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MATERNAL-FETAL MEDICINE

The influence of partnership quality and breastfeeding on postpartum female sexual function

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Abstract

Introduction Female sexual dysfunction is known to have a huge impact on quality of life and is highly prevalent during the peripartum period. Several influencing variables were found to be associated with impaired sexual function postpartum, among them breastfeeding and partnership quality. However, little is known about the predictive value of these variables. Therefore, this longitudinal cohort study aimed to examine prospectively the influence of the two variables on sexual function 4-month postpartum.

Materials and methods Questionnaires were administered to 330 women prenatally (TI, third trimester) and postpartum (TII, 1 week; TIII, 4 months). Medical data were collected from the respondents' hospital records. The Female Sexual Function Index (FSFI) was used to determine overall sexual function, desire, arousal, lubrication, orgasm, satisfaction, and pain perinatally.

Results At all timepoints, mean FSFI scores were below the critical FSFI-score of 26.55. Partnership quality, breastfeeding, high maternal education, and maternal depressive symptoms correlated significantly with FSFI scores postpartum. Further analyses confirmed antenatal partnership quality and breastfeeding behavior as strong predictors of sexual function 4-month postpartum, explaining 24.3% of variance. Women who stopped breastfeeding or never breastfed at all showed the highest FSFI scores.

Conclusion Our findings indicate that exclusively breastfeeding women and those who report low partnership quality have an increased likelihood of sexual functioning problems 4-month postpartum. Health-care providers need to be encouraged to counsel on postpartum sexuality and influencing factors during prenatal classes to de-pathologize those changes and to foster a positive approach to peripartum sexuality.

Keywords Sexual function · Breastfeeding · Delivery · Pregnancy · Partnership quality

Introduction

Sexuality represents an important aspect of human identity and substantially contributes to quality of life for both women and men [1]. The concept of sexual health dates back on the 1970s and is defined by the World Health Organization as "a state of physical, emotional, mental and social well-being in relation to sexuality" [2]. Female sexual function includes libido, arousal, pain, and orgasm [3]; persisting disturbances in any of these areas, or rather disorders relating to sexual desire and sexual satisfaction, are referred to as female sexual dysfunction (FSD) [3, 4]. The previous studies indicated that 30–60% of women experience some degree of sexual dysfunction at least once in their lives [5], with broad variances of prevalence estimates going back

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both to differing measurements of FSD and to different age distributions of the study populations [6]. Particularly, in the peripartum period, the frequency of sexual activity drastically decreases by the third trimester in almost all women [5] and remains diminished up to 1-year postpartum [7], even though most women resume sexual activity within 3–6 months after delivery [8]. The previous studies consistently showed low FSFI scores, indicating FSD at prevalence rates of 40% ante- and up to 83% postnatally [8–12]. Alongside physiological, functional, and mental adjustments accompanying the peripartum period, several variables were found to significantly influence sexuality peripartum [13]. In particular, partnership quality and breastfeeding have been repeatedly correlated with FSD during the peripartum period [14, 15]. The previous studies consistently identified relationship problems to negatively affect arousal, lubrication, and orgasm prenatally [14] and to reduce sexual frequency, desire, and enjoyment postnatally [15–18].

Regarding the association between breastfeeding and peripartum sexual functioning, the existing literature is partly conflicting. Whereas some studies suggested a positive effect of breastfeeding on postpartum sexuality due to increased breast sensitivity and oxytocin levels [13], others found breastfeeding to be a major risk factor for postpartum sexual dysfunction [8]; in the context of hormonal suppression, it could be linked to sexual intercourse not being resumed, dyspareunia, lubrication and arousal problems as well as decreased sexual desire [8, 19, 20].

Therefore, the aim of this study was to prospectively investigate sexual function in a diverse sample of peripartum women with a focus on antenatal partnership quality and breastfeeding. We hypothesized that exclusive breastfeeding compromises sexual function and that antenatal relationship quality significantly influences sexual function at 4-month postpartum.

