

# Male circumcision and sexual function in men and women: a survey-based, cross-sectional study in Denmark<sup>†</sup>

Morten Frisch,<sup>1\*</sup> Morten Lindholm<sup>1</sup> and Morten Grønbaek<sup>2</sup>

<sup>1</sup>Department of Epidemiology Research, Statens Serum Institut, DK-2300 Copenhagen S, Denmark and <sup>2</sup>National Institute of Public Health, DK-1353 Copenhagen K, Denmark

\*Corresponding author. Department of Epidemiology Research, Statens Serum Institut, 5 Artillerivej, DK-2300 Copenhagen S, Denmark. E-mail: mfr@ssi.dk

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**Background** One-third of the world's men are circumcised, but little is known about possible sexual consequences of male circumcision. In Denmark (~5% circumcised), we examined associations of male circumcision with a range of sexual measures in both sexes.

**Methods** Participants in a national health survey ( $n = 5552$ ) provided information about their own (men) or their spouse's (women) circumcision status and details about their sex lives. Logistic regression-derived odds ratios (ORs) measured associations of circumcision status with sexual experiences and current difficulties with sexual desire, sexual needs fulfilment and sexual functioning.

**Results** Age at first intercourse, perceived importance of a good sex life and current sexual activity differed little between circumcised and uncircumcised men or between women with circumcised and uncircumcised spouses. However, circumcised men reported more partners and were more likely to report frequent orgasm difficulties after adjustment for potential confounding factors [11 vs 4%,  $OR_{adj} = 3.26$ ; 95% confidence interval (CI) 1.42–7.47], and women with circumcised spouses more often reported incomplete sexual needs fulfilment (38 vs 28%,  $OR_{adj} = 2.09$ ; 95% CI 1.05–4.16) and frequent sexual function difficulties overall (31 vs 22%,  $OR_{adj} = 3.26$ ; 95% CI 1.15–9.27), notably orgasm difficulties (19 vs 14%,  $OR_{adj} = 2.66$ ; 95% CI 1.07–6.66) and dyspareunia (12 vs 3%,  $OR_{adj} = 8.45$ ; 95% CI 3.01–23.74). Findings were stable in several robustness analyses, including one restricted to non-Jews and non-Moslems.

**Conclusions** Circumcision was associated with frequent orgasm difficulties in Danish men and with a range of frequent sexual difficulties in women, notably orgasm difficulties, dyspareunia and a sense of incomplete sexual needs fulfilment. Thorough examination of these matters in areas where male circumcision is more common is warranted.

**Keywords** Circumcision, Denmark, dyspareunia, epidemiology, ejaculation, erectile dysfunction, health survey, libido, orgasm, sexual dysfunction, sexual partners, vaginismus

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## Introduction

For >60 years it has been known from unselected population-based studies that the tight foreskin of newborn boys, a natural state sometimes referred to as physiological phimosis, regresses spontaneously during childhood and puberty,<sup>1</sup> leaving a freely mobile foreskin by age 17 years in 99% of boys.<sup>2</sup> Yet, prevention of the rare cases of pathological phimosis remains a leading argument for proponents of routine circumcision. Other claimed benefits of circumcision, such as reduced risks of balanoposthitis, sexually transmitted infections and penile cancer, can be achieved without tissue loss through the maintenance of good penile hygiene combined with proper use of condoms, and whether circumcision reduces the risk of urinary tract infections in infancy has been questioned.<sup>3,4</sup> Despite the fact that no professional medical organization recommends routine circumcision, not even in the USA where most newborn boys undergo the operation,<sup>5</sup> it remains a widespread belief that circumcision provides superior penile hygiene and protects against urinary tract infections, phimosis, paraphimosis, balanoposthitis, venereal diseases and cancer.<sup>6,7</sup>

Considering the organ involved with its sensitive anatomical structures,<sup>8</sup> surprisingly few population-based studies have been carried out to evaluate circumcision's possible sexual consequences.<sup>9–11</sup> A number of methodologically questionable reports have led to claims of impaired, improved or unaltered sexual function in circumcised men and their female partners. We wanted to explore these issues further, using data from a national health survey in Denmark, a country with a low prevalence of male circumcision.<sup>12</sup> In light of the conflicting literature, we deliberately did not set up a series of specific a priori hypotheses for the study.

## Materials and Methods

The Health and Morbidity Study is a series of interview surveys that has addressed matters of public health in Denmark since 1987.<sup>13</sup> The surveys are based on nationally representative samples of Danish citizens aged  $\geq 16$  years drawn randomly by their unique personal identification number in the continuously updated Danish Civil Registration System.<sup>14</sup> Each identified person received an information letter with an invitation to participate. Upon written informed consent, participants underwent a structured personal interview in their home conducted by a professional interviewer. A total of 10916 persons were invited to take part in that arm of the 2005 survey, which included questions about sexual health.

The interview covered matters related to health and morbidity, family situation, lifestyle and sociodemographic, cultural and religious background. After the

interview, participants were asked to complete a self-administered questionnaire covering more sensitive issues, including questions about circumcision status or, for women, circumcision status of the spouse or steady male partner (referred to hereafter as the spouse), general sexual experiences (age at first sexual intercourse, number of sex partners since age 15 years, perceived importance of having a good sex life, and frequency of sexual activity with a partner in the last year), and experiences in the last year of low or lacking sexual desire, of incomplete fulfilment of sexual needs, or of difficulties in relation to sexual functioning with a partner [men: erectile difficulties, delayed orgasm or complete anorgasmia (hereafter referred to as orgasm difficulties), premature ejaculation or dyspareunia; women: lubrication insufficiency, orgasm difficulties, dyspareunia or vaginismus]. The degree to which a given sexual difficulty was present was rated on a five-point Likert scale ('not at all', 'rarely', 'sometimes', 'often' or 'every time'), as described in detail elsewhere.<sup>15–17</sup>

## Statistical analysis

We used chi-squared tests to evaluate possible differences in background variables between participants and non-participants and differences in background variables and general sexual experiences between circumcised men and men with an intact foreskin (referred to hereafter as uncircumcised), and between women with circumcised and uncircumcised spouses.

