

The Positive Effect of Breastfeeding Self-Efficacy on Exclusive Breastfeeding Within 6 Months Postpartum and Analysis of Its Influencing Factors

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Abstract

Background

Although the benefits of exclusive breastfeeding (EBF) are well established, its global prevalence remains low. Breastfeeding self-efficacy is a key factor influencing initiation and continuation of breastfeeding. This prospective longitudinal study examined early postpartum breastfeeding self-efficacy and its longitudinal association with EBF rates at 1, 3, and 6 months postpartum. The findings may provide evidence to support targeted interventions for promoting sustained breastfeeding.

Methods

This prospective longitudinal cohort study included 93 postpartum women at Chongqing General Hospital, China, with follow-ups at 1, 3, and 6 months postpartum. Online data were collected using the validated Breastfeeding Self-Efficacy Scale-Short Form (BSES-SF) and Breastfeeding Knowledge Questionnaire (BKQ). Infant feeding patterns were assessed at each follow-up. All statistical analyses (Wilcoxon rank-sum test, Spearman's rank correlation, multivariate linear regression, and GEE) were performed using R 4.4.2.

Results

EBF rates were 43.0% at 1 month, 45.2% at 3 months, and declined to 31.2% at 6 months. Breastfeeding knowledge showed a weak-to-moderate positive correlation with self-efficacy ($\rho = 0.297$; $p = 0.004$). In univariate analyses, gravidity, gestational age, and pre-pregnancy BMI were marginally associated with self-efficacy ($p = 0.056$, 0.079 , and 0.082). Multivariate linear regression revealed pre-pregnancy overweight ($B = 9.97$; $p = 0.010$) and multigravidity ($B = 4.65$; $p = 0.042$) as independent predictors of self-efficacy (adjusted $R^2 = 0.107$). Longitudinal GEE analysis demonstrated that each 1-point increase in self-efficacy was associated with higher EBF likelihood (OR: 1.063; 95% CI: 1.024, 1.104), while EBF rates were significantly lower at 6 months (OR: 0.563; $p = 0.014$).

Conclusion

Breastfeeding self-efficacy is a significant predictor of exclusive breastfeeding (EBF) during the first 6 months postpartum. Pre-pregnancy BMI and gravidity are independent predictors of breastfeeding self-efficacy. Generalized estimating equation (GEE) longitudinal analysis confirmed that the predictive effect of self-efficacy on EBF persists throughout the 6-month postpartum period. Clinicians should pay targeted attention to mothers with low breastfeeding self-efficacy, particularly primigravidae and women with normal pre-pregnancy BMI.

Introduction

Breast milk constitutes the optimal nutritional source for infants during the first six months of life, adequately supporting their growth, immune development, and neurological maturation [1,2]. Furthermore, breastfeeding facilitates maternal postpartum recovery and lowers the risk of cardiovascular disease, type 2 diabetes, certain malignancies, and postpartum depression [3]. In light of these benefits, the World Health Organization (WHO) and international health authorities recommend exclusive breastfeeding for the first six months, followed by complementary feeding while continuing breastfeeding for at least two years [4,5].

However, the WHO 2030 Global Nutrition Targets: Breastfeeding Brief reported that only 48% of infants worldwide are exclusively breastfed [6]. In China, a comprehensive review of breastfeeding research indicated that the 6-month exclusive breastfeeding (EBF) rate is merely around 30% [7,8], which falls substantially short of both the WHO target of 60% for infants under 6 months by 2030 [6] and the goal of over 50% specified in China's Healthy China 2030 Blueprint [9]. Therefore, identifying key influencing factors is critical to promoting early breastfeeding initiation, improving EBF rates, and prolonging breastfeeding duration.

Successful EBF is determined by a complex interplay of multidimensional factors, including national policies, sociocultural norms, and individual characteristics of infants, mothers, and families [10,11], among which maternal factors play a central role. Breastfeeding self-efficacy is defined as a mother's belief in her ability to breastfeed successfully [12]. Women with low breastfeeding self-efficacy commonly report perceived insufficient milk supply, which may lead to early formula supplementation or exclusive formula feeding and significantly increase the risk of early breastfeeding discontinuation [13–15]. As reported by Dennis et al., breastfeeding self-efficacy is a strong predictor of breastfeeding duration, with each 1-point increase in self-efficacy associated with a 10% higher likelihood of EBF [16]. Higher breastfeeding self-efficacy also supports longer breastfeeding maintenance, especially at 4 and 6 months postpartum, which represent critical time points for sustained breastfeeding [17].

