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MATERNAL-FETAL MEDICINE

Predictors of impaired breastfeeding initiation and maintenance in a diverse sample: what is important?

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Abstract
Purpose This study aimed to investigate socio-demographic, medical and psychological factors that have an impact on breastfeeding.
Methods Questionnaires were administered to 330 women prenatally (TI third trimester) and postpartum (TII 3–4 days, TIII 4 months). Medical data were collected from the hospital records. Self-reported data on initiation and maintenance of breastfeeding was collected simultaneously. Primary endpoint was breastfeeding initiation and maintenance. Data analyses were performed using Spearman's ρ correlations between breastfeeding and other study variables and generalized multiple ordinal logistic regression analysis.
Results Neonatal admission to the NICU, high BMI, cesarean section, difficulties with breastfeeding initiation and high maternal state anxiety were the strongest predictors of impaired breastfeeding initiation, explaining together 50 % of variance. After 4 months, the strongest predictors of impaired maintenance of breastfeeding were maternal smoking, a high BMI and a history of postpartum anxiety disorder, explaining 30 % of variance.
Conclusions Successful initiation and maintenance of breast feeding is a multifactorial process. Our results underline the need of interdisciplinary approaches to optimise breastfeeding outcomes by demonstrating the equality of medical and psychological variables. Whereas practices on maternity wards are crucial for optimal initiation, continuous lifestyle modifying and supporting approaches are essential for breastfeeding maintenance. Healthcare providers can also significantly influence breastfeeding initiation and maintenance by counselling on the importance of maternal BMI.

Keywords Breastfeeding · Breastfeeding initiation · Breastfeeding duration · Predictors · Obesity, smoking, anxiety

Introduction

Breastfeeding is associated with benefits for both, mother and child, and is therefore recommended as the ideal form of infant feeding [1–3]. Following the recommendations of the World Health Organization [3] and the American Academy of Pediatrics [2], infants worldwide should be exclusively breastfed for the first 6 months of their life.

Several reports have drawn attention to the changing pattern of breastfeeding inequalities across countries and population groups [4]. In western societies, only a fraction of infants are still breastfed at the age of 6 months. Even though rates of initiation are encouragingly high, there is a rapid decline during the first weeks postpartum [5]. Only 46.2 and 25.5 % of children born in the US in 2012 were exclusively breastfed through 3 and 6 months of age [6]. These rates are fairly consistent worldwide, with <36 % of infants being exclusively breastfed at any point <6 months of age [3]. Regarding these facts, identification of the main barriers for impaired initiation and risk factors for early

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cessation of breastfeeding is clearly warranted to develop tailored prevention strategies [3].

Many studies describe the influence of single predictive factors on breast feeding initiation and maintenance [7–9]. The literature consistently shows that socio-demographic factors as maternal age, socio-economic status, level of education, marital status and place of residence are associated with both, breastfeeding initiation and maintenance [7, 8, 10].

Furthermore, other studies highlight psychological and psychosocial factors as being more predictive of exclusive breastfeeding duration than demographic factors combined [7]. Positive influences of breastfeeding on an attenuated stress response [11, 12] an enhanced sleep [13] as well as on maternal self-efficacy [14, 15] were described. Contrariwise, maternal depressive symptoms have been associated with a decrease in intention, initiation and maintenance of breastfeeding [16–18]. Medical practices also remain crucial for breastfeeding success. After delivery, more than 80 % of the mothers experience one or more difficulties related to breastfeeding and many ablactate due to having troubles with suckling, cracked nipples or painful breasts [19, 20]. Regarding immediate skin-to-skin contact after delivery, it has been shown to have a beneficial effect on the likelihood of breastfeeding [21]. While this is routinely performed in vaginal deliveries, caesarean births are known to increase the length of time before the first breastfeed, significantly delay the onset of lactation and increase the likelihood of supplementation [22].

Furthermore, recent studies published in 2015 focused on the body mass index (BMI) and were able to demonstrate negative associations between a high maternal prepregnancy BMI and breastfeeding initiation and maintenance [23–25].

Given the proportion of women who are not meeting the WHO global recommendation of exclusive breastfeeding for 6 months, there is very limited research examining the complexity and interaction of these risk factors.

