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Full Title: Obstetric perineal ruptures, sexual function and dyspareunia among primiparous women 12 months postpartum: a prospective cohort study

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ABSTRACT

Background/introduction: Sexuality is an important aspect of human identity and contributes significantly to the quality of life in women as well as in men. Impairment in sexual health after vaginal delivery is a major concern for many women. We aimed to examine the association between degree of perineal rupture and sexual function 12 months postpartum.

Methods: A prospective cohort study was conducted at four Danish hospitals between July 2015 and January 2019 among 554 primiparous women: 191 with no/labia/first-degree ruptures, 189 with second-degree ruptures, and 174 with third-/fourth-degree ruptures. Baseline data were obtained 2 weeks postpartum by a questionnaire and a clinical examination. Sexual function was evaluated 12

months postpartum by an electronic questionnaire (PISQ-12) and a clinical examination. Main outcomes were total PISQ-12 score and dyspareunia.

Results: The proportion of women with dyspareunia was: 25%, 38% and 53% of women with no/labia-/first-degree, second-degree or third-/fourth-degree ruptures, respectively.

Compared to women with no/labia-/first-degree ruptures, women with second degree or anal sphincter ruptures had higher risk of **dyspareunia** (aRR 2.05; 95% CI 1.51-2.78 and aRR 2.09; 95% CI 1.55-2.81, respectively).

Conclusions: Impairment of sexual health is common among primiparous women after vaginal delivery. At 12 months postpartum more than half of the women with an anal sphincter rupture experienced dyspareunia. Women delivering with no/labia-/first-degree ruptures reported the best outcomes overall. Thus, it is important to minimize the extent of perineal trauma and to counsel about sexuality during and after pregnancy.

Article summary

Strengths and limitations of this study:

- The study had a high follow-up rate for both the web-based questionnaire and clinical examination.
- The study included both subjective and objective outcome measurements.
- All the clinical examinations were performed by the same examiner raising a possible risk of intra observer bias.
- There was a risk of recall bias as information about pre-pregnancy sexual function was obtained postpartum.

INTRODUCTION

Sexuality is an important aspect of human identity and contributes significantly to the quality of life in women as well as in men.[1] Sexual function postpartum is affected by the changes in hormonal milieu, anatomy, and family structure following childbirth. Dyspareunia and other sexual problems such as loss of sex drive in the postpartum period is a well-known problem and frequencies of sexual dysfunction as high as 30-60% three months postpartum and 17-31% six months postpartum have been reported.[2-7] A large cohort study from Sweden found vaginal or perineal ruptures, regardless of degree, to be associated with a delay in women's resumption of sexual intercourse,[8] while about 10% of primiparous women had not yet resumed sexual intercourse six months postpartum.[3] The causes of sexual dysfunction are multifactorial and the mechanisms are still not fully understood.[3-5 9] Thus sexual dysfunction remains an unsolved problem for many women. Among other things, anatomical changes caused by vaginal or perineal ruptures may contribute to dyspareunia and has important effects on both the timing and quality of the resumption of sexual relations during the initial postpartum months.[10] The association between obstetrical risk factors and postpartum sexual function is not yet well described or understood and thus the aim of this study was to investigate the association between degree of perineal rupture, sexual function and dyspareunia 12 months postpartum.

METHODS

Study setting

This study is part of a larger prospective cohort study conducted at two university and two tertiary hospital units in Denmark, Odense (OUH), Aarhus (AUH), Esbjerg, and Kolding, between July 2015 and January 2019. The inclusion procedure and sample size calculation is described thoroughly elsewhere.[11]

Study population

The study involved three groups of women i) 203 women with no/labia/first-degree perineal ruptures, ii) 200 women with second-degree perineal ruptures and iii) 200 women with third-/fourth-degree perineal ruptures.

Patient and Public Involvement

There was no patient or public involvement in design and conduct of this study.

Inclusion and follow-up procedure

Women delivering vaginally, at least 18 years old, able to read and speak Danish were eligible. After the delivery, they were informed about the study. **F**urther information was sent by e-mail and the women were invited to participate in a baseline face-to-face interview and clinical examination 16±5 days postpartum, including baseline questionnaires. Written informed consent was obtained at baseline.[11] At 12 months postpartum, all participants received the same questionnaires electronically and were invited to a gynaecological examination followed by a three-dimensional high-resolution anal manometry (3D HRAM). Study data were collected and managed using REDCap electronic data capture tools hosted at OUH.[12]

Outcome measurements

The primary outcome was sexual function. We used the Danish version of the Pelvic Organ Prolapse/Urinary Incontinence Sexual Function Questionnaire (PISQ-12).[13] The PISQ-12 is a self-administered, objective and validated questionnaire with scores based on 12 questions to evaluate sexual function. The score of each item ranges from 0=never to 4=always (reverse scoring for questions 1, 2, 3 and 4). Missing responses are handled by multiplying the mean of answered items and the score is valid with up to 2 missing answers.[13] The questionnaire has previously been used to evaluate sexual function after vaginal delivery.[14 15] We used the total score (range 0-48) with lower scores indicating better sexual function, and the individual score for question 5;"Do you feel pain

during sexual intercourse?". The total score was used as a continuous variable presented as mean and standard deviation (SD) and the single score for question 5 was dichotomized as dyspareunia when answering "sometimes", "usually" or "always" and no dyspareunia when answering "seldom" or "never".

Exposure variables and covariates

Degrees of perineal ruptures

The degree of perineal rupture was defined according to the Green-top Guideline No. 29.[16] First-degree ruptures were defined as injury to perineal skin and/or vaginal mucosa. Second-degree ruptures were defined as injury to perineum involving perineal muscles but not the anal sphincter. Third-degree ruptures were defined as injury to perineum involving the anal sphincter complex including: Grade 3a rupture with less than 50% of the external anal sphincter (EAS) thickness torn. Grade 3b rupture with more than 50% of EAS thickness torn and Grade 3c ruptures with both EAS and internal anal sphincter (IAS) torn. Fourth-degree ruptures were defined as an injury to perineum involving the anal sphincter complex (EAS and IAS) and anorectal mucosa. Labia ruptures were isolated to the labia. Episiotomies were lateral or mediolateral. Episiotomies equivalent to a second-degree rupture were analyzed independently while episiotomies extending to the anal sphincter muscles were classified as a third- or fourth-degree rupture depending on severity.

Baseline information

At baseline 16±5 days postpartum, a questionnaire was completed providing information about age (years), height (centimetres), smoking status (yes/no), and pregestational BMI (kg/m^2). Information about pregnancy, birth and the postpartum period was obtained from the obstetric journal and included diabetes mellitus (yes/no), length of active birth and length of the second stage of labour (minutes), operative delivery (yes/no), birthweight (gram) and head circumference (centimetres).

The PISQ-12 was likewise completed at baseline providing information about pre-pregnancy sexual function. Question 5 was used and dichotomized as the postpartum score described previously.

Clinical examination 12 months postpartum

Perineal length and strength were evaluated by a gynecological examination and 3D HRAM. All procedures were done by the first author (DG), with the women in the dorsal lithotomy position without bowel preparation. At the gynecological examination, perineal body length was measured in centimeters, from the hymen to the middle of anus during Valsalva maneuver as done in the Pelvic Organ Quantification (POP-Q) system,[17] and used as a dichotomous variable (≤ 2 cm/> 2 cm). Perineal strength was measured by 3D HRAM performed using a rigid probe with 256 pressure sensors arranged in 16 rows (64mm length) with 16 circumferential sensors in each (10.75mm diameter) (Medtronic, Shoreview, MN; USA). Data were analyzed using ManoViewAR software (Medtronic, Minneapolis, MN; USA). A one minute resting period was observed before initiating measurements of anal and rectal pressure in mm Hg during a 20 seconds resting period, maximum squeeze pressure during 3 periods of five seconds each and maximum duration of squeeze in seconds. All three measurements were used as continuous variables.

Statistical analyses

Baseline characteristics according to degree of rupture were described as frequencies for categorical variables. To investigate the association between the degree of perineal rupture and dyspareunia, perineal body length and strength, a relative risk regression by use of a generalized linear model with log-link function and binomial distribution as statistical family was performed with estimates reported as relative risks (RR) with 95% confidence intervals (CI). To investigate the association between the degree of perineal rupture and sexual dysfunction measured as the total PISQ-12 score, a linear regression was performed, and results presented as regression coefficients (β) with 95% CI. In the adjusted analysis, we controlled for pre-pregnancy dyspareunia, smoking, diabetes and

operative delivery as categorical variables and age, BMI, duration of the second stage of labor, duration of active birth and fetal birthweight as continuous variables. These potential confounders were chosen a priori based on directed acyclic graphs generated for the outcome variable using DAGitty v2.3 as graphical tool for analyzing the causal diagrams.[18] The analyses were carried out using STATA statistical software version 15.0.

RESULTS

Participants

Initially, a total of 832 women were invited to participate in the study. Of these, 81 declined and 138 could not be reached. This left 613 women completing a written consent and a baseline questionnaire who were booked for a clinical examination 16±5 days postpartum. Ten women withdrew their consent. Thus, the study population comprised 603 women. At the one year follow-up, 554 of the 603 women answered the web-based questionnaire corresponding to 92%, and 485 women had the clinical examination performed corresponding to 80%. Fewer women (n=482) underwent 3D HRAM either due to rejection of the procedure or due to technical problems with the equipment. Due to more than two missing answers, 13 women were excluded from analyses of total PISQ-12 score.

Characteristics according to degree of rupture

Women sustaining third- or fourth-degree ruptures were on average 0.5 years older than women sustaining second-degree ruptures and 1.2 years older than women sustaining no/labia/first-degree ruptures (Table 1).

Table 1: Characteristics according to degree of rupture among primiparous women (n=554).

	Total (*n*=554)	Group 1 (No/labia/ 1st degree) (*n*=191)	Group 2 (2nd degree) (*n*=189)	Group 3 (3rd/4th degree) (*n*=174)
	n (%)	**n (%)**	**n (%)**	**n (%)**
BMI, pre-pregnancy (kg/m²)*				
<25	357 (64.6)	128 (67.0)	116 (61.7)	113 (64.9)
25-29.9	126 (22.8)	41 (21.5)	46 (24.5)	39 (22.4)
≥29.9	70 (12.7)	22 (11.5)	26 (13.8)	22 (12.6)
Age at inclusion (years)				
≤25	141 (25.5)	63 (33.0)	50 (26.5)	28 (16.1)
26-30	278 (50.2)	91 (47.6)	89 (47.1)	98 (56.3)
>30	135 (24.4)	37 (19.4)	50 (26.5)	48 (27.6)
Active birth duration (minutes)				
<220	140 (25.3)	69 (36.1)	46 (24.3)	25 (14.4)
221-340	141 (25.5)	45 (23.6)	53 (28.0)	43 (24.7)
341-570	143 (25.8)	50 (26.2)	49 (25.9)	44 (25.3)
>570	130 (23.5)	27 (14.1)	41 (21.7)	62 (35.6)
Second stage duration (minutes)				
<16	109 (19.7)	40 (20.9)	47 (24.9)	22 (12.6)
16-30	187 (33.8)	80 (41.9)	60 (31.8)	47 (27.0)
31-45	89 (16.1)	31 (16.2)	27 (14.3)	31 (17.8)
>45	169 (30.5)	40 (20.9)	55 (29.1)	74 (42.5)
Birthweight (grams)				
<2999	76 (13.7)	39 (20.4)	23 (12.2)	14 (8.1)
3000-3499	193 (34.8)	69 (36.1)	81 (42.9)	43 (24.7)
3500-3999	210 (37.9)	64 (33.5)	65 (34.4)	81 (46.6)
≥4000	75 (13.5)	19 (10.0)	20 (10.6)	36 (20.7)
Head circumference (cm)**				
<34	141 (25.5)	58 (30.5)	52 (27.7)	31 (17.8)
34	119 (21.6)	45 (23.7)	37 (19.7)	37 (21.3)
35	131 (23.7)	35 (18.4)	53 (28.2)	43 (24.7)
>35	161 (29.2)	52 (27.4)	46 (24.5)	63 (36.2)
Pre-pregnancy dyspareunia (yes)	107 (19.3)	26 (13.6)	39 (20.6)	42 (24.1)
Operative delivery (yes)	95 (17.2)	6 (3.1)	29 (15.3)	60 (34.5)
Episiotomi (yes)	54 (9.8)	-	32 (16.9)	22 (12.6)
Smoker, at inclusion (yes)*	21 (3.8)	8 (4.2)	8 (4.2)	5 (2.9)
Diabetes mellitus (yes)	19 (3.4)	5 (2.6)	7 (3.7)	7 (4.0)

*One missing values, n=553
**Two missing values, n=552

Moreover, a higher degree of rupture was seen with higher birthweight, longer second stage of labour and longer duration of active birth. Instrumental delivery was more frequent among women with second-degree (15%) and third- or fourth-degree ruptures (34%) compared to women with no/labia/first-degree ruptures (3%).