In addition, delayed breastfeeding initiation, shortened duration, and early formula introduction are closely associated with inadequate breastfeeding knowledge and skills, prevalent misconceptions, and insufficient family support [18,19]. Limited knowledge often leads to poor mastery of core practices, such as proper latching techniques, the demand-supply principle of lactation, infant feeding assessment, standard milk storage, breastfeeding after returning to work, and breastfeeding under special medical conditions. As a result, mothers may discontinue breastfeeding prematurely due to anxiety, physical discomfort, and misleading information [20]. Moreover, breastfeeding knowledge exerts a significant positive effect on maternal feeding motivation [21]. Consistent with the Knowledge-Attitude-Practice (KAP) model, adequate knowledge promotes positive and accurate perceptions, thereby providing intrinsic motivation for implementing sustained breastfeeding behaviors [22].

According to Bandura's self-efficacy theory, the development of self-efficacy is positively shaped by knowledge acquisition, mastery experiences, verbal persuasion, and physiological status [23]. Based on

this theory, Dennis proposed the concept of breastfeeding self-efficacy, referring to maternal confidence in performing breastfeeding tasks [12]. Accumulating evidence suggests that breastfeeding knowledge acts as a critical cognitive prerequisite for breastfeeding self-efficacy. Sufficient and accurate knowledge helps mothers manage common lactation problems effectively, thereby enhancing confidence and improving breastfeeding self-efficacy [24]. Conversely, knowledge deficits, misconceptions, and incorrect beliefs can reduce self-efficacy levels, aggravate feeding anxiety, and significantly increase the risk of early breastfeeding cessation [25]. Collectively, breastfeeding knowledge provides an important foundation for developing breastfeeding self-efficacy, which further serves as a key mediator in translating knowledge into actual breastfeeding behavior.

However, most existing studies have separately investigated the roles of breastfeeding knowledge and breastfeeding self-efficacy in breastfeeding practices, while longitudinal evidence comparing their dynamic associations and relative predictive effects on EBF remains scarce. This prospective longitudinal study was therefore performed to explore early postpartum breastfeeding self-efficacy and its longitudinal relationship with EBF at 1, 3, and 6 months postpartum, and to clarify whether self-efficacy exhibits a stronger predictive effect on EBF than breastfeeding knowledge. The results are expected to provide robust evidence for the development of targeted interventions aimed at improving sustained breastfeeding.

Methods

Study design, setting, and population

This prospective longitudinal cohort study was conducted at Chongqing General Hospital, China, from October 2024 to April 2025. Postpartum women were followed up at 1, 3, and 6 months postpartum.

The inclusion criteria were as follows: (a) aged > 18 years; (b) gestational age ≥ 37 weeks (full-term pregnancy); (c) singleton pregnancy; (d) having the intention to breastfeed; (e) voluntarily participating in the study and signing the written informed consent form. The exclusion criteria were as follows: (a) mother-infant separation (e.g., due to infant hospitalization or other medical reasons); (b) breastfeeding prohibited by medical advice (e.g., maternal infectious diseases or other contraindications to breastfeeding). The study protocol was approved by the Ethics Committee of Chongqing General Hospital. To protect participant confidentiality, the questionnaire was anonymized, and no personally identifiable information was collected.

Measurement

Sociodemographic and obstetric data were collected using a researcher-designed questionnaire, including maternal age, ethnicity, educational level, occupation, family income, gravidity, parity, gestational age, mode of delivery, body mass index (BMI), postpartum hemorrhage, complications, and rooming-in practice.

Breastfeeding knowledge was measured using the Breastfeeding Knowledge Questionnaire (BKQ) [26], a 25-item scale with scores ranging from 25 to 125. Higher scores indicate greater breastfeeding knowledge. The Cronbach's α coefficient of the BKQ was 0.824 [27], indicating good internal consistency.

