Male circumcision does not result in inferior perceived male sexual function – a systematic review

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ABSTRACT

INTRODUCTION: The debate on non-medical male circumcision has gaining momentum during the past few years. The objective of this systematic review was to determine if circumcision, medical indication or age at circumcision had an impact on perceived sexual function in males.
METHODS: Systematic searches were performed in MEDLINE and EMBASE. The included studies compared long-term sexual function in circumcised and non-circumcised males, before and after circumcision, or compared different ages at circumcision. The quality of the studies was assessed according to the level of evidence (Grade A-D).
RESULTS: Database and hand searches yielded 3,677 records. Inclusion criteria were fulfilled in 38 studies including two randomised trials. Overall, the only identified differences in sexual function in circumcised males were decreased premature ejaculation and increased penile sensitivity (Grade A-B). Following non-medical circumcision, no inferior sexual function was reported (A-B). Following medical circumcision, most outcomes were comparable (B); however, problems in obtaining an orgasm were increased (C) and erectile dysfunction was reported with inconsistency (D). A younger age at circumcision seemed to cause less sexual dysfunction than circumcision later in life.
CONCLUSIONS: The hypothesis of inferior male sexual function following circumcision could not be supported by the findings of this systematic review. However, further studies on medical circumcision and age at circumcision are required.

Male circumcision is performed for cultural, religious and medical reasons with a prevalence of about one third of the world's male population [1]. The focus on non-medical male circumcision has been gaining momentum in public debate in both Europe and the United States over the past few years. The Danish College of General Practitioners has defined non-medical circumcisions as mutilation [2]. Some Danish medical professionals [3-6], Danish activists [7], and parliament members [8] have promoted the narrative that male circumcision results in decreased penile sensitivity or other types of male sexual dysfunction.

Circumcision carries a risk of complications like any other surgical intervention. Studies from Europe and the United States report overall complication rates of 0.19-3.8% [9]. Complication rates are lower if circumcision is performed during infancy, by experienced providers and under sterile conditions [10]. A Danish study from Rigshospitalet [11] reported an overall complication rate of 5.1% following circumcision in children 0-16 years of age. Short-term complications comprised superficial skin infections (0.6%), bleeding (1.6%) and anaesthesiology complications (0.6%). Long-term complications included re-operations due to meatal stenosis (0.6%). No major complications such as amputation or death were seen [11]. An age stratification of the data from the Danish study showed lower complication rates in younger boys. These rates were comparable to the relatively low complication rates previously reported in US studies [12]. The Danish Health Authorities do not recommend a law-enforced ban of non-medical circumcisions in Denmark based on these low rates of short-term complications; however, they do stress the lack of evidence with respect to long-term complications and male sexual function [13].

Inferior sexual function following circumcision is suggested to be caused by loss of sensory tissue followed by keratinisation and desensitisation of the glans penis [14-16]. This hypothesis is generated by two histopathological findings; the description of Meissner's corpuscles in human prepuce and longer epithelial extensions into underlying connective tissue (rete ridges) in the dorsal glans of the circumcised penis [14, 17].

The purpose of the present study was to test the hypothesis of increased sexual dysfunction in circumcised men through a systematic review of the literature and to perform a detailed synthesis of the available evidence in order to guide patients, parents and decision-makers on male circumcision.

The objective was to determine if circumcision had an impact on sexual function in males defined as perceived and self-reported erectile dysfunction, pain during intercourse, premature ejaculation, problems in obtaining orgasm, sexual drive, penile sensitivity or sexual satisfaction. A second objective was to determine whether medical circumcision or age at circumcision influenced perceived male sexual function.

METHODS

A protocol including outcomes and overall design was written before searches were performed. Systematic searches were performed in the MEDLINE and EMBASE

> ! **KEY POINTS**

The debate about male circumcision has gained momentum in Denmark during the past few years. A narrative about circumcision and sexual dysfunction has been promoted by some medical professionals, activists and parliament members.

The objective of this study was to perform a systematic review to determine whether circumcision had an impact on perceived sexual function in males and to determine the impact of age at circumcision.

