For debate

Male circumcision: assessment of health benefits and risks

Stephen Moses, Robert C Bailey, Allan R Ronald

Objectives: Globally approximately 25% of men are circumcised for religious, cultural, medical, or parental choice reasons. However, controversy surrounds the procedure, and its benefits and risks to health. We review current knowledge of the health benefits and risks associated with male circumcision.
Methods: We have used, where available, previously conducted reviews of the relation between male circumcision and specific outcomes as "benchmarks", and updated them by searching the Medline database for more recent information.
Results: There is substantial evidence that circumcision protects males from HIV infection, penile carcinoma, urinary tract infections, and ulcerative sexually transmitted diseases. We could find little scientific evidence of adverse effects on sexual, psychological, or emotional health. Surgical risks associated with circumcision, particularly bleeding, penile injury, and local infection, as well as the consequences of the pain experienced with neonatal circumcision, are valid concerns that require appropriate responses.
Conclusion: Further analyses of the utility and cost effectiveness of male circumcision as a preventive health measure should, in the light of this information, be research and policy priorities. A decision as to whether to recommend male circumcision in a given society should be based upon an assessment of the risk for and occurrence of the diseases which are associated with the presence of the foreskin, versus the risk of the complications of the procedure. In order for individuals and their families to make an informed decision, they should be provided with the best available evidence regarding the known benefits and risks.
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Departments of Medical Microbiology, Community Health Sciences and Medicine, University of Manitoba, Winnipeg, Manitoba, Canada
S Moses
A R Ronald

Division of Epidemiology and Department of Anthropology, School of Public Health, University of Illinois at Chicago, Chicago, Illinois, USA
R C Bailey

Correspondence to:
Stephen Moses, MD, Departments of Medical Microbiology, Community Health Sciences and Medicine, University of Manitoba, Basic Medical Sciences Building, Room 543, 730 William Avenue, Winnipeg, Manitoba R3E 0W3, Canada.

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Introduction

Ritualistic circumcision has been carried out in west Africa for over 5000 years, and in the Middle East for at least 3000 years.[1] In the United States and Canada, circumcision appeared as part of the medical culture during the late 19th and early part of the 20th century, and by the early 1970s, about 40% of Canadian and 80% of American newborns were being circumcised.[2] In 1971, because of insufficient evidence as to health benefit, the American Academy of Pediatrics adopted a position against routine neonatal circumcision, and the rate of the procedure in the United States declined to about 60% by the mid 1980s.[3] In 1989, in the light of new evidence regarding associations between lack of circumcision and various health risks, the American Academy of Pediatrics modified its position to one of neither supporting nor discouraging the practice,[4] and there is some evidence that the circumcision rate in the United States has increased again (for example, to over 80% among infants delivered in US army hospitals in 1990).[5] Currently, about one quarter of men in the world are circumcised, largely concentrated in the United States, Canada, countries in the Middle East and Asia with Muslim populations, and large portions of Africa. We review here the current state of knowledge on the association between male circumcision and important health benefits and risks, as well as on the foreskin and sexual health. We have used, where available, previously conducted reviews of the relation between male circumcision and specific outcomes as "benchmarks", and updated them by searching the Medline database for more recent information.

Human immunodeficiency virus infection

In 1994, we conducted a review of epidemiological studies investigating the association between male circumcision and risk for human immunodeficiency virus (HIV) infection.[6] Of 30 studies that were identified at that time, 26 were cross sectional, of which 18 from six countries reported a statistically significant association, four from four countries found a trend towards an association, and four from two countries found no association. There were also two prospective and two ecological studies identified which reported significant associations. Since that time, we have identified reports from an additional 11 cross sectional and five prospective studies. Of the 11 cross sectional studies, one was from Côte d'Ivoire,[7] two from India,[8 9] three from Kenya,[10–12] one from Rwanda,[13] three from Tanzania,[14–16] and one from Uganda.[17] Eight reported a statistically significant association between presence of the foreskin and HIV infection,[7–12 15 17] one reported a trend towards an association,[16] one reported no association,[14] and one reported an increased risk with circumcision.[13] To our knowledge, the latter report is the only one in