Methods

Sample

A longitudinal cohort study was carried out at the University Hospital of Heidelberg between January and August 2014. The hospital has a perinatal center of the highest level that provides health services to low-, medium-, and high-risk obstetrical patients from an area with approximately 200,000 inhabitants and performs 2000 deliveries per year. Pregnant women were recruited while waiting for their routine medical check-ups. The eligibility criteria included being 18 years or older and having a sufficient knowledge of the German language. Not all eligible women were assessed as recruitment only took place on certain days of the week. In all, 427 pregnant women were approached, of whom 330 (73.7%) gave their informed consent; $N=315$ (73.77%) had at least one measure on the Female Sexual Function Index (FSFI) [21]. Questionnaires were completed during the third trimester (TI, $N=313$, 73.30%) and postpartum (TII, 1 week, $N=238$, 55.74%, and TIII, 4 months, $N=150$, 35.13%). Ethics approval was granted by the Ethical Committee of Heidelberg.

Procedure

The questionnaire was developed to include a range of validated tools, as described below, as well as scales covering socio-demographic and medical data.

Female Sexual Function Index

The FSFI reflects the respondent's sexual experience over the last 4 weeks [21]. We used the German FSFI version validated by Berner et al. [22]. The answers to the 19 FSFI questions yield an FSFI total score composed of sub-scores for desire, arousal, lubrication, orgasm, satisfaction, and pain. The questionnaire was proven to detect clinically relevant disturbances in the domains arousal, libido and orgasm [22]. In their validation study, Rosen et al. [21] identified a critical FSFI-score of 26.55. The FSFI reliability (Cronbach's α) for our sample was good to excellent in all subscales at all measurement points ($\alpha=0.868-\alpha=0.984$).

Edinburgh Postnatal Depression Scale

The Edinburgh Postnatal Depression Scale (EPDS) was used to detect symptoms of depression. Answers are based on a person's psychological state over the past 7 days. The scale is sensitive to changes in severity of depression and has been shown to have a sensitivity of 91% and a specificity of 95% in predicting depressive disorders [23]. Internal consistency proved good for our sample (TI: $\alpha=0.87$, TII: $\alpha=0.86$, TIII: $\alpha=0.90$).

Breastfeeding characteristics

Breastfeeding characteristics included the intention to breastfeed and breastfeeding after discharge and after 4 months (exclusive, partly, ablactation, and never breastfed). Breastfeeding behavior was inversely ordinally coded ("1" = exclusive breastfeeding, "2" = partial breastfeeding, "3" = ablactated to TIII, and "4" = never breastfed).

Questionnaire on partnership

The Questionnaire on partnership (PFB) assesses the general quality of partnership, consisting of 30 four-point items which are categorized into three scales: conflict behavior,

tenderness, and communication [24]. The previous analyses have evinced adequate scale reliability [25], with Cronbach's α ranging from 0.88 to 0.93 and 6-month test–retest reliability ranging from $r = 0.68$ to 0.83. In our sample, Cronbach's α for conflict behavior was $\alpha = 0.86$. Tenderness achieved an internal consistency of Cronbach's $\alpha = 0.85$. Communication was reliable to $\alpha = 0.85$. For the general sum scale, Cronbach's α was excellent ($\alpha = 0.92$).

Statistical analyses

We used the *Statistical Package for Social Sciences* (IBM® SPSS® v. 23.0.0.0) for all analyses. Power estimations were computed using G-Power v. 3.1.9.2. The valid number of cases *n* varied depending on the data sub-sets used for the particular test. Prior to all analyses, Little's Missing Completely at Random (MCAR-) test was carried out to evaluate differences between excluded cases and the remaining sample [26]. The following variables were considered: sociodemographic variables (e.g., age, level of education), pregnancy- and birth-related variables (e.g., gestation age), as well as questionnaire data (e.g., PFB and FSFI scores). The results of the MCAR test were not significant ($\chi^2 = 8092.11$, $df = 7949$, $P = 0.13$); the case exclusions were valid for our sample and the subpopulation representative for the larger sample.