Subsequently, by means of logistic regression analyses we calculated two sets of odds ratios (ORs) with accompanying 95% confidence intervals (CIs) for associations between the exposure variable, circumcision and the sexual outcome variables, low or lacking sexual desire, incomplete sexual needs fulfilment and sexual function difficulties, with the latter categorized as either dichotomous outcomes ('not at all' vs any frequency of sexual difficulties) or polytomous outcomes ['not at all' vs 'rarely' or 'sometimes' (i.e. occasional difficulties) vs 'often' or 'every time' (i.e. frequent difficulties)]. Dichotomized outcomes were used when <10% of circumcised men or <10% of women with circumcised spouses reported frequent difficulties for the sexual difficulty in question. One set of ORs was calculated with adjustment only for age (16–29, 30–44, 45–59,  $\geq 60$  years), and the other (referred to hereafter as OR<sub>adj</sub>), included adjustment for age and a number of other potentially confounding differences between circumcised and uncircumcised participants. Specifically, OR<sub>adj</sub> were adjusted for age (16–29, 30–44, 45–59,  $\geq 60$  years), cultural background (Danish vs other; persons with at least one Danish-born parent were considered Danish), membership of religious community (yes vs no), three sociodemographic variables that were recently reported to be associated with sexual dysfunction in Denmark,<sup>15</sup> i.e. marital status (married vs not married), school attendance ( $\leq 9$ , 10–11,  $\geq 12$  years) and

household income in year 2004 (<400 000 vs  $\geq$ 400 000 Danish Kroner; 100 000 Danish Kroner  $\sim$ 11 500 UK£  $\sim$ 13 400 Euros  $\sim$ 18 400 US\$), and age at first sexual intercourse (<17 vs  $\geq$ 17 years), number of sex partners since age 15 years (<4 vs  $\geq$ 4), and frequency of sexual activity with a partner in the last year ( $\geq$ weekly vs <weekly).

In 16 supplementary analyses, we examined the robustness of our main findings. First, we restricted the study population to participants whose cultural background was Danish, participants who were not Jews or Moslems, or participants aged 20–69 years (robustness analyses 1–3) to obtain less heterogeneous study populations. Secondly, we evaluated the impact of making various assumptions about men and women who provided no information about their circumcision status or that of their spouse (robustness analyses 4–7). Thirdly, we evaluated the stability of our multivariate statistical model by adding or removing possible health-related, socioeconomic or behavioural confounders in the logistic regression analysis (robustness analyses 8–16).

All ORs express the odds among circumcised men (or women reporting a circumcised spouse) vs the odds among the reference category of uncircumcised men (or women reporting an uncircumcised spouse). ORs were calculated using the LOGISTIC procedure in SAS version 9.1.<sup>18</sup>

The study was approved by the Danish Data Inspection Board (approval nos 2001-54-0894, 2007-41-0022 and 2008-54-0472).

## Results

Of 10 916 invited persons (5395 men, 5521 women), 7275 (67%) underwent the initial personal interview and, of these, 76% (2573 men, 2979 women) returned the self-administered questionnaire, yielding overall participation rates of 48% for men and 54% for women. There were some sociodemographic differences between participants and non-participants, with non-participants comprising those who did not participate at all and those who underwent the personal interview but did not return the questionnaire. Participation rates were lower among individuals who were not currently married, those aged <40 or  $\geq$ 70 years, and those living in the capital area. Moreover, according to information obtained in the personal interview, non-participants had poorer self-rated overall health, shorter school attendance, and shorter post-secondary education than participants (chi-squared tests; all  $P < 0.01$ ).

### Men

Of the 2573 men, 87 (3%) had never had sexual intercourse, and another 141 (5%) did not provide information about their circumcision status. Selected background characteristics for the 2345 sexually

experienced men who stated their circumcision status are shown in Table 1. Overall, 125 men (5%) reported that they were circumcised, with little variation by age, membership of a religious community, marital status or household income, although seven of eight Moslem or Jewish participants (88%) were circumcised. A high proportion (29%) of the rather few participants (i.e. 14 of 49) with a non-Danish background were circumcised, and more circumcised than uncircumcised men had attended school for  $\geq$ 12 years.

### General sexual experiences

There were few differences between the general sexual experiences of circumcised and uncircumcised men (Table 2). Median age at first sexual intercourse was 17 years and median number of sex partners since age 15 years was 4–9 in both groups, but circumcised men were more likely (38%) than uncircumcised men (28%) to report  $\geq$ 10 sex partners (age-adjusted OR = 1.55; 95% CI 1.06–2.28). The perceived importance of having a good sex life was similar in the two groups, with 90% of circumcised and 89% of uncircumcised men considering a good sex life to be ‘important’, ‘very important’ or ‘extremely important’. Similar proportions of circumcised (18%) and uncircumcised (15%) men reported no sexual activity with a partner in the last year.

All subsequent analyses were restricted to 1996 men who were sexually active with a partner in the last year and who reported their circumcision status as either circumcised ( $n = 103$ , 5%) or uncircumcised ( $n = 1893$ , 95%). Of the 103 circumcised men, 15 men (15%) reported the circumcision to have occurred before age 6 months. In both groups, the median frequency of partner-related sexual activity in the last year was one to three times per month.

### Difficulties associated with sexual desire and fulfilment of sexual needs

Around half of the men reported episodes of low or lacking sexual desire in the last year (Table 3), with no major difference between circumcised and uncircumcised men (OR<sub>adj</sub> = 1.34; 95% CI 0.85–2.12). Likewise, the two groups were equally likely to report incomplete sexual needs fulfilment in the last year (OR<sub>adj</sub> = 1.05; 95% CI 0.64–1.72).

### Sexual function difficulties

Considering the sexual function difficulties together revealed no difference between circumcised and uncircumcised men (Table 4). The two most common sexual difficulties, premature ejaculation (reported as an occasional or frequent difficulty by 61%) and erectile difficulties (reported by 40%), were equally frequent in the two groups. Likewise, occasional orgasm difficulties were equally common among circumcised (29%) and uncircumcised (32%) men.

**Table 1** Background characteristics of 2345 men and of 2234 women with a spouse, by circumcision status, Denmark 2005

	Men		Women	
	Uncircumcised [ <i>n</i> = 2220; <i>n</i> (%)]	Circumcised [ <i>n</i> = 125; <i>n</i> (%)]	Uncircumcised spouse [ <i>n</i> = 2151; <i>n</i> (%)]	Circumcised spouse [ <i>n</i> = 83; <i>n</i> (%)]
<b>Age (years)</b>				
16–29	312 (14)	21 (17)	344 (16)	18 (22)
30–44	603 (27)	40 (32)	675 (31)	29 (35)
45–59	667 (30)	32 (26)	696 (32)	27 (33)
≥60	638 (29)	32 (26)	436 (20)	9 (11)
$\chi^2$ test for homogeneity	<i>P</i> = 0.42		<i>P</i> = 0.14	
<b>Cultural background<sup>a</sup></b>				
Danish	2183 (98)	111 (89)	2126 (99)	69 (83)
Other	35 (2)	14 (11)	25 (1)	14 (17)
$\chi^2$ test for homogeneity	<i>P</i> < 0.001		<i>P</i> < 0.001	
<b>Membership of religious community</b>				
Yes	1967 (89)	103 (84)	2013 (94)	72 (87)
Lutheran protestant	1850 (84)	90 (73)	1912 (89)	59 (71)
Roman catholic	9 (0.4)	1 (0.8)	12 (0.6)	2 (2)
Jehova's witness	13 (0.6)	0 (0)	5 (0.2)	1 (1)
Moslem	0 (0)	5 (4)	0 (0)	6 (7)
Jew	1 (<0.1)	2 (2)	1 (<0.1)	1 (1)
Buddhist	2 (<0.1)	1 (0.8)	1 (<0.1)	0 (0)
Other specified	17 (0.8)	0 (0)	23 (1)	2 (2)
Unknown	75 (3)	4 (3)	58 (3)	1 (1)
No	235 (11)	20 (16)	129 (6)	11 (13)
$\chi^2$ test for homogeneity <sup>b</sup>	<i>P</i> = 0.05		<i>P</i> = 0.008	
<b>Marital status</b>				
Married	1385 (62)	68 (54)	1417 (66)	59 (71)
Not married <sup>c</sup>	835 (38)	57 (46)	734 (34)	24 (29)
$\chi^2$ test for homogeneity	<i>P</i> = 0.07		<i>P</i> = 0.33	
<b>School attendance (years)</b>				
≤9	799 (37)	30 (26)	553 (26)	18 (23)
10–11	748 (34)	44 (38)	761 (36)	18 (23)
≥12	631 (29)	43 (37)	798 (38)	42 (54)
$\chi^2$ test for homogeneity	<i>P</i> = 0.04		<i>P</i> = 0.01	
<b>Household income, Danish Kroner<sup>d</sup></b>				
<200 000	261 (12)	12 (10)	226 (12)	11 (16)
200 000–399 999	552 (26)	30 (26)	496 (26)	13 (19)
400 000–599 999	646 (31)	42 (37)	616 (32)	29 (41)
≥600 000	638 (30)	31 (27)	589 (31)	17 (24)
$\chi^2$ test for homogeneity	<i>P</i> = 0.58		<i>P</i> = 0.17	