Breastfeeding self-efficacy was assessed using the Breastfeeding Self-Efficacy Scale-Short Form (BSES-SF) [28]. Developed by Dennis et al. in 1999, this 14-item scale is used to evaluate breastfeeding confidence in the early postpartum period, with scores ranging from 14 to 70. Higher scores reflect stronger breastfeeding self-efficacy. The Cronbach's α coefficient of the BSES-SF was 0.953 [29], indicating excellent internal consistency.

Breastfeeding knowledge scores and breastfeeding self-efficacy scores were measured once within 1 week postpartum and used as baseline predictive variables to analyze their effects on exclusive breastfeeding (EBF) outcomes at 1, 3, and 6 months postpartum.

Feeding Patterns

In line with guidelines from the WHO and the United Nations Children's Fund (UNICEF) [30], EBF was defined as infants receiving only breast milk (including expressed breast milk and donor milk), with no other foods or liquids (including water) provided, except for vitamin, mineral supplements, or medically prescribed medications. Infant feeding patterns at 1, 3, and 6 months postpartum were collected through telephone follow-up and categorized into three types: EBF, mixed feeding (breast milk combined with formula milk), and formula feeding.

Data Collection

Baseline data were collected using QuestionStar, a professional free online survey platform in China, during the mothers' hospitalization. Follow-up data at 1, 3, and 6 months postpartum were obtained through telephone interviews. A total of 97 mothers completed the baseline assessment, among whom 93 (95.9%) finished all follow-up visits, and 4 were lost to follow-up due to unreachable phone numbers during the follow-up period. The flow of participant recruitment, baseline assessment, postpartum telephone follow-ups (1, 3, and 6 months), and loss to follow-up is summarized in Fig. 1.

Statistical Analysis

Data analysis was done with R 4.4.2. The Shapiro-Wilk test assessed normality of continuous variables. As breastfeeding self-efficacy scores were non-normal (Shapiro-Wilk $p = 0.011$; see Supplementary file : Figure S1), continuous variables were presented as mean $\pm$ SD or median (IQR), with between-group comparisons via Wilcoxon rank-sum test. Spearman's ρ analyzed correlations between breastfeeding knowledge and self-efficacy scores.

Variables with $p < 0.1$ in univariate analysis plus clinically relevant variables (i.e., maternal age) were entered into a multivariate linear regression model. Model diagnostics included VIF, Durbin-Watson test, and Cook's distance (see Supplementary file : Figure S2); HC3 robust standard errors were used for sensitivity analysis.

Generalized estimating equations (GEE) with exchangeable correlation structure evaluated the longitudinal predictive effect of self-efficacy on EBF, reporting crude and adjusted models. For knowledge, Wilcoxon rank-sum test compared EBF vs. non-EBF group differences at each follow-up, and time-specific logistic regression analyzed its association with EBF. An additional GEE model (knowledge as independent variable) assessed its longitudinal predictive effect on EBF at 1, 3, and 6 months.

To compare relative effect magnitudes, standardized knowledge and self-efficacy were simultaneously entered into a joint GEE model (supplementary analysis). As EBF outcomes were repeated binary measurements, Cochran's Q test compared overall differences across time points, with pairwise comparisons via McNemar test.

Receiver operating characteristic (ROC) curves evaluated self-efficacy's predictive performance (see Supplementary file: Figure S3). All tests were two-tailed, with significance set at $p < 0.05$.

Results

Participant Characteristics

A total of 93 postpartum women were included in the final analysis. Table 1 presents the baseline characteristics of the study participants. The majority of participants were aged ≥ 30 years (55.9%), of Han Chinese ethnicity (96.8%), and married (98.9%). Regarding educational and occupational status, 52.7% had a higher education level, and 67.7% were employed in high-income occupations. For obstetric characteristics, 51.6% had a history of multiple gravidities, 72.0% were primiparous, and 57.0% underwent cesarean section delivery.