Therefore, through examining socio-demographic, medical and psychological characteristics of breastfeeding initiation and maintenance in a longitudinal study, we aim to identify strong predictive factors that provide guidance to optimize future breastfeeding strategies to clinical practitioners.

Methods

Sample

A longitudinal cohort study was carried out amongst pregnant women who attended prenatal care at the University Hospital of Heidelberg between January and August 2014 at the perinatal center of the highest level providing health services to low, medium, and high-risk obstetrical patients and performing approximately 1800 deliveries per year. Participants were recruited anonymously while waiting for their routine medical check-ups. The eligibility criteria included being 18 years and older and having a sufficient knowledge of the German language. The participants completed written self-administered questionnaires at three time points: third trimester (T1, $N = 330$), 3–4 days postpartum (T2, $N = 247$) and 4 months postpartum (T3, $N = 154$). We chose to examine feeding practices at 4 months as many mothers start to add complementary foods to the diet of their child at this point of time. The first questionnaire was filled out on-site while the other questionnaires were mailed to the participants at a nominated address and returned in envelopes provided. Ethics approval was granted by the Ethical Committee of the University of Heidelberg.

Measurements

The questionnaires were developed to include a range of psychometrically validated tools as wells as scales covering socio-demographic and medical data. All medical details were double checked for accuracy with the hospital's medical record and the delivery record.

Breastfeeding characteristics

Breastfeeding characteristics included breastfeeding practices after delivery and after 4 months. It also covered difficulties of breastfeeding, e.g. sore nipples.

Edinburgh Postnatal Depression Scale

The Edinburgh Postnatal Depressive Scale (EPDS) is used to detect symptoms of depression during pregnancy. The EPDS is a 10-item self-rating scale, scored from 0 to 3 (normal response 0 and severe response 3) that has been validated in the detection of postpartum and ante partum depression in numerous studies [26]. Answers are based on the 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 and specificity of 91 and 95 % in predicting depressive disorders [27]. Internal consistency revealed as good for our sample (TI: $\alpha = .87$, TII: $\alpha = .86$, TIII: $\alpha = .90$).

State/Trait Anxiety Inventory

This State/Trait Anxiety Inventory (STAI) has been used to measure anxiety related to evaluation apprehension [28]. The STAI differentiates between the temporary condition

of "state anxiety" and the more general and long-standing quality of "trait anxiety". The 20 items are scored from 1 to 4, with higher numbers corresponding to greater agreement. Internal consistency revealed as excellent for our sample (STAI-S TI: $\alpha = .93$, TII: $\alpha = .91$, TIII: $\alpha = .94$; STAI-T TI: $\alpha = .92$, TII: $\alpha = .91$, TIII: $\alpha = .94$).

Pregnancy-Related Anxiety Questionnaire

The Pregnancy Related Anxiety Questionnaire (PRAQ) was developed by Van den Bergh [29]. An abridged version (PRAQ-R) with 34 items was used by Huizink et al. [30] to examine closely pregnancy-related anxiety. Huizink et al. applied three scales consisting of 10 items and demonstrated the following internal consistencies: scale 1 (birth), Cronbach's α between .79 and .83; scale 2 (health of the child), between .87 and .88; scale 3 (own appearance), between .76 and .83. With a Cronbach's α of $\alpha = .83$, internal consistency was evaluated as good in our sample (TI).

Statistical analyses

We used the *Statistical Package for Social Sciences* (IBM™ SPSS® v. 22.0.0.0) for all analyses conducted. Power-estimations for the confirmative analysis were computed using G-Power v. 3.1.9.2 [31, 32]. Due to scale-specific amounts of missing values, the valid number of cases n varied depending on the data sub-sets used for the particular test. Prior to the main analyses, we evaluated if missing values depended on third variables using Little's MCAR-test [33]. If non-significant, missing values are unlikely to depend on third variables.

