%)	122 (36%)
	Other	0	2 (100%)	2 (0.6%)

The prevalence of STIs overall was 27.4% (93/339) (95% CI 22.8–32.6%). The prevalence of STIs was higher in uncircumcised males, compared to those circumcised (33.6% vs 15.5%, respectively. Further, the prevalence of STIs in participants who were medically circumcised was 17.7% versus 10.8% in those who were culturally circumcised.

Table 2: The prevalence of sexually transmitted infections by age group

		STI presence				95% Confidence Interval for STI presence
		Present (n=93)		Absent (n=246)		
		Count	%	Count	%	
Age group	20-24	39	25.5%	114	74.5%	19.1% to 32.8%
	24-29	27	24.8%	82	75.2%	17.4% to 33.5%
	30-34	16	40.0%	24	60.0%	25.9% to 55.4%
	35-39	7	26.9%	19	73.1%	12.9% to 45.7%
	>=40	4	36.4%	7	63.6%	13.7% to 65.2%
	Overall	93	27.4%	246	72.6%	22.8% to 32.6%

Table 3: Univariate association between circumcision, other risk factors, and STI presence

Factor	Levels	STI Presence		Crude OR (95% CI)	P-value
		Present	Absent		
Circumcision	No	75 (33.6%)	148 (66.4%)	1 (reference)	
	Yes	18 (15.5%)	98 (84.5%)	0.36 (0.20 to 0.64)	<0.001
Employment	Unemployed	35(21.1%)	131(78.9%)	1 (reference)	
	Self employed	8(34.8%)	15(65.2%)	1.99 (0.78 to 5.09)	0.148
	Student	5(19.2%)	21(80.8%)	0.89 (0.31 to 2.53)	0.829
	Employed	44(36.1%)	78(63.9%)	2.11 (1.25 to 3.57)	0.005
	Other	1(50.0%)	1(50.0%)	3.74 (0.23 to 61.35	0.355
Does your partner live with you?	No	66(25.5%)	193(74.5%)	1 (reference)	
	Yes	20(36.4%)	35(63.6%)	1.67 (0.90 to 3.09)	0.103
	Not applicable	7(28.0%)	18(72.0%)	1.14 (0.46 to 2.84)	0.783
During the last month, on average, how often have you had a drink Containing alcohol?	none	23 (24.7%)	69 (28.0%)	1(reference)	
	1-3 times	39 (41.9%)	103 (41.9%)	1.14 (0.62 to 2.07)	0.677
	Weekly	27 (29.0%)	68 (27.6%)	1.19(0.62 to 2.28)	0.597
	Daily	4 (4.3%)	6 (2.4%)	2.00 (0.52 to 7.71)	0.314
During the last month, how often were you drunk/drinking alcohol before sex?	never	128 (52.0%)	49 (52.7%)	1 (reference)	
	sometimes	91 (37.0%)	36 (38.7%)	1.03 (0.62 to 1.72)	0.899
	frequently	18(7.3%)	4 (4.3%)	0.58 (0.19 to 1.80)	0.347
	always	9 (3.7%)	4 (4.3%)	1.16 (0.34 to 3.94)	0.811
Frequency of use of condom with female partner(s)	Never	18 (38.3%)	29 (61.7%)	1 (reference)	
	Sometimes	43 (32.6%)	89 (67.4%)	0.78 (0.39 to 1.55)	0.478
	Frequently	16 (22.2%)	56 (77.8%)	0.46 (0.21 to 1.03)	0.060
	Always	13 (15.3%)	72 (84.7%)	0.29 (0.13 to 0.67)	0.004
Frequency of use of condom with new female partner(s)	Never	4 (17.4%)	19 (82.6%)	1 (reference)	
	Sometimes	8 (17.8%)	37 (82.2%)	1.03 (0.27 to 3.85)	0.968
	Frequently	4 (16.0%)	21(84.0%)	0.91 (0.19 to 4.13)	0.897
	Always	25(18.4%)	111(81.6%)	1.07 (0.34 to 3.42)	0.909
	N/A	52(47.3%)	58(52.7%)	4.26 (1.36 to 13.33)	0.013
Enrolment Age: median (IQR)		26 (23-30)	25 (22-28)	1.03 (0.99 to 1.07)	0.166
Sexual debut sex age: median (IQR)		17 (16-18)	17 (15-18)	0.98 (0.91 to 1.05)	0.479
Years of schooling: mean (sd)		12.53(1.75)	12.19(1.96)	1.10 (0.97 to 1.25)	0.144

Table 3 shows univariate associations between risk factors and STI prevalence. Circumcised males were less likely to develop STIs than uncircumcised men, (OR 0.362, 95%CI 0.20–0.64, $p < 0.001$). Always using condoms was significantly protective for STIs (OR 0.291, 95%CI 0.13–0.67 $p = 0.004$), while using condoms with new female partners was not associated with STI protection. The enrolment age and years of schooling were weakly positively associated with STIs.

