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

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9 ABSTRACT

40 Background/introduction: Sexuality is an important aspect of human identity and contributes 41 significantly to the quality of life in women as well as in men. Impairment in sexual health after 42 vaginal delivery is a major concern for many women. We aimed to examine the association between 43 degree of perineal rupture and sexual function 12 months postpartum.

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44 Methods: A prospective cohort study was conducted at four Danish hospitals between July 2015 45 and January 2019 among 554 primiparous women: 191 with no/labia/first-degree ruptures, 189 with 46 second-degree ruptures, and 174 with third-/fourth-degree ruptures. Baseline data were obtained 2 47 weeks postpartum by a questionnaire and a clinical examination. Sexual function was evaluated 12

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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. 21C

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

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100 **Study population**

101 The study involved three groups of women i) 203 women with no/labia/first-degree perineal 102 ruptures, ii) 200 women with second-degree perineal ruptures and iii) 200 women with third-103 /fourth-degree perineal ruptures.

104 Patient and Public Involvement

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

³106 **Inclusion and follow-up procedure**

7 Women delivering vaginally, at least 18 years old, able to read and speak Danish were eligible. 8 After the delivery, they were informed about the study. Further information was sent by e-mail and 9 the women were invited to participate in a baseline face-to-face interview and clinical examination 0 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 1 2 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 3 REDCap electronic data capture tools hosted at OUH.¹² 4

115 **Outcome measurements**

6 The primary outcome was sexual function. We used the Danish version of the Pelvic Organ 7 Prolapse/Urinary Incontinence Sexual Function Questionnaire (PISQ-12).¹³ The PISQ-12 is a self-8 administered, objective and validated questionnaire with scores based on 12 questions to evaluate 9 sexual function. The score of each item ranges from 0=never to 4=always (reverse scoring for 0 questions 1, 2, 3 and 4). Missing responses are handled by multiplying the mean of answered items 1 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 2 3 scores indicating better sexual function, and the individual score for question 5;"Do you feel pain

124 during sexual intercourse?". The total score was used as a continuous variable presented as mean 125 and standard deviation (SD) and the single score for question 5 was dichotomized as dyspareunia 126 when answering "sometimes", "usually" or "always" and no dyspareunia when answering "seldom" 127 or "never".

128 **Exposure variables and covariates**

Degrees of perineal ruptures 16 129

18 130 The degree of perineal rupture was defined according to the Green-top Guideline No. 29.¹⁶ First-131 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. 23 1 3 2 25 1 3 3 Third-degree ruptures were defined as injury to perineum involving the anal sphincter complex ²⁷ 134 including: Grade 3a rupture with less than 50% of the external anal sphincter (EAS) thickness torn. 30 135 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 32 1 36 ³⁴ 137 involving the anal sphincter complex (EAS and IAS) and anorectal mucosa. Labia ruptures were 37 138 isolated to the labia. Episiotomies were lateral or mediolateral. Episiotomies equivalent to a second-39 1 39 degree rupture were analyzed independently while episiotomies extending to the anal sphincter 41 140 muscles were classified as a third- or fourth-degree rupture depending on severity.

141 **Baseline information**

At baseline 16±5 days postpartum, a questionnaire was completed providing information about age 48 1 4 3 (years), height (centimetres), smoking status (yes/no), and pregestational BMI (kg/m²). Information ⁵⁰ 144 about pregnancy, birth and the postpartum period was obtained from the obstetric journal and 53 145 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).

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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.

149 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.

162 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

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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 16 176

18 177 **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 23 179 25 180 questionnaire who were booked for a clinical examination 16±5 days postpartum. Ten women 28 181 withdrew their consent. Thus, the study population comprised 603 women. At the one year follow-₃₀⁻⁻182 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) 32 183 underwent 3D HRAM either due to rejection of the procedure or due to technical problems with the 37¹⁸⁵ equipment. Due to more than two missing answers, 13 women were excluded from analyses of total 39 186 PISQ-12 score.

41 187 Characteristics according to degree of rupture

Women sustaining third- or fourth-degree ruptures were on average 0.5 years older than women 46 189 sustaining second-degree ruptures and 1.2 years older than women sustaining no/labia/first-degree 48 190 ruptures (Table 1).

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Table 1: Characteristics according to degree of rupture among primipa	arous women (n=554).
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		Group 1	Group 2	Group 3
	Total	(No/labia/	(2 nd degree)	(3 rd /4 th degree)
		1 st degree)		
	(<i>n</i> =554)	(<i>n</i> =191)	(<i>n</i> =189)	(<i>n</i> =174)
	n (%)	n (%)	n (%)	n (%)
BMI, pre-pregnancy (kg/m ²)*				
<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)**		ζ, γ	· · · ·	()
<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 (ves)	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 (ves)	19 (3.4)	5 (2 6)	7 (3 7)	7 (4 0)

**Two missing values, n=552

Moreover, a higher degree of rupture was seen with higher birthweight, longer second stage of 93 labour and longer duration of active birth. Instrumental delivery was more frequent among women 94 95 with second-degree (15%) and third- or fourth-degree ruptures (34%) compared to women with no/labia/first-degree ruptures (3%). 96

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3 4 5 198	Risk of sexual dysfunction and dyspareunia
6 7 199	The proportion of pre-pregnancy dyspareunia was: 14%, 21%, and 24% in the no/labia/first-degree,
8 9 200	second-degree and third- or fourth-degree rupture groups, respectively (Table 1). At 12 months
$\frac{11}{12}201$	postpartum, the proportion in all three groups was higher than pre-pregnancy; 25%, 38% and 53%
$^{13}_{14}202$	respectively.
15 16 203 17 18 204 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 53	The risks for dyspareunia at 12 months postpartum are presented in Table 2.
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Table 2: Relative Risks for dyspareunia 12 months postpartum among primiparous women in Denmark (n=554).

		Dyspa	reunia				
	Total	Yes	No	Crude		Adjusted*	
	<i>n</i> =554	n= 211	<i>n</i> = 343	RR	(95% CI)	RR	(95% CI)
	п	n (%)	n (%)				
Degree of rupture							
No/labia/1 st	191	47 (24.6)	144 (75.4)	1.00	reference	1.00	reference
2 nd (spontanous)	157	59 (37.8	97 (62.2	1.53	(1.11 - 2.10)	2.05	(1.51 - 2.78)
2 nd (mediolateral episiotomy)	32	13 (40.6)	19 (59.4)	1.65	(1.01 - 2.69)	1.62	(0.99 - 2.67)
3 rd or 4 th	174	92 (52.9)	82 (47.1)	2.15	(1.62 - 2.86)	2.09	(1.55 - 2.81)
BMI, pre-pregnancy (kg/m ²)**, 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. <mark>2</mark>)	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)

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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).