All variables except maternal age were not normally distributed (Kolmogorov–Smirnov-statistic with Lilliefors significance correction and/or Shapiro–Wilk-statistic $p < .05$). Therefore, non-parametric tests respective generalized linear modeling (with robust maximum likelihood estimations) were the method of choice. First, we computed Spearman's ρ correlations between breastfeeding and the other study variables. Second, to evaluate the independent contribution of the detected risk factors for each of the outcome variables, we used a generalized multiple ordinal logistic regression analysis. A stepwise backward regression was chosen since a forward regression analysis bears the risk of not selecting independent variables with small but meaningful effects. As estimator for effect sizes w^2 ($\frac{\chi^2}{N}$) was computed for significant results. According to Cohen's conventions [34], $w^2 = .01$ are small, $w^2 = .09$ are medium-sized and $w^2 = .25$ are large effects.

Results

Sample characteristics

330 women were included in the final study sample. Mean maternal age was 32.8 years (SD = 4.7, min = 21, max = 44) and mean gestational age at study inclusion was 34.8 weeks of pregnancy (SD = 3.6, min = 25, max = 42). Mean gestational age at delivery was 39.1 weeks (SD = 1.9, min = 30, max = 42). Mean pre-pregnancy BMI was $M = 25.2$ (SD = 6.3, min = 16.7, max = 55.8). Demographics are shown in Tables 1 and 2.

At the second assessment (T2), 101 patients delivered spontaneously (41.9 %), 75 had a primary cesarean section (31.1 %) and 49 a secondary cesarean section (20.3 %). There were 16 ventouse deliveries (6.6 %). Mean birth weight was 3225.3 g (min = 990 g to max = 4550 g,

Table 1 Demographic characteristics (total $N = 330$)

	f	Valid (%)
Graduation		
Low secondary education	27	8.4
High secondary education	93	28.8
University entrance qualification	63	.2
University degree	140	.4
Total	323	100.0
Social status		
Married and living together	245	.8
Married but living apart	5	.0
Single and living together	65	.2
Single and living alone	7	.0
Divorced	4	.0
Total	326	100.0
Family income		
<2000 €	120	40.1
<4000 €	97	32.4
<6000 €	52	17.4
≥6000 €	30	10.0
Total	299	100.0
Level of employment		
Fulltime	97	29.9
Part-time (15–34 h)	53	16.4
Part-time (<15 h)	13	4.0
In training	6	1.9
Housewife	25	7.7
Unemployed	9	2.7
Temporary exempted	120	37.0
Total	324	100.0

Table 2 Pregnancy- and birth-related characteristics (total $N = 330$)

	f	Valid (%)		*f*	Valid (%)
Gravidity			History of preterm birth		
First pregnancy	131	40.1	None	121	81.8
Second	103	31.5	One	24	16.2
Third or more	93	28.4	Two or more	3	2.0
Total	327	100.0	Total	148	100.0
Desired mode of delivery			History of cesarean section		
Vaginal	151	73.7	True	82	54.3
Cesarean section	54	26.3	False	69	45.7
Total	205	100.0	Total	151	100.0
History of prepartum depression			History of prepartum anxiety disorder		
True	12	6.3	True	24	12.6
False	178	93.7	False	166	87.4
Total	190	100.0	Total	190	100.0
History of postpartum depression			History of postpartum anxiety disorder		
True	18	12.2	True	10	6.8
False	103	92.0	False	136	93.2
Total	147	100.0	Total	146	100.0
Planned pregnancy			Desired pregnancy		
True	244	80.5	True	293	88.8
False	59	19.5	False	13	11.2
Total	303	100.0	Total	306	100.0
Smoking			Alcohol intake		
Not at all	310	59.4	Not at all	318	97.8
<5 cigarettes/day	8	2.5	<Once/month	4	1.2
5–10/day	7	2.2	1–2 times/month or more	3	.9
Total	325	100.0	Total	325	100.0
Diabetes			Breastfed in infancy		
Non-insulin-dependent gestational	28	8.5	Fully	158	48.5
Insulin-dependent gestational	26	7.9	Partly	63	19.3
Preexisting	5	1.5	Not at all	105	32.2
Total	330	100.0	Total	326	100.0
Hypothyroidism			Intention to breastfeed		
True	75	22.7	True	302	92.4
False	255	77.3	False	25	7.6
Total	330	100.0	Total	327	100.0
Infant gender			NICU admittance		
Male	125	51.9	True	11	4.9
Female	116	48.1	False	212	95.1
Total	241	100.0	Total	223	100.0
PDA			Immediate skin-to-skin contact		
True	82	37.3	True	78	33.5
False	138	62.7	False	155	66.5
Total	220	100.0	Total	233	100.0

SD = 37.1 g). APGAR values were $M = 8.5$ (1 min, SD = 1.0, min = 5, max = 10), $M = 9.5$ (5 min, SD = .9, min = 4, max = 10) an $M = 9.8$ (10 min, SD = .5, min = 8, max = 10).