Numbers do not always add up to the total numbers of men and women due to missing information for some participants.

<sup>a</sup>Persons with at least one Danish-born parent were considered Danish.

<sup>b</sup>Test for homogeneity for membership of religious community performed on dichotomous variable (yes, no).

<sup>c</sup>Including unmarried, separated, divorced, widowed and registered same-sex partners.

<sup>d</sup>Household income for the year 2004. 100 000 Danish Kroner ~11 500 UK£ ~13 400 Euros ~18 400 US\$.

**Table 2** Sexual experiences of 2345 men and of 2234 women with a spouse, by circumcision status, Denmark 2005

	Men		Women	
	Uncircumcised [n = 2220; n (%)]	Circumcised [n = 125; n (%)]	Uncircumcised spouse [n = 2151; n (%)]	Circumcised spouse [n = 83; n (%)]
<b>Age at first sexual intercourse (years)</b>				
≤15	398 (20)	28 (24)	532 (26)	31 (38)
16	309 (15)	19 (16)	404 (20)	10 (12)
17	346 (17)	23 (20)	382 (19)	15 (19)
18	345 (17)	13 (11)	346 (17)	6 (7)
≥19	641 (31)	34 (29)	376 (18)	19 (23)
$\chi^2$ test for homogeneity	P = 0.39		P = 0.02	
<b>Number of sex partners since age 15 years</b>				
1	331 (16)	25 (21)	438 (21)	19 (23)
2–3	502 (24)	22 (18)	612 (30)	20 (24)
4–9	688 (32)	28 (23)	618 (30)	24 (29)
10–19	322 (15)	26 (21)	277 (13)	14 (17)
20–49	206 (10)	13 (11)	107 (5)	4 (5)
≥50	73 (3)	7 (6)	18 (1)	1 (1)
$\chi^2$ test for homogeneity <sup>a</sup>	P = 0.04		P = 0.80	
<b>Perceived importance of having a good sex life</b>				
Extremely important	635 (29)	36 (30)	518 (25)	18 (22)
Very important	716 (33)	36 (30)	682 (32)	31 (37)
Important	575 (27)	37 (31)	632 (30)	26 (31)
Not very important	182 (8)	9 (7)	205 (10)	8 (10)
Not at all important	56 (3)	3 (2)	62 (3)	0 (0)
$\chi^2$ test for homogeneity <sup>b</sup>	P = 0.75		P = 0.68	
<b>Sexual activity with partner last year</b>				
Active	1893 (85)	103 (82)	1907 (89)	75 (90)
Inactive	327 (15)	22 (18)	244 (11)	8 (10)
$\chi^2$ test for homogeneity	P = 0.38		P = 0.63	
<b>Frequency of sexual activity with a partner last year<sup>c</sup></b>				
≥3 times per week	193 (11)	8 (8)	228 (13)	17 (24)
1–2 times per week	643 (36)	32 (32)	711 (40)	19 (26)
1–3 times per month	647 (36)	39 (39)	597 (33)	28 (39)
<1 time per month	302 (17)	21 (21)	255 (14)	8 (11)
$\chi^2$ test for homogeneity	P = 0.52		P = 0.01	

Numbers do not always add up to the total numbers of men and women due to missing information for some participants.

<sup>a</sup>Categories '20–49' and '≥50' combined.

<sup>b</sup>Categories 'Not very important' and 'Not at all important' combined.

<sup>c</sup>Among 1996 men who were sexually active with a partner in the last year and 1982 women who were married or in a steady relationship and who were sexually active with a partner in the past year.

However, circumcised men (11%) were more likely than uncircumcised men (4%) to report frequent orgasm difficulties (OR<sub>adj</sub> = 3.26; 95% CI 1.42–7.47). Proportions reporting occasional or frequent episodes of dyspareunia did not differ between circumcised (10%) and uncircumcised (9%) men (OR<sub>adj</sub> = 1.31; 95% CI 0.61–2.83); only one circumcised (1.1%) and

one uncircumcised (0.06%) man reported frequent episodes of dyspareunia.

### Women

Of the 2979 women, 120 (4%) had never had sexual intercourse. Another 322 women (11%) had no

**Table 3** ORs of low or lacking sexual desire and incomplete sexual needs fulfilment by circumcision status in 1996 sexually active men and 1982 sexually active women, Denmark 2005

	Low or lacking sexual desire <sup>a</sup>			Incomplete sexual needs fulfilment <sup>a</sup>				
	No	Yes	OR <sup>b</sup> (95% CI)	OR <sup>c</sup> <sub>adj</sub> (95% CI)	No	Yes	OR <sup>b</sup> (95% CI)	OR <sup>c</sup> <sub>adj</sub> (95% CI)
<b>Men</b>								
Uncircumcised	901 (49)	938 (51)	1 (ref)	1 (ref)	1087 (59)	755 (41)	1 (ref)	1 (ref)
Circumcised	43 (42)	60 (58)	1.38 (0.92–2.08)	1.34 (0.85–2.12)	55 (55)	45 (45)	1.14 (0.76–1.72)	1.05 (0.64–1.72)
Unknown <sup>d</sup>	20 (40)	30 (60)			29 (46)	34 (54)		
<b>Women</b>								
Uncircumcised spouse	299 (16)	1564 (84)	1 (ref)	1 (ref)	1336 (72)	508 (28)	1 (ref)	1 (ref)
Circumcised spouse	6 (8)	68 (92)	2.18 (0.94–5.08)	2.65 (0.80–8.73)	45 (62)	28 (38)	1.76 (1.08–2.86)	2.09 (1.05–4.16)
Unknown <sup>d</sup>	13 (18)	59 (82)			47 (47)	52 (53)		

Numbers for the individual sexual difficulties do not add up to the total numbers of men and women because 2–3% of participants provided no information about sexual desire or sexual needs fulfilment.