*Table 1 Summary of results of prospective studies investigating the association between lack of male circumcision and risk for HIV infection**

Study	*Country*	*Year(s) of study*	*Population*	*Sample size*	*% Circumcised*	*HIV seroconversion % (n/n)*	*Association†*	*Attempt to control for confounders*
1 Cameron *et al*[18]	Kenya	1986–7	Male STD patients	293	73.0	8.2 (24/293)	RR = 8.1 95% CI 3.4–19.7	RR adjusted for potential confounders, including indices of sexual behaviour
2 Tyndall *et al*[19]	Kenya	1990–1	Male genital ulcer disease patients	413	76.5	10.9 (45/413)	RR = 4.5 95% CI 2.6–7.7	Not reported
3 Telzak *et al*[23]	USA	1990	Male STD patients (heterosexual, non-drug using)	758	40.6	1.8 (14/758)	RR = 3.5 95% CI 0.8–15.8 (p = 0.11)	RR adjusted for potential confounders, including indices of sexual behaviour
4 Mehendale *et al*[8]	India	1993–5	Male STD patients	721	6.9	8.4 (95/1131)	RR = 3 (p = 0.11)	RR adjusted for potential confounders, including indices of sexual behaviour
5 Kassler *et al*[24]	USA	1994–5	Male STD patients	Cases: 65 Controls: 131	Cases: 35.3 Controls: 61.8	65 cases (seroconversions)	RR = 2.9 95% CI 1.3–6.3	RR adjusted for potential confounders, including indices of sexual behaviour
6 Lavreys *et al*[21]	Kenya	1993–5	Male trucking company employees	746	87.3	5.8 (43/746)	RR = 2.3 95% CI 1.0–5.1 (p = 0.03)	RR adjusted for potential confounders, including indices of sexual behaviour
7 Kapiga *et al*[22]	Tanzania	1992–5	Women attending family planning clinics	2471	2.1% of husbands	4.5 (47/1044)	RR = 3.4 95% CI 1.03–11.3	RR adjusted for potential confounders, including indices of sexual behaviour

*All studies involve HIV-1 and heterosexual transmission.
†Reported associations are from multivariate analysis where conducted. RR = risk ratio.

the literature in which, after controlling for potential confounding factors, male circumcision has been associated with an increased risk for HIV infection.

The two prospective studies reviewed in 1994 were both from Kenya.[18 19] The additional five prospective studies which have been identified since then are from India,[8 20] Kenya,[21] Tanzania,[22] and two from the United States.[23 24] The results of all seven are summarised in table 1. Four have been published as papers and three as conference abstracts. For one of them,[24] additional information was provided from the authors that was not included in the conference abstract. In five of the studies, statistically significant associations were found between lack of circumcision and risk for HIV acquisition. In the two remaining ones, multivariate risk ratios were three or above, but did not attain statistical significance. Each of these latter studies was limited by lack of statistical power, one because of a low proportion of circumcised men in the sample,[8] and the other because of a small number of HIV seroconversions observed.[23]

It has been pointed out that different sexual practices or hygienic behaviours can confound the association between circumcision status and HIV infection.[25 26] For example, ethnic groups which perform ritual circumcision may have different sexual behaviours from those which do not circumcise. Thus, different risks of becoming infected may be due to behavioural factors, not circumcision status. Recently, this has been found not to be the case in eastern Uganda and Rwanda, where circumcised men were found in fact to engage in higher risk behaviours than uncircumcised men.[27 28] In addition, non-circumcising groups in Africa are suggested to have their distribution largely because of outward diffusion over time of loss of the circumcision ritual.[29] There is little reason to expect sexual behaviours to diffuse in parallel with lack of circumcision. In a Ugandan study, although no differences were found in various self reported hygienic practices between circumcised and uncircumcised men,[30] both men and women felt that it was more difficult to maintain genital cleanliness in uncircumcised men. Further research is required to clarify the relation between genital hygiene and risk for HIV and other genital infections.