Breastfeeding initiation and maintenance rates

At TII 159 women (62.8 %) exclusively breastfed their infant. Further 64 mothers breastfed their infant partly

(25.3 %). 30 mothers never breastfed or ablactated at an early stage (11.9 %). 100 breastfeeding mothers (71.9 %) reported at least one difficulty with breastfeeding (milk production, painful breasts, lacerations, cracked nipples, infection).

After 4 months, 61 women (36.7 % of valid $N = 166$ cases) exclusively breastfed their infant and 36 (21.7 %) partly breastfed. 43 mothers (25.9 %) had stopped breastfeeding and 26 mothers (15.7 %) had never breastfed. 103 of breastfeeding mothers (78.0 %) reported at least having experienced one complication of breastfeeding.

Variables associated with impaired breastfeeding initiation and maintenance

We considered socio-demographic (e.g. age), life-style (e.g. smoking), and pregnancy-related data (e.g. gravidity), psychological measures (e.g. EPDS), data assessed at birth (e.g. gestation age) and breast-feeding data for the MCAR-test. The test was non-significant ($\chi^2 = 8092.11$, $df = 7949$, $p = .13$); the missing values did not depend on third variables and thus sub-populations are representative for the larger sample.

All factors significantly associated with breastfeeding initiation and maintenance are demonstrated in Tables 3 and 4.

Variables predictive of impaired breastfeeding initiation and maintenance

All significant risk factors were considered for the backward procedure of the generalized ordinal logistic regression models (cumulative logit link function). At TII, high maternal pre-pregnancy BMI ($w^2 = .06$), cesarean section as mode of delivery ($w^2 = .03$), admission to the NICU ($w^2 = .10$), difficulties with breastfeeding in the first days postpartum ($w^2 = .05$) and high state anxiety ($w^2 = .04$) were found to be strong predictors of impaired breastfeeding initiation (Table 5).

The final model explained 50.19 % of variance ($\chi^2 = 50.19$, $df = 5$, $p < .001$).

For breastfeeding maintenance, family income, history of postpartum depressive disorders, planned pregnancy and complications of breastfeeding (TIII) could not be considered as parameters for the regression models, as there was a quasi-complete data separation. However, their correlation coefficients to breastfeeding at TIII were less significant than the remaining parameters (p values >.30) (Table 4).

After 4 months, pre-pregnancy BMI ($w^2 = .08$), maternal smoking ($w^2 = .21$) and history of postpartum anxiety disorder ($w^2 = .17$) remained in the final model (Table 6). Maternal smoking behavior was revealed to be the strongest explanatory factor of breastfeeding cessation, followed by history of postpartum anxiety disorders. 30.68 % (Nagelkerke) of variance could be explained by the final model.

Discussion

The aim of the study was to specifically examine the complexity and interaction of socio-demographic, medical and psychological predictors of breastfeeding in a diverse study population including patients of all risk categories. Although breastfeeding initiation rates were high in our study sample (62.8 % exclusively and 25.3 % partly breastfed), there was a marked decline with only 36.7 % of mothers still exclusively breastfeeding after 4 months. These rates do not meet WHO standards demanding 75 % of mothers exclusively breastfeeding when discharged of the hospital [35] and are fairly consistent with those reported by UNICEF in 2011 with <36 % of infants being exclusively breastfed at any point <6 months of age [1].

Furthermore, a number of variables were associated and predictive of breastfeeding initiation and maintenance.