 , BMI; body mass index ...ve birth duration, smoking, diabetes, operative deliv. .ually adjusted for each other).

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⁴ ₅ 206	Compared to women with no/labia/first-degree ruptures, women with third- or fourth-degree
6 7 207	ruptures had higher risk of dyspareunia (aRR 2.09; 1.55-2.81), as did women with spontaneous
9 208 10	second-degree ruptures (aRR 2.05; 1.51-2.78). Further, we found pre-pregnancy dyspareunia to be
11 209 12	associated with postpartum dyspareunia (aRR 1.79; 1.45-2.21).
$^{13}_{14}210$	The mean PISQ-12 score was higher among women with third- or fourth-degree ruptures (12.2)
16 21 1 17	than among women with no/labia-/first-degree ruptures (10.4) (Table 3).
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Table 3: Risk for sexual dysfunction 12 months postpartum among primiparous women in Denmark (n=541).

			PISQ-1	2 score*				
	Total		Crude		Adjusted**			
	<i>n</i> =541		coef.	(95% CI)	coef.	(9	95% C	CI)
	n	mean (SD)			mean (SD)			
Degree of rupture								
No/labia/1 st	188	10.4 (4.2)	0	reference	0	re	feren	се
2 nd (spontanous)	153	10.7 (5.1)	0.37	(-0.65 - 1.38)	0.21	(-0.81	-	1.22)
2 nd (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/m ²)***, mean (SD)								
<25	349	11.2 (4.7)	0	reference	0	re	feren	се
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	re	feren	се
>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	re	feren	се
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	re	feren	се
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	re	feren	се
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)

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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) For peer review only

***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.

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		Dyspa	reunia	_			
	Total	Yes	No	Crude		Adju	sted*
	<i>n</i> =481	<i>n</i> = 182	<i>n</i> = 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 - 2.72
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 - 1.02
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

Table 4: Risk for dyspareupia according to peripeal body length and peripeal strength 12 months postpartum among priminarous women in Denmark (n=481)

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).

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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.

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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 muscles²⁶. 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.

5256 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
 PISQ-12 questionnaire is developed and validated in populations of heterogeneous couples. The

271 questions addressing partner erection and premature ejaculation are only relevant for women with a 272 male partner. As the total PISQ-12 score depended on at least 10 answered questions, some women 273 were excluded from these analyses based on their partner relationship. Thus, some of our results ¹¹ 274 may only be relevant for heterosexual couples.

14¹³275 Other studies have found an association between sexual dysfunction and breastfeeding, as 16276 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 18 277 ²⁰ 278 have no reason to believe that breastfeeding should be unevenly distributed across degrees of 23 279 perineal ruptures.

The study had a risk of recall bias as we asked the women to recall pre-pregnancy information. 25 280 ²⁷ 281 Ideally, sexual function should have been established before pregnancy. However this would ²₃₀282 require another study design.

32 283 **Clinical implications**

³⁴ 284 Although sexual problems are common one year after childbirth, especially among women 35 ³⁶ 37 285 sustaining ruptures of second-, third- or fourth-degree the proportion of women who ask for help or 38 39 286 discuss their problems is low.^{5 30} Thus, it is important to give words to the sexual well-being in the 40 41 287 postpartum assessment of women and to put a particular focus on the women in high risk of 42 43 44 288 developing sexual dysfunction. If dyspareunia seem to be caused by vaginal dryness, local vaginal 45 46 289 oestrogen or lubricants should be provided. If tender scar tissue is identified, perineal massage or 47 use of lignocaine gel may be help-full,³¹ and thus new mothers should be given these advises. 48 2 9 0 49

⁵⁰ 291 Conclusion

52 53 292 The findings from this cohort study of primiparous women demonstrate that impairment of sexual 54 55 293 health is common among primiparous women after vaginal delivery. Women delivering with no 56 ⁵⁷ 294 ruptures, ruptures isolated to the labia or small ruptures of first-degree reported the best outcomes 58

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295 overall, while more than half of the women with anal sphincter ruptures were experiencing 296 dyspareunia. It is therefore important to minimize the extent of perineal trauma and to thoroughly 297 counsel women and their partners about sexuality during and after pregnancy.

Disclosure of interests

299 Nothing to declare

300 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.

⁸ 305 **Data sharing**

306 Extra data is available by emailing the corresponding author.

Details of ethics approval

⁵ 308 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	1
		abstract	
		(b) Provide in the abstract an informative and balanced summary of what was	2-3
		done and what was found	
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being	4
		reported	
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	4-5
		recruitment, exposure, follow-up, and data collection	
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of	5-6
		participants. Describe methods of follow-up	
		(b) For matched studies, give matching criteria and number of exposed and	N/A
		unexposed	
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and	6-7
		effect modifiers. Give diagnostic criteria, if applicable	
Data sources/	8*	For each variable of interest, give sources of data and details of methods of	6-7
measurement		assessment (measurement). Describe comparability of assessment methods if	
		there is more than one group	
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,	5-7
		describe which groupings were chosen and why	
Statistical methods	12	(a) Describe all statistical methods, including those used to control for	7-8
		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	
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers	8
1 wi vi vi p wi vo	10	notentially 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	
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic clinical social)	Table
		and information on exposures and potential confounders	1, p.9
		(b) Indicate number of participants with missing data for each variable of	
		interest	
		(c) Summarise follow-up time (eg. average and total amount)	
Outcome data	15*	Report numbers of outcome events or summary measures over time	10-
o acconto autu	1.7	report numbers of outcome events of summary measures over time	15

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Main results	16	(<i>a</i>) 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	10- 15
		(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	
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.	19-
		Discuss both direction and magnitude of any potential bias	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 informati	ion		
Funding	22	Give the source of funding and the role of the funders for the present study and, if	21
		applicable, for the original study on which the present article is based	