The effect of circumcision in reducing the rate of increase of HIV infection at the population level may be greater than suggested by the two to threefold reduction in prevalence observed in most epidemiological studies. As Koopman and Longini have shown, with infectious diseases, where a disease outcome in a given individual influences exposures and outcomes in other individuals, risk measured at the individual level underestimates effects at the population level.[31] They argue that disease transmission models should be used to analyse the relation between risk factors for transmission and outcomes. When such modelling is conducted to analyse the population level effect of a potential risk factor such as male circumcision on HIV prevalence, dramatic

effects can be demonstrated over time between populations where circumcision is practised and not practised.[32] The effect on populations can also be observed in ecological studies. Male circumcision is generally not practised in virtually all populations in which HIV seroprevalence exceeds 10% in "low risk" urban adult populations.[33 34]

Sexually transmitted diseases

The relation between the presence of the foreskin and sexually transmitted diseases (STDs) other than HIV is complex and varies with the individual STD. There is strong evidence for an association between ulcerative STDs (particularly chancroid and syphilis) and lack of circumcision in at least 11 studies.[12 18 35–43] We were unable to identify any studies with sufficient statistical power which reported increased risk with circumcision or no association. For genital herpes, two studies have reported statistically significant associations with lack of circumcision,[37 44] and four have reported no association.[43 45–47] For gonorrhoea, five studies have reported significant associations with lack of circumcision,[35 37 43 48 49] and two have reported no association.[47 50] For chlamydial, non-gonococcal, or other types of urethritis, two studies have reported a significant association with lack of circumcision,[34 48] three have reported increased risk with circumcision,[42 47 50] and three have reported no association.[43 45 47] For genital warts, one study has reported a significant association with lack of circumcision,[34] one increased risk with circumcision,[43] and one no association.[45] In addition, associations have been reported between the uncircumcised foreskin and the presence of anaerobes,[51 52] as well as Gram negative rods, streptococci, and mycoplasmas.[52] These may potentially be transmitted to women, contributing to the bacterial vaginosis syndrome. The above findings are summarised in table 2. Although there is some inconsistency among studies, there is good concordance for an association between lack of circumcision with chancroid, syphilis, genital herpes, and gonorrhoea. Only for urethritis other than gonorrhoea and genital warts is the evidence for an effect of circumcision inconclusive.

Penile carcinoma

In the 1989 review of the American Academy of Pediatrics' Task Force on Circumcision,[4] five major published studies of penile carcinoma in North America were identified, in which essentially all men with penile carcinoma had not been circumcised neonatally (circumcision later in life may not offer as much protection against penile carcinoma).[53] Similar observations have been reported from Africa.[54] Increased susceptibility to penile carcinoma among uncircumcised men may be mediated by the human papillomavirus.[55 56] A more recent case-control study from North America found a strong association between penile carcinoma and not being circumcised neonatally.[53] A cross sectional study from France found that penile intraepithelial neoplasia (PIN), which may be a precursor to penile carcinoma in some men, was also associated with lack of circumcision.[57] Although arguments have been advanced that improved hygiene will reduce the risk for penile carcinoma, there is no scientific evidence that this intervention is effective. It is estimated that about 750–1000 cases of penile carcinoma occur per year in the United States, virtually all among men who have not been circumcised at birth,[3] and mortality may be as high as 25%.[4] Neonatal circumcision reduces the risk for penile carcinoma by at least 10-fold, and probably by much more. It has been argued, however, that as most cases of disease occur in men over the age of 50, and as the disease is relatively rare (annual incidence of about 2 per 100 000 among uncircumcised men in North America),[3] neonatal circumcision is not a cost effective intervention with respect to the prevention of penile carcinoma alone.[58]