Variables associated with impaired breastfeeding initiation

Socio-demographic risk factors: we found a lower level of graduation and if the mother was not breastfed herself as significant risk factors. Contrarily worded, having a high level of education is a variable well known in Western societies to positively influence breastfeeding outcomes [36, 37]. Mothers who are aware of their own duration of breastfeeding as an infant show a longer duration of exclusive and total breastfeeding than mothers who don't know [38]. A recent systemic review supports this issue by stating that having been breastfed as an infant was consistently correlated with breastfeeding intention, initiation, and duration [39].

Medical factors for impaired initiation of breastfeeding included a high pre-pregnancy BMI, having had a cesarean section, NICU admission of the newborn, delayed early skin-to-skin contact and difficulties with breastfeeding in the first 3–4 days. Most of these variables potentially reflect different sides of the aspect delayed early skin-to-skin contact. An Australian study showed that breastfeeding duration up to 3 months was related to the timing of the first breastfeeding and the extent of mother–infant contact in the 72 h after birth [40]. One meta-analysis reported a negative association between prelabor cesarean section and initiation of breastfeeding [41]. The authors assumed that the effect of a cesarean section on early breastfeeding

Table 3 Spearman's ρ correlations with breastfeeding initiation (inversely coded)

Graduation (TI)	
ρ	−.215
$p_{(2\text{-tailed})}$	.001
n	247
Income (TI)	
ρ	−.020
$p_{(2\text{-tailed})}$	.760
n	229
Self-rated health (inversely coded)	
ρ	.203
$p_{(2\text{-tailed})}$	.001
n	248
History of preterm birth (TI)	
ρ	.161
$p_{(2\text{-tailed})}$	.081
n	118
History of anxiety disorder (TI)	
ρ	.238
$p_{(2\text{-tailed})}$	.003
n	152
History of postpartum depressive disorder (TI)	
ρ	.126
$p_{(2\text{-tailed})}$	.172
n	119
History of postpartum anxiety disorder (TI)	
ρ	.292
$p_{(2\text{-tailed})}$	.001
n	118
Pregnancy planned (TI)	
ρ	−.079
$p_{(2\text{-tailed})}$	.225
n	237
Pregnancy wished (TI)	
ρ	−.230
$p_{(2\text{-tailed})}$	.000
n	237
Mother breast fed herself (TI)	
ρ	−.184
$p_{(2\text{-tailed})}$	.003
n	249
Maternal smoking (TI)	
ρ	.090
$p_{(2\text{-tailed})}$	.158
n	250
EPDS (TI)	
ρ	.144
$p_{(2\text{-tailed})}$	.023
n	251
PRAQ (TI)	
ρ	.164
$p_{(2\text{-tailed})}$	.009
n	251
STAI-S (TI)	
ρ	.229
$p_{(2\text{-tailed})}$	.000
n	244
BMI (TI)	
ρ	.132
$p_{(2\text{-tailed})}$	.037
n	251
Complications during delivery (TII)	
ρ	.151
$p_{(2\text{-tailed})}$	.019
n	242
Skin-to-skin contact (TII)	
ρ	−.209
$p_{(2\text{-tailed})}$	.001
n	233
Difficulties breastfeeding initiation (TII)	
ρ	.255
$p_{(2\text{-tailed})}$	.000
n	229
EPDS (TII)	
ρ	.232
$p_{(2\text{-tailed})}$	.000
n	243
STAI-S (TII)	
ρ	.149
$p_{(2\text{-tailed})}$	.020
n	245
STAI-T (TII)	
ρ	.185
$p_{(2\text{-tailed})}$	.004
n	247
Cesarean section (TII)	
ρ	.168
$p_{(2\text{-tailed})}$	.009
n	241
Birth weight (TII)	
ρ	−.117
$p_{(2\text{-tailed})}$	.073
n	237
APGAR 1 (TII)	
ρ	−.137
$p_{(2\text{-tailed})}$	.034
n	238
Admission to NICU (TII)	
ρ	.232
$p_{(2\text{-tailed})}$	.000
n	223
Difficulties breastfeeding maintenance (TIII)	
ρ	.077
$p_{(2\text{-tailed})}$	.387
n	127

might be mediated through processes delaying the onset of lactation, disrupting mother–infant interaction or inhibiting infant suckling [41].