*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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4 5	1	Full Title: Obstetric perineal tears, sexual function and dyspareunia among primiparous women 12
6 7	2	months postpartum: a prospective cohort study
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1 2 2		
3 4 5	40	ABSTRACT
6 7	41	Objective: Sexuality is an important aspect of human identity and contributes significantly to the
8 9 10	42	quality of life in women as well as in men. Impairment in sexual health after vaginal delivery is a
10 11 12	43	major concern for many women. We aimed to examine the association between degree of perineal
13 14	44	tear and sexual function 12 months postpartum.
15 16 17	45	Design: A prospective cohort study
17 18 19	46	Setting: Four Danish hospitals between July 2015 and January 2019
20 21	47	Participants: A total of 554 primiparous women: 191 with no/labia/first-degree tears, 189 with
22 23	48	second-degree tears, and 174 with third-/fourth-degree tears. Baseline data were obtained 2 weeks
24 25 26	49	postpartum by a questionnaire and a clinical examination. Sexual function was evaluated 12 months
27 28	50	postpartum by an electronic questionnaire (PISQ-12) and a clinical examination.
29 30	51	Primary outcome measures: Total PISQ-12 score and dyspareunia.
31 32 33	52	Results: Episiotomy was performed in 54 cases and 95 women had an operative vaginal delivery.
34 35	53	The proportion of women with dyspareunia was: 25%, 38% and 53% of women with no/labia/first-
36 37	54	degree, second-degree or third-/fourth-degree tears, respectively.
38 39 40	55	Compared to women with no/labia/first-degree tears, women with second degree or third- or fourth-
40 41 42	56	degree tears had higher risk of dyspareunia (aRR 2.05; 95% CI 1.51-2.78 and aRR 2.09; 95% CI
43 44	57	1.55-2.81, respectively). Women with third- or fourth-degree tears had a higher mean PISQ-12
45 46 47	58	score (12.2) than women with no/labia/first-degree tears (10.4)
47 48 49	59	Conclusions: Impairment of sexual health is common among primiparous women after vaginal
50 51	60	delivery. At 12 months postpartum more than half of the women with an third- or fourth-degree tear
52 53	61	experienced dyspareunia. Women delivering with no/labia/first-degree tears reported the best
54 55 56	62	outcomes overall. Thus, it is important to minimize the extent of perineal trauma and to counsel
57 58 59 60	63	about sexuality during and after pregnancy.

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4 5	64	
6 7 8	65	Article summary
9 10 11	66	Strengths and limitations of this study:
12 13 14 15	67 68 69	• The study had a high follow-up rate for both the web-based questionnaire and clinical examination.
16 17 18	70	• The study included both subjective and objective outcome measurements.
19 20 21 22	71 72 73 74	• All the clinical examinations were performed by the same examiner raising a possible risk of intra observer bias.
23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 90	75 76 77 78	• 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.

96 METHODS

97 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

57 102 Study population

3 4 103 The study involved three groups of women i) 203 women with no/labia/first-degree perineal tears, 104 ii) 200 women with second-degree perineal tears and iii) 200 women with third-/fourth-degree 8 9 105 perineal tears. 10 11 106 **Patient and Public Involvement** 12 13 14¹⁰⁷ There was no patient or public involvement in design and conduct of this study. 15 **Inclusion and follow-up procedure** 16 108 17 18 109 Women delivering vaginally, at least 18 years old, able to read and speak Danish were eligible. 19 20 110 After the delivery, they were informed about the study. Further information was sent by e-mail and 21 22 the women were invited by phone to participate in a face-to-face interview including baseline 23 111 24 25 1 1 2 questionnaires and a clinical examination comprising a perineal inspection at 16±5 days 26 ²⁷ 113 postpartum. Written informed consent was obtained at baseline.¹¹ At 12 months postpartum, all 29 ₃₀114 participants received the same questionnaires electronically and were invited to a gynaecological 31 examination. All examinations took place at the hospital and participants could bring their baby. 32 115 33 ³⁴ 116 Study data were collected and managed using REDCap electronic data capture tools hosted at 35 36 37¹¹⁷ OUH.¹² 38 39 1 1 8 **Outcome measurements** 40

41 1 19 The primary outcome was sexual function. We used the Danish version of the Pelvic Organ 42 43 120 Prolapse/Urinary Incontinence Sexual Function Questionnaire (PISQ-12).¹³ The PISQ-12 is a self-44 45 46 121 administered, objective and validated questionnaire with scores based on 12 questions to evaluate 47 48 1 2 2 sexual function. The score of each item ranges from 0=never to 4=always (reverse scoring for 49 ⁵⁰ 123 questions 1, 2, 3 and 4). Missing responses are handled by multiplying the mean of answered items 51 52 53 124 and the score is valid with up to 2 missing answers.¹³ The questionnaire has previously been used to 54 evaluate sexual function after vaginal delivery.^{14 15} We used the total score (range 0-48) with lower 55 125 56 ⁵⁷ 126 scores indicating better sexual function, and the individual score for question 5;"Do you feel pain 58

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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".

131 Exposure variables and covariates

32 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.

140 **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/m²). 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.

148 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

151 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 152 153 Quantification (POP-Q) system,¹⁷ and used as a dichotomous variable ($\leq 2 \text{ cm} > 2 \text{ cm}$).

¹¹ 154 **Statistical analyses** 12

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155 Baseline characteristics according to degree of tear were described as frequencies for categorical 16 1 56 variables. To investigate the association between the degree of perineal tear and dyspareuniaor 18 157 perineal body length, a relative risk regression by use of a generalized linear model with log-link 158 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 23 159 25 160 degree of perineal tear and sexual health problems measured as the total PISQ-12 score, a linear 27 28 161 regression was performed, and results presented as regression coefficients (β) with 95% CI. In the ₃₀ 162 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 32 163 ³⁴ 164 active birth and birthweight as continuous variables. These potential confounders were chosen a 37³165 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 39 166 ⁴¹ 167 statistical software version 15.0.

43 168 RESULTS 44

46 169 **Participants**

48 170 Initially, a total of 832 women were invited to participate in the study (Figure 1). Of these, 81 49 ⁵⁰ 171 declined and 138 could not be reached. This left 613 women completing a written consent and a 51 52 53 172 baseline questionnaire who were booked for a clinical examination 16±5 days postpartum. Ten 54 55 173 women withdrew their consent. Thus, the study population comprised 603 women. At the one year 56 ⁵⁷ 174 follow-up, 554 of the 603 women answered the web-based questionnaire corresponding to 92%, and 58
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3 4 175	481 women had the clinical examination performed corresponding to 80%. Due to more than two
6 7 176	missing answers, 13 women were excluded from analyses of total PISQ-12 score.
8 9 177 10	Characteristics according to degree of tear
¹¹ 178 12	Women sustaining third- or fourth-degree tears were on average 0.5 years older than women
13 14 179	sustaining second-degree tears and 1.2 years older than women sustaining no/labia/first-degree tears
14 14 15 16 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58	(Table 1).
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		Group 1	Group 2	Group 3
	Total	(No/labia/	(2 nd degree)	(3 rd /4 th degre
		1 st degree)		
	(<i>n</i> =554)	(<i>n</i> =191)	(<i>n</i> =189)	(<i>n</i> =174)
	n (%)	n (%)	n (%)	n (%)
BMI, pre-pregnancy (kg/m ²)*				
<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)
	10 (2 1)		7 (2 7)	7 (1 0)

Table 4. Ch والروالية والألو (... EE A) £ 1

48 182 Moreover, a higher degree of tear was seen with higher birthweight, longer second stage of labour 49 50 51 183 and longer duration of active birth. Instrumental delivery was more frequent among women with 52 53 184 second-degree (15%) and third- or fourth-degree tears (34%) compared to women with 54 55 185 no/labia/first-degree tears (3%). 56

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3 4 5 187	Risk of sexual health problems and dyspareunia
6 7 188	The proportion of pre-pregnancy dyspareunia was: 14%, 21%, and 24% in the no/labia/first-degree,
8 9 189 10	second-degree and third- or fourth-degree tear groups, respectively (Table 1). At 12 months
11 12 190	postpartum, the proportion in all three groups was higher than pre-pregnancy; 25%, 38% and 53%
13 14 191	respectively.
15 16 192 17 18 18 193 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 60	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).