Risk of sexual dysfunction and dyspareunia

The proportion of pre-pregnancy dyspareunia was: 14%, 21%, and 24% in the no/labia/first-degree, second-degree and third- or fourth-degree rupture groups, respectively (Table 1). At 12 months postpartum, the proportion in all three groups was higher than pre-pregnancy; 25%, 38% and 53% respectively.

The risks for dyspareunia at 12 months postpartum are presented in Table 2.

Table 2: Relative Risks for dyspareunia 12 months postpartum among primiparous women in Denmark (n=554).

	Total	Dyspareunia		Crude		Adjusted*	
		Yes	No				
	n=554	*n*= 211	*n*= 343	RR	(95% CI)	RR	(95% CI)
	n	*n* (%)	*n* (%)				
Degree of rupture							
No/labia/1st	191	47 (24.6)	144 (75.4)	*1.00*	*reference*	*1.00*	*reference*
2nd (spontanous)	157	59 (37.8	97 (62.2	1.53	(1.11 - 2.10)	2.05	(1.51 - 2.78)
2nd (mediolateral episiotomy)	32	13 (40.6)	19 (59.4)	1.65	(1.01 - 2.69)	1.62	(0.99 - 2.67)
3rd or 4th	174	92 (52.9)	82 (47.1)	2.15	(1.62 - 2.86)	2.09	(1.55 - 2.81)
BMI, pre-pregnancy (kg/m²),** mean (SD)					-		-
<25	357	140 (39.2)	217 (60.8)	1.00	reference	1.00	reference
25-29.9	126	50 (39.7)	76 (60.3)	1.01	(0.79 - 1.30)	1.05	(0.82 - 1.36)
>29.9	70	21 (30.0)	49 (70.0)	0.77	(0.52 - 1.12)	0.82	(0.56 - 1.19)
Age at inclusion (years), mean (SD)							
≤25	141	52 (36.9)	89 (63.1)	0.94	(0.72 - 1.22)	0.94	(0.72 - 1.22)
26-30	278	109 (39.2)	169 (60.8)	*1.00*	*reference*	*1.00*	*reference*
>30	135	50 (37.0)	85 (63.0)	0.94	(0.73 - 1.23)	0.91	(0.70 - 1.19)
Active birth duration (minutes), mean (SD)							
<220	140	49 (35.0)	91 (65.0)	0.97	(0.71 - 1.33)	0.90	(0.66 - 1.24)
221-340	141	51 (36.2)	90 (63.8)	*1.00*	*reference*	*1.00*	*reference*
341-570	143	52 (36.4)	91 (63.6)	1.00	(0.74 - 1.37)	1.00	(0.74 - 1.37)
>570	130	59 (45.4)	71 (54.6)	1.26	(0.94 - 1.68)	1.26	(0.92 - 1.70)
2nd stage duration (minutes), mean (SD)							
<16	109	34 (31.2)	75 (68.8)	0.82	(0.59 - 1.15)	0.80	(0.57 - 1.12)
16-30	187	71 (38.0)	116 (62.0)	*1.00*	*reference*	*1.00*	*reference*
31-45	89	29 (32.6)	60 (67.4)	0.86	(0.60 - 1.22)	0.86	(0.61 - 1.23)
>45	169	77 (45.6)	92 (54.4)	1.20	(0.94 - 1.54)	1.15	(0.88 - 1.52)
Birthweight (grams), mean (SD)							
<2999	76	31 (40.8)	45 (59.2)	1.05	(0.76 - 1.45)	1.09	(0.79 - 1.51)
3000-3499	193	75 (38.9)	118 (61.1)	*1.00*	*reference*	*1.00*	*reference*
3500-3999	210	82 (39.1)	128 (60.9)	1.01	(0.79 - 1.28)	0.96	(0.75 - 1.22)
≥4000	75	23 (30.7)	52 (69.3)	0.79	(0.54 - 1.16)	0.74	(0.50 - 1.10)

Pre-pregnancy dyspareunia (yes)	107	66 (31.3)	41 (12.0)	1.90 (1.56 - 2.32)	1.79 (1.45 - 2.21)
Operative delivery (yes)	65	45 (47.4)	50 (52.6)	1.31 (1.03 - 1.67)	1.18 (0.90 - 1.54)
Smoker at inclusion (yes)**	21	10 (47.6)	11 (52.4)	1.27 (0.80 - 2.01)	1.31 (0.82 - 2.10)
Diabetes (yes)	19	7 (36.8)	12 (63.2)	0.97 (0.53 - 1.76)	1.02 (0.56 - 1.88)

RR; relative risk ratio, CI; confidence interval, SD; standard deviation, BMI; body mass index

** Adjusted for; age, BMI , birthweight, 2nd stage duration, active birth duration, smoking, diabetes, operative delivery, pre-pregnancy dyspareunia (2nd stage duration and active birth duration are not mutually adjusted for each other).

**One missing value (n=553).

Compared to women with no/labia/first-degree ruptures, women with third- or fourth-degree ruptures had higher risk of dyspareunia (aRR 2.09; 1.55-2.81), as did women with spontaneous second-degree ruptures (aRR 2.05; 1.51-2.78). Further, we found pre-pregnancy dyspareunia to be associated with postpartum dyspareunia (aRR 1.79; 1.45-2.21).

The mean PISQ-12 score was higher among women with third- or fourth-degree ruptures (12.2) than among women with no/labia-/first-degree ruptures (10.4) (Table 3).

Table 3: Risk for sexual dysfunction 12 months postpartum among primiparous women in Denmark (n=541).

	Total *n*=541		PISQ-12 score* Crude coef.	(95% CI)	Adjusted** coef.	(95% CI)
	n	*mean (SD)*			*mean (SD)*	
Degree of rupture						
No/labia/1st	188	10.4 (4.2)	*0*	*reference*	*0*	*reference*
2nd (spontanous)	153	10.7 (5.1)	0.37	(-0.65 - 1.38)	0.21	(-0.81 - 1.22)
2nd (mediolateral episiotomy)	31	11.2 (4.2)	0.81	(-0.95 - 2.56)	0.67	(-1.13 - 2.46)
3rd or 4th	169	12.1 (5.0)	1.80	(0.81 - 2.78)	1.69	(0.61 - 2.76)
BMI (kg/m²)*,** mean (SD)						
<25	349	11.2 (4.7)	*0*	*reference*	*0*	*reference*
25-29.9	121	10.8 (4.8)	-0.44	(-1.43 - 0.56)	-0.23	(-1.22 - 0.76)
>29.9	70	10.6 (5.4)	-0.60	(-1.83 - 0.64)	-0.51	(-1.74 - 0.72)
Age (years), mean (SD)						
≤25	137	11.2 (5.1)	0.45	(-0.53 - 1.44)	0.49	(-0.49 - 1.47)
26-30	270	10.8 (4.7)	*0*	*reference*	*0*	*reference*
>30	134	11.5 (4.6)	0.67	(-0.32 - 1.67)	0.61	(-0.37 - 1.59)
Active birth duration (minutes), mean (SD)						
<220	137	10.9 (4.5)	-0.22	(-1.35 - 0.91)	-0.24	(-1.27 - 0.79)
221-340	139	11.1 (5.5)	*0*	*reference*	*0*	*reference*
341-570	140	10.7 (4.4)	-0.46	(-1.58 - 0.67)	-0.55	(-1.57 - 0.47)
>570	125	11.6 (4.7)	0.51	(-0.65 - 1.67)	0.09	(-1.01 - 1.19)
Second stage duration (minutes), mean (SD)						
<16	109	10.9 (5.0)	-0.22	(-1.36 - 0.92)	-0.30	(-1.44 - 0.84)
16-30	181	11.1 (4.9)	*0*	*reference*	*0*	*reference*
31-45	87	10.5 (4.4)	-0.60	(-1.83 - 0.62)	-0.76	(-1.98 - 0.46)
>45	164	11.5 (4.8)	0.37	(-0.64 - 1.39)	0.05	(-1.00 - 1.11)
Birthweight (grams), mean (SD)						
<2999	75	12.3 (4.9)	1.13	(-0.14 - 2.41)	0.99	(-0.27 - 2.27)
3000-3499	191	11.2 (4.6)	*0*	*reference*	*0*	*reference*
3500-3999	205	10.5 (4.8)	-0.66	(-1.60 - 0.28)	-0.73	(-1.68 - 0.21)
≥4000	70	11.2 (5.1)	0.08	(-1.23 - 1.38)	0.20	(-1.10 - 1.51)

Pre-pregnancy dyspareunia (yes)	104	13.0 (4.6)	2.44	(1.43	-	3.44)	2.45	(1.44	-	3.46)
Operative delivery (yes)	92	11.7 (4.7)	0.69	(-0.38	-	1.76)	0.46	(-0.72	-	1.63)
Smoker at inclusion (yes)* **	21	13.8 (4.9)	2.78	(0.70	-	4.86)	2.99	(0.93	-	5.06)
Diabetes (yes)	19	11.1 (4.9)	0.00	(-2.19	-	2.20)	-0.09	(-2.27	-	2.09)

RR; relative risk ratio, CI; confidence interval, SD; standard deviation

*PISQ-12 score; Pelvic Organ Prolapse/Urinary Incontinence Sexual Function Questionnaire, range 0-48, higher score indicating higher degree of dysfunction, n=13 not included in analyses because of > 2 missing answers in the questionnaire

** Adjusted for; age, BMI, birthweight, duration of the second stage of labour, duration of active birth, pre-pregnancy dyspareunia, smoking, diabetes, operative delivery (2nd stage duration and active birth duration are not mutually adjusted for each other)

***One missing value (n=540).

After adjustment, women with anal sphincter ruptures had 1.69 points higher score (95% CI 0.61-2.76) compared to women with no/labia/first-degree ruptures. Women reporting pre-pregnancy dyspareunia had an average 2.45 point higher score (95% CI 1.44-3.46) compared to women without pre-pregnancy dyspareunia. Further, we found smoking women to have a higher PISQ-12 score compared to non-smoking women (aβ 2.99; 0.93-5.06).

The relative risks for dyspareunia postpartum according to perineal body length and perineal strength are presented in Table 4.

Table 4: Risk for dyspareunia according to perineal body length and perineal strength 12 months postpartum among primiparous women in Denmark (n=481).

		Dyspareunia					
	Total	Yes	No	Crude		Adjusted*	
	n=481	*n*= 182	*n*= 285	RR	(95% CI)	RR	(95% CI)
	n	*n* (%)	*n* (%)				
Perineal body lenght							
> 2 cm	468	182 (38.9)	286 (61.1)	*1.00*	*reference*	*1.00*	*reference*
≤ 2 cm	13	8 (61.5)	5 (38.5)	1.58	(1.02 - 2.47)	1.72	(1.10 - 2.71)
Perineal strength,**	467						
Change in the risk for every 10 mm Hg higher pressure	*mean (SD)*	*mean (SD)*	*mean (SD)*				
Resting pressure (mm Hg)	77.7 (22.0)	75.5 (22.4)	79.1 (21.7)	0.96	(0.91 - 1.01)	0.96	(0.91 - 1.01)
Maximum squeeze pressure(mm Hg)	156.3 (49.4)	150.1 (50.0)	160.5 (49.0)	0.97	(0.95 - 0.99)	0.97	(0.95 - 0.99)

RR; relative risk ratio, CI; confidence interval, SD; standard deviation

* Adjusted for; age, BMI, birthweight, 2nd stage duration, active birth duration, smoking, diabetes, operative delivery, pre-pregnancy dyspareunia, degree of rupture

**14 missing values (n=467).

We found women with a perineal body length ≤ 2 cm to be in higher risk of dyspareunia compared to women with a perineal body length > 2cm (aRR 1.72; 1.10-2.71). A lower maximal perineal pressure in women with dyspareunia compared to women without dyspareunia (150 vs 161 mm Hg) was observed. For every 10 mm Hg higher maximum pressure, the risk of dyspareunia decreased with 3% (aRR 0.97; 0.95-0.99).