The main analyses included two steps. Significantly associated variables at TIII were used as independent variables [multivariate analysis of variance (MANOVA)], taking all FSFI subscales as dependent variables to evaluate each independent contribution to the explanation of sexual functioning. Hereby, parametric variables were entered as continuous predictors (covariates). In addition, post-hoc analyses of variance (ANOVAs) and *t* tests were conducted. Dunn's multiple comparison procedure was used as a post-hoc test due to its economic qualities in multiple testing [27]. This procedure resulted in a minimum significant difference (ψ).

In addition, we performed an exploratory data analysis of the course and thus the change in the FSFI total score over time by repeated measures of variance (ANOVA). As low scores at TII could derive from the fact that the FSFI assesses sexual functioning during the last 4 weeks, e.g., in this case from the last 3 weeks of pregnancy, we still included these in our results to provide baseline data for the postpartum assessment. Mauchly's procedure was used to test for violation of the assumption of sphericity. If significant, repeated measures *df*s were Huynh–Feldt corrected. This was done for all repeated measure analyses on FSFI scores ($P = 0.001$, $\varepsilon = 0.976$). Effect sizes of significant MANOVA and ANOVA effects are reported as partial η^2, which is a sample-based estimator of explained variance. According to Cohen [28] $\eta^2 = 0.01$ represents small effects, $\eta^2 = 0.06$ medium-sized effects, and $\eta^2 = 0.14$ large effects. In all analyses, we set a conventional, critical, two-sided α-error of $\alpha = 0.05$. Trends were not interpreted. The power for medium-sized within-subject effects and within–between interaction terms ($f = 0.25$) was excellent in our sample ($1 - \beta > 0.99$). Medium-sized between-subject effects were shown to have a power of $1 - \beta = 0.62$.

Results

Demographics

Mean age of the 315 participants was 32.8 (SD 4.6) years and mean gestational age at study inclusion was 34.8 (SD 3.5, range 25.0–42.0) weeks. Mean gestational age at delivery was 39.1 (SD 1.9, range 30.0–42) weeks. At TII, 156 (63.9%) of participants fully breastfed their baby, 60 (19.0%) partly breastfed, and 28 (8.9%) primarily ablactated or did not have any milk. Sample characteristics and questionnaire data are summarized in Tables 1 and 2.

Main analyses: important factors for sexual functioning 4-month postpartum

Table 3 shows significant Pearson correlations between the FSFI subscales and other study variables. Partnership quality (PFB), breastfeeding characteristics, high maternal education, and maternal depressive symptoms (EPDS) were significantly associated with sexual dysfunction 4-month postpartum.

All significantly correlated variables were analyzed for their independent contribution in explaining sexual functioning (MANOVA). Partnership quality at TI (PFB) and breastfeeding remained significantly associated with sexual function. Maternal education [$F(6,123) = 0.90$, $P = 0.50$, partial $\eta^2 = 0.04$] and depressive symptoms [EPDS at TIII; $F(6,123) = 1.76$, $P = 0.11$, partial $\eta^2 = 0.08$)] were no longer associated with sexual functioning in this variable subset. Overall, partnership quality [$F(6,123) = 3.96$, $P < 0.01$, partial $\eta^2 = 0.16$)] and breastfeeding behavior [$F(6,123) = 1.83$, $P = 0.02$, partial $\eta^2 = 0.08$] explained 24% of FSFI variance.

Post-hoc ANOVAs (see Table 4) further revealed that a low PFB total score at TI had a negative effect on the FSFI subscales "desire", "arousal", and "satisfaction" while breastfeeding behavior significantly affected the subscales "desire", "arousal", "lubrication", and "pain" in the full-factorial model. Partnership quality explained 3.1% (subscale "satisfaction") to 10.1% (subscale "desire") of the FSFI scale variance, while breastfeeding behavior explained 7.4% (subscale "lubrication") to 11.3% (subscale "desire").