*Table 2 Summary of studies investigating the association between lack of male circumcision and risk for the "conventional" sexually transmitted diseases**

STD	*Number of studies reporting a protective effect of male circumcision*	*Number of studies reporting increased risk with male circumcision*	*Number of studies reporting no association*
Chancroid/syphilis	11	0	0
Genital herpes	2	0	4
Gonorrhoea	5	0	2
Urethritis other than gonorrhoea	2	3	3
Genital warts	1	1	1

*See text for references.

Cervical carcinoma

Cervical cancer is almost certainly a sexually transmitted disease, caused by oncogenic strains of the human papillomavirus.[4] Evidence linking risk for cervical cancer with uncircumcised male partners is largely ecological, drawing on the observation that cervical carcinoma is relatively uncommon in certain populations where men are generally circumcised.[59–61] In addition, a case-control study from India has reported that among women with one lifetime sexual partner, cervical cancer is significantly associated with having a husband who was not circumcised during the first year of life (risk ratio 4.1).[62] Although cervical and penile carcinoma are likely caused by the same agent, and penile carcinoma is strongly linked to the presence of the foreskin, a protective effect of circumcision of male partners with respect to the occurrence of cervical carcinoma remains to be demonstrated.

Urinary tract infections

In 1993, Wiswell and Hachey conducted a meta-analysis of studies reported in the literature which had investigated the association between lack of male circumcision and risk for urinary tract infection among male infants.[5] Nine studies were identified, six retrospective and three prospective. In all of the studies, uncircumcised infants were more likely to develop urinary tract infections than circumcised ones, with risk ratios ranging from 5 to 89. The meta-analysis yielded a pooled risk ratio of 12.0 (95% confidence interval 10.6–13.6, $p < 0.001$). Similar findings have been reported in older children[63 64] and adults.[65]

Bacterial adherence to the prepuce may explain the increased risk.[66] Although these infections can be readily treated, they are associated with expensive and at times invasive investigations, and occasionally lead to renal injury. The incidence of urinary tract infections among uncircumcised boys in the first year of life ranges from 0.9% to 5.3% in North American and European populations.[67] It has been argued, however, that if a higher incidence of urinary tract infection were the only untoward outcome of non-circumcision in the neonatal period, then the incidence would have to be much higher for the benefit of circumcision to outweigh the risk of complications.[68] It was noted, though that if other adverse outcomes were associated with lack of circumcision, then circumcision could become a preferred intervention.

Pain during circumcision

The 1989 review of the American Academy of Pediatrics' Task Force on Circumcision noted that infants undergoing circumcision without anaesthesia demonstrate physiological responses suggesting that they are experiencing pain and behavioural changes.[4] More recently, it has been reported that circumcised infants exhibit a stronger pain response to subsequent routine vaccination than uncircumcised infants.[69] Local anaesthesia should be applied in all cases of neonatal circumcision,[70] either through dorsal penile nerve block,[71] the application of topical lignocaine-prilocaine cream,[72] or both.

Complications of the circumcision procedure

The 1989 review of the American Academy of Pediatrics' Task Force on Circumcision reported that the rate of postoperative complications of male circumcision was approximately 0.2% to 0.6%. The majority of complications are minor, the most common being local infection and bleeding, although two deaths from the procedure did occur in the United States over a 25 year period.[4] Another review has indicated that the complication rate may be somewhat higher, in the order of 0.2% to 2%.[73]