DISCUSSION

Main Findings

At 12 months postpartum, more than half of the women who sustained anal sphincter ruptures had dyspareunia compared to one fourth in women with no/labia/first-degree ruptures. Women with anal sphincter ruptures had a higher degree of sexual dysfunction in general. In addition, we found women with perineal body length ≤ 2 cm and reduced perineal strength to be in higher risk of dyspareunia.

Interpretation (in light of other evidence)

The literature on sexual dysfunction measured more than six months postpartum is in general sparse which makes it difficult to compare our results to those from other studies. Our study showed that primiparous women, regardless degree of rupture, experienced high levels of sexual dysfunction postpartum in accordance with the findings from another large cohort study.[3] In line with other studies, [3 5 19] we found more women with second-degree ruptures to have dyspareunia compared to women with no or minor ruptures. The same studies found pre-pregnancy dyspareunia to be associated with postpartum dyspareunia[3 5 19]. We observed the same association, but the association between degree of perineal rupture and postpartum dyspareunia, did not seem to be affected by the presence of dyspareunia before pregnancy.

Our study showed smoking women to have a higher PISQ-12 score than the non-smoking women. Studies addressing the association between smoking and female sexual health are few and results are inconsistent.[20-23] However, smoking has an anti-oestrogenic effect,[24] and low oestrogen levels are related to higher prevalence of sexual dysfunction among women.[25]

There is limited knowledge on dyspareunia postpartum and the role of the pelvic floor muscles[26]. To our knowledge, only one study including 177 women has investigated the relation between perineal strength and dyspareunia and found no association.[26] We found both perineal length and strength to be associated with the risk of dyspareunia. Thus more women with a short perineum and reduced perineal strength had dyspareunia.

Strengths and limitations

The study had a high follow-up rate for both the web-based questionnaire and clinical examination. A major strength of this study is the inclusion of only primiparous women. Hereby, we were able to assess the possible association between the degree of rupture and the risk of sexual dysfunction without the influence of previous deliveries and ruptures. Further, the inclusion of a control group without perineal muscle ruptures made it possible to assess the effect of a vaginal delivery itself without ruptures to the perineal muscles. In addition, all women had a clinical examination two weeks postpartum and thereby the risk of misclassification according to exposure group was minimized.

A limitation of the present study is the fact that all clinical examinations were performed by the same examiner (DG). To limit differential misclassification, the examiner was blinded of the sexual function status of each participant and aimed to stay blinded to the degree of rupture the women in question had sustained.

In the present study, we used the standardized and validated PISQ-12 questionnaire. However, the PISQ-12 questionnaire is developed and validated in populations of heterogeneous couples. The

questions addressing partner erection and premature ejaculation are only relevant for women with a male partner. As the total PISQ-12 score depended on at least 10 answered questions, some women were excluded from these analyses based on their partner relationship. Thus, some of our results may only be relevant for heterosexual couples.

Other studies have found an association between sexual dysfunction and breastfeeding, as breastfeeding might fulfil parts of a woman`s need for proximity and lead to decreased oestrogen levels causing vaginal dryness.[27-29] We did not have information on breastfeeding. However, we have no reason to believe that breastfeeding should be unevenly distributed across degrees of perineal ruptures.

The study had a risk of recall bias as we asked the women to recall pre-pregnancy information. Ideally, sexual function should have been established before pregnancy. However this would require another study design.

Clinical implications

Although sexual problems are common one year after childbirth, especially among women sustaining ruptures of second-, third- or fourth-degree the proportion of women who ask for help or discuss their problems is low.[5 30] Thus, it is important to give words to the sexual well-being in the postpartum assessment of women and to put a particular focus on the women in high risk of developing sexual dysfunction. If dyspareunia seem to be caused by vaginal dryness, local vaginal oestrogen or lubricants should be provided. If tender scar tissue is identified, perineal massage or use of lignocaine gel may be help-full,[31] and thus new mothers should be given these advises.

Conclusion

The findings from this cohort study of primiparous women demonstrate that impairment of sexual health is common among primiparous women after vaginal delivery. Women delivering with no ruptures, ruptures isolated to the labia or small ruptures of first-degree reported the best outcomes

overall, while more than half of the women with anal sphincter ruptures were experiencing dyspareunia. It is therefore important to minimize the extent of perineal trauma and to thoroughly counsel women and their partners about sexuality during and after pregnancy.

Disclosure of interests

Nothing to declare

Contribution to Authorship

All authors contributed to the design of this study. DG performed the data collection and conducted the analyses and DG, VR, EAN and NQ contributed to the interpretation of data. DG drafted the manuscript and all authors critically revised the manuscript and approved the version to be published.

Data sharing

Extra data is available by emailing the corresponding author.

Details of ethics approval

The study was approved by the Scientific Ethics Committee for the Region of Southern Denmark (S-20120213, 14.5.2013) and by the Danish Data Protection Agency (ID-2008-58-0035, 14.1.2015). All participants provided written informed consent.

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STROBE Statement—Checklist of items that should be included in reports of ***cohort studies***

	Item No	Recommendation	Page No
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract (*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	1 2-3
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4
Objectives	3	State specific objectives, including any prespecified hypotheses	4
Methods			
Study design	4	Present key elements of study design early in the paper	4
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	4-5
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up (*b*) For matched studies, give matching criteria and number of exposed and unexposed	5-6 N/A
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6-7
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	6-7
Bias	9	Describe any efforts to address potential sources of bias	7-8
Study size	10	Explain how the study size was arrived at	4
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	5-7
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding (*b*) Describe any methods used to examine subgroups and interactions (*c*) Explain how missing data were addressed (*d*) If applicable, explain how loss to follow-up was addressed (*e*) Describe any sensitivity analyses	7-8
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed (b) Give reasons for non-participation at each stage (c) Consider use of a flow diagram	8
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders (b) Indicate number of participants with missing data for each variable of interest (c) Summarise follow-up time (eg, average and total amount)	Table 1, p.9
Outcome data	15*	Report numbers of outcome events or summary measures over time	10-15

Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included (*b*) Report category boundaries when continuous variables were categorized (*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	10-15
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	
Discussion			
Key results	18	Summarise key results with reference to study objectives	18
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	19-20
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	18-21
Generalisability	21	Discuss the generalisability (external validity) of the study results	19-20
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	21

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at http://www.strobe-statement.org.

BMJ Open

Obstetric perineal tears, sexual function and dyspareunia among primiparous women 12 months postpartum: a prospective cohort study

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ABSTRACT

Objective: Sexuality is an important aspect of human identity and contributes significantly to the quality of life in women as well as in men. Impairment in sexual health after vaginal delivery is a major concern for many women. We aimed to examine the association between degree of perineal tear and sexual function 12 months postpartum.

Design: A prospective cohort study

Setting: Four Danish hospitals between July 2015 and January 2019

Participants: A total of 554 primiparous women: 191 with no/labia/first-degree tears, 189 with second-degree tears, and 174 with third-/fourth-degree tears. Baseline data were obtained 2 weeks postpartum by a questionnaire and a clinical examination. Sexual function was evaluated 12 months postpartum by an electronic questionnaire (PISQ-12) and a clinical examination.

Primary outcome measures: Total PISQ-12 score and dyspareunia.

Results: Episiotomy was performed in 54 cases and 95 women had an operative vaginal delivery. The proportion of women with dyspareunia was: 25%, 38% and 53% of women with no/labia/first-degree, second-degree or third-/fourth-degree tears, respectively.

Compared to women with no/labia/first-degree tears, women with second degree or third- or fourth-degree tears had higher risk of dyspareunia (aRR 2.05; 95% CI 1.51-2.78 and aRR 2.09; 95% CI 1.55-2.81, respectively). Women with third- or fourth-degree tears had a higher mean PISQ-12 score (12.2) than women with no/labia/first-degree tears (10.4)

Conclusions: Impairment of sexual health is common among primiparous women after vaginal delivery. At 12 months postpartum more than half of the women with an third- or fourth-degree tear experienced dyspareunia. Women delivering with no/labia/first-degree tears reported the best outcomes overall. Thus, it is important to minimize the extent of perineal trauma and to counsel about sexuality during and after pregnancy.

Article summary

Strengths and limitations of this study:

- The study had a high follow-up rate for both the web-based questionnaire and clinical examination.
- The study included both subjective and objective outcome measurements.
- All the clinical examinations were performed by the same examiner raising a possible risk of intra observer bias.
- There was a risk of recall bias as information about pre-pregnancy sexual function was obtained postpartum.

INTRODUCTION

Sexuality is an important aspect of human identity and contributes significantly to the quality of life in women as well as in men.[1] Sexual function postpartum is affected by the changes in hormonal milieu, anatomy, and family structure following childbirth. Dyspareunia and other sexual problems such as loss of sex drive in the postpartum period is a well-known problem and frequencies of sexual health problems as high as 30-60% three months postpartum and 17-31% six months postpartum have been reported.[2-7] A large cohort study from Sweden found vaginal or perineal tears, regardless of degree, to be associated with a delay in women's resumption of sexual intercourse defined as more than 3 months after giving birth,[8] while about 10% of primiparous women had not yet resumed sexual intercourse six months postpartum.[3] The causes of sexual health problems are multifactorial and the mechanisms are still not fully understood.[3-5 9] Thus sexual health problems remains an unsolved problem for many women. Among other things, anatomical changes caused by vaginal or perineal tears may contribute to dyspareunia and has important effects on both the timing and quality of the resumption of sexual relations during the initial postpartum months.[10] The association between obstetrical risk factors and postpartum sexual function is not yet well described or understood and thus the aim of this study was to investigate the association between degree of perineal tear, sexual function and dyspareunia 12 months postpartum.

METHODS

Study setting

This study is part of a larger prospective cohort study conducted at two university and two tertiary hospital units in Denmark, Odense (OUH), Aarhus (AUH), Esbjerg, and Kolding, between July 2015 and January 2019. The inclusion procedure and sample size calculation is described thoroughly elsewhere.[11]

Study population

The study involved three groups of women i) 203 women with no/labia/first-degree perineal tears, ii) 200 women with second-degree perineal tears and iii) 200 women with third-/fourth-degree perineal tears.

Patient and Public Involvement

There was no patient or public involvement in design and conduct of this study.

Inclusion and follow-up procedure

Women delivering vaginally, at least 18 years old, able to read and speak Danish were eligible. After the delivery, they were informed about the study. Further information was sent by e-mail and the women were invited by phone to participate in a face-to-face interview including baseline questionnaires and a clinical examination comprising a perineal inspection at 16±5 days postpartum. Written informed consent was obtained at baseline.[11] At 12 months postpartum, all participants received the same questionnaires electronically and were invited to a gynaecological examination. All examinations took place at the hospital and participants could bring their baby. Study data were collected and managed using REDCap electronic data capture tools hosted at OUH.[12]

Outcome measurements

The primary outcome was sexual function. We used the Danish version of the Pelvic Organ Prolapse/Urinary Incontinence Sexual Function Questionnaire (PISQ-12).[13] The PISQ-12 is a self-administered, objective and validated questionnaire with scores based on 12 questions to evaluate sexual function. The score of each item ranges from 0=never to 4=always (reverse scoring for questions 1, 2, 3 and 4). Missing responses are handled by multiplying the mean of answered items and the score is valid with up to 2 missing answers.[13] The questionnaire has previously been used to evaluate sexual function after vaginal delivery.[14 15] We used the total score (range 0-48) with lower scores indicating better sexual function, and the individual score for question 5;"Do you feel pain

during sexual intercourse?". The total score was used as a continuous variable presented as mean and standard deviation (SD) and the single score for question 5 was dichotomized as dyspareunia when answering "sometimes", "usually" or "always" and no dyspareunia when answering "seldom" or "never".

Exposure variables and covariates

Degrees of perineal tears

The degree of perineal tear was defined according to the Green-top Guideline No. 29.[16] First-degree tears were defined as injury to perineal skin and/or vaginal mucosa. Second-degree tears were defined as injury to perineum involving perineal muscles but not the anal sphincter. Third- and fourth-degree tears were defined as injury to perineum involving the anal sphincter complex. Episiotomies were lateral or mediolateral. Episiotomies equivalent to a second-degree tear were analysed independently while episiotomies extending to the anal sphincter muscles were classified as a third- or fourth-degree tear.

Baseline information

At baseline 16±5 days postpartum, a questionnaire was completed providing information about age (years), height (centimetres), smoking status (yes/no), and pregestational BMI (kg/m^2). Information about pregnancy, birth and the postpartum period was obtained from the obstetric journal and included diabetes mellitus (yes/no), length of active birth and length of the second stage of labour (minutes), operative delivery (yes/no), birthweight (gram) and head circumference (centimetres). The PISQ-12 was likewise completed at baseline providing information about pre-pregnancy sexual function. Question 5 was used and dichotomized as the postpartum score described previously.