Regarding psychological factors our results showed significant correlations of history of peripartum anxiety disorder, symptoms of depression and anxiety as well as experiencing a high amount of birth-related fear with impaired breastfeeding.

Variables predictive of impaired breastfeeding initiation

Significant predictors emerged in the following ranking and explained 50 % of variance: NICU admission of the newborn, high pre-pregnancy BMI, difficulties with breastfeeding initiation, maternal symptoms of anxiety and cesarean section.

Our results showed that the strongest predictive value had admission to the NICU, emphasizing the extensive implications of delayed skin-to-skin contact, emotional distress and physical separation from the infant [42]. Additionally, more than half of the infants admitted to a NICU receive formula or glucose as their first feeding thereby disrupting breastfeeding initiation [43].

Both predictors together, admission to the NICU and cesarean section, emphasize the importance of the first postnatal hours for establishing the mother–infant interaction and breastfeeding success [41, 44]. Postoperative care routines often interrupt bonding [45] and delay mothers holding their infants [41, 46].

Furthermore, our results showed that the more difficulties breastfeeding mothers had during the first days, the less they continued. This supports an Australian study demonstrating that women who had experienced problems within the first days and weeks postpartum were significantly more likely to discontinue full breastfeeding before 6 months and had a shorter duration of breastfeeding overall [47].

As an additional psychological predictor, our results showed that high maternal state anxiety was as important as early difficulties with breastfeeding. The existing literature on anxiety and breastfeeding is sparse. A 2011 review by the Cochrane Pregnancy and Childbirth Group notes that perinatal anxiety remains under-researched despite evidence suggesting that its subclinical form is highly prevalent at all stages of pregnancy [48]. Adedinsewo et al. [49] showed that a single point increase in STAI State and STAI Trait scores at 3 months postpartum was associated with a 4 and 7 % reduction, respectively, in the odds of any breastfeeding at 12 months. All these findings suggest a relationship between maternal anxiety and reduced exclusivity and continuation of breastfeeding.

Variables associated with impaired breastfeeding maintenance

After 4 months, we found the following socio-demographic variables significantly correlated with breastfeeding; household income, history of being breastfed and a desired pregnancy. Hereby, the last item is rather difficult to interpret. It might reflect several issues, e.g. no individual estimate of planned breast feeding duration [50] or less social or partner support in case of an undesired pregnancy [43, 51].

Medical correlates: We observed a high maternal pre-pregnancy BMI, difficulties with breastfeeding during the first 4 months, and maternal smoking as relevant factors negatively influencing breastfeeding success in the long-term.

As relevant psychological factors, having experienced a peripartum anxiety or depressive disorder, depressive symptoms and/or symptoms of anxiety correlated significantly with impaired breastfeeding maintenance. Maternal perinatal depressive symptoms have been associated with a decrease in intention, initiation and maintenance of breastfeeding [16, 17, 52]. Our results support the study of Nishioka et al. [53] which reasoned that the appearance of depressive symptoms seems to promote discontinuation of breastfeeding postpartum. Contrariwise, women with negative early breastfeeding experiences are more likely to develop depressive symptoms at 2 months postpartum [54].

Variables predictive of impaired breastfeeding maintenance

We observed the following significant predictors of impaired breastfeeding maintenance explaining 30 % of variance: maternal smoking, history of postpartum anxiety disorder and a high BMI.

Smoking appeared to be the strongest predictor of breastfeeding cessation. Our results are in line with a review regarding maternal nicotine consume stating that women who smoke are less likely to intend to breastfeed, less likely to initiate breastfeeding and also less likely to maintain breastfeeding compared to nonsmokers [55]. We also know that among those, who had quit smoking during pregnancy, approximately half relapse postpartum [56]. Thus, supporting smoking cessation interventions for women at risk are of crucial importance.