Non-medical circumcision was not associated with perceived sexual dysfunction.

Following medical circumcisions, premature ejaculation was decreased and sexual satisfaction increased. Results for erectile dysfunction were reported with inconsistencies.

Higher age at circumcision was associated with sexual dysfunction in adulthood.

Studies on medical circumcision and age at circumcision are of lower quality than studies on non-medical circumcisions. Results may therefore be biased by pre-existing pathology in prepuce.

More studies on medical circumcision and age at circumcision are needed.

databases. Exploded index terms (MeSH) were "Circumcision, male" or "Circumcision" in combination with "Sexual dysfunction, physiological", "Sexual dysfunction, psychological", "Sexual dysfunction", "Sexual arousal disorder", "Premature ejaculation", "Ejaculation disorder", "Ejaculation", "Erectile dysfunction", "Penile erection", "Orgasm", "Orgasm disorder", "Libido", "Libido disorder", "Sensibility" or "Sexual satisfaction". Keywords were circumcision in combination with sensitivity, sensibility, sensory, neuro*, erectile, ejaculation, orgasm, libido, lust, desire, satisfaction, or sex*. Final searches were performed on 29 February 2016. Additional hand-searches were performed through screening reviews, original studies and their reference lists. Endnote X7 was used for management of references.

Study selection included a screening of titles and abstracts by the primary author (DMS). Full texts of eligible studies were obtained and screened for the inclusion criteria by two authors independently (SD and DMS). Discrepancies were resolved through discussion until consensus was reached between all three authors. The following inclusion criteria were applied:

1. Circumcision was the exposure or intervention.
2. Non-exposed controls were either a) uncircumcised participants, b) same participants assessed before circumcision, or c) individuals circumcised at different ages.
3. Outcomes had to include perceived adult male sexual function as defined in the previously mentioned objective. A long-term follow-up period was required.
4. All study designs including a non-exposed control were included. Statistical testing had to be performed in order to compare outcomes of exposed and non-exposed groups. A significance level of $p < 0.05$ was used to reject the null hypothesis of no difference between exposed and non-exposed participants.

All publication types indexed in databases and all languages were accepted. Chinese studies were translated orally by a fellow PhD student.

Data extraction from studies was performed onto preformatted sheets including the first author's name, year of publication, country, overall study design, number of participants circumcised and non-circumcised, indication for circumcision, rates for medical and non-medical circumcisions, age at circumcision, follow-up length, lost to follow-up and age adjustment. Based on the results of statistical testing, outcomes in circumcised males were defined as "increased", "decreased" or "non-significant". Erectile dysfunction, pain, premature ejaculation, difficult ejaculation and problems in obtaining orgasm were defined as negative outcomes; and increased levels of sexual drive, penile sensitivity and satisfaction were defined as positive outcomes. If available, estimates adjusted for age were reported. Data extraction was performed by the primary author and reviewed by the co-authors.

The questionnaires used in the identified studies varied with respect to their assessment of ejaculatory function. Some assumptions therefore had to be made for this systematic review. The Brief Male Sexual Functioning Inventory and Male Sexual Health Questionnaire described difficulties in ejaculation, which was included as a separate outcome [18, 19]. The International Index of Erectile Function assessed problems in obtaining an orgasm [20]. The Premature Ejaculation Diagnostic Tool assessed premature ejaculation [21]. Where possible, results from these questionnaires were extracted for each sub-domain of erectile function, ejaculation, drive and satisfaction.

The quality of each study was assessed through levels of evidence for therapy developed by The Oxford Centre for Evidence-based Medicine in 2009 and 2011 [22, 23]. In brief, assessments were performed at the outcome level with the possibility of downgrading if studies failed to measure exposures and outcomes in the same way in both exposed and non-exposed participants, failed to control known confounders, or failed to carry out sufficiently follow-up [22]. A cohort study only assessing sexual function retrospectively was downgraded due to inconsistencies in measuring outcomes and exposure causing recall bias. Both randomised studies and cohort studies were downgraded if the

share of patients lost to follow-up exceeded 20% or if loss to follow up was not reported. Age at assessment and medical indication for circumcision were chosen as possible confounders. Sexual difficulties have a rising prevalence with age in men [24] and the indications for circumcision differ with age as well. Studies were downgraded if age was not included in the design through randomisation, through prospective assessments in cohort studies at fixed or short periods of follow-up or through matching. Age could also be included in the analysis through adjustment or stratification. Indication for circumcision was considered mainly medical or non-medical if reported as such in more than half of the circumcisions performed in the study.