These main effects on the FSFI subscales revealed that mothers who never breastfed or had ablactated reported significantly higher FSFI scores compared to mothers who

Table 1 Sample characteristics

Education (TI)	Frequency (%)	Valid % (cumulative %)	Income (TI)	Frequency (%)	Valid % (cumulative %)
Low secondary education	26 (8.3)	8.4 (8.4)	– 999 €	37 (11.7)	12.8 (12.8)
High secondary education	87 (27.6)	28.1 (36.5)	– 1999 €	78 (24.7)	26.9 (39.7)
University entrance qualification	63 (20.0)	20.3 (56.8)	– 2999 €	57 (18.1)	19.7 (59.3)
University degree	134 (42.5)	43.2 (100.0)	≥ 3000 €	118 (37.5)	40.7 (100.0)
Number of pregnancies (TI)			Birth mode (TII)		
First	125 (39.7)	40.1 (40.1)	Vaginal delivery	99 (30.0)	42.7 (42.7)
Second	100 (31.7)	32.1 (72.1)	Primary C-section	70 (21.2)	30.2 (72.8)
Third	49 (15.6)	15.7 (87.8)	Secondary C-section	47 (14.2)	20.3 (93.1)
More than three	38 (12.1)	12.2 (100.0)	Ventouse/forceps	16 (4.8)	6.9 (100.0)
Breastfeeding characteristics (TII)			Breastfeeding characteristics (TIII)		
Exclusively	156 (49.5)	63.9 (63.9)	Exclusively	59 (18.7)	36.6 (36.6)
Partly	60 (19.0)	24.6 (88.5)	Partly	35 (11.1)	21.7 (58.4)
Ablactation	28 (8.9)	11.5 (100.0)	Ablactation	42 (13.3)	26.1 (84.5)
			Never breastfed	25 (7.9)	15.5 (100.0)

exclusively breastfed their infant. Dunn's multiple comparison procedure (desire: $t_{120,5;0.05} = 2.6$, $\Psi_{Dunn} = 0.64$; arousal: $\Psi_{Dunn} = 1.17$; lubrication: $\Psi_{Dunn} = 1.36$; pain: $\Psi_{Dunn} = 1.40$) further showed a significant group difference for the subscale "pain" between women who exclusively breastfed ($M = 3.1$) and women who never breastfed ($M = 4.6$) (see Table 5 for estimated marginal means). The power to find medium-sized effects ($f^2(V) = 0.0625$) in our MANOVA was $1 - \beta = 0.95$.

Additional analyses: time course of sexual function

Considering the predictors *partnership quality* at TI and *breastfeeding behavior* at TIII as well as whether mothers had had a cesarean section at TII (correlated with the subscale "satisfaction"), there was no effect of time [$F(1.95,207) = 0.70$, $P = 0.50$, partial $\eta^2 = 0.01$]. In addition, no interaction term reached statistical significance ($P > 0.34$). However, partnership quality [$F(1,106) = 8.50$, $P < 0.01$, partial $\eta^2 = 0.07$] and breastfeeding behavior [$F(3,106) = 4.96$, $P < 0.01$, partial $\eta^2 = 0.12$] remained significant in explaining sexual functioning.

The main effect "breastfeeding" revealed that mothers who exclusively breastfed at TIII showed lower FSFI scores ($M = 17.44$, SE = 1.27) than did mothers who never breastfed ($M = 25.05$, SE = 4.26). Dunn's multiple comparison procedure ($t_{60;5;0.05} = 2.66$, $\Psi_{Dunn} = 9.89$) revealed no further significant, mean differences among the other group comparisons (partial breastfeeding: $M = 23.02$, SE = 1.60; ablactation: $M = 23.91$, SE = 1.36). Figure 1 depicts the course of the FSFI-D sum scores for the four breastfeeding groups.

Discussion

This study aimed to investigate the course of female sexual function in the peripartum period and to further explore the predictive influence of breastfeeding and partnership quality.