<sup>a</sup>OR for low or lacking sexual desire based on a comparison of participants who experienced low or lacking sexual desire in the last year (Yes) vs participants with no such experience (No). OR for incomplete sexual needs fulfilment based on a comparison of participants whose sexual needs were met 'partly', 'a little', 'not at all' or who had 'no sexual needs' in the last year (Yes) vs participants whose sexual needs were met 'completely' or 'almost completely' (No).

<sup>b</sup>OR adjusted for age.

<sup>c</sup>OR adjusted for age, cultural background, membership of religious community, marital status, school attendance, household income, age at first sexual intercourse, number of sex partners since age 15 years and frequency of sexual activity with a partner in the past year.

<sup>d</sup>Unknown circumcision status.

spouse, and 303 (10%) either did not know or provided no information about their spouse's circumcision status. Table 1 shows the background characteristics of the 2234 sexually experienced women with a spouse stratified by the reported circumcision status of the spouse. Women with circumcised and uncircumcised spouses did not differ markedly with respect to age, marital status or household income but, as seen for men, women with circumcised spouses were more likely to have a non-Danish background and to have attended school for  $\geq 12$  years. However, while fewer women with circumcised (87%) than uncircumcised (94%) spouses were members of a religious community, seven of eight women who were Moslems or Jews (88%) had circumcised spouses.

### General sexual experiences

As for men, the median age at first sexual intercourse was 17 years in both groups (Table 2). Median number of sex partners after age 15 years was 2–3 in women with uncircumcised spouses and 4–9 in women with circumcised spouses. Having a good sex life was 'important', 'very important' or 'extremely important' to 90% of women with circumcised spouses and 87% of women with uncircumcised spouses. Similar proportions of women with circumcised (10%) and uncircumcised (11%) spouses reported no sexual activity with a partner in the last year.

All subsequent analyses were restricted to 1982 sexually active women who reported their spouse's circumcision status to be either circumcised ( $n = 75$ , 4%) or uncircumcised ( $n = 1907$ , 96%). Age at circumcision in the spouse was known by 71 women, with 20 (28%) reporting circumcision to have occurred before age 6 months. The median frequency of sexual activity in the last year was 1–2 times per week in both groups.

### Difficulties associated with sexual desire and fulfilment of sexual needs

The majority of women with circumcised spouses (92%) and of women with uncircumcised spouses (84%), reported episodes of low or lacking sexual desire in the last year (OR<sub>adj</sub> = 2.65; 95% CI 0.80–8.73) (Table 3). Women with circumcised spouses (38%) more often than women with uncircumcised spouses (28%) reported that their sexual needs were incompletely fulfilled (OR<sub>adj</sub> = 2.09; 95% CI 1.05–4.16).

### Sexual function difficulties

Sexual function difficulties were consistently more often reported by women with circumcised than uncircumcised spouses (Table 5). Sexual function difficulties overall, orgasm difficulties, lubrication insufficiency, dyspareunia and vaginismus were reported to have occurred either occasionally or

**Table 4** ORs of sexual function difficulties by circumcision status in 1996 sexually active men, Denmark 2005

	No difficulties			Occasional difficulties <sup>a</sup>			Frequent difficulties <sup>a</sup>		
	n (%)	n (%)	OR <sup>b</sup> (95% CI)	n (%)	OR <sup>b</sup> (95% CI)	OR <sup>c</sup> <sub>adj</sub> (95% CI)	n (%)	OR <sup>b</sup> (95% CI)	OR <sup>c</sup> <sub>adj</sub> (95% CI)
<b>Sexual function difficulties, overall<sup>d</sup></b>									
Uncircumcised	367 (21)	1116 (63)	1 (ref)	1 (ref)	1 (ref)	1 (ref)	296 (17)	1 (ref)	1 (ref)
Circumcised	21 (21)	54 (55)	0.85 (0.51–1.43)	0.73 (0.42–1.27)			24 (24)	1.46 (0.78–2.72)	1.29 (0.66–2.53)
Unknown <sup>e</sup>	5 (17)	14 (47)					11 (37)		
<b>Premature ejaculation</b>									
Uncircumcised	670 (39)	890 (52)	1 (ref)	1 (ref)	1 (ref)	1 (ref)	162 (9)	1 (ref)	1 (ref)
Circumcised	38 (41)	44 (47)	0.86 (0.55–1.35)	0.86 (0.52–1.41)			11 (12)	1.20 (0.60–2.39)	1.23 (0.58–2.60)
Unknown <sup>e</sup>	4 (18)	13 (59)					5 (23)		
<b>Erectile difficulties</b>									
Uncircumcised	1062 (60)	572 (33)	1 (ref)	1 (ref)	1 (ref)	1 (ref)	125 (7)	1 (ref)	1 (ref)
Circumcised	59 (61)	28 (29)	0.93 (0.57–1.52)	0.92 (0.54–1.58)			10 (10)	1.57 (0.72–3.45)	1.46 (0.62–3.46)
Unknown <sup>e</sup>	9 (31)	15 (52)					5 (17)		
<b>Orgasm difficulties</b>									
Uncircumcised	1094 (65)	537 (32)	1 (ref)	1 (ref)	1 (ref)	1 (ref)	63 (4)	1 (ref)	1 (ref)
Circumcised	57 (60)	28 (29)	1.05 (0.65–1.68)	0.94 (0.55–1.61)			10 (11)	3.21 (1.55–6.66)	3.26 (1.42–7.47)
Unknown <sup>e</sup>	12 (52)	10 (43)					1 (4)		
<b>No difficulties</b>									
<b>Occasional or frequent difficulties<sup>a</sup></b>									
<b>Dyspareunia</b>									
Uncircumcised	1543 (91)	152 (9)	1 (ref)	1 (ref)	1 (ref)	1 (ref)			
Circumcised	85 (90)	9 (10)	1.07 (0.53–2.18)	1.31 (0.61–2.83)					
Unknown <sup>e</sup>	17 (77)	5 (23)							

Numbers for the individual sexual difficulties do not add up to the total numbers of men and women because 7–10% of participants provided no information about the particular sexual difficulty.

<sup>a</sup>Occasional difficulties occurred ‘rarely’ or ‘sometimes’ during sexual activity with a partner in the last year, whereas frequent difficulties occurred ‘often’ or ‘every time’.

<sup>b</sup>OR adjusted for age.

<sup>c</sup>OR adjusted for age, cultural background, membership of religious community, marital status, school attendance, household income, age at first sexual intercourse, number of sex partners since age 15 years and frequency of sexual activity with a partner in the past year.

<sup>d</sup>Sexual function difficulties, overall include premature ejaculation, erectile difficulties, orgasm difficulties and dyspareunia.

<sup>e</sup>Unknown circumcision status.