Clinical examination 12 months postpartum

Perineal length was evaluated by a gynaecological examination. All procedures were done by the first author (DG), with the women in the dorsal lithotomy position without bowel preparation. At

the gynaecological examination, perineal body length was measured in centimetres, from the hymen to the middle of anus during Valsalva manoeuvre as done in the Pelvic Organ Quantification (POP-Q) system,[17] and used as a dichotomous variable (≤ 2 cm/> 2 cm).

Statistical analyses

Baseline characteristics according to degree of tear were described as frequencies for categorical variables. To investigate the association between the degree of perineal tear and dyspareuniaor perineal body length, a relative risk regression by use of a generalized linear model with log-link function and binomial distribution as statistical family was performed with estimates reported as relative risks (RR) with 95% confidence intervals (CI). To investigate the association between the degree of perineal tear and sexual health problems measured as the total PISQ-12 score, a linear regression was performed, and results presented as regression coefficients (β) with 95% CI. In the adjusted analysis, we controlled for pre-pregnancy dyspareunia, smoking, diabetes and operative delivery as categorical variables and age, BMI, duration of the second stage of labour, duration of active birth and birthweight as continuous variables. These potential confounders were chosen a priori based on directed acyclic graphs generated for the outcome variable using DAGitty v2.3 as graphical tool for analyzing the causal diagrams.[18] The analyses were carried out using STATA statistical software version 15.0.

RESULTS

Participants

Initially, a total of 832 women were invited to participate in the study (Figure 1). Of these, 81 declined and 138 could not be reached. This left 613 women completing a written consent and a baseline questionnaire who were booked for a clinical examination 16±5 days postpartum. Ten women withdrew their consent. Thus, the study population comprised 603 women. At the one year follow-up, 554 of the 603 women answered the web-based questionnaire corresponding to 92%, and

481 women had the clinical examination performed corresponding to 80%. Due to more than two missing answers, 13 women were excluded from analyses of total PISQ-12 score.

Characteristics according to degree of tear

Women sustaining third- or fourth-degree tears were on average 0.5 years older than women sustaining second-degree tears and 1.2 years older than women sustaining no/labia/first-degree tears (Table 1).

Table 1: Characteristics according to degree of tear among primiparous women (n=554).

	Total (*n*=554)	Group 1 (No/labia/ 1st degree) (*n*=191)	Group 2 (2nd degree) (*n*=189)	Group 3 (3rd/4th degree) (*n*=174)
	n (%)	**n (%)**	**n (%)**	**n (%)**
BMI, pre-pregnancy (kg/m²)*				
<25	357 (64.6)	128 (67.0)	116 (61.7)	113 (64.9)
25-29.9	126 (22.8)	41 (21.5)	46 (24.5)	39 (22.4)
≥29.9	70 (12.7)	22 (11.5)	26 (13.8)	22 (12.6)
Age at inclusion (years)				
≤25	141 (25.5)	63 (33.0)	50 (26.5)	28 (16.1)
26-30	278 (50.2)	91 (47.6)	89 (47.1)	98 (56.3)
>30	135 (24.4)	37 (19.4)	50 (26.5)	48 (27.6)
Active birth duration (minutes)				
<220	140 (25.3)	69 (36.1)	46 (24.3)	25 (14.4)
221-340	141 (25.5)	45 (23.6)	53 (28.0)	43 (24.7)
341-570	143 (25.8)	50 (26.2)	49 (25.9)	44 (25.3)
>570	130 (23.5)	27 (14.1)	41 (21.7)	62 (35.6)
Second stage duration (minutes)				
<16	109 (19.7)	40 (20.9)	47 (24.9)	22 (12.6)
16-30	187 (33.8)	80 (41.9)	60 (31.8)	47 (27.0)
31-45	89 (16.1)	31 (16.2)	27 (14.3)	31 (17.8)
>45	169 (30.5)	40 (20.9)	55 (29.1)	74 (42.5)
Birthweight (grams)				
<2999	76 (13.7)	39 (20.4)	23 (12.2)	14 (8.1)
3000-3499	193 (34.8)	69 (36.1)	81 (42.9)	43 (24.7)
3500-3999	210 (37.9)	64 (33.5)	65 (34.4)	81 (46.6)
≥4000	75 (13.5)	19 (10.0)	20 (10.6)	36 (20.7)
Head circumference (cm)**				
<34	141 (25.5)	58 (30.5)	52 (27.7)	31 (17.8)
34	119 (21.6)	45 (23.7)	37 (19.7)	37 (21.3)
35	131 (23.7)	35 (18.4)	53 (28.2)	43 (24.7)
>35	161 (29.2)	52 (27.4)	46 (24.5)	63 (36.2)
Pre-pregnancy dyspareunia (yes)	107 (19.3)	26 (13.6)	39 (20.6)	42 (24.1)
Operative delivery (yes)	95 (17.2)	6 (3.1)	29 (15.3)	60 (34.5)
Episiotomi (yes)	54 (9.8)	-	32 (16.9)	22 (12.6)
Smoker, at inclusion (yes)*	21 (3.8)	8 (4.2)	8 (4.2)	5 (2.9)
Diabetes mellitus (yes)	19 (3.4)	5 (2.6)	7 (3.7)	7 (4.0)

*One missing values, n=553
**Two missing values, n=552

Moreover, a higher degree of tear was seen with higher birthweight, longer second stage of labour and longer duration of active birth. Instrumental delivery was more frequent among women with second-degree (15%) and third- or fourth-degree tears (34%) compared to women with no/labia/first-degree tears (3%).

Risk of sexual health problems and dyspareunia

The proportion of pre-pregnancy dyspareunia was: 14%, 21%, and 24% in the no/labia/first-degree, second-degree and third- or fourth-degree tear groups, respectively (Table 1). At 12 months postpartum, the proportion in all three groups was higher than pre-pregnancy; 25%, 38% and 53% respectively.

The risks for dyspareunia at 12 months postpartum are presented in Table 2.

Table 2: Relative Risks for dyspareunia 12 months postpartum among primiparous women in Denmark (n=554).

	Total	Dyspareunia		Crude		Adjusted*	
		Yes	No				
	n=554	*n*= 211	*n*= 343	RR	(95% CI)	RR	(95% CI)
	n	*n* (%)	*n* (%)				
Degree of tear							
No/labia/1st	191	47 (24.6)	144 (75.4)	*1.00*	*reference*	*1.00*	*reference*
2nd (spontanous)	157	59 (37.8	97 (62.2	1.53	(1.11 - 2.10)	2.05	(1.51 - 2.78)
2nd (mediolateral episiotomy)	32	13 (40.6)	19 (59.4)	1.65	(1.01 - 2.69)	1.62	(0.99 - 2.67)
3rd or 4th	174	92 (52.9)	82 (47.1)	2.15	(1.62 - 2.86)	2.09	(1.55 - 2.81)
BMI, pre-pregnancy (kg/m²),** mean (SD)					-		-
<25	357	140 (39.2)	217 (60.8)	1.00	reference	1.00	reference
25-29.9	126	50 (39.7)	76 (60.3)	1.01	(0.79 - 1.30)	1.05	(0.82 - 1.36)
>29.9	70	21 (30.0)	49 (70.0)	0.77	(0.52 - 1.12)	0.82	(0.56 - 1.19)
Age at inclusion (years), mean (SD)							
≤25	141	52 (36.9)	89 (63.1)	0.94	(0.72 - 1.22)	0.94	(0.72 - 1.22)
26-30	278	109 (39.2)	169 (60.8)	*1.00*	*reference*	*1.00*	*reference*
>30	135	50 (37.0)	85 (63.0)	0.94	(0.73 - 1.23)	0.91	(0.70 - 1.19)
Active birth duration (minutes), mean (SD)							
<220	140	49 (35.0)	91 (65.0)	0.97	(0.71 - 1.33)	0.90	(0.66 - 1.24)
221-340	141	51 (36.2)	90 (63.8)	*1.00*	*reference*	*1.00*	*reference*
341-570	143	52 (36.4)	91 (63.6)	1.00	(0.74 - 1.37)	1.00	(0.74 - 1.37)
>570	130	59 (45.4)	71 (54.6)	1.26	(0.94 - 1.68)	1.26	(0.92 - 1.70)
2nd stage duration (minutes), mean (SD)							
<16	109	34 (31.2)	75 (68.8)	0.82	(0.59 - 1.15)	0.80	(0.57 - 1.12)
16-30	187	71 (38.0)	116 (62.0)	*1.00*	*reference*	*1.00*	*reference*
31-45	89	29 (32.6)	60 (67.4)	0.86	(0.60 - 1.22)	0.86	(0.61 - 1.23)
>45	169	77 (45.6)	92 (54.4)	1.20	(0.94 - 1.54)	1.15	(0.88 - 1.52)
Birthweight (grams), mean (SD)							
<2999	76	31 (40.8)	45 (59.2)	1.05	(0.76 - 1.45)	1.09	(0.79 - 1.51)
3000-3499	193	75 (38.9)	118 (61.1)	*1.00*	*reference*	*1.00*	*reference*
3500-3999	210	82 (39.1)	128 (60.9)	1.01	(0.79 - 1.28)	0.96	(0.75 - 1.22)
≥4000	75	23 (30.7)	52 (69.3)	0.79	(0.54 - 1.16)	0.74	(0.50 - 1.10)

Pre-pregnancy dyspareunia (yes)	107	66 (31.3)	41 (12.0)	1.90 (1.56 - 2.32)	1.79 (1.45 - 2.21)
Operative delivery (yes)	65	45 (47.4)	50 (52.6)	1.31 (1.03 - 1.67)	1.18 (0.90 - 1.54)
Smoker at inclusion (yes)**	21	10 (47.6)	11 (52.4)	1.27 (0.80 - 2.01)	1.31 (0.82 - 2.10)
Diabetes (yes)	19	7 (36.8)	12 (63.2)	0.97 (0.53 - 1.76)	1.02 (0.56 - 1.88)

RR; relative risk ratio, CI; confidence interval, SD; standard deviation, BMI; body mass index

** Adjusted for; age, BMI , birthweight, 2nd stage duration, active birth duration, smoking, diabetes, operative delivery, pre-pregnancy dyspareunia (2nd stage duration and active birth duration are not mutually adjusted for each other).

**One missing value (n=553).

Compared to women with no/labia/first-degree tears, women with third- or fourth-degree tears had higher risk of dyspareunia (aRR 2.09; 1.55-2.81), as did women with spontaneous second-degree tears (aRR 2.05; 1.51-2.78). Further, we found pre-pregnancy dyspareunia to be associated with postpartum dyspareunia (aRR 1.79; 1.45-2.21).

At 12 months postpartum the mean PISQ-12 score was higher among women with third- or fourth-degree tears (12.2) than among women with no/labia/first-degree tears (10.4) (Table 3).

Table 3: Risk for sexual health problems 12 months postpartum among primiparous women in Denmark (n=541).