Our results showed that sexual function declined from the third trimester (TI) to shortly postpartum (TII) and then rose again to prepartum conditions 4 months after birth (TIII). As one of our key results, we demonstrated that mean FSFI scores at all timepoints were below the critical FSFI-score of 26.55, that Rosen et al. [21] identified. On the one hand, our results could indicate that there is an extremely high risk for FSD in the peripartum period, or, on the other hand, our results might strongly support the assumption that the peripartum period represents a time of decreased sexual function, and demonstrates the need to adjust FSFI standards [8–12]. Several authors showed that postpartum sexual function problems are transient in the majority of women during a space of 6 months and that most of the women do not perceive those changes as constituting a severe sexual problem [6]. This generally raises the question of where to draw the line when it comes to postpartum FSD and whether research should apply the same criteria for peripartum female sexual function as for FSD outside of the peripartum period. Future research is needed to focus on a suitable questionnaire for peripartum sexuality in comparison to the FSFI.

Table 2 Descriptive statistics of questionnaire data

	M (SD)	Range		*M* (SD)	Range		*M* (SD)	Range		*M* (SD)	Range		*M* (SD)	Range
PFB (TI) ($n = 305$)	72.9 (11.2)	28.0–90.0	EPDS (TI) ($n = 313$)	6.8 (5.4)	0.0–23.0	EPDS (TII) ($n = 234$)	6.9 (5.1)	0.0–23.0	EPDS (TIII) ($n = 147$)	5.0 (5.3)	0.0–28.0	FSFI sum score (TI) ($n = 295$)	21.1 (10.9)	1.3–36.0
FSFI sum score (TII) ($n = 214$)	17.7 (11.4)	1.3–36.0	FSFI sum score (TIII) ($n = 141$)	22.4 (10.2)	1.3–35.1	FSFI desire (TI) ($n = 302$)	3.1 (1.2)	1.2–6.0	FSFI desire (TII) ($n = 223$)	2.8 (1.3)	1.2–6.0	FSFI desire (TIII) ($n = 143$)	3.0 (1.1)	1.2–6.0
FSFI arousal (TI) ($n = 303$)	3.3 (2.1)	0.0–6.0	FSFI arousal (TII) ($n = 217$)	2.8 (2.2)	0.0–6.0	FSFI arousal (TIII) ($n = 142$)	3.7 (2.0)	0.0–6.0	FSFI lubrication (TI) ($n = 302$)	3.7 (2.5)	0.0–6.0	FSFI lubrication (TII) ($n = 215$)	3.0 (2.6)	0.0–6.00
FSFI lubrication (TIII) ($n = 141$)	3.9 (2.3)	0.0–6.0	FSFI orgasm (TI) ($n = 305$)	3.4 (2.4)	0.0–6.0	FSFI orgasm (TII) ($n = 215$)	2.7 (2.5)	0.0–6.0	FSFI orgasm (TIII) ($n = 142$)	3.7 (2.2)	0.0–6.0	FSFI satisfaction (TI) ($n = 285$)	4.3 (1.5)	0.8–6.0
FSFI satisfaction (TII) ($n = 208$)	4.0 (1.6)	0.8–6.0	FSFI satisfaction (TIII) ($n = 140$)	4.3 (1.5)	0.8–6.0	FSFI pain (TI) ($n = 301$)	3.3 (2.6)	0.0–6.0	FSFI pain (TII) ($n = 218$)	2.5 (2.6)	0.0–6.0	FSFI pain (TIII) ($n = 143$)	3.9 (2.3)	0.0–6.0

M mean, *SD* standard deviation

Furthermore, our results showed significant negative correlations between female sexual function 4-month postpartum and low partnership quality, breastfeeding, high maternal education, as well as maternal depressive symptoms. As one of our main findings, partnership quality and breastfeeding negatively contributed to predicting FSD 4-month postpartum, explaining 24.3% of the variance and hereby confirming our hypotheses. The variable "breastfeeding" alone explained 8.1% of FSFI variance and could be assigned to a main effect, indicating that women who exclusively breastfed were most likely to experience postpartum FSD, followed by women who partly breastfed and those who primarily/secondarily weaned. Women who did not breastfeed at all and those who stopped breastfeeding in the early postpartum period, exceeded prepartum FSFI scores at TIII, whereas women who were exclusively or partly breastfeeding did not achieve prepartum conditions after 4 months (see Fig. 1). Interestingly, these subgroup differences were already evident prepartum as women who subsequently exclusively breastfed showed the lowest prepartum FSFI scores. On the one hand, this observation could be explained by an unknown variable, such as high maternal education, which is positively associated with FSD [29] and breastfeeding initiation [30]. On the other hand, there could be certain maternal characteristics influencing the decision to breastfeed that have not yet been explored. Furthermore, for breastfeeding women, 4 months might simply not be enough time to reestablish the sexual relationship with their partners. As we did not find any literature on this interesting observation, it should be the subject of future research.