The six covariates were entered into a multiple logistic regression model. Using backward selection based on likelihood ratios, within four steps the final model containing circumcision, employment, and frequency of condom use remained. Circumcision remained strongly protective against STIs (OR 0.36, 95%CI 020-0.64, $p = 0.001$), after adjusting for employment, and condom use, as shown in Table 4.

Table 4: Multiple logistic regression model for risk factors for STIs

Factor	p value	Odds Ratio	Lower 95% CI	Upper 95% CI
Circumcised (yes vs no)	0.001	0.36	0.19	0.66
Employment	0.046			
Self-employed vs unemployed	0.160	2.01	0.76	5.32
Student vs unemployed	0.752	0.83	0.26	2.66
Employed vs unemployed	0.005	2.22	1.28	3.85
Other vs unemployed	0.469	2.84	0.17	48.31
Frequent use of condom with female partner(s)	0.022			
Sometimes vs never	0.607	0.83	0.40	1.71
Frequently vs never	0.116	0.51	0.22	1.18
Always vs never	0.009	0.32	0.13	0.75

Discussion

In this study, we found a high prevalence of 27.4% for STIs overall, and that uncircumcised males had double the prevalence (33.6%) compared to circumcised males (15.5%). We also found that circumcision reduced the risk of STIs by 64%, after adjusting for sociodemographic variables and risky sexual behavior variables. Medically circumcised males had a higher prevalence of STIs compared to traditionally circumcised males, however, further studies are needed to determine the effect of medial circumcision versus traditional male circumcision.

In 2007, UNAIDS and WHO concluded that the efficacy of male circumcision in reducing female to male transmission of HIV had been proved beyond reasonable doubt (17). The risk reduction that circumcision showed in our study is similar to three randomized controlled trials that evaluated male circumcision for the prevention of sexually transmitted infections. The trials found that circumcision decreased human immunodeficiency virus acquisition by 53–60%, herpes simplex virus type 2 acquisition by 28–34%, and human papillomavirus by 32 to 35% (16). Therefore, our study results add more support to the former findings. Furthermore, the protective effect of circumcision held after the adjustment for condom use and other factors, providing further evidence of its independent effect in reducing the risk of STIs.

Employed men were more likely to acquire STIs compared to unemployed men in our study. This may be partially due to the thriving commercial sex trade in this region(15). We also found that condoms were protective against STIs, which was expected (18). The control of STIs is an important public health priority for HIV prevention and included male circumcision, health education, condom promotion, and STIs and HIV testing.

Since this study was not a randomized controlled trial, it is also difficult to determine the causality of effect. We can merely state an association that is apparent in the data. Another limitation is that the risk behavior was determined by self- report of participants and risky behaviors might have been under-reported and may lead to potential information bias.

Conclusion

Male circumcision is associated with lower odds of sexually transmitted infections in a population with a relatively high STI prevalence and a 34% circumcision rate. Further evidence from robust randomized controlled trials may be required to assess the efficacy of male circumcision as a prevention tool against STIs in this population. The prevalence of STIs in culturally circumcised participants was slightly lower than that in medically circumcised participants (10.8% vs 17.7%), however, stratification by type of circumcision was not possible due to the low sample size of culturally circumcised individuals. A future study comparing these two populations with enough power in each group would be required to confirm any differences in STI risk.

Abbreviations

STI: Sexually transmitted infection

HIV: Human immunodeficiency virus

HSV2: Herpes simplex virus 2

MSM: Men who have sex with men

SPSS: Statistical package for social science

AOR: Adjusted odds ratio

CI: Confidence intervals

IRQ: Inter-quarter range

VMMC: voluntary medical male circumcision

Declarations

Ethics approval and consent to participate

In the parent study, the ethics approval was obtained at the University of Kwazulu Natal Health Research Ethics Committee (ethics reference no: BF059/08) and each participant provided written informed consent. For this sub-study ethics approval and waiver of informed consent was obtained from the Stellenbosch University Health Research Ethics Committee, as the study did not investigate objectives outside the primary study.

Consent for publication

Not Applicable

Availability of data and materials

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Competing interests

BMI – none declared

TC – none declared

TME – none declared

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Authors contributions

BMI – conception of, drafting of protocol, data analysis, writing up manuscript and approval for final submission.

TC - conception of, revision of protocol, revision of manuscript and approval for final submission

TME – conception of, revision of the protocol, revision of the manuscript, data analysis and approval for final submission

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