Sexual and psychological issues

Long term psychological, emotional, and sexual adverse effects from male circumcision have been claimed by some, but we were able to find only anecdotal accounts,[74] and scientific evidence is lacking. A longitudinal study which began in 1946 in Britain and followed more than 5000 individuals from birth to age 27 found no difference between uncircumcised and circumcised males in relation to a number of developmental and behavioural indices.[75] Although some maintain that male circumcision interferes with sexual satisfaction,[74] few studies have addressed this issue. In an American study examining female attitudes to male circumcision, 87% of college aged women expressed preference for pictures of circumcised penises over uncircumcised ones,[76] and when asked why they preferred to have sex with a circumcised man, 90% of a sample of predominantly white US women responded that it "looked sexier". Among women whose partners were uncircumcised, over 50% expressed preference for vaginal sex with a circumcised man, and this proportion was much higher if oral sex was considered. Among Ugandan tribes that do not generally practise male circumcision, women have indicated that they derive greater sexual pleasure from circumcised men.[30]

Laumann *et al*,[47] in a survey of more than 1400 American men, found that circumcised men reported a more highly elaborated set of sexual practices, and were slightly less likely than uncircumcised men to experience various sexual difficulties. There is indirect evidence suggesting that the foreskin may have an important sensory function,[77] although aside from anecdotal reports, it has not been demonstrated that this is associated with increased male sexual pleasure. Some loss of sensory function may not be an important consideration, or may not even be felt to be disadvantageous by men and women more troubled by premature ejaculation than concerned with increased penile sensitivity.[78] However, few studies have investigated the relation between male circumcision and sexual pleasure or satisfaction; more research is needed to clarify the role of the foreskin in sexual health.

Conclusion

In summary, substantive evidence supports the premise that circumcision protects males from HIV infection, penile carcinoma, urinary tract infections and ulcerative sexually transmitted diseases. Although we could find little scientific evidence of significant adverse effects on sexual, psychological, or emotional health, there are surgical risks associated with circumcision. A decision as to whether to recommend male circumcision in a given society should be based upon an assessment of the risk for and occurrence of the diseases which are associated with the presence of the foreskin, versus the risk of the complications of the procedure. Further analyses of the utility and cost effectiveness of male circumcision should be made in the light of currently available information. Although it may be debatable to recommend circumcision to reduce the risk of acquiring any one of the diseases noted above in isolation, taken together reduction in their overall risk appears compelling.

While the decision to circumcise or not is often made more on the basis of sociocultural values than medical knowledge,[79] people's preferences can be changed by information provided by health professionals, as indicated previously in relation to neonatal circumcision in the United States and the changing recommendations of the American Academy of Pediatrics. Experience from Africa may be similar. In eastern Uganda, 27% of uncircumcised men have indicated that they would opt for circumcision if the procedure could be performed at minimal cost, and 33% have indicated that they would choose to have their sons circumcised.[27] In South Africa, some indigenous healers have

advised their uncircumcised male clients to be circumcised to avoid STDs and HIV infection.[80] It has also been observed in east Africa that, with the widespread publicity given to studies finding an association between lack of circumcision and HIV infection, clinics specialising in male circumcision have opened, and men now come to hospitals and clinics in increasing numbers to request circumcision for themselves and their sons.[81]

While some argue against performing neonatal circumcision without the affected newborn male's consent, many men who later elect or require circumcision to treat phimosis or recurrent balanitis face a significant surgical procedure that would have been relatively minor if performed as an infant. It has been estimated that 10–15% of males not circumcised at birth will require the procedure later in life because of such problems.[82] Removal of the foreskin could be viewed as preventive care, analogous to other procedures, such as immunisation, which are administered to children without their consent. If male circumcision is to be promoted in any region, it should be in conjunction with the range of effective interventions available (for example, condom promotion, behavioural change, and STD prevention and treatment to prevent HIV infection). In addition, adequate safety measures should be in place, and operational requirements must be met.[6 25] Since cultural traditions and social values are often paramount in the decision whether to circumcise or not,[76 79] there is need not only for clear explanations of the health risks and benefits of circumcision, but also for the ability by health professionals to act as cultural brokers, honouring clients' perceptions of health and optimal sexual function.

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Notes