To our knowledge, this is the first study demonstrating a gradual dependency between the extent of breastfeeding and sexual function. Considering the FSFI subscales, breastfeeding significantly affected the domains "desire", "arousal", "lubrication", and "pain", which is consistent with the previous research also linking breastfeeding with dyspareunia, decreased sexual desire and problems with lubrication and arousal [8, 13, 19, 20, 31]. This could be explained by hormonal changes in lactating women, with elevated prolactin levels, resulting in decreased ovarian production of androgens and estrogen, and potentially impairing vaginal lubrication and sexual desire on the one hand [9, 13, 32, 33], as well as fatigueness due to interrupted overnight sleep, on the other [20]. Another interesting approach is presented by Byrd et al., who hypothesized that breastfeeding might fulfill parts of a woman`s need for proximity, which used to be met by physical closeness to her partner [34].

Prepartum partnership quality alone explained 16.2% of the variance of FSD 4-month postpartum and particularly affected the domains "desire", "arousal", and "satisfaction". As the previous studies found mutual dependencies between partnership quality and peripartum FSD, but failed to identify any predictive value [15–18, 35], our findings add to the current literature.

Table 3 FSFI subscales: significant correlations with study variables

	Desire	Arousal	Lubrication	Orgasm	Satisfaction	Pain
	TI (third trimester)					
PFB sum score (TI)						
r	0.09	**0.17**	**0.12**	0.07	**0.28**	0.10
$P_{(2\text{-tailed})}$	0.14	**0.00**	**0.04**	0.26	**< 0.001**	0.08
n	294	**295**	**294**	297	**279**	293
Breastfeeding characteristics (TIII)						
r	**0.24**	0.14	0.16	0.11	0.06	0.12
$P_{(2\text{-tailed})}$	**0.00**	0.08	0.05	0.18	0.46	0.14
n	**155**	155	155	156	148	155
	TII (1-week postpartum)					
PFB sum score (TI)						
r	**0.15**	0.12	0.10	0.12	**0.24**	0.11
$P_{(2\text{-tailed})}$	**0.03**	0.07	0.15	0.10	**0.00**	0.12
n	**215**	211	208	209	**202**	211
Cesarean section (TII)						
r	− 0.01	− 0.06	− 0.08	− 0.09	**− 0.22**	− 0.10
$P_{(2\text{-tailed})}$	0.93	0.39	0.24	0.18	**0.00**	0.17
n	217	211	209	209	**202**	212
Breastfeeding characteristics (TIII)						
r	**0.20**	0.11	0.13	0.13	0.07	0.10
$P_{(2\text{-tailed})}$	**0.02**	0.21	0.13	0.14	0.41	0.27
n	**141**	140	136	137	131	139
	TIII (4-month postpartum)					
High maternal education (TI)						
r	− 0.13	− 0.11	− 0.14	**− 0.18**	− 0.10	− 0.12
$P_{(2\text{-tailed})}$	0.12	0.21	0.10	**0.03**	0.25	0.15
n	142	141	140	**141**	139	142
PFB sum score (TI)						
r	**0.29**	**0.20**	0.16	0.12	**0.20**	0.09
$P_{(2\text{-tailed})}$	**< 0.001**	**0.02**	0.06	0.16	**0.02**	0.29
n	**142**	**141**	140	141	**139**	142
EPDS (TIII)						
r	− 0.05	− 0.14	− 0.07	− 0.13	**− 0.21**	− 0.06
$P_{(2\text{-tailed})}$	0.55	0.11	0.45	0.14	**0.01**	0.47
n	141	141	139	140	**138**	141
Breastfeeding characteristics (TIII)						
r	**0.25**	**0.26**	**0.24**	**0.18**	0.16	**0.26**
$P_{(2\text{-tailed})}$	**0.00**	**0.00**	**0.01**	**0.04**	0.06	**0.00**
n	**143**	**142**	**141**	**142**	140	**143**

r = Pearson correlation coefficient; bold print indicates statistically significant correlations