		Dyspa	reunia				
	Total	Yes	No	Crude		Adjusted*	
	<i>n</i> =554	<i>n</i> = 211	n= 343	RR	(95% CI)	RR	(95% CI)
	n	n (%)	n (%)				
Degree of tear							
No/labia/1 st	191	47 (24.6)	144 (75.4)	1.00	reference	1.00	reference
2 nd (spontanous)	157	59 (37.8	97 (62.2	1.53	(1.11 - 2.10)	2.05	(1.51 - 2.78)
2 nd (mediolateral episiotomy)	32	13 (40.6)	19 (59.4)	1.65	(1.01 - 2.69)	1.62	(0.99 - 2.67)
3 rd or 4 th	174	92 (52.9)	82 (47.1)	2.15	(1.62 - 2.86)	2.09	(1.55 - 2.81)
BMI, pre-pregnancy (kg/m ²)**, 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)

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Operative delivery (yes) Smoker at inclusion (yes)**	65	15 (17 1)		· · · · · · · · · · · · · · · · · · ·	
Smoker at inclusion (yes)**	24	43 (47.4)	50 (52.6)	1.31 (1.03 - 1.67)	1.18 (0.90 - 1.54)
Dishetes (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, diabet (2nd stage duration and active birth duration are not mutually adjusted for each other). **One missing value (n=553).	19 es, operative	7 (36.8) delivery, pre-preg	12 (63.2)	0.97 (0.53 - 1.76)	1.02 (0.56 - 1.88)

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4 5 195	Compared to women with no/labia/first-degree tears, women with third- or fourth-degree tears had
6 7 196	higher risk of dyspareunia (aRR 2.09; 1.55-2.81), as did women with spontaneous second-degree
8 9 197 10	tears (aRR 2.05; 1.51-2.78). Further, we found pre-pregnancy dyspareunia to be associated with
11 11 12	postpartum dyspareunia (aRR 1.79; 1.45-2.21).
13 14 199	At 12 months postpartum the mean PISQ-12 score was higher among women with third- or fourth-
15 16 200 17 18 201 19 20 202 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 60	degree tears (12.2) than among women with no/labia/first-degree tears (10.4) (Table 3).

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

	Total		PISQ-12	2 score*	Adjuctod**		
	n=541		coef.	(95% CI)	coef.	(95% C	CI)
	п	mean (SD)					
Degree of tear							
No/labia/1 st	188	10.4 (4.2)	0	reference	0	referen	псе
2 nd (spontaneous)	153	10.7 (5.1)	0.37	(-0.65 - 1.38)	0.21	(-0.81 -	1.22)
2 nd (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/m ²)***, mean (SD)							
<25	349	11.2 (4.7)	0	reference	0	referen	псе
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	referen	псе
>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	referen	псе
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	referen	псе
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	referen	псе
3500-3999	205	10.5 (4.8)	-0.66	(-1.60 - 0.28)	-0.73	(-1.68 -	0.21)
. 1000	70		0.00	(1.22 1.20)	0.00	1 4 4 0	

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).

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1 2	
$\frac{3}{5}$ 204	After adjustment, women with anal sphincter tears had 1.69 points higher score (95% CI 0.61-2.76)
${}^{6}_{7}$ 205	compared to women with no/labia/first-degree tears. Women reporting pre-pregnancy dyspareunia
8 9 206	had an average 2.45 point higher score (95% CI 1.44-3.46) compared to women without pre-
$\frac{11}{12}207$	pregnancy dyspareunia. Further, we found smoking women to have a higher PISQ-12 score
$^{13}_{14}208$	compared to non-smoking women (aβ 2.99; 0.93-5.06).
15 16 209	The relative risks for dyspareunia postpartum according to perineal body length are presented in
17 18 210	Table 4.
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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		Adju	sted*
	<i>n</i> =481	<i>n</i> = 182	<i>n</i> = 285	RR	(95% CI)	RR	(95% CI)
	п	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

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3 4 213	
5^{213}	We found women with a perineal body length < 2 cm to be in higher risk of dyspareunia compared
8 9 215	to women with a perineal body length > 2cm (aRR 1.72; 1.10-2.71).
10 11 216	DISCUSSION
12 ¹³ 217	Main Findings
14 ²¹⁷ 15	
16 218	At 12 months postpartum, more than half of the women who sustained anal sphincter tears had
18 219 19	dyspareunia compared to one fourth in women with no/labia/first-degree tears. Women with anal
²⁰ 220 21	sphincter tears had a higher degree of sexual health problems in general. In addition, we found
$22_{23}_{23}_{221}_{24}$	women with perineal body length ≤ 2 cm to be in higher risk of dyspareunia.
24 25 222 26	Interpretation (in light of other evidence)
²⁷ 223 28	The literature on sexual function measured more than six months postpartum is in general sparse
²⁹ 30224	which makes it difficult to compare our results to those from other studies. Our study showed that
31 32 225 33	primiparous women, regardless degree of tear, experienced high levels of sexual health problems
34 226 35	postpartum in accordance with the findings from another large cohort study. ³ In line with other
³⁶ 37 227	studies, ^{3 5 19} we found more women with second-degree tears to have dyspareunia compared to
38 39 228	women with no or minor tears. The same studies found pre-pregnancy dyspareunia to be associated
40 41 229 42	with postpartum dyspareunia. ^{3 5 19} We observed the same association, but the association between
⁴³ ₄₄ 230	degree of perineal tear and postpartum dyspareunia, did not seem to be affected by the presence of
45 46 231	dyspareunia before pregnancy.
47 48 232 49	Our study showed smoking women to have a higher PISQ-12 score than the non-smoking women.
50 233 51	Studies addressing the association between smoking and female sexual health are few and results
⁵² 53 234	are inconsistent. ²⁰⁻²³ However, smoking has an anti-oestrogenic effect, ²⁴ and low oestrogen levels
54 55 235	are related to higher prevalence of sexual health problems among women. ²⁵
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236 There is limited knowledge on dyspareunia postpartum and the role of the pelvic floor muscles²⁶. To our knowledge, only one study including 177 women has investigated the relation between the 237 perineal muscles and dyspareunia and found no association.²⁶ We found perineal length to be 238 ¹¹239 associated with the risk of dyspareunia. Thus more women with a short perineum had dyspareunia.