	Total *n*=541		PISQ-12 score* Crude coef.	(95% CI)	Adjusted** coef.	(95% CI)
	n	*mean (SD)*				
Degree of tear						
No/labia/1st	188	10.4 (4.2)	*0*	*reference*	*0*	*reference*
2nd (spontaneous)	153	10.7 (5.1)	0.37	(-0.65 - 1.38)	0.21	(-0.81 - 1.22)
2nd (mediolateral episiotomy)	31	11.2 (4.2)	0.81	(-0.95 - 2.56)	0.67	(-1.13 - 2.46)
3rd or 4th	169	12.1 (5.0)	1.80	(0.81 - 2.78)	1.69	(0.61 - 2.76)
BMI (kg/m²)*,** mean (SD)						
<25	349	11.2 (4.7)	*0*	*reference*	*0*	*reference*
25-29.9	121	10.8 (4.8)	-0.44	(-1.43 - 0.56)	-0.23	(-1.22 - 0.76)
>29.9	70	10.6 (5.4)	-0.60	(-1.83 - 0.64)	-0.51	(-1.74 - 0.72)
Age (years), mean (SD)						
≤25	137	11.2 (5.1)	0.45	(-0.53 - 1.44)	0.49	(-0.49 - 1.47)
26-30	270	10.8 (4.7)	*0*	*reference*	*0*	*reference*
>30	134	11.5 (4.6)	0.67	(-0.32 - 1.67)	0.61	(-0.37 - 1.59)
Active birth duration (minutes), mean (SD)						
<220	137	10.9 (4.5)	-0.22	(-1.35 - 0.91)	-0.24	(-1.27 - 0.79)
221-340	139	11.1 (5.5)	*0*	*reference*	*0*	*reference*
341-570	140	10.7 (4.4)	-0.46	(-1.58 - 0.67)	-0.55	(-1.57 - 0.47)
>570	125	11.6 (4.7)	0.51	(-0.65 - 1.67)	0.09	(-1.01 - 1.19)
Second stage duration (minutes), mean (SD)						
<16	109	10.9 (5.0)	-0.22	(-1.36 - 0.92)	-0.30	(-1.44 - 0.84)
16-30	181	11.1 (4.9)	*0*	*reference*	*0*	*reference*
31-45	87	10.5 (4.4)	-0.60	(-1.83 - 0.62)	-0.76	(-1.98 - 0.46)
>45	164	11.5 (4.8)	0.37	(-0.64 - 1.39)	0.05	(-1.00 - 1.11)
Birthweight (grams), mean (SD)						
<2999	75	12.3 (4.9)	1.13	(-0.14 - 2.41)	0.99	(-0.27 - 2.27)
3000-3499	191	11.2 (4.6)	*0*	*reference*	*0*	*reference*
3500-3999	205	10.5 (4.8)	-0.66	(-1.60 - 0.28)	-0.73	(-1.68 - 0.21)
≥4000	70	11.2 (5.1)	0.08	(-1.23 - 1.38)	0.20	(-1.10 - 1.51)

Pre-pregnancy dyspareunia (yes)	104	13.0 (4.6)	2.44	(1.43	-	3.44)	2.45	(1.44	-	3.46)
Operative delivery (yes)	92	11.7 (4.7)	0.69	(-0.38	-	1.76)	0.46	(-0.72	-	1.63)
Smoker at inclusion (yes)* **	21	13.8 (4.9)	2.78	(0.70	-	4.86)	2.99	(0.93	-	5.06)
Diabetes (yes)	19	11.1 (4.9)	0.00	(-2.19	-	2.20)	-0.09	(-2.27	-	2.09)

RR; relative risk ratio, CI; confidence interval, SD; standard deviation

*PISQ-12 score; Pelvic Organ Prolapse/Urinary Incontinence Sexual Function Questionnaire, range 0-48, higher score indicating higher degree of sexual health problems, n=13 not included in analyses because of > 2 missing answers in the questionnaire

** Adjusted for; age, BMI, birthweight, duration of the second stage of labour, duration of active birth, pre-pregnancy dyspareunia, smoking, diabetes, operative delivery (2nd stage duration and active birth duration are not mutually adjusted for each other)

***One missing value (n=540).

After adjustment, women with anal sphincter tears had 1.69 points higher score (95% CI 0.61-2.76) compared to women with no/labia/first-degree tears. Women reporting pre-pregnancy dyspareunia had an average 2.45 point higher score (95% CI 1.44-3.46) compared to women without pre-pregnancy dyspareunia. Further, we found smoking women to have a higher PISQ-12 score compared to non-smoking women (aβ 2.99; 0.93-5.06).

The relative risks for dyspareunia postpartum according to perineal body length are presented in Table 4.

Table 4: Risk for dyspareunia according to perineal body length 12 months postpartum among primiparous women in Denmark (n=481).

		Dyspareunia					
	Total	Yes	No	Crude		Adjusted*	
	n=481	*n*= 182	*n*= 285	RR	(95% CI)	RR	(95% CI)
	n	*n* (%)	*n* (%)				
Perineal body length							
> 2 cm	468	182 (38.9)	286 (61.1)	*1.00*	*reference*	*1.00*	*reference*
≤ 2 cm	13	8 (61.5)	5 (38.5)	1.58	(1.02 - 2.47)	1.72	(1.10 - 2.71)

RR; relative risk ratio, CI; confidence interval, SD; standard deviation

* Adjusted for; age, BMI, birthweight, 2nd stage duration, active birth duration, smoking, diabetes, operative delivery, pre-pregnancy dyspareunia, degree of tear

We found women with a perineal body length ≤ 2 cm to be in higher risk of dyspareunia compared to women with a perineal body length > 2cm (aRR 1.72; 1.10-2.71).

DISCUSSION

Main Findings

At 12 months postpartum, more than half of the women who sustained anal sphincter tears had dyspareunia compared to one fourth in women with no/labia/first-degree tears. Women with anal sphincter tears had a higher degree of sexual health problems in general. In addition, we found women with perineal body length ≤ 2 cm to be in higher risk of dyspareunia.

Interpretation (in light of other evidence)

The literature on sexual function measured more than six months postpartum is in general sparse which makes it difficult to compare our results to those from other studies. Our study showed that primiparous women, regardless degree of tear, experienced high levels of sexual health problems postpartum in accordance with the findings from another large cohort study.[3] In line with other studies, [3 5 19] we found more women with second-degree tears to have dyspareunia compared to women with no or minor tears. The same studies found pre-pregnancy dyspareunia to be associated with postpartum dyspareunia.[3 5 19] We observed the same association, but the association between degree of perineal tear and postpartum dyspareunia, did not seem to be affected by the presence of dyspareunia before pregnancy.

Our study showed smoking women to have a higher PISQ-12 score than the non-smoking women. Studies addressing the association between smoking and female sexual health are few and results are inconsistent.[20-23] However, smoking has an anti-oestrogenic effect,[24] and low oestrogen levels are related to higher prevalence of sexual health problems among women.[25]

There is limited knowledge on dyspareunia postpartum and the role of the pelvic floor muscles[26]. To our knowledge, only one study including 177 women has investigated the relation between the perineal muscles and dyspareunia and found no association.[26] We found perineal length to be associated with the risk of dyspareunia. Thus more women with a short perineum had dyspareunia.

Strengths and limitations

The study had a high follow-up rate for both the web-based questionnaire and clinical examination. A major strength of this study is the inclusion of only primiparous women. Hereby, we were able to assess the possible association between the degree of tear and the risk of sexual health problems without the influence of previous deliveries and tears. Further, the inclusion of a control group without perineal muscle tears made it possible to assess the effect of a vaginal delivery itself without tears to the perineal muscles. In addition, all women had a clinical examination two weeks postpartum and thereby the risk of misclassification according to exposure group was minimized.

A limitation of the present study is the fact that all clinical examinations were performed by the same examiner (DG). To limit differential misclassification, the examiner was blinded of the sexual function status of each participant and aimed to stay blinded to the degree of tear the women in question had sustained.

In the present study, we used the standardized and validated PISQ-12 questionnaire. However, the PISQ-12 questionnaire is developed and validated in populations of heterogeneous couples. The questions addressing partner erection and premature ejaculation are only relevant for women with a male partner. As the total PISQ-12 score depended on at least 10 answered questions, some women were excluded from these analyses based on their partner relationship. Thus, some of our results may only be relevant for heterosexual couples. The PISQ-12 score has biophysical focus in general and lacks the relational and psychological issues that may have an impact on postpartum sexual

health. Thus, this study does not address these issues, which are highly relevant in the context of sexual health in a vulnerable period of life.

Other studies have found an association between sexual health problems and breastfeeding, as breastfeeding might fulfil parts of a woman`s need for proximity and lead to decreased oestrogen levels causing vaginal dryness.[27-29] We did not have information on breastfeeding. Yet, we have no reason to believe that breastfeeding should be unevenly distributed across degrees of perineal tears. In accordance with the results from a large Irish cohort study, we did not find episiotomies to be associated with sexual health problems 12 months postpartum.[19] In our primary adjusted analyses, we included episiotomy to adjust for any potential confounding effect. Excluding episiotomy from the analyses only changed the adjusted estimates marginally and thus episiotomy did not seem to be a confounder in this study.

We found 19.3% to report pre-pregnancy dyspareunia. However, the study had a risk of recall bias as we asked the women to recall pre-pregnancy information 2 weeks postpartum, which might be influenced by the degree of perineal tear experienced. Ideally, sexual function should have been established before pregnancy but this would require another study design. Ideally, sexual function should have been established before pregnancy. However this would require another study design.

Clinical implications

Although sexual problems are common one year after childbirth, especially among women sustaining tears of second-, third- or fourth-degree the proportion of women who ask for help or discuss their problems is low.[5 30] Thus, it is important to give words to the sexual well-being in the postpartum assessment of women and to put a particular focus on the women in high risk of developing sexual health problems. Further, pregnancy is a time in women's life when they are in contact with the health services. This leaves an opportunity to identify and counsel women with dyspareunia as they are at risk of persistent sexual health problems 12 months postpartum.

Spontaneous second-degree tears seemed to increase the risk of dyspareunia. The same association was not found for mediolateral or lateral episiotomies. Thus, episiotomy might be considered to prevent dyspareunia in some cases. However, this needs to be investigated further in larger datasets with more episiotomies and perhaps also accounting for methods of repair which may vary across clinical settings.

If dyspareunia seem to be caused by vaginal dryness, local vaginal oestrogen or lubricants should be provided. If tender scar tissue is identified, perineal massage or use of lignocaine gel may be help-full,[31] and thus new mothers should be given these advises.

Conclusion

The findings from this cohort study of primiparous women demonstrate that impairment of sexual health is common among primiparous women after vaginal delivery. Women delivering with no tears, tears isolated to the labia or small tears of first-degree reported the best outcomes overall, while more than half of the women with anal sphincter tears were experiencing dyspareunia. It is therefore important to minimize the extent of perineal trauma and to thoroughly counsel women and their partners about sexuality before, during and after pregnancy.

Disclosure of interests

Nothing to declare

Contribution to Authorship

All authors contributed to the design of this study. DG performed the data collection and conducted the analyses and DG, VR, EAN and NQ contributed to the interpretation of data. DG drafted the manuscript and all authors critically revised the manuscript and approved the version to be published.

Data sharing

Extra data is available by emailing the corresponding author.

Details of ethics approval

The study was approved by the Scientific Ethics Committee for the Region of Southern Denmark (S-20120213, 14.5.2013) and by the Danish Data Protection Agency (ID-2008-58-0035, 14.1.2015). All participants provided written informed consent.

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Data sharing: Data are available upon reasonable request. Deidentified participant data are available from the corresponding author by request: ditte.gommesen@rsyd.dk

Figure 1: Flowchart of inclusion and follow-up. Reasons for not participating in the clinical examination: Withdrawal of consent/lost to follow-up; 111 women, moved away; 5 women, gave birth again; 5 women, dead; 1 woman.

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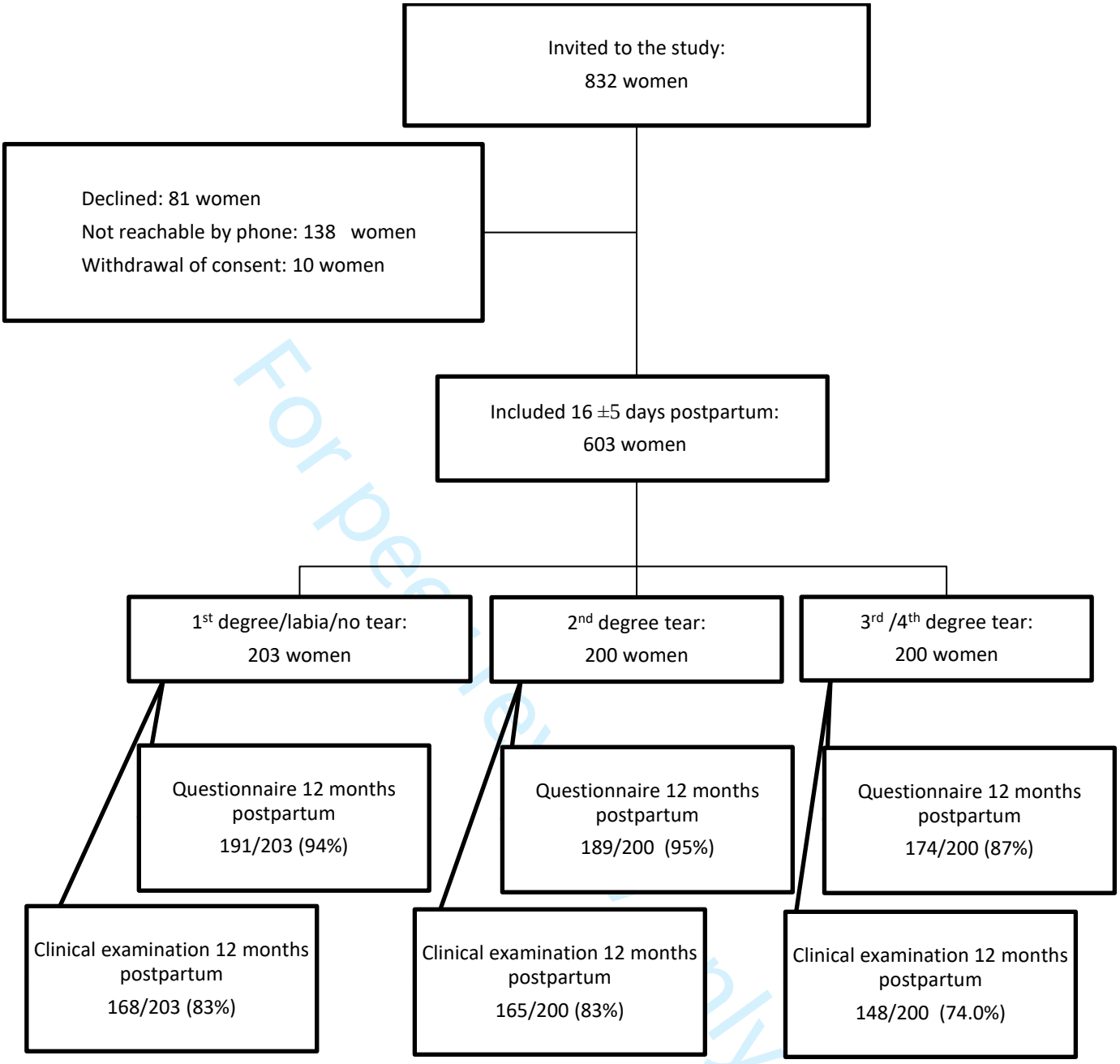