As an explanation, McCabe et al. suggested that women in poor relationships might tend to avoidance behavior, resulting in sexual intercourse less frequently and restricting sexual experience and intimacy [36]. Furthermore, relationship problems may potentially foster maternal postpartum sexual concerns, such as being afraid of dyspareunia [37]. As the transition to parenthood is known to be a major stressor for a couple [38], it is easy to imagine that a stable relationship may buffer the adverse effects of the birth of a child on postpartum sexual functioning.

Table 4 Post-hoc ANOVAs on Between-subject effects for FSFI at TIII (only significant factors; adjusted for EPDS and graduation)

FSFI scale	*F*	*P*	Partial η^2
Corrected model[a]			
Desire[d]	5.735	< 0.001	0.212
Arousal[e]	3.527	0.003	0.142
Lubrication[f]	2.651	0.019	0.111
Orgasm[g]	2.060	0.062	0.088
Satisfaction[h]	3.249	0.005	0.132
Pain[i]	2.802	0.014	0.116
PFB (TI)[b]			
Desire	14.373	< 0.001	0.101
Arousal	4.267	0.041	0.032
Lubrication	2.663	0.105	0.020
Orgasm	0.457	0.500	0.004
Satisfaction	4.048	0.046	0.031
Pain	0.171	0.680	0.001
Breast feeding characteristics (TIII)[c]			
Desire	5.445	0.001	0.113
Arousal	4.002	0.009	0.086
Lubrication	3.420	0.019	0.074
Orgasm	1.800	0.151	0.040
Satisfaction	1.987	0.119	0.044
Pain	4.827	0.003	0.102

[a]Numerator $df = 6$, error $df = 134$

[b]Numerator $df = 1$, error $df = 128$

[c]Numerator $df = 3$, error $df = 128$

[d]$R^2 = 0.212$ (adjusted $R^2 = 0.175$)

[e]$R^2 = 0.142$ (adjusted $R^2 = 0.102$)

[f]$R^2 = 0.111$ (adjusted $R^2 = 0.069$)

[g]$R^2 = 0.088$ (adjusted $R^2 = 0.045$)

[h]$R^2 = 0.132$ (adjusted $R^2 = 0.091$)

[i]$R^2 = 0.116$ (adjusted $R^2 = 0.075$)

Limitations

Some limitations should be considered. First, an analytical bias may have been introduced by distortion of our sample resulting from loss to follow-up after 4 months. In the case of non-significant results, the possibility of small effects could not be fully assessed as analyses ran out of power. Random results could not be excluded, as alpha errors in our analyses were not corrected. Regarding sample size and analyses, the causal direction for the association between breastfeeding and sexual function could not be determined.

Another important limitation to the study is presented by the FSFI itself, as the questionnaire has repeatedly been criticized for several weaknesses: Most importantly, there is evidence that the FSFI may lead to biased results within sexually inactive samples [39]. In addition, as it was originally designed to specifically assess arousal disorders [21], the validity of the other domains has been repeatedly discussed as has the question, if the items fully reflect all aspects of female sexuality [39]. Despite all criticism, the FSFI remains one of the most widely used measures of female sexual function and is cited in over 1500 publications [39]. In addition, the diagnosis of FSD requires the presence of personal distress due to functioning problems. As we solely asked about problems with sexual function and did not assess whether or not the women perceived those problems as distressing, our results should be considered with caution to prevent premature pathologization.