We also found a history of postpartum anxiety disorder relevant for breastfeeding outcome. As already noted above, anxiety seems to be more common than depression among breastfeeding women [57]. Paul et al. [57] also showed that anxiety remained more common during 6 months after childbirth, and was associated with increased health care use

Table 4 Spearman's ρ correlations with breastfeeding maintenance (inversely coded)

Graduation (TI)	
ρ	−.334
$p_{(2\text{-tailed})}$	.000
n	164
Income (TI)	
ρ	−.172
$p_{(2\text{-tailed})}$	.035
n	150
Self-rated health (TI) (inversely coded)	
ρ	.130
$p_{(2\text{-tailed})}$	.096
n	164
History of preterm birth (TI)	
ρ	.294
$p_{(2\text{-tailed})}$	.012
n	73
History of prepartum anxiety disorder (TI)	
ρ	.297
$p_{(2\text{-tailed})}$	.003
n	97
History of postpartum depressive episode (TI)	
ρ	.251
$p_{(2\text{-tailed})}$	.032
n	73
History of postpartum anxiety disorder (TI)	
ρ	.377
$p_{(2\text{-tailed})}$	.001
n	73
Pregnancy planned (TI)	
ρ	−.163
$p_{(2\text{-tailed})}$	.042
n	155
Pregnancy wished (TI)	
ρ	−.132
$p_{(2\text{-tailed})}$	.100
n	157
Mother breast fed herself (TI)	
ρ	−.214
$p_{(2\text{-tailed})}$	.006
n	165
Maternal smoking (TI)	
ρ	.220
$p_{(2\text{-tailed})}$	.004
n	166
EPDS (TI)	
ρ	.194
$p_{(2\text{-tailed})}$	.012
n	166
PRAQ (TI)	
ρ	.144
$p_{(2\text{-tailed})}$	.064
n	166
STAI-S (TI)	
ρ	.182
$p_{(2\text{-tailed})}$	.021
n	161
BMI (TI)	
ρ	.271
$p_{(2\text{-tailed})}$	.000
n	166
Complications during delivery (TII)	
ρ	−.006
$p_{(2\text{-tailed})}$	.939
n	152
Skin-to-skin contact (TII)	
ρ	−.064
$p_{(2\text{-tailed})}$	.442
n	145
Difficulties breastfeeding initiation (TII)	
ρ	.083
$p_{(2\text{-tailed})}$	.330
n	140
EPDS (TII)	
ρ	.106
$p_{(2\text{-tailed})}$	.191
n	153
STAI-S (TII)	
ρ	.076
$p_{(2\text{-tailed})}$	.352
n	153
STAI-T (TII)	
ρ	.098
$p_{(2\text{-tailed})}$	.227
n	155
Cesarean section (TII)	
ρ	.100
$p_{(2\text{-tailed})}$	.220
n	152
Birth weight (TII)	
ρ	−.216
$p_{(2\text{-tailed})}$	.008
n	148
APGAR 1 (TII)	
ρ	−.009
$p_{(2\text{-tailed})}$	.913
n	150
NICU (TII)	
ρ	.154
$p_{(2\text{-tailed})}$	.072
n	138
Difficulties breastfeeding maintenance (TIII)	
ρ	.189
$p_{(2\text{-tailed})}$	.030
n	132

Table 5 Generalized linear regression model on impaired breastfeeding initiation

Parameter	*B*	SE	Lower 95 % CI bound	Upper 95 % CI bound	Wald χ^2	*p*
Threshold 1 breastfeeding at TII	3.203	1.231	.790	5.615	6.771	.009
Threshold 2 breastfeeding at TII	5.275	1.313	2.701	7.849	16.134	<.001
Difficulties breastfeeding at TII	−1.913	.611	−3.110	−.715	9.797	.002
Cesarean section	−.749	.321	−1.377	−.120	5.446	.020
NICU admission	−1.508	.333	−2.161	−.855	20.464	<.001
BMI	−.114	.032	.050	.177	12.360	<.001
STAI-S at TII	−.051	.018	.017	.085	8.508	.004

Likelihood-ration omnibus test: compares the fitted model against the thresholds-only model; $\chi^2 = 50.19$, $df = 5$, $p < .001$

Table 6 Generalized linear regression model on impaired breastfeeding maintenance