Randomised controlled trials were assessed for random sequence generation, allocation concealment, attrition and blinding of outcome assessment as recommended by the Cochrane Handbook [25]. Blinding of participants or personnel was unfeasible because of the nature of circumcision. If the statistical significance of the intervention and control group had a small absolute effect size, the study was downgraded [23].

Perceived sexual function outcomes in circumcised males was reported overall across studies. Subgroup analyses were performed for circumcised versus uncircumcised males, before versus after circumcision, and both were stratified by medical indication for circumcision. Evidence for each outcome was summarised as Grade A-D with A indicating the highest level of evidence. In studies that had the same level of evidence, statistically significant results were given higher priority than non-significant results, and inconsistencies between statistically significant results were graded D [22]. Reporting was performed according to the PRISMA statement [26].

RESULTS
The database searches yielded 3,673 records and the hand searches identified four additional studies [27-30]. Of 171 eligible studies, 133 were excluded leaving 38 studies for inclusion in this systematic review (**Figure 1**). The included studies comprised 36 observational studies and two randomised controlled trials. The studies were performed in Asia, The Middle East, North and South America, Europe, Africa and Australia.

Indications for circumcision were mainly non-medical in 11 studies, medical in ten studies and not reported in 17 studies. Age at circumcision was categorised as adulthood or non-infancy in 22 studies, infancy in one study and childhood in three studies (**Table 1**).

Nine cohort studies had a risk of attrition bias due to insufficient completion of follow-up [28, 31-38], and ten observational studies did not adjust for age [28, 29, 37-44]. A risk of recall bias was present in four retrospective cohort studies [28, 36-38] (Table 1).

The two randomised controlled trials had adequate random sequence generation, allocation concealment [45, 46], and follow-up at one year. No blinding of outcome assessment was performed [47, 48]. One trial was graded down due to a very small absolute effect size, where 98.0-99.4% had a positive sexual function at baseline and an almost equally high sexual function (98.7-99.9%) at follow-up in both arms [47].

A qualitative synthesis without meta-analysis was chosen due to considerable clinical heterogeneity in circumcision indications and procedures, study designs, quality and reporting of results in the identified studies.

Overall sexual function and circumcision status
When all studies were assessed without stratification, non-significant differences were found for erectile dysfunction, pain, problems in obtaining an orgasm, satisfaction (Grade A) and difficult ejaculation (Grade B) (**Table 2**) in circumcised compared with uncircumcised males. Premature ejaculation was decreased (Grade A) (Table 2), drive and penile sensitivity were increased (Grade B) in the circumcised participants (**Table 3**).