Conclusions

From our study, three key results emerged. First, all mean FSFI scores were below the critical FSFI score of 26.55 at all timepoints. Therefore, the FSFI should be critically reconsidered as a suitable instrument to measure peripartum sexuality. Second, breastfeeding and prepartum partnership quality proved to be powerful predictors for FSD 4-month postpartum, accounting for 24.3% of the cummulative variance. Third, we demonstrated for the first time a gradual dependency between the extend of breastfeeding and female sexual function, as women who exclusively breastfed were most likely to achieve low FSFI scores when compared to those who partly or did not breastfeed at all. As the previous studies indicated that postpartum sexual function problems are transient in most cases and only half of women concerned perceived those changes as straining [6], it will be necessary to clarify where to draw the line when it comes to postpartum female sexual dysfunction to prevent pathologization. However, our findings definitely add to the existing literature and suggest an important association between breastfeeding, partnership quality, and sexual function problems. In summary, health-care professionals should inform their patients about peripartum relationship dynamics as well as anticipated physiological changes in sexuality within the scope of prenatal counselling and antenatal classes, and contribute to establishing an environment in which women are encouraged to talk about sexual concerns and to seek professional (partnership) support, if required.

Table 5 Estimated marginal means of FSFI sub-scores in TIII MANOVA

Dependent variable	Breastfeeding behavior	M^a	SE	95% CI lower bound	95% CI upper bound
Desire	Exclusively	2.665	0.142	2.384	2.947
	Partly	3.059	0.173	2.716	3.402
	Ablactation	3.538	0.163	3.216	3.861
	Never breastfed	3.101	0.306	2.495	3.707
Arousal	Exclusively	3.185	0.260	2.670	3.701
	Partly	3.782	0.317	3.154	4.410
	Ablactation	4.542	0.299	3.952	5.133
	Never breastfed	4.136	0.561	3.026	5.247
Lubrication	Exclusively	3.288	0.302	2.691	3.885
	Partly	4.114	0.368	3.387	4.841
	Ablactation	4.738	0.346	4.053	5.422
	Never breastfed	4.191	0.650	2.905	5.477
Pain	Exclusively	3.122	0.311	2.508	3.737
	Partly	4.121	0.379	3.372	4.870
	Ablactation	4.849	0.356	4.144	5.554
	Never breastfed	4.649	0.670	3.324	5.974

M mean, *SE* standard error, *CI* confidence interval

[a]Covariates appearing in the model are evaluated at the following values: maternal graduation (TI) = 3.24, EPDS (TIII) = 4.99, PFB (TI) = 73.35

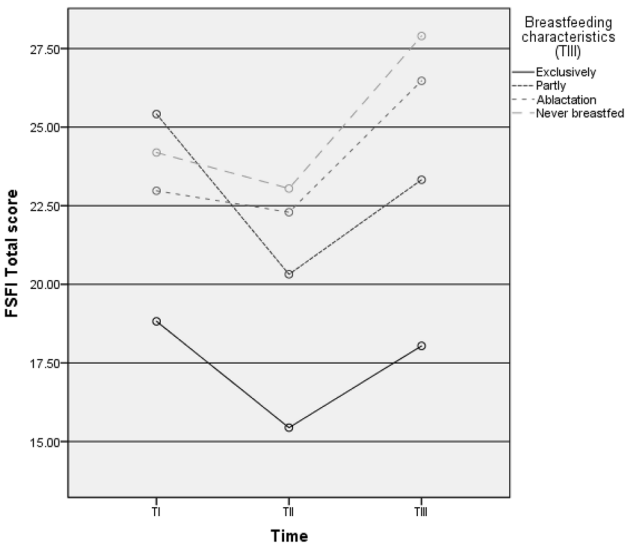

Fig. 1 Time course of FSFI-D sum score means throughout the measurement points. Covariates appearing in the model are evaluated at the following value: PFB (TI) = 72.73

Author contributions LMM: data collection and manuscript writing. MW: protocol development. CR: protocol development, data management, and manuscript editing. CS: protocol development and manuscript editing. MM: data collection and management, data analysis, and manuscript writing. SW: protocol development, data collection and management, data analysis, and manuscript writing.

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Compliance with ethical standards

Conflict of interest We declare that we have no conflict of interest.

Ethical approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed consent Informed consent was obtained from all individual participants included in the study.

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