13 13 240 **Strengths and limitations**

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16 2 4 1 The study had a high follow-up rate for both the web-based questionnaire and clinical examination.

¹⁸242 A major strength of this study is the inclusion of only primiparous women. Hereby, we were able to ²⁰ 243 assess the possible association between the degree of tear and the risk of sexual health problems 23 244 without the influence of previous deliveries and tears. Further, the inclusion of a control group 25 2 4 5 without perineal muscle tears made it possible to assess the effect of a vaginal delivery itself ²⁷ 246 without tears to the perineal muscles. In addition, all women had a clinical examination two weeks ²₃₀ 247 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 32 2 4 8 ³⁴ 249 same examiner (DG). To limit differential misclassification, the examiner was blinded of the sexual ³⁶ 37 250 function status of each participant and aimed to stay blinded to the degree of tear the women in 38 39 251 question had sustained.

41 252 In the present study, we used the standardized and validated PISQ-12 questionnaire. However, the 42 43 44 253 PISQ-12 questionnaire is developed and validated in populations of heterogeneous couples. The 45 46 254 questions addressing partner erection and premature ejaculation are only relevant for women with a 47 48 2 5 5 male partner. As the total PISQ-12 score depended on at least 10 answered questions, some women 49 ⁵⁰ 256 were excluded from these analyses based on their partner relationship. Thus, some of our results 51 52 53 257 may only be relevant for heterosexual couples. The PISQ-12 score has biophysical focus in general 54 55 2 58 and lacks the relational and psychological issues that may have an impact on postpartum sexual

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 9 health. Thus, this study does not address these issues, which are highly relevant in the context of0 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.

1 2 3 4 276 5 6 7 8 9 278 10 ¹¹279 12 13 14 15 16 281 17 18 282 19 ²⁰ 283 21 22 23 284 24 25 285 26 ²⁷ 286 29 ²₃₀287 31 32 288 33 ³⁴ 289 35 30 37 290 36 38 39 291 40 41 292 42 ⁴³ 293 44 45 46 294 47 48 295 49 ⁵⁰ 296 51 52 53 297 54 55 298 56 ⁵⁷ 299 58

76 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 helpfull,³¹ and thus new mothers should be given these advises.

292 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.

⁷299 **Disclosure of interests**

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4 5 300	Nothing to declare
6 7 301	Contribution to Authorship
9 302 10	All authors contributed to the design of this study. DG performed the data collection and conducted
11 303 12	the analyses and DG, VR, EAN and NQ contributed to the interpretation of data. DG drafted the
$^{13}_{14}304$	manuscript and all authors critically revised the manuscript and approved the version to be
16 305 17	published.
18 19 306	Data sharing
20 21 22 307	Extra data is available by emailing the corresponding author.
$\frac{23}{24}$ 308	Details of ethics approval
25 26 309 27	The study was approved by the Scientific Ethics Committee for the Region of Southern Denmark
²⁸ 310 29	(S-20120213, 14.5.2013) and by the Danish Data Protection Agency (ID-2008-58-0035, 14.1.2015).
$30_{31}_{31}_{31}_{31}_{31}$	All participants provided written informed consent.
33 312 34	Funding: The study was funded by Odense University Hospitals Research Foundation, The Region
35 313 36	of Southern Denmark, University of Southern Denmark, the Department of Gynaecology and
³⁷ 314 38	Obstetrics, Odense University Hospital, The A.P. Moeller Foundation for the Advancement of
40 315 41	Medical Science (grant no.13-93), and The Danish Association of Midwives. The funding sources
42 316 43	had no influence or involvement in the study.
⁴⁴ 317 45 46	Data sharing: Data are available upon reasonable request. Deidentified participant data are
47 318 48	available from the corresponding author by request: ditte.gommesen@rsyd.dk
49 319 50	Figure 1: Flowchart of inclusion and follow-up. Reasons for not participating in the clinical
51 320 52 53	examination: Withdrawal of consent/lost to follow-up; 111 women, moved away; 5 women, gave
54 ³²¹ 55	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	(<i>a</i>) Indicate the study's design with a commonly used term in the title or the abstract	1
		(b) Provide in the abstract an informative and balanced summary of what was	2-3
		done and what was found	
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being	4
<u> </u>		reported	
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	4-5
-		recruitment, exposure, follow-up, and data collection	
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of	5-6
		participants. Describe methods of follow-up	
		(b) For matched studies, give matching criteria and number of exposed and	N/A
		unexposed	
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and	6-7
		effect modifiers. Give diagnostic criteria, if applicable	
Data sources/	8*	For each variable of interest, give sources of data and details of methods of	6-7
measurement		assessment (measurement). Describe comparability of assessment methods if	
		there is more than one group	
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,	5-7
		describe which groupings were chosen and why	
Statistical methods	12	(a) Describe all statistical methods, including those used to control for	7-8
		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	
		(<u>e</u>) Describe any sensitivity analyses	
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers	8
		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	
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social)	Table
		and information on exposures and potential confounders	1, p.9
		(b) Indicate number of participants with missing data for each variable of	
		interest	
			1
		(c) Summarise follow-up time (eg, average and total amount)	

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			10
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their	10-
		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	
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.	19-
		Discuss both direction and magnitude of any potential bias	20
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations,	18-
-		multiplicity of analyses, results from similar studies, and other relevant evidence	21
Generalisability	21	Discuss the generalisability (external validity) of the study results	19-
			20
Other informati	on		
Funding	22	Give the source of funding and the role of the funders for the present study and, if	21
		applicable for the original study on which the present article is based	

*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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Keywords:	EPIDEMIOLOGY, Urogynaecology < GYNAECOLOGY, Maternal medicine < OBSTETRICS, SEXUAL MEDICINE