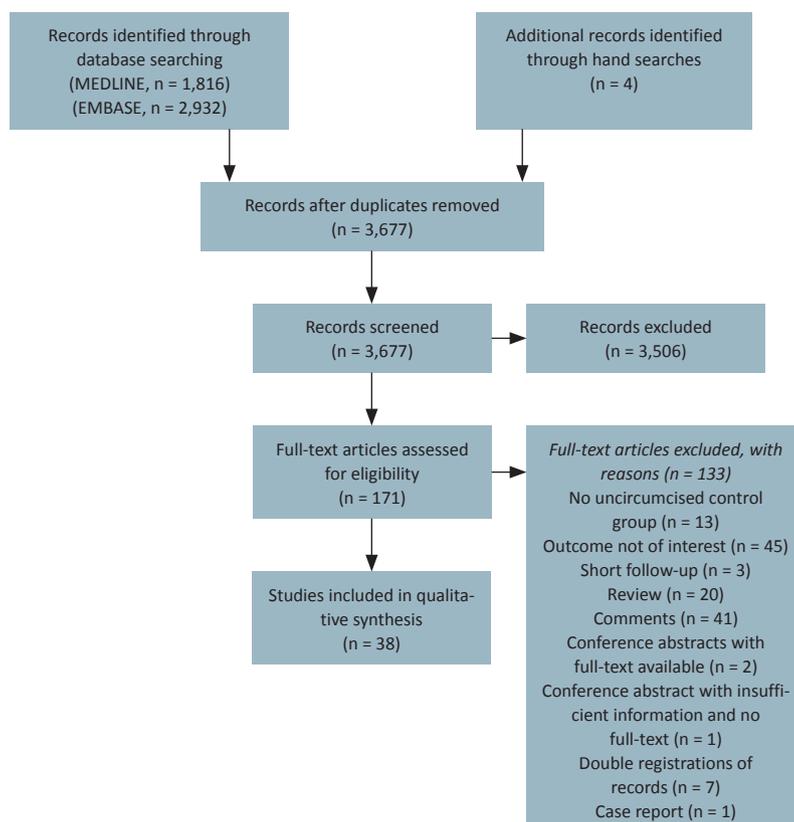**FIGURE 1**

Study flow (PRISMA) diagram.

TABLE 1

Characteristics of included studies. Studies are sorted according to study design, indication for circumcision, and year of publication.

Reference, year, country	Design	Participants, total or circumcised/ uncircumcised, n	Indication for circumcision	Age at circumcision	Adjustment for age in design or in multiple analyses	Follow-up length	lost to, %
Kigozi et al, 2008, Uganda [47]	Randomized controlled trial	2,210/2,246	Non-medical: HIV prevention	15-49 yrs	Yes	1 yr/2 yrs	10/66
Krieger et al, 2008, Kenya [48]	Randomized controlled trial	1,313/1,371	Non-medical: HIV prevention	18-24 yrs	Yes	1 yr/2 yrs	11/48
Senkul et al, 2004, Turkey [31]	Prospective cohort	42	Religious/cosmetic	Adult	Yes	12 wks	–
Senol et al, 2008, Turkey [32]	Prospective cohort	43	Non-medical	Adults	Yes	Min. 12 wks	–
Decastro et al, 2010, USA [69]	Prospective cohort	30	Non-medical 68%, medical 32%	Adult	Yes	8-10 wks	7
Senel et al, 2012, Turkey [33]	Prospective cohort	142	Religious	Adult	Yes	12-52 mo.	24
Alp et al, 2014, Turkey [34]	Prospective cohort	30	Voluntary	Adult	Yes	3 mo.	–
Yang et al, 2014, Taiwan [63]	Prospective cohort	442	Non-medical 56%, medical 44%	Adult	Yes	90 days	0
Zulu, 2015, Zambia [30]	Prospective cohort	257	Non-medical: HIV prevention	Adult	Yes	6-12 mo.	0.4
Collins et al, 2002, USA [70]	Prospective cohort	15	Medical 93%, cosmetic 7%	Adult	Yes	12 wks	0
Shen et al, 2004, China [71]	Prospective cohort	95	Medical: phimosis, balanitis, condyloma	Adult	Yes	1 yr	0
Masood et al, 2005, England [35]	Prospective cohort	88	Medical: phimosis, balanitis	Adult	Yes	Min. 3 mo.	41
Zhang et al, 2006, China [64]	Prospective cohort	51/29	Medical: redundant prepuce	Adult	Yes	18 mo.	4
Cortés-Gonzalez et al, 2009, Mexico [72]	Prospective cohort	22	Medical 72%, aesthetic 14%	Adult	Yes	12 wks	0
Yu et al, 2009, China [73]	Prospective cohort	40	Medical: redundant prepuce, balanitis	Adults	Yes	4 mo.	0
Yue et al, 2014, China [74]	Prospective cohort	98	Medical: phimosis, abundant foreskin	Adults	Yes	19 (9-28) mo.	0
Gao et al, 2015, China [65]	Prospective cohort	575/623	Medical: phimosis and balanitis	Adult	Yes	1 yr	17
Feldblum et al, 2015, Kenya [28]	Retrospective cohort	194	Voluntary	Adult	No	Median 32 mo.	–
Fink et al, 2002, USA [36]	Retrospective cohort	43	Medical 86%, non-specified 14%	Adult	Yes	–	56
Kim et al, 2007, South Korea [37]	Retrospective cohort	255/118	–	Adults	No	–	–
Dias et al, 2014, Portugal [38]	Retrospective cohort	62	Medical: phimosis, balanitis, condyloma	Adult	No	Min. 3 mo.	23
Mao et al, 2008, Australia [49]	Cross-sectional	939/487	Routine 91%	Infants 91%, after infancy 9%	Yes	–	–
Laumann et al, 1997, USA [75]	Cross-sectional	1,449	–	–	Yes	–	–
Laumann et al, 1999, USA [27]	Cross-sectional	1,202	–	–	Yes	–	–
Richters et al, 2006, Australia [76]	Cross-sectional	5,972/4,201	–	–	Yes	–	–
Son et al, 2010, Korea [77]	Cross-sectional	600	–	–	Yes	–	–
Ferris et al, 2010, Australia [78]	Cross-sectional	2,317/1,973	–	–	Yes	–	–
Frisch et al, 2011, Denmark [50]	Cross-sectional	103/1,893	11% had non-Danish parents, 6% were Moslims or Jews among the circumcised	15% before age 6 mo.	Yes	–	–
Tang & Khoo, 2011, Malaysia [39]	Cross-sectional	110/97	–	–	No	–	–
Shaeer & Shaeer, 2012, Egypt [43]	Cross-sectional	796/8	–	–	No	–	–
Bronselaer et al, 2013, Belgium [40]	Cross-sectional	310/1,059	–	Birth or childhood < 10 yrs 56%, adolescence or adulthood > 10 yrs 44%	No	–	–
Hoschke et al, 2013, Germany [51]	Cross-sectional	167/2,332			Yes: erectile dysfunction only	–	–
Shaeer O, 2013, USA [44]	Cross-sectional	909/224	–	–	No	–	–
Homfray et al, 2015, England [52]	Cross-sectional	954/3,862	–	–	Yes	–	–
Payne et al, 2007, Canada [58]	Case-control	20/20	–	–	Yes	–	–