Figure 1: Flowchart of inclusion and follow-up. Reasons for not participating in the clinical examination: Withdrawal of consent/lost to follow-up; 111 women, moved away; 5 women, gave birth again; 5 women, dead; 1 woman.

STROBE Statement—Checklist of items that should be included in reports of ***cohort studies***

	Item No	Recommendation	Page No
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract (*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	1 2-3
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4
Objectives	3	State specific objectives, including any prespecified hypotheses	4
Methods			
Study design	4	Present key elements of study design early in the paper	4
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	4-5
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up (*b*) For matched studies, give matching criteria and number of exposed and unexposed	5-6 N/A
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6-7
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	6-7
Bias	9	Describe any efforts to address potential sources of bias	7-8
Study size	10	Explain how the study size was arrived at	4
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	5-7
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding (*b*) Describe any methods used to examine subgroups and interactions (*c*) Explain how missing data were addressed (*d*) If applicable, explain how loss to follow-up was addressed (*e*) Describe any sensitivity analyses	7-8
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed (b) Give reasons for non-participation at each stage (c) Consider use of a flow diagram	8
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders (b) Indicate number of participants with missing data for each variable of interest (c) Summarise follow-up time (eg, average and total amount)	Table 1, p.9
Outcome data	15*	Report numbers of outcome events or summary measures over time	10-15

Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included (*b*) Report category boundaries when continuous variables were categorized (*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	10-15
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	
Discussion			
Key results	18	Summarise key results with reference to study objectives	18
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	19-20
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	18-21
Generalisability	21	Discuss the generalisability (external validity) of the study results	19-20
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	21

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at http://www.strobe-statement.org.

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Obstetric perineal tears, sexual function and dyspareunia among primiparous women 12 months postpartum: a prospective cohort study

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ABSTRACT

Objective: Sexuality is an important aspect of human identity and contributes significantly to the quality of life in women as well as in men. Impairment in sexual health after vaginal delivery is a major concern for many women. We aimed to examine the association between degree of perineal tear and sexual function 12 months postpartum.

Design: A prospective cohort study

Setting: Four Danish hospitals between July 2015 and January 2019

Participants: A total of 554 primiparous women: 191 with no/labia/first-degree tears, 189 with second-degree tears, and 174 with third-/fourth-degree tears. Baseline data were obtained 2 weeks postpartum by a questionnaire and a clinical examination. Sexual function was evaluated 12 months postpartum by an electronic questionnaire (PISQ-12) and a clinical examination.

Primary outcome measures: Total PISQ-12 score and dyspareunia.

Results: Episiotomy was performed in 54 cases and 95 women had an operative vaginal delivery. The proportion of women with dyspareunia was: 25%, 38% and 53% of women with no/labia/first-degree, second-degree or third-/fourth-degree tears, respectively.

Compared to women with no/labia/first-degree tears, women with second degree or third- or fourth-degree tears had higher risk of dyspareunia (aRR 2.05; 95% CI 1.51-2.78 and aRR 2.09; 95% CI 1.55-2.81, respectively). Women with third- or fourth-degree tears had a higher mean PISQ-12 score (12.2) than women with no/labia/first-degree tears (10.4)

Conclusions: Impairment of sexual health is common among primiparous women after vaginal delivery. At 12 months postpartum more than half of the women with an third- or fourth-degree tear experienced dyspareunia. Women delivering with no/labia/first-degree tears reported the best outcomes overall. Thus, it is important to minimize the extent of perineal trauma and to counsel about sexuality during and after pregnancy.

Article summary

Strengths and limitations of this study:

- The study had a high follow-up rate for both the web-based questionnaire and clinical examination.
- The study included both subjective and objective outcome measurements.
- All the clinical examinations were performed by the same examiner raising a possible risk of intra observer bias.
- There was a risk of recall bias as information about pre-pregnancy sexual function was obtained postpartum.

INTRODUCTION

Sexuality is an important aspect of human identity and contributes significantly to the quality of life in women as well as in men.[1] Sexual function postpartum is affected by the changes in hormonal milieu, anatomy, and family structure following childbirth. Dyspareunia and other sexual problems such as loss of sex drive in the postpartum period is a well-known problem and frequencies of sexual health problems as high as 30-60% three months postpartum and 17-31% six months postpartum have been reported.[2-7] A large cohort study from Sweden found vaginal or perineal tears, regardless of degree, to be associated with a delay in women's resumption of sexual intercourse defined as more than 3 months after giving birth,[8] while about 10% of primiparous women had not yet resumed sexual intercourse six months postpartum.[3] The causes of sexual health problems are multifactorial and the mechanisms are still not fully understood.[3-5 9] Thus sexual health problems remains an unsolved problem for many women. Among other things, anatomical changes caused by vaginal or perineal tears may contribute to dyspareunia and has important effects on both the timing and quality of the resumption of sexual relations during the initial postpartum months.[10] The association between obstetrical risk factors and postpartum sexual function is not yet well described or understood and thus the aim of this study was to investigate the association between degree of perineal tear, sexual function and dyspareunia 12 months postpartum.

METHODS

Study setting

This study is part of a larger prospective cohort study conducted at two university and two tertiary hospital units in Denmark, Odense (OUH), Aarhus (AUH), Esbjerg, and Kolding, between July 2015 and January 2019. The inclusion procedure and sample size calculation is described thoroughly elsewhere.[11]

Study population

The study involved three groups of women i) 203 women with no/labia/first-degree perineal tears, ii) 200 women with second-degree perineal tears and iii) 200 women with third-/fourth-degree perineal tears.

Patient and Public Involvement

There was no patient or public involvement in design and conduct of this study.

Inclusion and follow-up procedure

Women delivering vaginally, at least 18 years old, able to read and speak Danish were eligible. After the delivery, they were informed about the study. Further information was sent by e-mail and the women were invited by phone to participate in a face-to-face interview including baseline questionnaires and a clinical examination comprising a perineal inspection at 16±5 days postpartum. Written informed consent was obtained at baseline.[11] At 12 months postpartum, all participants received the same questionnaires electronically and were invited to a gynaecological examination. All examinations took place at the hospital and participants could bring their baby. Study data were collected and managed using REDCap electronic data capture tools hosted at OUH.[12]

Outcome measurements

The primary outcome was sexual function. We used the Danish version of the Pelvic Organ Prolapse/Urinary Incontinence Sexual Function Questionnaire (PISQ-12).[13] The PISQ-12 is a self-administered, objective and validated questionnaire with scores based on 12 questions to evaluate sexual function. The score of each item ranges from 0=never to 4=always (reverse scoring for questions 1, 2, 3 and 4). Missing responses are handled by multiplying the mean of answered items and the score is valid with up to 2 missing answers.[13] The questionnaire has previously been used to evaluate sexual function after vaginal delivery.[14 15] We used the total score (range 0-48) with lower scores indicating better sexual function, and the individual score for question 5;"Do you feel pain

during sexual intercourse?". The total score was used as a continuous variable presented as mean and standard deviation (SD) and the single score for question 5 was dichotomized as dyspareunia when answering "sometimes", "usually" or "always" and no dyspareunia when answering "seldom" or "never".

Exposure variables and covariates

Degrees of perineal tears

The degree of perineal tear was defined according to the Green-top Guideline No. 29.[16] First-degree tears were defined as injury to perineal skin and/or vaginal mucosa. Second-degree tears were defined as injury to perineum involving perineal muscles but not the anal sphincter. Third- and fourth-degree tears were defined as injury to perineum involving the anal sphincter complex. Episiotomies were lateral or mediolateral. Episiotomies equivalent to a second-degree tear were analysed independently while episiotomies extending to the anal sphincter muscles were classified as a third- or fourth-degree tear.

Baseline information

At baseline 16±5 days postpartum, a questionnaire was completed providing information about age (years), height (centimetres), smoking status (yes/no), and pregestational BMI (kg/m^2). Information about pregnancy, birth and the postpartum period was obtained from the obstetric journal and included diabetes mellitus (yes/no), length of active birth and length of the second stage of labour (minutes), operative delivery (yes/no), birthweight (gram) and head circumference (centimetres). The PISQ-12 was likewise completed at baseline providing information about pre-pregnancy sexual function. Question 5 was used and dichotomized as the postpartum score described previously.

Clinical examination 12 months postpartum

Perineal length was evaluated by a gynaecological examination. All procedures were done by the first author (DG), with the women in the dorsal lithotomy position without bowel preparation. At

the gynaecological examination, perineal body length was measured in centimetres, from the hymen to the middle of anus during Valsalva manoeuvre as done in the Pelvic Organ Quantification (POP-Q) system,[17] and used as a dichotomous variable (≤ 2 cm/> 2 cm).

Statistical analyses

Baseline characteristics according to degree of tear were described as frequencies for categorical variables. To investigate the association between the degree of perineal tear and dyspareuniaor perineal body length, a relative risk regression by use of a generalized linear model with log-link function and binomial distribution as statistical family was performed with estimates reported as relative risks (RR) with 95% confidence intervals (CI). To investigate the association between the degree of perineal tear and sexual health problems measured as the total PISQ-12 score, a linear regression was performed, and results presented as regression coefficients (β) with 95% CI. In the adjusted analysis, we controlled for pre-pregnancy dyspareunia, smoking, diabetes and operative delivery as categorical variables and age, BMI, duration of the second stage of labour, duration of active birth and birthweight as continuous variables. These potential confounders were chosen a priori based on directed acyclic graphs generated for the outcome variable using DAGitty v2.3 as graphical tool for analyzing the causal diagrams.[18] The analyses were carried out using STATA statistical software version 15.0.

RESULTS

Participants

Initially, a total of 832 women were invited to participate in the study (Figure 1). Of these, 81 declined and 138 could not be reached. This left 613 women completing a written consent and a baseline questionnaire who were booked for a clinical examination 16±5 days postpartum. Ten women withdrew their consent. Thus, the study population comprised 603 women. At the one year follow-up, 554 of the 603 women answered the web-based questionnaire corresponding to 92%, and

481 women had the clinical examination performed corresponding to 80%. Due to more than two missing answers, 13 women were excluded from analyses of total PISQ-12 score.

Characteristics according to degree of tear

Women sustaining third- or fourth-degree tears were on average 0.5 years older than women sustaining second-degree tears and 1.2 years older than women sustaining no/labia/first-degree tears (Table 1).

Table 1: Characteristics according to degree of tear among primiparous women (n=554).