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2 3		
4 5	1	Full Title: Obstetric perineal tears, sexual function and dyspareunia among primiparous women 12
6 7	2	months postpartum: a prospective cohort study
8 9 10	3	
11 12	4	Ditte Gommesen, MHSc, Midwife and PhD student
13 14 15	5	Institute of Clinical Research, University of Southern Denmark
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1 2 2		
3 4 5	40	ABSTRACT
6 7	41	Objective: Sexuality is an important aspect of human identity and contributes significantly to the
8 9 10	42	quality of life in women as well as in men. Impairment in sexual health after vaginal delivery is a
10 11 12	43	major concern for many women. We aimed to examine the association between degree of perineal
13 14	44	tear and sexual function 12 months postpartum.
15 16 17	45	Design: A prospective cohort study
17 18 19	46	Setting: Four Danish hospitals between July 2015 and January 2019
20 21	47	Participants: A total of 554 primiparous women: 191 with no/labia/first-degree tears, 189 with
22 23	48	second-degree tears, and 174 with third-/fourth-degree tears. Baseline data were obtained 2 weeks
24 25 26	49	postpartum by a questionnaire and a clinical examination. Sexual function was evaluated 12 months
27 28	50	postpartum by an electronic questionnaire (PISQ-12) and a clinical examination.
29 30	51	Primary outcome measures: Total PISQ-12 score and dyspareunia.
31 32 33	52	Results: Episiotomy was performed in 54 cases and 95 women had an operative vaginal delivery.
34 35	53	The proportion of women with dyspareunia was: 25%, 38% and 53% of women with no/labia/first-
36 37	54	degree, second-degree or third-/fourth-degree tears, respectively.
38 39 40	55	Compared to women with no/labia/first-degree tears, women with second degree or third- or fourth-
40 41 42	56	degree tears had higher risk of dyspareunia (aRR 2.05; 95% CI 1.51-2.78 and aRR 2.09; 95% CI
43 44	57	1.55-2.81, respectively). Women with third- or fourth-degree tears had a higher mean PISQ-12
45 46 47	58	score (12.2) than women with no/labia/first-degree tears (10.4)
47 48 49	59	Conclusions: Impairment of sexual health is common among primiparous women after vaginal
50 51	60	delivery. At 12 months postpartum more than half of the women with an third- or fourth-degree tear
52 53	61	experienced dyspareunia. Women delivering with no/labia/first-degree tears reported the best
54 55 56	62	outcomes overall. Thus, it is important to minimize the extent of perineal trauma and to counsel
57 58 59 60	63	about sexuality during and after pregnancy.

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4 5	64	
6 7 8	65	Article summary
9 10 11	66	Strengths and limitations of this study:
12 13 14 15	67 68 69	• The study had a high follow-up rate for both the web-based questionnaire and clinical examination.
16 17 18	70	• The study included both subjective and objective outcome measurements.
19 20 21 22	71 72 73 74	• All the clinical examinations were performed by the same examiner raising a possible risk of intra observer bias.
23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 9 90	75 76 77 78	• 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.

96 METHODS

97 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

57 102 Study population

3 4 103 The study involved three groups of women i) 203 women with no/labia/first-degree perineal tears, 104 ii) 200 women with second-degree perineal tears and iii) 200 women with third-/fourth-degree 8 9 105 perineal tears. 10 11 106 **Patient and Public Involvement** 12 13 14¹⁰⁷ There was no patient or public involvement in design and conduct of this study. 15 **Inclusion and follow-up procedure** 16 108 17 18 109 Women delivering vaginally, at least 18 years old, able to read and speak Danish were eligible. 19 20 110 After the delivery, they were informed about the study. Further information was sent by e-mail and 21 22 the women were invited by phone to participate in a face-to-face interview including baseline 23 111 24 25 1 1 2 questionnaires and a clinical examination comprising a perineal inspection at 16±5 days 26 ²⁷ 113 postpartum. Written informed consent was obtained at baseline.¹¹ At 12 months postpartum, all 29 ₃₀114 participants received the same questionnaires electronically and were invited to a gynaecological 31 examination. All examinations took place at the hospital and participants could bring their baby. 32 115 33 ³⁴ 116 Study data were collected and managed using REDCap electronic data capture tools hosted at 35 36 37¹¹⁷ OUH.¹² 38 39 1 1 8 **Outcome measurements** 40

41 1 19 The primary outcome was sexual function. We used the Danish version of the Pelvic Organ 42 43 120 Prolapse/Urinary Incontinence Sexual Function Questionnaire (PISQ-12).¹³ The PISQ-12 is a self-44 45 46 121 administered, objective and validated questionnaire with scores based on 12 questions to evaluate 47 48 1 2 2 sexual function. The score of each item ranges from 0=never to 4=always (reverse scoring for 49 ⁵⁰ 123 questions 1, 2, 3 and 4). Missing responses are handled by multiplying the mean of answered items 51 52 53 124 and the score is valid with up to 2 missing answers.¹³ The questionnaire has previously been used to 54 evaluate sexual function after vaginal delivery.^{14 15} We used the total score (range 0-48) with lower 55 125 56 ⁵⁷ 126 scores indicating better sexual function, and the individual score for question 5;"Do you feel pain 58

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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".

131 Exposure variables and covariates

32 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.

140 **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/m²). 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.

148 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

151 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 152 153 Quantification (POP-Q) system,¹⁷ and used as a dichotomous variable ($\leq 2 \text{ cm} > 2 \text{ cm}$).

¹¹ 154 **Statistical analyses** 12

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155 Baseline characteristics according to degree of tear were described as frequencies for categorical 16 1 56 variables. To investigate the association between the degree of perineal tear and dyspareuniaor 18 157 perineal body length, a relative risk regression by use of a generalized linear model with log-link 158 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 23 159 25 160 degree of perineal tear and sexual health problems measured as the total PISQ-12 score, a linear 27 28 161 regression was performed, and results presented as regression coefficients (β) with 95% CI. In the ₃₀ 162 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 32 163 ³⁴ 164 active birth and birthweight as continuous variables. These potential confounders were chosen a 37³165 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 39 166 ⁴¹ 167 statistical software version 15.0.

43 168 RESULTS 44

46 169 **Participants**

48 170 Initially, a total of 832 women were invited to participate in the study (Figure 1). Of these, 81 49 ⁵⁰ 171 declined and 138 could not be reached. This left 613 women completing a written consent and a 51 52 53 172 baseline questionnaire who were booked for a clinical examination 16±5 days postpartum. Ten 54 55 173 women withdrew their consent. Thus, the study population comprised 603 women. At the one year 56 ⁵⁷ 174 follow-up, 554 of the 603 women answered the web-based questionnaire corresponding to 92%, and 58

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3 4 175	481 women had the clinical examination performed corresponding to 80%. Due to more than two
6 7 176	missing answers, 13 women were excluded from analyses of total PISQ-12 score.
8 9 177 10	Characteristics according to degree of tear
¹¹ 178 12	Women sustaining third- or fourth-degree tears were on average 0.5 years older than women
13 14 179	sustaining second-degree tears and 1.2 years older than women sustaining no/labia/first-degree tears
14 14 15 16 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58	(Table 1).
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		Group 1	Group 2	Group 3
	Total	(No/labia/	(2 nd degree)	(3 rd /4 th degre
		1 st degree)		
	(<i>n</i> =554)	(<i>n</i> =191)	(<i>n</i> =189)	(<i>n</i> =174)
	n (%)	n (%)	n (%)	n (%)
BMI, pre-pregnancy (kg/m ²)*				
<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)
	10 (2 1)		7 (2 7)	7 (1 0)