TABLE 1 CONTINUED

Reference, year, country	Design	Participants, total or circumcised/ uncircumcised, n	Indication for circumcision	Age at circumcision	Adjustment for age in design or in multiple analyses	Follow-up length	lost to, %
Studies exploring age at circumcision and sexual function only							
Aydur et al, 2007, Turkey [41]	Cross-sectional	107	–	0-2 yrs 11%, 3-5 yrs 27%, 6-12 yrs 62%	No	–	–
Cüceloğlu et al, 2012, Turkey [29]	Cross-sectional	80	–	0-3 yrs 27.5%, 3-7 yrs 27.5%, 7-11 yrs 27.5%, > 11 yrs 17.5%	No		
Armagan et al, 2014, Turkey [42]	Cross-sectional	302	–	Phallic period 3-6 yrs 45%, non-phallic period 55%	No	–	–

Circumcised versus uncircumcised

Sexual function outcomes in circumcised versus uncircumcised participants were reported in 19 studies (Table 2). In non-medically circumcised participants, non-significant differences were found for erectile dysfunction, pain, problems in obtaining an orgasm, satisfaction (Grade A), difficult ejaculation and drive (Grade B). Premature ejaculation was significantly decreased (Grade A). No assessment for penile sensitivity was identified. In medically circumcised participants, a non-significant difference was found for erectile dysfunction (Grade B). Premature ejaculation was found to be decreased and satisfaction increased (Grade B). No assessments for pain, difficult ejaculation, problems in obtaining an orgasm, drive or sensitivity were identified (Table 2).