	Total (*n*=554)	Group 1 (No/labia/ 1st degree) (*n*=191)	Group 2 (2nd degree) (*n*=189)	Group 3 (3rd/4th degree) (*n*=174)
	n (%)	**n (%)**	**n (%)**	**n (%)**
BMI, pre-pregnancy (kg/m²)*				
<25	357 (64.6)	128 (67.0)	116 (61.7)	113 (64.9)
25-29.9	126 (22.8)	41 (21.5)	46 (24.5)	39 (22.4)
≥29.9	70 (12.7)	22 (11.5)	26 (13.8)	22 (12.6)
Age at inclusion (years)				
≤25	141 (25.5)	63 (33.0)	50 (26.5)	28 (16.1)
26-30	278 (50.2)	91 (47.6)	89 (47.1)	98 (56.3)
>30	135 (24.4)	37 (19.4)	50 (26.5)	48 (27.6)
Active birth duration (minutes)				
<220	140 (25.3)	69 (36.1)	46 (24.3)	25 (14.4)
221-340	141 (25.5)	45 (23.6)	53 (28.0)	43 (24.7)
341-570	143 (25.8)	50 (26.2)	49 (25.9)	44 (25.3)
>570	130 (23.5)	27 (14.1)	41 (21.7)	62 (35.6)
Second stage duration (minutes)				
<16	109 (19.7)	40 (20.9)	47 (24.9)	22 (12.6)
16-30	187 (33.8)	80 (41.9)	60 (31.8)	47 (27.0)
31-45	89 (16.1)	31 (16.2)	27 (14.3)	31 (17.8)
>45	169 (30.5)	40 (20.9)	55 (29.1)	74 (42.5)
Birthweight (grams)				
<2999	76 (13.7)	39 (20.4)	23 (12.2)	14 (8.1)
3000-3499	193 (34.8)	69 (36.1)	81 (42.9)	43 (24.7)
3500-3999	210 (37.9)	64 (33.5)	65 (34.4)	81 (46.6)
≥4000	75 (13.5)	19 (10.0)	20 (10.6)	36 (20.7)
Head circumference (cm)**				
<34	141 (25.5)	58 (30.5)	52 (27.7)	31 (17.8)
34	119 (21.6)	45 (23.7)	37 (19.7)	37 (21.3)
35	131 (23.7)	35 (18.4)	53 (28.2)	43 (24.7)
>35	161 (29.2)	52 (27.4)	46 (24.5)	63 (36.2)
Pre-pregnancy dyspareunia (yes)	107 (19.3)	26 (13.6)	39 (20.6)	42 (24.1)
Operative delivery (yes)	95 (17.2)	6 (3.1)	29 (15.3)	60 (34.5)
Episiotomi (yes)	54 (9.8)	-	32 (16.9)	22 (12.6)
Smoker, at inclusion (yes)*	21 (3.8)	8 (4.2)	8 (4.2)	5 (2.9)
Diabetes mellitus (yes)	19 (3.4)	5 (2.6)	7 (3.7)	7 (4.0)

*One missing values, n=553
**Two missing values, n=552

Moreover, a higher degree of tear was seen with higher birthweight, longer second stage of labour and longer duration of active birth. Instrumental delivery was more frequent among women with second-degree (15%) and third- or fourth-degree tears (34%) compared to women with no/labia/first-degree tears (3%).

Risk of sexual health problems and dyspareunia

The proportion of pre-pregnancy dyspareunia was: 14%, 21%, and 24% in the no/labia/first-degree, second-degree and third- or fourth-degree tear groups, respectively (Table 1). At 12 months postpartum, the proportion in all three groups was higher than pre-pregnancy; 25%, 38% and 53% respectively.

The risks for dyspareunia at 12 months postpartum are presented in Table 2.

Table 2: Relative Risks for dyspareunia 12 months postpartum among primiparous women in Denmark (n=554).

	Total	Dyspareunia		Crude		Adjusted*	
		Yes	No				
	n=554	*n*= 211	*n*= 343	RR	(95% CI)	RR	(95% CI)
	n	*n* (%)	*n* (%)				
Degree of tear							
No/labia/1st	191	47 (24.6)	144 (75.4)	*1.00*	*reference*	*1.00*	*reference*
2nd (spontanous)	157	59 (37.8	97 (62.2	1.53	(1.11 - 2.10)	2.05	(1.51 - 2.78)
2nd (mediolateral episiotomy)	32	13 (40.6)	19 (59.4)	1.65	(1.01 - 2.69)	1.62	(0.99 - 2.67)
3rd or 4th	174	92 (52.9)	82 (47.1)	2.15	(1.62 - 2.86)	2.09	(1.55 - 2.81)
BMI, pre-pregnancy (kg/m²),** mean (SD)					-		-
<25	357	140 (39.2)	217 (60.8)	1.00	reference	1.00	reference
25-29.9	126	50 (39.7)	76 (60.3)	1.01	(0.79 - 1.30)	1.05	(0.82 - 1.36)
>29.9	70	21 (30.0)	49 (70.0)	0.77	(0.52 - 1.12)	0.82	(0.56 - 1.19)
Age at inclusion (years), mean (SD)							
≤25	141	52 (36.9)	89 (63.1)	0.94	(0.72 - 1.22)	0.94	(0.72 - 1.22)
26-30	278	109 (39.2)	169 (60.8)	*1.00*	*reference*	*1.00*	*reference*
>30	135	50 (37.0)	85 (63.0)	0.94	(0.73 - 1.23)	0.91	(0.70 - 1.19)
Active birth duration (minutes), mean (SD)							
<220	140	49 (35.0)	91 (65.0)	0.97	(0.71 - 1.33)	0.90	(0.66 - 1.24)
221-340	141	51 (36.2)	90 (63.8)	*1.00*	*reference*	*1.00*	*reference*
341-570	143	52 (36.4)	91 (63.6)	1.00	(0.74 - 1.37)	1.00	(0.74 - 1.37)
>570	130	59 (45.4)	71 (54.6)	1.26	(0.94 - 1.68)	1.26	(0.92 - 1.70)
2nd stage duration (minutes), mean (SD)							
<16	109	34 (31.2)	75 (68.8)	0.82	(0.59 - 1.15)	0.80	(0.57 - 1.12)
16-30	187	71 (38.0)	116 (62.0)	*1.00*	*reference*	*1.00*	*reference*
31-45	89	29 (32.6)	60 (67.4)	0.86	(0.60 - 1.22)	0.86	(0.61 - 1.23)
>45	169	77 (45.6)	92 (54.4)	1.20	(0.94 - 1.54)	1.15	(0.88 - 1.52)
Birthweight (grams), mean (SD)							
<2999	76	31 (40.8)	45 (59.2)	1.05	(0.76 - 1.45)	1.09	(0.79 - 1.51)
3000-3499	193	75 (38.9)	118 (61.1)	*1.00*	*reference*	*1.00*	*reference*
3500-3999	210	82 (39.1)	128 (60.9)	1.01	(0.79 - 1.28)	0.96	(0.75 - 1.22)
≥4000	75	23 (30.7)	52 (69.3)	0.79	(0.54 - 1.16)	0.74	(0.50 - 1.10)

Pre-pregnancy dyspareunia (yes)	107	66 (31.3)	41 (12.0)	1.90 (1.56 - 2.32)	1.79 (1.45 - 2.21)
Operative delivery (yes)	65	45 (47.4)	50 (52.6)	1.31 (1.03 - 1.67)	1.18 (0.90 - 1.54)
Smoker at inclusion (yes)**	21	10 (47.6)	11 (52.4)	1.27 (0.80 - 2.01)	1.31 (0.82 - 2.10)
Diabetes (yes)	19	7 (36.8)	12 (63.2)	0.97 (0.53 - 1.76)	1.02 (0.56 - 1.88)

RR; relative risk ratio, CI; confidence interval, SD; standard deviation, BMI; body mass index

** Adjusted for; age, BMI , birthweight, 2nd stage duration, active birth duration, smoking, diabetes, operative delivery, pre-pregnancy dyspareunia (2nd stage duration and active birth duration are not mutually adjusted for each other).

**One missing value (n=553).

Compared to women with no/labia/first-degree tears, women with third- or fourth-degree tears had higher risk of dyspareunia (aRR 2.09; 1.55-2.81), as did women with spontaneous second-degree tears (aRR 2.05; 1.51-2.78). Further, we found pre-pregnancy dyspareunia to be associated with postpartum dyspareunia (aRR 1.79; 1.45-2.21).

At 12 months postpartum the mean PISQ-12 score was higher among women with third- or fourth-degree tears (12.2) than among women with no/labia/first-degree tears (10.4) (Table 3).

Table 3: Risk for sexual health problems 12 months postpartum among primiparous women in Denmark (n=541).

	Total *n*=541		PISQ-12 score* Crude coef.	(95% CI)	Adjusted** coef.	(95% CI)
	n	*mean (SD)*				
Degree of tear						
No/labia/1st	188	10.4 (4.2)	*0*	*reference*	*0*	*reference*
2nd (spontaneous)	153	10.7 (5.1)	0.37	(-0.65 - 1.38)	0.21	(-0.81 - 1.22)
2nd (mediolateral episiotomy)	31	11.2 (4.2)	0.81	(-0.95 - 2.56)	0.67	(-1.13 - 2.46)
3rd or 4th	169	12.1 (5.0)	1.80	(0.81 - 2.78)	1.69	(0.61 - 2.76)
BMI (kg/m²)*,** mean (SD)						
<25	349	11.2 (4.7)	*0*	*reference*	*0*	*reference*
25-29.9	121	10.8 (4.8)	-0.44	(-1.43 - 0.56)	-0.23	(-1.22 - 0.76)
>29.9	70	10.6 (5.4)	-0.60	(-1.83 - 0.64)	-0.51	(-1.74 - 0.72)
Age (years), mean (SD)						
≤25	137	11.2 (5.1)	0.45	(-0.53 - 1.44)	0.49	(-0.49 - 1.47)
26-30	270	10.8 (4.7)	*0*	*reference*	*0*	*reference*
>30	134	11.5 (4.6)	0.67	(-0.32 - 1.67)	0.61	(-0.37 - 1.59)
Active birth duration (minutes), mean (SD)						
<220	137	10.9 (4.5)	-0.22	(-1.35 - 0.91)	-0.24	(-1.27 - 0.79)
221-340	139	11.1 (5.5)	*0*	*reference*	*0*	*reference*
341-570	140	10.7 (4.4)	-0.46	(-1.58 - 0.67)	-0.55	(-1.57 - 0.47)
>570	125	11.6 (4.7)	0.51	(-0.65 - 1.67)	0.09	(-1.01 - 1.19)
Second stage duration (minutes), mean (SD)						
<16	109	10.9 (5.0)	-0.22	(-1.36 - 0.92)	-0.30	(-1.44 - 0.84)
16-30	181	11.1 (4.9)	*0*	*reference*	*0*	*reference*
31-45	87	10.5 (4.4)	-0.60	(-1.83 - 0.62)	-0.76	(-1.98 - 0.46)
>45	164	11.5 (4.8)	0.37	(-0.64 - 1.39)	0.05	(-1.00 - 1.11)
Birthweight (grams), mean (SD)						
<2999	75	12.3 (4.9)	1.13	(-0.14 - 2.41)	0.99	(-0.27 - 2.27)
3000-3499	191	11.2 (4.6)	*0*	*reference*	*0*	*reference*
3500-3999	205	10.5 (4.8)	-0.66	(-1.60 - 0.28)	-0.73	(-1.68 - 0.21)
≥4000	70	11.2 (5.1)	0.08	(-1.23 - 1.38)	0.20	(-1.10 - 1.51)

Pre-pregnancy dyspareunia (yes)	104	13.0 (4.6)	2.44	(1.43	-	3.44)	2.45	(1.44	-	3.46)
Operative delivery (yes)	92	11.7 (4.7)	0.69	(-0.38	-	1.76)	0.46	(-0.72	-	1.63)
Smoker at inclusion (yes)* **	21	13.8 (4.9)	2.78	(0.70	-	4.86)	2.99	(0.93	-	5.06)
Diabetes (yes)	19	11.1 (4.9)	0.00	(-2.19	-	2.20)	-0.09	(-2.27	-	2.09)

RR; relative risk ratio, CI; confidence interval, SD; standard deviation

*PISQ-12 score; Pelvic Organ Prolapse/Urinary Incontinence Sexual Function Questionnaire, range 0-48, higher score indicating higher degree of sexual health problems, n=13 not included in analyses because of > 2 missing answers in the questionnaire

** Adjusted for; age, BMI, birthweight, duration of the second stage of labour, duration of active birth, pre-pregnancy dyspareunia, smoking, diabetes, operative delivery (2nd stage duration and active birth duration are not mutually adjusted for each other)

***One missing value (n=540).

After adjustment, women with anal sphincter tears had 1.69 points higher score (95% CI 0.61-2.76) compared to women with no/labia/first-degree tears. Women reporting pre-pregnancy dyspareunia had an average 2.45 point higher score (95% CI 1.44-3.46) compared to women without pre-pregnancy dyspareunia. Further, we found smoking women to have a higher PISQ-12 score compared to non-smoking women (aβ 2.99; 0.93-5.06).

