

Gender-related effects of expanded adult male circumcision programs in Southern Africa: The impact of relationship dynamics and potential risk compensation on heterosexual HIV transmission

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BACKGROUND

Adult male circumcision has been found in three randomized controlled trials conducted in African populations to reduce female-to-male HIV transmission by approximately 60%.

The potential for post-intervention risk-taking behavior to increase poses a significant threat to the successful use of any partially effective HIV prevention program, including adult male circumcision.

In the case of male circumcision, risk compensation may be gender-specific and circumcision would confer direct protection only to men. Little is known about whether this has a substantial impact in populations where women are less able to negotiate safe sex.

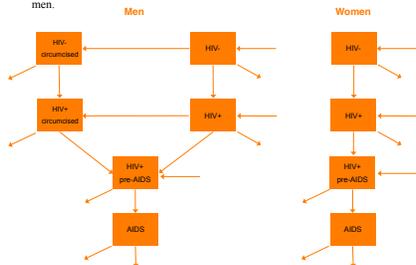
METHODS

We developed a dynamic, compartmental epidemic model (see diagram below) for heterosexual HIV transmission and disease progression to examine the population-level impact of expanded adult male circumcision programs on the HIV epidemic in Southern Africa.

We calculated annual rates of movement between population groups defined by gender (male/female), disease stage (HIV-, HIV+, AIDS, and death) and male circumcision status (uncircumcised/circumcised).

We simulated various program scenarios and explored the effects of subsequent changes in sexual risk behavior, using input parameters and estimates for the population of Soweto, South Africa as an example.

We used the model to predict the number of HIV infections averted over a 20-year period following 5-year expanded male circumcision programs, using varying assumptions regarding changes in post-intervention condom use for circumcised men.



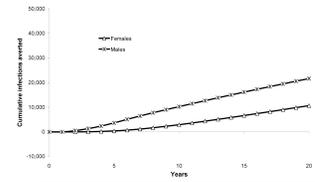
- Input data included (see parameter table below):
- (1) A sexually-active, anti-retroviral-naive population of 823,000 men and women
 - (2) Varying contact rates and per-partner infectivity rates, depending upon disease stage
 - (3) Exclusive male negotiation of condom use in heterosexual partnerships
 - (4) Circumcision efficacy of 61% in reducing FTM transmission
 - (5) Baseline circumcision levels of 35%
 - (6) Varying program coverage levels for the percentage of additional eligible uncircumcised men who were circumcised annually in the expanded program
 - (7) Gender differences in post-circumcision risk compensation

Parameter name	Value	Source
Preventive circumcision program parameters		
Percentage of uncircumcised uncircumcised or uncircumcised asymptomatic HIV- males circumcised annually	0.100-0.200, 165	Assumption
Circumcision protective effect (percent of partnerships protected from infection)	0.61	1
Percentage change in (male-negotiated) condom use following circumcision	(Range: -1.0 to 1.0)	Assumption
HIV transmission parameters		
Male infectivity (per-partner probability of transmission to a female)	0.0684-0.1657	2
Female infectivity (per-partner probability of transmission to a male)	0.1112-0.2697	2
Contact rate (number of new partners per year) of males or females	3	3
Uninfected or HIV infected, asymptomatic period	1	Assumption
HIV infected, AIDS	0	Assumption
Baseline (male-negotiated) condom use for all partnerships (without implementation of an adult male circumcision program)	0.5	4
Condom failure rate for all partnerships	0.14	4
HIV disease duration parameters		
Asymptomatic HIV infection (years)	6.8	11
Symptomatic HIV infection (years)	2.6	11
AIDS (years)	0.8	11
Population parameters, heterosexual men/males > 16 years		
Mean age (years)	25.1	12
Mean AIDS life expectancy (years)	69.8	12
Initial population size	823,000	12, 14
Initial HIV prevalence, male population (%)	11.6	4
Initial HIV prevalence, female population (%)	28.0	4
Initial circumcision rate, baseline male population (%)	0.35	15
Anting male population HIV prevalence (%)	0.03	14, 16
Anting female population HIV prevalence (%)	0.10	14, 16
Anting male population circumcision rate (%)	0.35	4

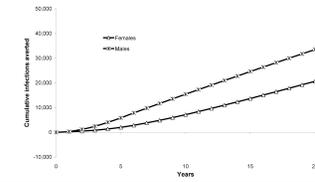
RESULTS

Assuming present levels of circumcision remain constant, 142,000 male and 102,000 female new HIV infections would occur in Soweto over the next 20 years

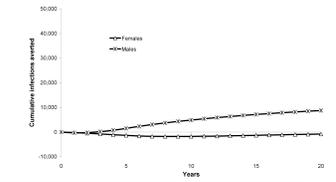
With **NO CHANGE** in average condom use post-circumcision, a 5-year program with 10% coverage would prevent 22,000 male infections and 11,000 female infections over 20 years



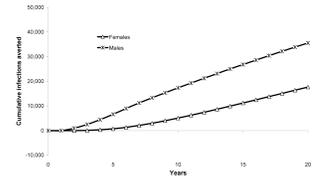
With a **25% INCREASE** in average condom use post-circumcision, the program would instead prevent 33,000 male infections and 21,000 female infections over 20 years



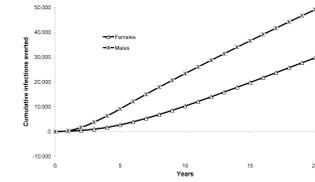
With a **25% DECREASE** in average condom use post-circumcision, the program would instead prevent 9,000 male infections but cause an **additional 1,000 (net) female infections** over 20 years



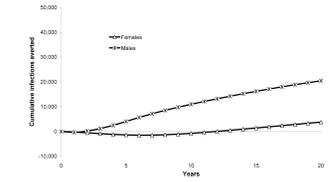
With **NO CHANGE** in average condom use post-circumcision, a 5-year program with 20% coverage would prevent 36,000 male infections and 18,000 female infections over 20 years



With a **25% INCREASE** in average condom use post-circumcision, the program would instead prevent 49,000 male infections and 30,000 female infections over 20 years



With a **25% DECREASE** in average condom use post-circumcision, the program would instead prevent 20,000 male infections and 4,000 (net) female infections over 20 years



CONCLUSIONS

- Programs offering male circumcision in Southern Africa may confer substantial health benefits in terms of HIV infections prevented, even for short-term programs with modest coverage goals. However, changes in sexual risk behaviors could greatly impact program outcomes and the consequences may be more severe for women.
- Women do not receive direct protection from male circumcision and they are therefore more vulnerable to risk compensation in men. This effect is magnified in societies where women have a decreased ability to negotiate safe sex, such as in the decision to use condoms.
- These factors will necessitate substantial risk-reduction counseling efforts in programs to expand male circumcision, which should be gender-specific and targeted to both men and women. Further, female-controlled methods for HIV prevention are urgently needed.