Before versus after circumcision

Sexual function in participants undergoing circumcision was reported in 21 studies (Table 3). Following non-medical circumcision, difficult ejaculation was non-significantly changed (Grade B). Erectile dysfunction, pain, premature ejaculation and problems in obtaining an orgasm were decreased (Grade B). Drive, penile sensitivity and satisfaction were increased (Grade B). Following medical circumcisions, pain, difficult ejaculation, drive and sensitivity were non-significantly changed (Grade B). Premature ejaculation was decreased and satisfaction increased (Grade B). Problems in obtaining an orgasm were increased (Grade C) and results for erectile dysfunction were reported with inconsistency (Grade D) (Table 3).

Age at circumcision

Five studies reported adult sexual function outcomes for participants who were circumcised as children or infants compared with participants who were circumcised later in life [29, 40-42, 49]. Four of these did not report indication or adjust for age at assessment [29, 40-42] (Table 1). Circumcision after infancy was associated with non-significant differences in satisfaction, increased erection difficulties and decreased premature ejaculation (Grade B). Indication for circumcision after infancy was reported in 49% and the most frequent indication was phimosis [49]. Adult circumcision caused increased pain at intercourse and decreased satisfaction (Grade C) [40]. Circumcision above the age of seven caused increased premature ejaculation (Grade C) [29]. When comparing age groups of 0-12 years or the specific period of 3-6 years at circumcision, non-significant differences were found for erectile dysfunction, premature ejaculation, problems in obtaining orgasm, desire and satisfaction (Grade C) [41, 42].

DISCUSSION

The results of the present systematic review indicate that non-medical circumcision does not generally seem to cause an inferior male sexual function at a statistically significant level (Grade A-B). Following medical circumcisions, erectile dysfunction, pain, difficult ejaculation, drive and sensitivity were all found to be non-significantly changed, whereas premature ejaculation decreased and satisfaction improved (Grade B). However, inconsistencies in reporting of erectile dysfunction (Grade D) were identified in studies with the same level of evidence, and problems in obtaining an orgasm were increased (Grade C). A higher age at circumcision was associated with negative sexual function (Grades B-C). Studies not reporting indication for circumcision did not reach a high enough level of evidence for assessment of overall sexual function, and some reported inconsistent results when compared with studies of a higher level of evidence.

Best level of evidence including randomised controlled trials was identified only for non-medical circumcisions. Although many of the outcomes of non-medical circumcisions were from one well-designed randomised study, outcomes from lower-quality studies were also consistent with a conclusion of no negative impact on sexual function in circumcised males [48]. Satisfaction was decreased in one randomised study; however, absolute effects were negligible and probably a chance finding due to a type 1 error [47]. Among studies not reporting the indication for circumcision, four were performed in countries where non-medical circumcisions are uncommon and indications were therefore most likely medical [40, 50-52]. Sexual function following medical circumcisions was explored in non-randomised studies only and reported with some inconsistencies. Age at circumcision was only explored in studies including circumcised participants. Optimally, such studies should compare different ages of circumcision to age-matched non-circumcised controls at outcome assessment. Therefore, studies on medical circumcision and on age at circumcision were more biased than studies about non-medical circumcisions; and conclusions should accordingly be interpreted with caution. The discrepancy between sexual outcomes following medical and non-medical circumcisions identified in this systematic review has been reported before and it has been suggested that it is confounded by penile pathology causing sexual dysfunction prior to circumcision [49]. Adult medical circumcision is most often performed due to pathological conditions in prepuce, which presumably causes inferior sexual function and mental health disturbances [53-55]. Hence, pre-circumcision penile pathology may explain the identified discrepancies in obtaining an orgasm when comparing medical and non-medical circumcisions (Table 3) as well as the discrepancies in the results of the many studies not reporting indication when compared with results from studies reporting indication (Table 2 and Table 3). Therefore, circumcision serves as a proxy for underlying penile pathology, and studies including participants with mainly medical circumcision therefore measure the impact of pathology on sexual function rather than the impact of circumcision. Such selection bias and confounding are best avoided through a randomised design, and future observational studies should at least perform stratification or adjustment for penile pathology.