**Table 5** ORs of sexual function difficulties by circumcision status of the spouse in 1982 sexually active women, Denmark 2005

	No difficulties			Occasional difficulties <sup>a</sup>			Frequent difficulties <sup>a</sup>		
	n (%)	n (%)	OR <sup>b</sup> (95% CI)	n (%)	OR <sup>b</sup> (95% CI)	OR <sup>c</sup> <sub>adj</sub> (95% CI)	n (%)	OR <sup>b</sup> (95% CI)	OR <sup>c</sup> <sub>adj</sub> (95% CI)
<b>Sexual function difficulties, overall<sup>d</sup></b>									
Uncircumcised spouse	357 (20)	1021 (58)	1 (ref)	1 (ref)	1 (ref)	1 (ref)	384 (22)	1 (ref)	1 (ref)
Circumcised spouse	7 (10)	42 (59)	2.09 (0.93–4.71)	1.92 (0.73–5.09)			22 (31)	3.01 (1.26–7.19)	3.26 (1.15–9.27)
Unknown <sup>e</sup>	11 (28)	19 (49)					9 (23)		
<b>Orgasm difficulties</b>									
Uncircumcised spouse	536 (31)	924 (54)	1 (ref)	1 (ref)	1 (ref)	1 (ref)	246 (14)	1 (ref)	1 (ref)
Circumcised spouse	16 (23)	40 (58)	1.47 (0.82–2.66)	1.76 (0.83–3.70)			13 (19)	1.81 (0.85–3.85)	2.66 (1.07–6.66)
Unknown <sup>e</sup>	11 (31)	22 (61)					3 (8)		
<b>Lubrication insufficiency</b>									
Uncircumcised spouse	744 (43)	772 (45)	1 (ref)	1 (ref)	1 (ref)	1 (ref)	202 (12)	1 (ref)	1 (ref)
Circumcised spouse	23 (33)	36 (52)	1.53 (0.89–2.62)	1.72 (0.89–3.30)			10 (14)	1.69 (0.78–3.68)	2.03 (0.80–5.18)
Unknown <sup>e</sup>	13 (38)	16 (47)					5 (15)		
<b>Dyspareunia</b>									
Uncircumcised spouse	1225 (73)	402 (24)	1 (ref)	1 (ref)	1 (ref)	1 (ref)	56 (3)	1 (ref)	1 (ref)
Circumcised spouse	37 (54)	23 (34)	1.86 (1.08–3.19)	1.66 (0.84–3.29)			8 (12)	4.77 (2.10–10.85)	8.45 (3.01–23.74)
Unknown <sup>e</sup>	24 (80)	4 (13)					2 (7)		
<b>No difficulties</b>									
	n (%)	n (%)	OR <sup>b</sup> (95% CI)	OR <sup>c</sup> <sub>adj</sub> (95% CI)					
<b>Occasional or frequent difficulties<sup>a</sup></b>									
	n (%)	n (%)	OR <sup>b</sup> (95% CI)	OR <sup>c</sup> <sub>adj</sub> (95% CI)					
<b>Vaginismus</b>									
Uncircumcised spouse	1600 (96)	75 (4)	1 (ref)	1 (ref)	1 (ref)	1 (ref)	1 (ref)	1 (ref)	1 (ref)
Circumcised spouse	59 (91)	6 (9)	2.19 (0.91–5.25)	2.06 (0.59–7.13)					
Unknown <sup>e</sup>	26 (90)	3 (10)							

Numbers for the individual sexual difficulties do not add up to the total numbers of men and women because 10–12% of participants provided no information about the particular sexual difficulty.

<sup>a</sup>Occasional difficulties occurred 'rarely' or 'sometimes' during sexual activity with a partner in the last year, whereas frequent difficulties occurred 'often' or 'every time'.

<sup>b</sup>OR adjusted for age.

<sup>c</sup>OR adjusted for age, cultural background, membership of religious community, marital status, school attendance, household income, age at first sexual intercourse, number of sex partners since age 15 years, and frequency of sexual activity with a partner in the past year.

<sup>d</sup>Sexual function difficulties, overall include orgasm difficulties, lubrication insufficiency, dyspareunia and vaginismus.

<sup>e</sup>Unknown circumcision status of spouse.



frequently in the last year by 90, 77, 67, 46 and 9% of women with circumcised spouses as compared with 80, 69, 57, 27 and 4%, respectively, of women with uncircumcised spouses. Most notably, frequent sexual function difficulties overall (31 vs 22%,  $OR_{adj}=3.26$ ; 95% CI 1.15–9.27), frequent orgasm difficulties (19 vs 14%,  $OR_{adj}=2.66$ ; 95% CI 1.07–6.66) and frequent episodes of dyspareunia (12 vs 4%,  $OR_{adj}=8.45$ ; 95% CI 3.01–23.74) were more common among women with circumcised spouses.

### Robustness analyses

The main findings in Tables 3–5 were confirmed in 16 robustness analyses (Table 6). Specifically, all showed that circumcised men had around three times greater odds of frequent orgasm difficulties than uncircumcised men. This was the case even in two rather extreme scenarios in which we forced men with unknown circumcision status to produce the most favourable association with circumcision by allocating all such men with sexual difficulties to the uncircumcised group and all those without sexual difficulties to the circumcised group (robustness analysis 5) or by assuming that all men with unknown circumcision status were circumcised (robustness analysis 7). Similarly, women with circumcised spouses had consistently at least four times greater odds of frequent dyspareunia than women with uncircumcised spouses. Additionally, in the analysis restricted to non-Jews and non-Moslems, women with circumcised spouses more often reported episodes of vaginismus (age-adjusted  $OR=2.55$ ; 95% CI 1.06–6.18).

Finally, we examined if age at circumcision below or above age 6 months had any measurable impact on our main findings. Specifically, using likelihood ratio tests we compared two regression models with circumcision status treated as either a dichotomous variable (uncircumcised vs circumcised) or a trichotomous variable [uncircumcised vs circumcised in infancy (<6 months) vs circumcised later]. None of the main findings in Tables 3–5 differed between men who were, or women whose spouses were, circumcised before age 6 months and those circumcised later (all  $P>0.12$ ), suggesting no major impact of age at circumcision on the observed associations.

### Discussion

Across cultural, religious and health-related differences around the world, the pleasures of sexual intimacy and orgasm are ubiquitously considered important for well-being and health. In the present Danish study, having a good sex life was rated as ‘important’, ‘very important’ or ‘extremely important’ by 87% of female and 89% of male participants. Among factors that have previously been found to affect the prevalence of sexual problems are age, cultural background, marital status, parity, educational

level, tobacco smoking, personality traits and both mental and physical health problems.<sup>10,15–17,19–22</sup> Recently, we showed that 11% of sexually active Danish men and women fulfilled rather stringent criteria for having at least one sexual dysfunction.<sup>15–17</sup> In the present work, we focused on the possible role of the ~40–50 cm<sup>2</sup> penile foreskin,<sup>23,24</sup> which has caused more controversy than probably any other part of the human body. Before turning to the more disquieting findings, it should be emphasized that most men in our study, whether circumcised or not, reported only occasional sexual function difficulties. Likewise, most women with circumcised spouses reported that their sexual needs were fulfilled (62%) and did not complain about frequent sexual function difficulties (69%).