Table 4. Ch والروالية والألو (... EE A) £ 1

48 182 Moreover, a higher degree of tear was seen with higher birthweight, longer second stage of labour 49 50 51 183 and longer duration of active birth. Instrumental delivery was more frequent among women with 52 53 184 second-degree (15%) and third- or fourth-degree tears (34%) compared to women with 54 55 185 no/labia/first-degree tears (3%). 56

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3 4 5 187	Risk of sexual health problems and dyspareunia
6 7 188	The proportion of pre-pregnancy dyspareunia was: 14%, 21%, and 24% in the no/labia/first-degree,
8 9 189 10	second-degree and third- or fourth-degree tear groups, respectively (Table 1). At 12 months
11 12 190	postpartum, the proportion in all three groups was higher than pre-pregnancy; 25%, 38% and 53%
13 14 191	respectively.
15 16 192 17 18 18 193 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 60	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).

		Dyspa	reunia				
	Total	Yes	No	Crude		Adjusted*	
	<i>n</i> =554	<i>n</i> = 211	n= 343	RR	(95% CI)	RR	(95% CI)
	n	n (%)	n (%)				
Degree of tear							
No/labia/1 st	191	47 (24.6)	144 (75.4)	1.00	reference	1.00	reference
2 nd (spontanous)	157	59 (37.8	97 (62.2	1.53	(1.11 - 2.10)	2.05	(1.51 - 2.78)
2 nd (mediolateral episiotomy)	32	13 (40.6)	19 (59.4)	1.65	(1.01 - 2.69)	1.62	(0.99 - 2.67)
3 rd or 4 th	174	92 (52.9)	82 (47.1)	2.15	(1.62 - 2.86)	2.09	(1.55 - 2.81)
BMI, pre-pregnancy (kg/m ²)**, 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)

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Operative delivery (yes) Smoker at inclusion (yes)**	65	15 (17 1)		· · · · · · · · · · · · · · · · · · ·	
Smoker at inclusion (yes)**	24	43 (47.4)	50 (52.6)	1.31 (1.03 - 1.67)	1.18 (0.90 - 1.54)
Dishetes (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, diabet (2nd stage duration and active birth duration are not mutually adjusted for each other). **One missing value (n=553).	19 es, operative	7 (36.8) delivery, pre-preg	12 (63.2)	0.97 (0.53 - 1.76)	1.02 (0.56 - 1.88)

2	
4 5 195	Compared to women with no/labia/first-degree tears, women with third- or fourth-degree tears had
6 7 196	higher risk of dyspareunia (aRR 2.09; 1.55-2.81), as did women with spontaneous second-degree
8 9 197 10	tears (aRR 2.05; 1.51-2.78). Further, we found pre-pregnancy dyspareunia to be associated with
11 11 12	postpartum dyspareunia (aRR 1.79; 1.45-2.21).
13 14 199	At 12 months postpartum the mean PISQ-12 score was higher among women with third- or fourth-
15 16 200 17 18 201 19 20 202 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 60	degree tears (12.2) than among women with no/labia/first-degree tears (10.4) (Table 3).

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

	Total		PISQ-12 score*		۸ diuctod**					
	n=541		coef.	(95% CI)	coef.	(95% C	CI)			
	n	mean (SD)								
Degree of tear										
No/labia/1 st	188	10.4 (4.2)	0	reference	0	referen	reference			
2 nd (spontaneous)	153	10.7 (5.1)	0.37	(-0.65 - 1.38)	0.21	(-0.81 -	1.22)			
2 nd (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/m ²)***, 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	referen	псе			
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	referen	ice			
3500-3999	205	10.5 (4.8)	-0.66	(-1.60 - 0.28)	-0.73	(-1.68 -	0.21)			
× 4000	70	44 2 (5 4)	0.00	(1.22 1.20)	0.00	1 4 4 0				
Pre-pregnancy dyspareunia (yes)	104	13.0 (4.6)	2.44	(1.43	-	3.44)	2.45	(1.44	-	3.46)
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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).

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$\frac{3}{5}$ 204	After adjustment, women with anal sphincter tears had 1.69 points higher score (95% CI 0.61-2.76)
6 7 205	compared to women with no/labia/first-degree tears. Women reporting pre-pregnancy dyspareunia
8 9 206	had an average 2.45 point higher score (95% CI 1.44-3.46) compared to women without pre-
$\frac{11}{12}207$	pregnancy dyspareunia. Further, we found smoking women to have a higher PISQ-12 score
$^{13}_{14}208$	compared to non-smoking women (aβ 2.99; 0.93-5.06).
15 16 209	The relative risks for dyspareunia postpartum according to perineal body length are presented in
17 18 210	Table 4.
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Table 4: Risk for dyspareunia according to perineal body length 12 months postpartum among primiparous women in Denmark (n=481).

		Dyspa	reunia				
	Total	Yes	No	Crude		Adju	sted*
	<i>n</i> =481	<i>n</i> = 182	<i>n</i> = 285	RR	(95% CI)	RR	(95% CI)
	п	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

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5^{213}	We found women with a perineal body length < 2 cm to be in higher risk of dyspareunia compared
8 9 215	to women with a perineal body length > 2cm (aRR 1.72; 1.10-2.71).
10 11 216	DISCUSSION
12 ¹³ 217	Main Findings
14 ²¹⁷ 15	
16 218	At 12 months postpartum, more than half of the women who sustained anal sphincter tears had
18 219 19	dyspareunia compared to one fourth in women with no/labia/first-degree tears. Women with anal
²⁰ 220 21	sphincter tears had a higher degree of sexual health problems in general. In addition, we found
$22_{23}_{23}_{221}_{24}$	women with perineal body length ≤ 2 cm to be in higher risk of dyspareunia.
24 25 222 26	Interpretation (in light of other evidence)
²⁷ 223 28	The literature on sexual function measured more than six months postpartum is in general sparse
²⁹ 30224	which makes it difficult to compare our results to those from other studies. Our study showed that
31 32 225 33	primiparous women, regardless degree of tear, experienced high levels of sexual health problems
34 226 35	postpartum in accordance with the findings from another large cohort study. ³ In line with other
³⁶ 37 227	studies, ^{3 5 19} we found more women with second-degree tears to have dyspareunia compared to
38 39 228	women with no or minor tears. The same studies found pre-pregnancy dyspareunia to be associated
40 41 229 42	with postpartum dyspareunia. ^{3 5 19} We observed the same association, but the association between
⁴³ ₄₄ 230	degree of perineal tear and postpartum dyspareunia, did not seem to be affected by the presence of
45 46 231	dyspareunia before pregnancy.
47 48 232 49	Our study showed smoking women to have a higher PISQ-12 score than the non-smoking women.
50 233 51	Studies addressing the association between smoking and female sexual health are few and results
⁵² 53 234	are inconsistent. ²⁰⁻²³ However, smoking has an anti-oestrogenic effect, ²⁴ and low oestrogen levels
54 55 235	are related to higher prevalence of sexual health problems among women. ²⁵
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236 There is limited knowledge on dyspareunia postpartum and the role of the pelvic floor muscles²⁶. To our knowledge, only one study including 177 women has investigated the relation between the 237 perineal muscles and dyspareunia and found no association.²⁶ We found perineal length to be 238 ¹¹239 associated with the risk of dyspareunia. Thus more women with a short perineum had dyspareunia.