TABLE 2

Subjective sexual outcomes in circumcised versus uncircumcised in randomised, cross-sectional, and case-control studies. Studies are sorted according to indication for circumcision and level of evidence.

Reference, year	Level of evidence	Erectile dysfunction	Pain	Premature ejaculation	Difficult ejacula-tion	Problems in obtaining orgasm	Drive	Penile sensitivity	Satisfaction
Non-medical indication									
Krieger et al, 2008 [48]	1a	NS[a]	NS[a]	Decrease[a]	–	NS[a]	–	–	NS[a]
Kigozi et al, 2008 [47]	2b	NS	NS		NS[a]		NS	–	Decrease
Mao et al, 2008 [49]	2c	NS	–	NS	–		NS	–	NS
Medical indication									
Zhang et al, 2006 [64]	2c	–	–	–	–	–	–	–	Increase
Gao et al, 2015 [65]	2c	NS	–	Decrease	–	–	–	–	Increase
Indication not reported									
Laumann et al, 1997 [75]	2c	Decrease in 45-59 yrs	NS	NS	–	NS	NS	–	Increase in 45-59 yrs
Laumann et al, 1999 [27]	2c	NS	–	NS	–	–	NS	–	–
Richters et al, 2006 [76]	2c	Decrease	Decrease	NS	–	NS	NS	–	NS
Son et al, 2010 [77]	2c	–	–	NS	–		–	–	–
Ferris et al, 2010 [78]	2c	NS	NS	NS	–	NS	NS	–	NS
Frisch et al, 2011 [50]	2c	NS	NS	NS	–	Increase	NS	–	NS
Hoschke et al, 2013 [51]	2c	NS	–	–	–	–	–	–	–
Homfray et al, 2015 [52]	2c	NS	NS	NS	–	NS	NS	–	NS
Payne et al, 2007 [58]	3b	NS	–	–	–	NS	NS	–	NS
Tang & Khoo, 2011 [39]	4	–	–	Increase	–	–	–	–	–
Shaeer & Shaeer, 2012 [43]	4	–	–	NS	–	–	–	–	–
Bronselaer et al, 2013 [40]	4	–	Increase shaft, NS in glans	–	–	Increase lateral glans, NS other sites	–	Decrease	Decrease glans, NS shaft
Shaeer O, 2013 [44]	4	–	–	NS	–	–	–	–	–
Kim et al, 2007 [37]	4	NS	–	–	NS	–	NS	–	–

NS = non-significant.
a) The overall highest level of evidence.

Risks of observer and selective reporting bias were present in the included studies since none had blinded outcome assessment, only half of the studies included validated questionnaires and some studies reported only parts of questionnaires. Health-promoting beliefs related to non-medical circumcisions are present in some cultures [56] and may have caused overestimation of perceived sexual function towards the positive. Other limitations included short follow-up periods of 1-2 years in the prospective studies. Many results were non-significant, possibly due to small sample sizes causing a risk of type II error. Most studies focused on the heterosexual practice of intravaginal intercourse and did not take into account other important heterosexual or homosexual practices that comprise male sexual function.

The strength of this systematic review was the broad search strategy and the inclusion of non-English literature, thereby including participants from all populated continents. The qualitative assessment of the existing literature focused on minimising bias. The stratification by medical indication was performed in order to explore confounding. Other possible confounding factors such as cardiovascular, neurological, and psychiatric co-morbidities, illegal substances, complications to surgery, lifestyle and drugs such as use of psychopharmaceuticals may contribute to an inferior sexual function. Some of the studies adjusted for these factors; however, many of the factors are age-dependent why adjustment for age at assessment was most important. The limitation was the inability to perform a meta-analysis. A pooled analysis could, possibly, have identified more significant associations.