### Impact of circumcision on male sexual function

In accordance with prior studies,<sup>10,11,25</sup> we found circumcision to have little impact on most sexual domains in men. Circumcised and uncircumcised men had comparable sexual histories, they considered a good sex life equally important, they were equally likely to be sexually active, and their frequencies of partner-related sexual activity were similar. The only behavioural difference was that circumcised men were more likely than uncircumcised men to report a lifetime history of 10 or more sex partners. Considering all sexual function difficulties together revealed no difference, but circumcised men were three times more likely than uncircumcised men to experience frequent orgasm difficulties which, according to an international expert panel, are either psychogenic or due to reduced penile sensitivity.<sup>26</sup> Robustness analyses showed that these difficulties of circumcised men were not explained by an excess of anxiety or depression in this group. This suggests that reduced penile sensitivity may, at least in part, explain the difference, a situation that has been recognized for centuries<sup>27</sup> and supported by recent neurophysiological studies.<sup>25,28,29</sup> The more frequent orgasm difficulties of circumcised men and their partners are not only a concern from a sexual pleasure perspective. The ability to achieve orgasm is a major determinant of overall sexual life satisfaction and marital satisfaction,<sup>20,30–33</sup> and persons who rarely experience orgasm may even be a group with increased overall mortality.<sup>34</sup>

Historically, reduced penile sensitivity was not an unintended side effect of circumcision. Medieval rabbi, physician and philosopher Moses Maimonides (1135–1204) stated that circumcision was required to ‘cause man to be moderate’, because circumcision ‘weakens the power of sexual excitement’ and ‘lessens the natural enjoyment’.<sup>27</sup> In the 19th century, pre-occupation with the dangers of phimosis, masturbation and an ill-defined syndrome called spermatorrhoea gave rise to a series of preventive measures,

**Table 6** Robustness analyses; ORs with 95% CIs associated with male circumcision for selected sexual difficulties (vs no difficulties) in sexually active men and women, Denmark 2005

	Men				Women			
	Frequent orgasm difficulties	Frequent sexual function difficulties, overall	Frequent orgasm difficulties	Frequent difficulties with dyspareunia	Incomplete sexual needs fulfillment			
Main analyses (from Tables 3–5)	3.26 (1.42–7.47)	3.26 (1.15–9.27)	2.66 (1.07–6.66)	8.45 (3.01–23.74)	2.09 (1.05–4.16)			
Univariate analyses	3.21 (1.55–6.66)	3.01 (1.26–7.19)	1.81 (0.85–3.85)	4.77 (2.10–10.85)	1.76 (1.08–2.86)			
<b>Data restriction</b>								
1. Danish background <sup>a</sup>	3.53 (1.53–8.14)	3.39 (1.19–9.70)	3.11 (1.22–7.97)	8.48 (3.01–23.90)	2.16 (1.05–4.44)			
2. Non-Jewish, non-Moslem background <sup>b</sup>	2.89 (1.21–6.92)	3.28 (1.15–9.40)	3.37 (1.28–8.90)	8.77 (3.09–24.92)	2.05 (1.00–4.18)			
3. Age interval 20–69 years <sup>c</sup>	2.60 (1.02–6.63)	3.17 (1.11–9.05)	3.06 (1.20–7.80)	8.07 (2.88–22.59)	2.07 (1.03–4.14)			
<b>Assumptions about unknown circumcision status</b>								
4. Unknown circumcision status, 'worst case' <sup>d</sup>	3.47 (1.57–7.67)	3.75 (1.37–10.26)	2.48 (1.02–6.01)	8.01 (2.91–22.05)	4.20 (2.35–7.52)			
5. Unknown circumcision status, 'best case' <sup>e</sup>	2.53 (1.12–5.72)	1.51 (0.66–3.49)	1.69 (0.73–3.91)	4.25 (1.62–11.18)	0.95 (0.51–1.75)			
6. Unknown circumcision status assumed to be uncircumcised <sup>f</sup>	3.27 (1.43–7.52)	3.27 (1.15–9.31)	2.67 (1.07–6.68)	8.57 (3.05–24.08)	2.02 (1.02–4.01)			
7. Unknown circumcision status assumed to be circumcised <sup>g</sup>	2.72 (1.25–5.93)	1.79 (0.81–3.94)	1.60 (0.71–3.60)	4.17 (1.60–10.91)	2.06 (1.24–3.42)			
<b>Confounder selection</b>								
8. Plus adj. for current depression or anxiety <sup>h</sup>	3.01 (1.30–6.96)	3.37 (1.18–9.61)	2.71 (1.08–6.78)	9.00 (3.19–25.35)	2.12 (1.07–4.21)			
9. Plus adj. for chronic depression or anxiety <sup>i</sup>	3.23 (1.40–7.43)	3.19 (1.12–9.10)	2.65 (1.06–6.62)	8.21 (2.92–23.06)	2.07 (1.04–4.11)			
10. Plus adj. for current hypertension <sup>j</sup>	3.40 (1.48–7.84)	3.27 (1.15–9.32)	2.69 (1.08–6.71)	8.34 (2.95–23.56)	2.11 (1.06–4.22)			
11. Plus adj. for current diabetes <sup>k</sup>	3.43 (1.49–7.90)	–	–	–	–			
12. Plus adj. for smoker status <sup>l</sup>	3.34 (1.45–7.68)	3.30 (1.16–9.42)	2.74 (1.09–6.89)	8.36 (2.95–23.74)	2.06 (1.03–4.12)			
13. Plus adj. for problems paying bills last year <sup>m</sup>	3.26 (1.42–7.48)	3.30 (1.16–9.39)	2.70 (1.08–6.76)	8.28 (2.96–23.21)	2.12 (1.06–4.23)			
14. Minus adj. for frequency of sexual activity with a partner <sup>n</sup>	3.42 (1.50–7.80)	3.03 (1.08–8.56)	2.33 (0.96–5.66)	7.64 (2.78–21.01)	1.96 (1.10–3.52)			
15. Minus adj. for number of sex partners since age 15 years <sup>o</sup>	3.14 (1.37–7.19)	3.26 (1.15–9.27)	2.67 (1.07–6.66)	8.17 (2.92–22.92)	2.10 (1.06–4.18)			
16. Minus adj. for age at first sexual intercourse <sup>p</sup>	3.44 (1.55–7.61)	2.66 (1.00–7.09)	2.45 (1.00–6.00)	7.45 (2.69–20.65)	2.06 (1.04–4.09)			

Univariate ORs are adjusted only for age. As in the main analyses in Tables 3–5, ORs in robustness analyses 1–16 are adjusted for age, cultural background, membership of religious community, marital status, school attendance, household income, age at first sexual intercourse, number of sex partners since age 15 years, and frequency of sexual activity with a partner in the past year, except as specified in robustness analyses 8–16.

<sup>a</sup>Analyses restricted to participants with at least one Danish-born parent.