13 13 240 **Strengths and limitations**

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16 2 4 1 The study had a high follow-up rate for both the web-based questionnaire and clinical examination.

¹⁸242 A major strength of this study is the inclusion of only primiparous women. Hereby, we were able to ²⁰ 243 assess the possible association between the degree of tear and the risk of sexual health problems 23 244 without the influence of previous deliveries and tears. Further, the inclusion of a control group 25 2 4 5 without perineal muscle tears made it possible to assess the effect of a vaginal delivery itself ²⁷ 246 without tears to the perineal muscles. In addition, all women had a clinical examination two weeks ²₃₀ 247 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 32 2 4 8 ³⁴ 249 same examiner (DG). To limit differential misclassification, the examiner was blinded of the sexual ³⁶ 37 250 function status of each participant and aimed to stay blinded to the degree of tear the women in 38 39 251 question had sustained.

41 252 In the present study, we used the standardized and validated PISQ-12 questionnaire. However, the 42 43 44 253 PISQ-12 questionnaire is developed and validated in populations of heterogeneous couples. The 45 46 254 questions addressing partner erection and premature ejaculation are only relevant for women with a 47 48 2 5 5 male partner. As the total PISQ-12 score depended on at least 10 answered questions, some women 49 ⁵⁰ 256 were excluded from these analyses based on their partner relationship. Thus, some of our results 51 52 53 257 may only be relevant for heterosexual couples. The PISQ-12 score has biophysical focus in general 54 55 258 and lacks the relational and psychological issues that may have an impact on postpartum sexual

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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 ¹¹262 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. 16 264 ¹⁸265 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 23 267 25 268 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 ³⁴ 272 function should have been established before pregnancy but this would require another study

 design.

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75 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 helpfull,³¹ and thus new mothers should be given these advises.

286 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.

- 6 293 **Disclosure of interests**
- ⁸294 Nothing to declare
- ¹⁰ 295 **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 the analyses and DG, VR, EAN and NQ contributed to the interpretation of data. DG drafted the here analyses and DG drafted the here anal BMJ Open

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4 5 298	manuscript and all authors critically revised the manuscript and approved the version to be
6 7 299 8	published.
9 10 300 11	Data sharing
12 301 13	Extra data is available by emailing the corresponding author.
¹⁴ 302	Details of ethics approval
16 17 303 18	The study was approved by the Scientific Ethics Committee for the Region of Southern Denmark
19 304 20	(S-20120213, 14.5.2013) and by the Danish Data Protection Agency (ID-2008-58-0035, 14.1.2015).
²¹ 305	All participants provided written informed consent.
$^{23}_{24}$ 306	Funding: The study was funded by Odense University Hospitals Research Foundation, The Region
26 307 27	of Southern Denmark, University of Southern Denmark, the Department of Gynaecology and
28 308 29	Obstetrics, Odense University Hospital, The A.P. Moeller Foundation for the Advancement of
$30 \\ 31 \\ 309 \\ 32$	Medical Science (grant no.13-93), and The Danish Association of Midwives. The funding sources
33 310 34	had no influence or involvement in the study.
35 311 36	Data sharing: Data are available upon reasonable request. Deidentified participant data are
³⁷ 312 38	available from the corresponding author by request: ditte.gommesen@rsyd.dk
40 313	Figure 1: Flowchart of inclusion and follow-up. Reasons for not participating in the clinical
42 314 43	examination: Withdrawal of consent/lost to follow-up; 111 women, moved away; 5 women, gave
44 315 45	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	(<i>a</i>) Indicate the study's design with a commonly used term in the title or the abstract	1
		(b) Provide in the abstract an informative and balanced summary of what was	2-3
		done and what was found	
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being	4
		reported	
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	4-5
		recruitment, exposure, follow-up, and data collection	
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of	5-6
		participants. Describe methods of follow-up	
		(b) For matched studies, give matching criteria and number of exposed and	N/A
		unexposed	
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and	6-7
		effect modifiers. Give diagnostic criteria, if applicable	
Data sources/	8*	For each variable of interest, give sources of data and details of methods of	6-7
measurement		assessment (measurement). Describe comparability of assessment methods if	
		there is more than one group	
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,	5-7
		describe which groupings were chosen and why	
Statistical methods	12	(a) Describe all statistical methods, including those used to control for	7-8
		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	
		(<u>e</u>) Describe any sensitivity analyses	
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers	8
		notentially eligible examined for eligibility confirmed eligible included in the	
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		study, completing follow-up, and analysed	
		study, completing follow-up, and analysed (b) Give reasons for non-participation at each stage	
		study, completing follow-up, and analysed(b) Give reasons for non-participation at each stage(c) Consider use of a flow diagram	
 Descriptive data	14*	 (b) Give reasons for non-participation at each stage (c) Consider use of a flow diagram (a) Give characteristics of study participants (eg demographic, clinical, social) 	Table
Descriptive data	14*	 (b) Give reasons for non-participation at each stage (c) Consider use of a flow diagram (a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders 	Table 1, p.9
Descriptive data	14*	 (b) Give reasons for non-participation at each stage (c) Consider use of a flow diagram (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 	Table 1, p.9
Descriptive data	14*	 (b) Give reasons for non-participation at each stage (c) Consider use of a flow diagram (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 	Table 1, p.9
Descriptive data	14*	 (b) Give reasons for non-participation at each stage (c) Consider use of a flow diagram (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

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Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their	15
		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	
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.	19-
		Discuss both direction and magnitude of any potential bias	20
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations,	18-
-		multiplicity of analyses, results from similar studies, and other relevant evidence	21
Generalisability	21	Discuss the generalisability (external validity) of the study results	19-
			20
Other informati	ion		
Funding 22		Give the source of funding and the role of the funders for the present study and, if	21
		applicable for the original study on which the present article is based	

*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.