This systematic review focused on the participant-centred sexual function. A number of experimental tudies have investigated male sexual function through objective measures. In circumcised compared with uncircumcised males, differences in sensory tactile thresholds have been found to be non-significant [57-59] and increased [60, 61], and differences in ejaculatory latency period have been found to be non-significant [37, 62, 63] as well as increased [31, 32, 34, 64, 65]. Differences in penile temperature, penilo-cavernous reflexes and

TABLE 3

Subjective sexual outcomes before versus after circumcision in cohort studies. Studies are sorted according to indication for circumcision and level of evidence.

Reference, year	Level of evidence	Erectile dysfunction	Pain	Premature ejaculation	Difficult ejaculation	Problems in obtaining orgasm	Drive	Penile sensitivity	Satisfaction
Non-medical indication									
Krieger et al, 2008 [48]	2b	Decrease	Decrease	Decrease	–	Decrease	–	Increase[a]	Increase
Kigozi et al, 2008 [47]	2b	Decrease	Decrease	–	NS[a]	–	NS	–	NS
Decastro et al, 2010 [69]	2b	NS	–	–	NS[a]	–	–	–	NS
Yang et al, 2014 [63]	2b	NS	–	–	NS[a]	–	Increase[a]	–	NS
Zulu, 2015 [30]	2b	NS	–	–	–	Decrease	Increase[a]	–	Increase
Senkul et al, 2004 [31]	4	NS	–	–	NS	–	NS	–	NS
Senol et al, 2008 [32]	4	NS	–	–	NS	–	NS	–	NS
Senel et al, 2012 [33]	4	Decrease	–	–	NS	–	NS	–	Increase
Alp et al, 2014 [34]	4	–	–	Decrease	–	–	–	–	–
Feldblum et al, 2015 [28]	4	NS	–	–	–	–	–	–	Increase
Medical indication									
Collins et al, 2002 [70]	2b	NS	–	–	NS	-	NS	–	NS
Zhang et al, 2006 [64]	2b	–	–	–	–	–	–	–	Increase
Cortés-Gonzalez et al, 2009 [72]	2b	Decrease	NS	NS	–	–	NS	NS	NS
Yu et al, 2009 [73]	2b	NS	–	–	NS	–	NS	–	NS
Yue et al, 2014 [74]	2b	NS	–	–	NS	–	NS	–	NS
Gao et al, 2015 [65]	2b	NS	–	Decrease	–	–	–	–	Increase
Shen et al, 2004 [71]	2b	Increase	–	–	–	–	–	–	Increase
Masood et al, 2005 [35]	4	NS	Decrease	NS	–	–	NS	Increase	NS
Fink et al, 2002 [36]	4	Increase	–	–	–	–	–	NS	Increase
Dias et al, 2014 [38]	4	Increase	Decrease	NS	–	Increase	–	–	–
Indication not reported									
Kim et al, 2007 [37]	4	–	–	–	Increase in masturbatory difficulty	–	–	–	Decrease in masturbatory pleasure and sex life

NS = non-significant.
a) The overall highest level of evidence.

penile pudendal-evoked potentials [32, 58, 66] have also been reported. The interpretation of such measures is beyond what is known about male sexual function and these measures were therefore not included in the present systematic review. A recent review with focus on gaps in male circumcision research has specified the needs for consistent objective measures and for correlation of objective to subjective male sexual function outcomes [67]. Other systematic reviews from paediatric societies in the USA and Canada also conclude that circumcision is unlikely to change male sexual function [9, 68].

CONCLUSIONS

The highest level of evidence shows no perceived inferior male sexual function following non-medical circumcision. Medical circumcisions have negative outcomes for obtaining orgasm and discrepancies for erectile dysfunction. Younger age at circumcision seemed to cause less sexual dysfunction than circumcision later in life. The two latter findings are most likely not causal and more likely biased by observational designs. Future randomised controlled trials of medical circumcisions should be performed. Such studies should include non-circumcised controls and sexual function assessment at entry and at longer-term follow-up beyond two years. Age at circumcision should be explored in prospective studies including non-circumcised age-matched controls. The hypothesis of inferior male sexual function following circumcision is not supported by the findings of this systematic review. The popular narrative that male circumcision results in sexual dysfunction does not seem to be supported by evidence.

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