<sup>b</sup>Analyses restricted to participants who were not Jews or Moslems. Specifically, analyses were carried out after exclusion of participants who reported that they were Jews or Moslems and those who reported that they were members of a religious community but failed to mention which religious community.

<sup>c</sup>Analyses restricted to participants in the age interval 20–69 years.

<sup>d</sup>Participants with unknown circumcision status (or circumcision status of the spouse) treated to provide the most unfavourable association with circumcision. Specifically, participants with unknown circumcision status who had sexual difficulties were all considered to be circumcised, whereas those with unknown circumcision status who did not have sexual difficulties were all considered to be uncircumcised.

<sup>e</sup>Participants with unknown circumcision status (or circumcision status of the spouse) treated to provide the most favourable association with circumcision. Specifically, participants with unknown circumcision status who had sexual difficulties were all considered to be uncircumcised, whereas those with unknown circumcision status who did not have sexual difficulties were all considered to be circumcised.

<sup>f</sup>Participants with unknown circumcision status (or circumcision status of the spouse) considered to be uncircumcised.

<sup>g</sup>Participants with unknown circumcision status (or circumcision status of the spouse) considered to be circumcised.

<sup>h</sup>ORs additionally adjusted for a variable capturing participants (21% of men, 31% of women) who reported (i) suicidal thoughts or attempted suicide in the last year, (ii) current symptoms of chronic depression or anxiety, (iii) feeling low-spirited, sad or unhappy in the last 2 weeks or (iv) problems of insomnia in the past 2 weeks.

<sup>i</sup>ORs additionally adjusted for history (ever) of chronic depression or anxiety (7% of men, 12% of women).

<sup>j</sup>ORs additionally adjusted for current hypertension (12% of men, 12% of women).

<sup>k</sup>ORs additionally adjusted for current diabetes (3% of men). Only one woman whose spouse was circumcised had diabetes.

<sup>l</sup>ORs additionally adjusted for smoker status [current smokers (28% of men, 26% of women), former smokers (31% of men, 27% of women), never smokers (42% of men, 47% of women)].

<sup>m</sup>ORs additionally adjusted for a variable capturing participants who had problems paying their bills last year (7% of men, 8% of women).

<sup>n</sup>ORs adjusted as in main analyses, except for frequency of sexual activity with a partner in the past year.

<sup>o</sup>ORs adjusted as in main analyses, except for number of sex partners since age 15 years.

<sup>p</sup>ORs adjusted as in main analyses, except for age at first sexual intercourse.

including chastity belts, straight waistcoats, iatrogenic urethral inflammation and other measures to reduce sexual excitability.<sup>35</sup> These procedures eventually lost clinical relevance as circumcision grew in popularity to become the favoured method of preventing and treating the ill-regarded habit of masturbation.<sup>36–41</sup>

Logic suggests that amputation of the foreskin with its abundance of sensory nerve endings and specialized end organs<sup>8</sup> entails reduced penile sensitivity. Nevertheless, some authors maintain that there is either no difference in penile sensitivity between circumcised and uncircumcised men<sup>42</sup> or that the reduced sensitivity is advantageous because it prolongs the intravaginal ejaculation latency time<sup>25,28</sup>. One small study that was briefly mentioned in Masters and Johnson's pioneer work on sexual physiology has been repeatedly, yet incorrectly, cited as evidence of no sensitivity loss following circumcision. Comparing 35 circumcised and 35 uncircumcised men, these authors disproved contemporary claims of *increased* sensitivity of the circumcised glans,<sup>43</sup> but their findings have been misused as evidence against the opposite concern, namely that circumcision may cause *reduced* penile sensitivity. Other underpowered reports,<sup>44–46</sup> including a much cited study of sexual function in 15 men before and after circumcision,<sup>44</sup> have led authors to conclude that circumcision has no impact on male sexual function. Other authors reached the opposite conclusion, namely that circumcision reduces penile sensitivity.<sup>47–50</sup> As with the negative studies, however, these studies were small, based on self-selected participants, or lacked detailed accounts of the methods used.

In a few studies,<sup>25,28,29</sup> participants measured the time from vaginal intromission to intravaginal ejaculation and were subjected to neurophysiologic testing. In Turkey, 42 men without penile pathology reported longer intravaginal ejaculation latency times after circumcision,<sup>28</sup> and the reduced penile sensitivity was confirmed by increased post-circumcision pudendal nerve evoked potentials, which the authors attributed to the loss of sensory receptors.<sup>25</sup> In the USA, 91 circumcised and 68 uncircumcised men were subjected to the Semmes–Weinstein monofilament touch test. Five locations on the uncircumcised penis that are routinely removed at circumcision were found to be more sensitive than the ventral circumcision scar, the most sensitive part of the circumcised penis.<sup>29</sup>

Only two population-based studies can be meaningfully compared with our findings in men.<sup>9–11</sup> Among 1410 US men aged 18–59 years, of whom ~75% were circumcised, prevalence estimates were 10% for erectile dysfunction and 8% for orgasm problems. These estimates are close to the prevalence of frequent erectile difficulties (10%) and frequent orgasm difficulties (11%) among circumcised men in our study, but premature ejaculation was much more common in the US survey (31%) than in ours (12%). In agreement with our findings, the authors reported no association

of circumcision status with sexual dysfunction overall or with premature ejaculation (OR=0.87), erectile dysfunction (OR=1.30) or low desire (OR=1.64).<sup>10</sup> Unfortunately, the authors did not present an OR for the association between circumcision status and orgasm difficulties, the only male difficulty that was associated with circumcision status in our study. A survey of 10 173 Australian men aged 16–59 years showed a number of associations between sociodemographic and cultural factors on one side and circumcision status on the other. However, because the authors adjusted only for age when evaluating possible associations between circumcision status and sexual dysfunctions, the reported reduced rates of dyspareunia and erectile difficulties in circumcised men are hard to interpret.<sup>11</sup>

Two randomized trials evaluating the impact of male circumcision on risk of female-to-male transmission of HIV included personal interviews to address possible side effects of circumcision on sexual function and sexual satisfaction.<sup>51,52</sup> Among 18- to 24-year-old men in Kenya,<sup>52</sup> the overall prevalence of sexual problems decreased from 24% at baseline to 6% 2 years after the circumcision. The authors provided no explanation for this noticeable decline in sexual problems over time but felt reassured by a similar drop in sexual problems in the uncircumcised group (26% at baseline; 6% at 2 years). Measurement problems and drop out of men who experienced sexual problems during follow-up but were reluctant to report them in a personal interview with representatives of the circumcision team need consideration. Among 15- to 49-year-old men in neighbouring Uganda,<sup>51</sup> the prevalence of sexual difficulties was implausibly low and remained unchanged during follow-up. Specifically, 98.9% of circumcised men and 99.9% of uncircumcised men reported satisfaction with sexual intercourse at 12 months. As pointed out by others, bias needs consideration in these African studies because interviewers were not blinded to participants' circumcision status.<sup>53</sup>