Table 1

Baseline characteristics of study participants $N = 93$

Variables	Categories	N (%)
Age (years)	< 30	41 (44.1)
	≥ 30	52 (55.9)
Ethnicity	Han Chinese	90 (96.8)
	Minority	3 (3.2)
Marital status	Married	92 (98.9)
	Unmarried	1 (1.1)
Education level	Higher education	49 (52.7)
	Lower education	44 (47.3)
Work type	High-income occupation	63 (67.7)
	Low-income occupation	30 (32.3)
Family income	High Income ($\geq 100k$)	66 (71.0)
	Low Income (< 100k)	27 (29.0)
Gravidity	Primigravida	45 (48.4)
	Multigravida	48 (51.6)
Parity	Primipara	67 (72.0)
	Multipara	26 (28.0)
Gestational weeks	< 40 weeks	68 (73.1)
	≥ 40 weeks	25 (26.9)
Type of delivery	Vaginal delivery	40 (43.0)
	Caesarean section	53 (57.0)
Pre-pregnancy BMI	Normal weight	84 (90.3)
	Overweight/Obese	9 (9.7)
Postpartum BMI	Normal weight	25 (26.9)
	Overweight/Obese	68 (73.1)
BMI gain	Lower gain	47 (50.5)
	Higher gain	46 (49.5)

Variables	Categories	N (%)
Postpartum hemorrhage	No	86 (92.5)
	Yes	7 (7.5)
Postpartum complications	No	55 (59.1)
	Yes	38 (40.9)
Rooming-in	Yes	73 (78.5)
	No	20 (21.5)

Table 2 summarizes the descriptive statistics for breastfeeding knowledge and self-efficacy scores. The mean breastfeeding self-efficacy score was 47.1 ± 11.4 , with a median of 50.0 (IQR 39.0, 55.0). The Shapiro-Wilk test confirmed a non-normal distribution of self-efficacy scores ($W = 0.963$; $p = 0.011$), thus non-parametric statistical methods were used for subsequent analyses. The mean breastfeeding knowledge score was 86.5 ± 10.8 .

Table 2
Descriptive statistics for breastfeeding knowledge and self-efficacy scores

Variables	N	Mean $\pm$ SD	Median (IQR)
Breastfeeding knowledge score	93	86.5 ± 10.8	86.0 (81.0–89.0)
Breastfeeding self-efficacy score	93	47.1 ± 11.4	50.0 (39.0–55.0)

Feeding Patterns

Table 3 presents the distribution of infant feeding patterns at 1, 3, and 6 months postpartum. The EBF rate was 43.0% at 1 month, slightly increased to 45.2% at 3 months, and then declined to 31.2% at 6 months. In contrast, the formula feeding rate increased progressively from 9.7% at 1 month to 48.4% at 6 months. Further analysis of repeated binary measurements using Cochran's Q test revealed a statistically significant overall difference in EBF rates across the three time points ($Q = 11.31$; $p = 0.0035$). Pairwise comparisons (McNemar test) showed no statistically significant difference in EBF rates between 1 and 3 months postpartum. However, the EBF rate at 6 months was significantly lower than those at the previous two time points, with a more pronounced difference observed when compared to the 3-month rate (see Supplementary file : Table S1).

Table 3
Distribution of breastfeeding patterns at 1, 3, and 6 months
postpartum $N = 93$

Time point	Feeding pattern	N	%
1 month postpartum	Exclusive breastfeeding	40	43.0
	Mixed feeding	44	47.3
	Formula feeding	9	9.7
3 months postpartum	Exclusive breastfeeding	42	45.2
	Mixed feeding	29	31.2
	Formula feeding	22	23.7
6 months postpartum	Exclusive breastfeeding	29	31.2
	Mixed feeding	19	20.4
	Formula feeding	45	48.4

Correlation Between Knowledge and Self-Efficacy

Figure 2 illustrates the correlation between breastfeeding knowledge and self-efficacy scores. Spearman's rank correlation analysis revealed a weak-to-moderate positive correlation between the two variables ($\rho = 0.297$, $p = 0.004$), with breastfeeding knowledge explaining approximately 8.8% of the variance in breastfeeding self-efficacy. A broader correlation heatmap is provided in Supplementary file: Figure S4.