Parameter	*B*	SE	Lower 95 % CI bound	Upper 95 % CI bound	Wald χ^2	*p*
Threshold 1 breastfeeding at TIII	−.329	1.627	−3.518	2.860	.041	.840
Threshold 2 breastfeeding at TIII	.867	1.691	−2.446	4.180	.263	.608
Threshold 3 breastfeeding at TIII	2.066	1.745	−1.355	5.486	1.401	.237
History of postpartum anxiety disorder	−3.749	1.060	−5.827	−1.671	12.504	<.001
Maternal smoking at TI	−2.331	.595	1.164	3.498	15.332	<.001
BMI at TI	−.133	.054	.028	.238	6.155	.013

Likelihood-ration omnibus test: compares the fitted model against the thresholds-only model; $\chi^2 = 30.68$, $df = 3$, $p < .001$

and reduced breastfeeding duration, particularly among primiparous women. To our knowledge, studies examining the relationship between anxiety disorders diagnosed according to DSM criteria and breastfeeding are sparse in the current literature.

As a consistent variable throughout the whole study, a high maternal pre-pregnancy BMI emerged as one of the strongest correlates and predictors of both, breastfeeding initiation and maintenance which is in line with current literature. Following WHO criteria, a BMI equal or more than 30 is generally considered obese and the prevalence has more than doubled since 1980 [58]. A recent systematic review considered maternal obesity as a risk factor for adverse breastfeeding outcomes associated with a decreased intention and initiation of breastfeeding, a shortened duration of breastfeeding, a less adequate milk supply and a delayed onset of lactogenesis II [59]. Furthermore, Kachoria et al. [24] recently published a study that observed breastfeeding behavior in 244,196 women. Despite a significant increase of exclusive breastfeeding and breastfeeding continuation, they found worsening of the disparity between normal-weight women and obese women [24]. By providing further evidence for the significance of a high pre-pregnancy BMI, our study results contribute to the existing body of literature. They highlight the need for more concentrated efforts on breastfeeding particular in obese women.

Limitations

Although our study is unique in that it is longitudinal, following mothers from pregnancy through to 4 months postpartum with medical and psychological assessment at multiple time points, a number of limitations should be considered.

Participants had higher than average educational levels and ethnical diversity was minimal. Not all of the women who were recruited elected to participate and it is possible that breastfeeding initiation patterns were different in non-participators. The allover cesarean section rate was 51.4 % which was increased compared to the national average of approximately 38 %. Therefore, generalizability is limited. One explanations could be that patients who delivered spontaneously and experienced less problems with breastfeeding were less likely to continue participation. Despite the fact that the data demonstrated some convergence it is possible that other opinions and perspectives were missed. Furthermore, analytical bias could have resulted from distortion in our sample due to participant loss after 4 months.

Conclusions

Initiation and maintenance of breastfeeding is a multifactorial process depending on several variables. We were able to prove that medical and psychological variables

were equally important and complement each other. Whereas the variables NICU admission of the newborn, high pre-pregnancy BMI, difficulties with breastfeeding initiation, maternal symptoms of anxiety and cesarean section were most significant predictors of impaired breastfeeding initiation; maternal smoking, history of postpartum anxiety disorder and BMI significantly predicted impaired breastfeeding maintenance. Combined, these variables explained 50 % respective 30 % of variance. To our knowledge, no other study was able to demonstrate the complementary interaction between medical and psychological predictors before yielding such good predictive values for breastfeeding outcomes.

Our results point out the need to reassess practices in maternity care carefully including practices related to birth itself as well as routine screening for peripartal depression and anxiety. Mothers, especially those known to have symptoms of anxiety and/or depression, should be referred to psychological support services and to breastfeeding support postpartum. Whereas maternity practices in hospitals are essential to support breastfeeding initiation, lifestyle modifying and continuous supporting approaches seem to become more important for breastfeeding maintenance. Counselling obese patients should take place in early pregnancy and its importance should not be underestimated. The need for tailored, multidirectional educational approaches supporting and accompanying the mother through pregnancy and the whole breastfeeding period clearly exists. As one way of bridging this information gap, eHealth applications and online education/monitoring could become relevant tools between healthcare experts and mothers as an essential measure to foster initial breastfeeding and to maintain compliance [60, 61].

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Compliance with ethical standards

Conflict of interest All the authors declare that they have no conflict of interest.

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