### Impact of circumcision on female sexual function

Studies on the impact of male circumcision on women's sexual functioning are generally small or hampered by questionable, or overtly flawed, methodologies.<sup>54–58</sup> In one study, 145 mothers in Iowa, USA, expressed a clear preference for the circumcised penis. However, considering that 83% of participants had no sexual experience with uncircumcised men and 89% had their sons circumcised shortly before the interview, any other result would have been surprising.<sup>54</sup> In another US survey, 139 women who had sexual experience with both circumcised and uncircumcised men reported that they more often achieved orgasm with an uncircumcised partner. However, because participants were recruited through an anti-circumcision newsletter, results should be viewed

with scepticism.<sup>55</sup> Among 35 women in Australia, participants were more likely to have experienced vaginal dryness with circumcised partners, but insufficient methodological detail was provided.<sup>58</sup> Authors in a circumcision trial in Africa reported similar or greater levels of sexual satisfaction among female partners after the spouse's circumcision.<sup>56</sup> However, by focusing on changes in overall sexual satisfaction, readers were uninformed about the actual levels of sexual satisfaction reported. This is potentially problematic, considering the implausibly high levels of sexual satisfaction reported by men in that same study.<sup>51</sup>

Nowadays, most people will agree that, at least within the frames of heterosexual marriage, the ability of men and women to experience sexual intimacy and orgasm is important to health and well-being. According to the WHO, approximately 660 million men, 30–33% of the world's male population, have been circumcised as a matter of parental decision before age 15 years.<sup>59</sup> Consequently, our findings of increased rates of orgasm difficulties in circumcised men and of a variety of sexual troubles among their spouses are potentially relevant to millions of people around the world.

### Strengths and limitations

Our study is the first population-based study in Europe to examine possible sexual consequences of circumcision and the first to systematically address associations between circumcision status and sexual difficulties in both men and women. Other assets include the large size of our study, and the fact that Denmark with its relatively liberal views on sexual matters is a favourable setting for collecting this kind of sensitive information.<sup>60</sup>

Neonatal circumcision is uncommon in Denmark, explaining the low overall prevalence of circumcision in this country. Of circumcised male participants in our study, only 15% had been circumcised before age 6 months; among spouses of female participants, the corresponding proportion was 28%. Consequently, our study had limited statistical power to address in detail whether observed associations with sexual difficulties applied particularly to neonatal circumcisions or operations performed after infancy. We observed no difference between those circumcised before or after age 6 months, but this should be studied further in other settings where neonatal circumcision is more common.

With overall participation rates of 48% among men and 54% among women, our findings need cautious interpretation. Participants tended to be healthier and better educated and were more often married, middle-aged and residing outside the capital area than non-participants. Higher participation rates in US<sup>9</sup> (79%) and Australian<sup>11</sup> (69%) surveys are probably partly explained by their age restriction to persons <60 years. Reassuringly, restriction to 20- to

69-year-old participants (robustness analysis 3) confirmed our main findings. Theoretically, links between circumcision and sexual dysfunction may be overestimated in our study if higher proportions of sexually well-functioning circumcised men or women with circumcised spouses declined the invitation to take part in the study than corresponding proportions of sexually well-functioning uncircumcised men or spouses of such men. Considering that circumcision is an uncommon procedure in Denmark that rarely causes public attention, selective participation in a general health survey based on one's circumcision status or, among women, the circumcision status of one's spouse seems unlikely. A more relevant limitation is that our findings were limited to participants who had been sexually active with a partner in the last year. Consequently, the degree to which our findings are generalizable to the entire Danish population is uncertain. However, with due socioeconomic reservations, our findings are likely to apply to that majority of Danish men and women who are sexually active with a partner.

As mentioned, our findings need re-examination in settings where neonatal circumcision is more prevalent. Of note, however, they were not the result of unadjusted cultural or religious factors among groups that practice routine circumcision; all main findings were confirmed in robustness analyses restricted to non-Jews and non-Moslems or those with at least one Danish-born parent.

Current evidence shows no role for circumcision in preventing HIV transmission in industrialized parts of the world<sup>61,62</sup> or in reducing the male-to-female transmission of HIV in sub-Saharan Africa.<sup>63</sup> Actually, there are reports of increased risk of HIV transmission during circumcision in resource-poor countries.<sup>64</sup> However, randomized trials<sup>6</sup> have shown that circumcision carried out with appropriate surgical techniques and sterilization procedures may reduce the female-to-male transmission of HIV in Africa. The WHO strategic plan for sexual and reproductive health during 2010–15 includes 'support to countries to monitor the quality and acceptability of male circumcision services as they expand in the African Region and elsewhere' as well as research 'to assess the safety, effectiveness and acceptability of medical devices to facilitate expansion of male circumcision services'.<sup>65</sup> If, as suggested by our findings, circumcision is associated with non-trivial sexual difficulties in a substantial proportion of men and their partners, the continued promotion of male circumcision will constitute an ethical dilemma. Several studies document a widespread belief among African men that circumcised men have better penile sensitivity, enjoy sex more and confer more sexual pleasure to their partners, and these beliefs are among the central arguments for accepting the operation.<sup>66,67</sup> Our study should stimulate an unbiased quest for additional large-scale data on possible sexual consequences

of circumcision. In ongoing WHO-sponsored circumcision programmes, we suggest the incorporation of rigorous epidemiological studies of the possible sexual consequences of circumcision. In collaboration with local circumcision programme managers, such activities should be carried out by independent teams of researchers guided by sexual health experts and epidemiologists. In this way, the WHO would signal its dedication to ensuring sexual rights for all, along with its commitment to fighting the HIV epidemic in sub-Saharan Africa.

## Conclusions

Our study shows hitherto unrecognized associations between male circumcision and sexual difficulties in both men and women. While confirmatory findings in other settings are warranted, notably from areas where neonatal circumcision is more common, our findings may inform doctors and parents of baby boys for whom the decision of whether or not to circumcise is not dictated by religious or cultural traditions. Additionally, since it appears from our study

that both men and women may have fewer sexual problems when the man is uncircumcised, and because preputial plasties may sometimes serve as suitable alternatives to standard circumcision, our study may stimulate a more conservative, tissue-preserving attitude in situations where foreskin pathology requires surgical intervention.

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**Conflicts of interest:** M.F. has been an author of articles on the possible role of male circumcision in relation to penile cancer risk and has taken part in national debates about the ethics surrounding male and female circumcision. M.L. and M.G. declare that they have no conflicts of interest.

### KEY MESSAGES

- Few large-scale population-based studies have addressed the possible impact of male circumcision on sexual function in men and women.
- In the first population-based study on the subject in Europe, we explored associations of circumcision status with sexual experiences and current difficulties with sexual desire, sexual needs fulfilment and sexual functioning.
- Generally, sexual experiences and sexual desire were similar in circumcised and uncircumcised men and in women with circumcised and uncircumcised spouses. However, circumcision was associated with frequent orgasm difficulties in men and with a variety of frequent sexual difficulties in women, notably orgasm difficulties, dyspareunia and a sense of incomplete sexual needs fulfilment.
- Methodologically rigorous studies of these matters in areas where circumcision is more common are warranted.

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