Influencing Factors of Self-Efficacy

Univariate Wilcoxon rank-sum tests (Table 4) explored associations between 14 demographic/obstetric variables and breastfeeding self-efficacy scores. Three variables showed near-significant associations ($p < 0.1$): gravidity (multigravida: 49.4 ± 9.9 vs. primigravida: 44.7 ± 12.4 , $p = 0.056$), gestational age (≥ 40 weeks: 43.9 ± 9.5 vs. 48.3 ± 11.8 , $p = 0.079$), and pre-pregnancy BMI (overweight/obese: 56.0 ± 10.9 vs. normal weight: 46.2 ± 11.1 , $p = 0.082$). Remaining variables were non-significant (all $p > 0.1$); subgroup comparison boxplots are in the Supplementary file: Figure S5.

Table 4
Univariate analysis of self-efficacy scores by maternal characteristics (Wilcoxon rank-sum test)

Variable	Category	Mean $\pm$ SD	Median (IQR)	p-value
Age	< 30 years	47.8 $\pm$ 9.5		0.834
	$\geq$ 30 years	46.6 $\pm$ 12.7		
Education	Higher	45.6 $\pm$ 12.6		0.176
	Lower	48.8 $\pm$ 9.7		
Occupation	High-income	46.3 $\pm$ 12.2		0.313
	Low-income	48.9 $\pm$ 9.3		
Family income	High	47.0 $\pm$ 11.3		0.767
	Low	47.5 $\pm$ 11.9		
Gravidity	Primigravida	44.7 $\pm$ 12.4		0.056
	Multigravida	49.4 $\pm$ 9.9		
Parity	Primipara	46.7 $\pm$ 11.4		0.471
	Multipara	48.1 $\pm$ 11.6		
Gestational weeks	< 40 weeks	48.3 $\pm$ 11.8		0.079
	$\geq$ 40 weeks	43.9 $\pm$ 9.5		
Delivery	Vaginal	45.7 $\pm$ 9.9		0.419
	Cesarean	48.2 $\pm$ 12.4		
Pre-pregnancy BMI	Normal weight	46.2 $\pm$ 11.1		0.082
	Overweight/Obese	56.0 $\pm$ 10.9		
Postpartum BMI	Normal weight	44.8 $\pm$ 13.4		0.652
	Overweight/Obese	48.0 $\pm$ 10.5		
BMI gain	Lower	47.8 $\pm$ 11.6		0.434
	Higher	46.4 $\pm$ 11.3		
Hemorrhage	No	47.4 $\pm$ 11.4		0.516
	Yes	43.6 $\pm$ 11.4		
Rooming-in	Yes	47.3 $\pm$ 10.3		0.779
	No	46.5 $\pm$ 14.9		

Variable	Category	Mean $\pm$ SD	Median (IQR)	p-value
Complications	No	47.8 $\pm$ 10.9		0.560
	Yes	46.1 $\pm$ 12.2		

These three near-significant variables ($p < 0.1$) plus maternal age (clinically relevant) were included in a multivariate linear regression model (Table 5). Pre-pregnancy overweight/obesity ($B = 9.97$; 95% CI: 2.46, 17.48; $p = 0.010$) and multigravida ($B = 4.65$; 95% CI: 0.17, 9.13; $p = 0.042$) were independent positive predictors of self-efficacy (model $R^2 = 0.146$). Sensitivity analysis with HC3 robust standard errors confirmed consistency (pre-pregnancy BMI: $p = 0.023$; gravidity: $p = 0.050$). Model diagnostics indicated adequate fit: VIF < 1.5 (no multicollinearity), Durbin-Watson = 1.95 (no autocorrelation), and Cook's distances 5 (no influential outliers).

Table 5
Multivariate linear regression analysis of factors associated with breastfeeding self-efficacy scores

Variable	B	95% CI	β	p-value
OLS estimates				
(Intercept)	46.23	41.97 ~ 50.48	-	< 0.001
Multigravida (vs. Primigravida)	4.65	0.17 ~ 9.13	0.205	0.042
Gest. age ≥ 40 w (vs. <40 w)	-4.68	-9.72 ~ 0.35	-0.183	0.068
Pre-preg BMI Overweight (vs. Normal)	9.97	2.46 ~ 17.48	0.260	0.010
Age ≥ 30 (vs. <30)	-2.19	-6.72 ~ 2.34	-0.096	0.339
Robust SE (HC3) estimates				
(Intercept)	46.23	41.90 ~ 50.55	-	< 0.001
Multigravida (vs. Primigravida)	4.65	0.06 ~ 9.24	0.205	0.050
Gest. age ≥ 40 w (vs. <40 w)	-4.68	-9.31 ~ -0.06	-0.183	0.050
Pre-preg BMI Overweight (vs. Normal)	9.97	1.50 ~ 18.44	0.260	0.023
Age ≥ 30 (vs. <30)	-2.19	-6.70 ~ 2.32	-0.096	0.344
$R^2 = 0.146$, Adjusted $R^2 = 0.107$, $F(4,88) = 3.75$, $p = 0.007$				