The relative risks for dyspareunia postpartum according to perineal body length are presented in Table 4.

Table 4: Risk for dyspareunia according to perineal body length 12 months postpartum among primiparous women in Denmark (n=481).

		Dyspareunia					
	Total	Yes	No	Crude		Adjusted*	
	n=481	*n*= 182	*n*= 285	RR	(95% CI)	RR	(95% CI)
	n	*n* (%)	*n* (%)				
Perineal body length							
> 2 cm	468	182 (38.9)	286 (61.1)	*1.00*	*reference*	*1.00*	*reference*
≤ 2 cm	13	8 (61.5)	5 (38.5)	1.58	(1.02 - 2.47)	1.72	(1.10 - 2.71)

RR; relative risk ratio, CI; confidence interval, SD; standard deviation

* Adjusted for; age, BMI, birthweight, 2nd stage duration, active birth duration, smoking, diabetes, operative delivery, pre-pregnancy dyspareunia, degree of tear

We found women with a perineal body length ≤ 2 cm to be in higher risk of dyspareunia compared to women with a perineal body length > 2cm (aRR 1.72; 1.10-2.71).

DISCUSSION

Main Findings

At 12 months postpartum, more than half of the women who sustained anal sphincter tears had dyspareunia compared to one fourth in women with no/labia/first-degree tears. Women with anal sphincter tears had a higher degree of sexual health problems in general. In addition, we found women with perineal body length ≤ 2 cm to be in higher risk of dyspareunia.

Interpretation (in light of other evidence)

The literature on sexual function measured more than six months postpartum is in general sparse which makes it difficult to compare our results to those from other studies. Our study showed that primiparous women, regardless degree of tear, experienced high levels of sexual health problems postpartum in accordance with the findings from another large cohort study.[3] In line with other studies, [3 5 19] we found more women with second-degree tears to have dyspareunia compared to women with no or minor tears. The same studies found pre-pregnancy dyspareunia to be associated with postpartum dyspareunia.[3 5 19] We observed the same association, but the association between degree of perineal tear and postpartum dyspareunia, did not seem to be affected by the presence of dyspareunia before pregnancy.

Our study showed smoking women to have a higher PISQ-12 score than the non-smoking women. Studies addressing the association between smoking and female sexual health are few and results are inconsistent.[20-23] However, smoking has an anti-oestrogenic effect,[24] and low oestrogen levels are related to higher prevalence of sexual health problems among women.[25]

There is limited knowledge on dyspareunia postpartum and the role of the pelvic floor muscles[26]. To our knowledge, only one study including 177 women has investigated the relation between the perineal muscles and dyspareunia and found no association.[26] We found perineal length to be associated with the risk of dyspareunia. Thus more women with a short perineum had dyspareunia.

Strengths and limitations

The study had a high follow-up rate for both the web-based questionnaire and clinical examination. A major strength of this study is the inclusion of only primiparous women. Hereby, we were able to assess the possible association between the degree of tear and the risk of sexual health problems without the influence of previous deliveries and tears. Further, the inclusion of a control group without perineal muscle tears made it possible to assess the effect of a vaginal delivery itself without tears to the perineal muscles. In addition, all women had a clinical examination two weeks postpartum and thereby the risk of misclassification according to exposure group was minimized.

A limitation of the present study is the fact that all clinical examinations were performed by the same examiner (DG). To limit differential misclassification, the examiner was blinded of the sexual function status of each participant and aimed to stay blinded to the degree of tear the women in question had sustained.

In the present study, we used the standardized and validated PISQ-12 questionnaire. However, the PISQ-12 questionnaire is developed and validated in populations of heterogeneous couples. The questions addressing partner erection and premature ejaculation are only relevant for women with a male partner. As the total PISQ-12 score depended on at least 10 answered questions, some women were excluded from these analyses based on their partner relationship. Thus, some of our results may only be relevant for heterosexual couples. The PISQ-12 score has biophysical focus in general and lacks the relational and psychological issues that may have an impact on postpartum sexual

health. Thus, this study does not address these issues, which are highly relevant in the context of sexual health in a vulnerable period of life.

Other studies have found an association between sexual health problems and breastfeeding, as breastfeeding might fulfil parts of a woman`s need for proximity and lead to decreased oestrogen levels causing vaginal dryness.[27-29] We did not have information on breastfeeding. Yet, we have no reason to believe that breastfeeding should be unevenly distributed across degrees of perineal tears. In accordance with the results from a large Irish cohort study, we did not find episiotomies to be associated with sexual health problems 12 months postpartum.[19] In our primary adjusted analyses, we included episiotomy to adjust for any potential confounding effect. Excluding episiotomy from the analyses only changed the adjusted estimates marginally and thus episiotomy did not seem to be a confounder in this study.

We found 19.3% to report pre-pregnancy dyspareunia. However, pre-pregnancy information was obtained 2 weeks postpartum, which might have affected the precision of the recall. Ideally, sexual function should have been established before pregnancy but this would require another study design.

Clinical implications

Although sexual problems are common one year after childbirth, especially among women sustaining tears of second-, third- or fourth-degree the proportion of women who ask for help or discuss their problems is low.[5 30] Thus, it is important to give words to the sexual well-being in the postpartum assessment of women and to put a particular focus on the women in high risk of developing sexual health problems. Further, pregnancy is a time in women's life when they are in contact with the health services. This provides an opportunity to identify and counsel women with dyspareunia as they are at risk of persistent sexual health problems 12 months postpartum.

If dyspareunia seem to be caused by vaginal dryness, local vaginal oestrogen or lubricants should be provided. If tender scar tissue is identified, perineal massage or use of lignocaine gel may be help-full,[31] and thus new mothers should be given these advises.

Conclusion

The findings from this cohort study of primiparous women demonstrate that impairment of sexual health is common among primiparous women after vaginal delivery. Women delivering with no tears, tears isolated to the labia or small tears of first-degree reported the best outcomes overall, while more than half of the women with anal sphincter tears were experiencing dyspareunia. It is therefore important to minimize the extent of perineal trauma and to thoroughly counsel women and their partners about sexuality before, during and after pregnancy.

Disclosure of interests

Nothing to declare

Contribution to Authorship

All authors contributed to the design of this study. DG performed the data collection and conducted the analyses and DG, VR, EAN and NQ contributed to the interpretation of data. DG drafted the

manuscript and all authors critically revised the manuscript and approved the version to be published.

Data sharing

Extra data is available by emailing the corresponding author.

Details of ethics approval

The study was approved by the Scientific Ethics Committee for the Region of Southern Denmark (S-20120213, 14.5.2013) and by the Danish Data Protection Agency (ID-2008-58-0035, 14.1.2015). All participants provided written informed consent.

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Data sharing: Data are available upon reasonable request. Deidentified participant data are available from the corresponding author by request: ditte.gommesen@rsyd.dk

Figure 1: Flowchart of inclusion and follow-up. Reasons for not participating in the clinical examination: Withdrawal of consent/lost to follow-up; 111 women, moved away; 5 women, gave birth again; 5 women, dead; 1 woman.

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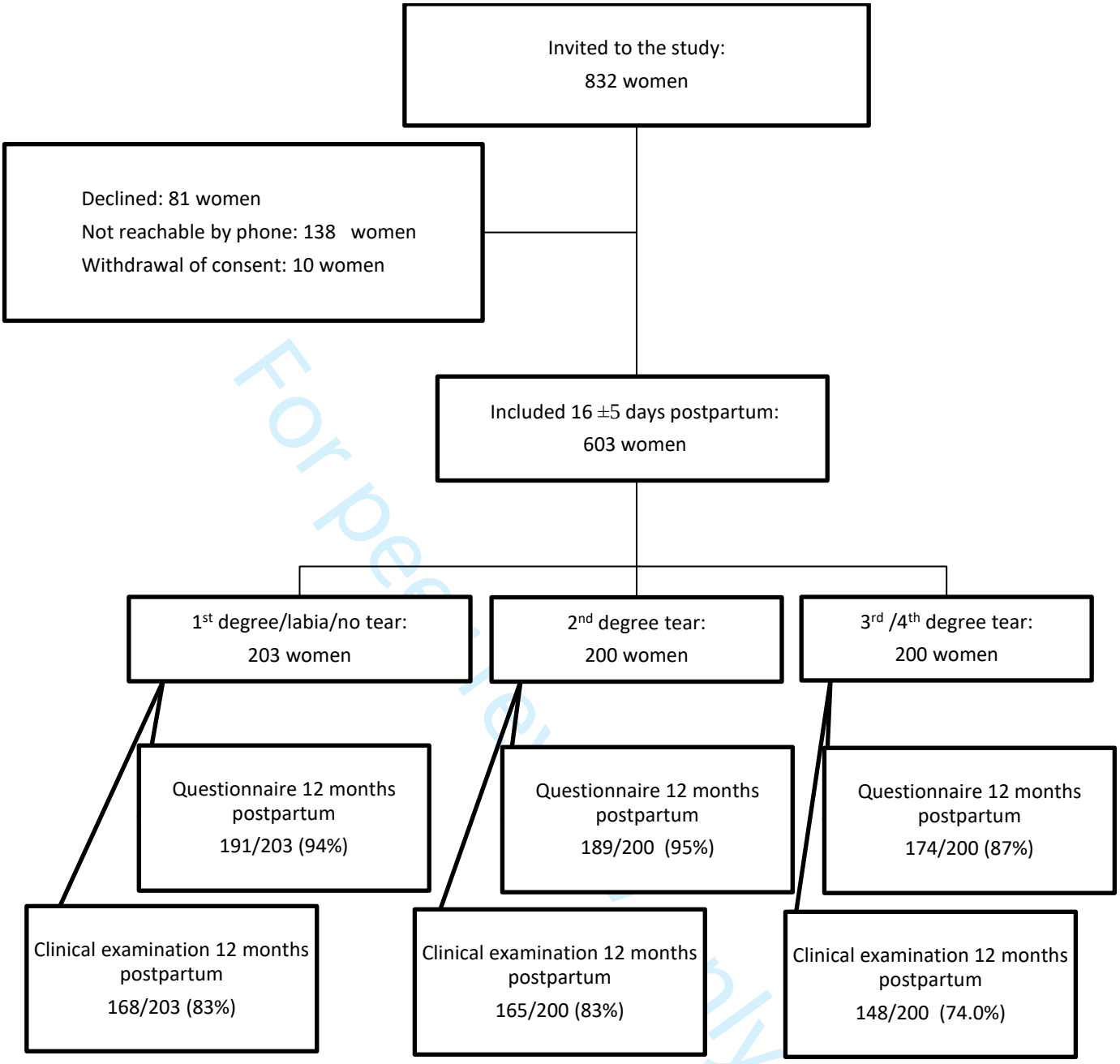

Figure 1: Flowchart of inclusion and follow-up. Reasons for not participating in the clinical examination: Withdrawal of consent/lost to follow-up; 111 women, moved away; 5 women, gave birth again; 5 women, dead; 1 woman.

STROBE Statement—Checklist of items that should be included in reports of ***cohort studies***

	Item No	Recommendation	Page No
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract (*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	1 2-3
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4
Objectives	3	State specific objectives, including any prespecified hypotheses	4
Methods			
Study design	4	Present key elements of study design early in the paper	4
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	4-5
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up (*b*) For matched studies, give matching criteria and number of exposed and unexposed	5-6 N/A
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6-7
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	6-7
Bias	9	Describe any efforts to address potential sources of bias	7-8
Study size	10	Explain how the study size was arrived at	4
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	5-7
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding (*b*) Describe any methods used to examine subgroups and interactions (*c*) Explain how missing data were addressed (*d*) If applicable, explain how loss to follow-up was addressed (*e*) Describe any sensitivity analyses	7-8
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed (b) Give reasons for non-participation at each stage (c) Consider use of a flow diagram	8
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders (b) Indicate number of participants with missing data for each variable of interest (c) Summarise follow-up time (eg, average and total amount)	Table 1, p.9
Outcome data	15*	Report numbers of outcome events or summary measures over time	10-15

Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included (*b*) Report category boundaries when continuous variables were categorized (*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	10-15
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	
Discussion			
Key results	18	Summarise key results with reference to study objectives	18
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	19-20
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	18-21
Generalisability	21	Discuss the generalisability (external validity) of the study results	19-20
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	21

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at http://www.strobe-statement.org.