Longitudinal Prediction of EBF by Self-Efficacy

Baseline breastfeeding self-efficacy scores (measured within 1 week postpartum) were significantly higher among mothers who achieved EBF at 1, 3, and 6 months postpartum compared to those who did

not, at each corresponding time point: 1 month (50.7 ± 10.2 vs. 44.4 ± 11.6 ; $p = 0.005$), 3 months (50.4 ± 10.0 vs. 44.4 ± 11.8 ; $p = 0.007$), and 6 months (51.6 ± 10.4 vs. 45.1 ± 11.3 ; $p = 0.013$) (Fig. 3).

Time-specific logistic regression analysis showed that for each 1-point increase in baseline self-efficacy score, the OR for subsequent EBF ranged from 1.05 to 1.06 (all $p < 0.05$). This association was further confirmed by a GEE longitudinal model (Table 6). In the crude model, each 1-point increase in self-efficacy was associated with a 5.6% higher odds of EBF (OR 1.056; 95%CI 1.017,1.096). After adjusting for maternal age and gravidity, the predictive effect of self-efficacy was enhanced (OR 1.063; 95%CI 1.024, 1.104). The model also revealed a significant time effect: EBF rates at 6 months were significantly lower than those at 1 month (OR 0.563; $p = 0.014$), while no significant difference was observed between 3 months and 1 month ($p = 0.617$).

Table 6
GEE analysis of breastfeeding self-efficacy predicting exclusive breastfeeding (1, 3, and 6 months postpartum)

Variable	OR	95% CI	p-value
Crude model			
Self-efficacy (per 1-point increase)	1.056	1.017 ~ 1.096	0.004
Time: 3 months (vs. 1 month)	1.099	0.758 ~ 1.594	0.617
Time: 6 months (vs. 1 month)	0.577	0.371 ~ 0.897	0.015
Adjusted model			
Self-efficacy (per 1-point increase)	1.063	1.024 ~ 1.104	0.001
Time: 3 months (vs. 1 month)	1.104	0.749 ~ 1.629	0.617
Time: 6 months (vs. 1 month)	0.563	0.356 ~ 0.892	0.014
Age ≥ 30 (vs. <30)	0.570	0.264 ~ 1.233	0.153
Multigravida (vs. Primigravida)	0.531	0.250 ~ 1.129	0.100
<i>GEE with exchangeable correlation structure; Adjusted model controls for age and gravidity.</i>			

Logistic regression prediction curves (Fig. 4) illustrate the predicted probability of EBF as a function of baseline self-efficacy scores at each follow-up time point. Additionally, ROC curve analysis demonstrated that baseline self-efficacy scores had moderate predictive value for EBF (AUC 0.66,0.67). The Youden index identified optimal cutoff values for self-efficacy scores ranging from approximately 43 to 50.

Effect of Breastfeeding Knowledge on EBF

Baseline breastfeeding knowledge scores (measured within 1 week postpartum) were higher among mothers who achieved EBF at 1, 3, and 6 months postpartum compared to those in the non-EBF group, though the differences were not statistically significant: 1 month (89.0 ± 12.5 vs. 84.6 ± 9.0 ; $p = 0.055$), 3

months (87.9 ± 11.4 vs. 85.4 ± 10.2 ; $p = 0.271$), and 6 months (88.3 ± 10.5 vs. 85.7 ± 10.9 ; $p = 0.162$) (see Supplementary file: Figure S6).

Time-specific logistic regression analyses showed that for each 1-point increase in baseline knowledge score, the OR for subsequent EBF was 1.040 (95% CI 0.998, 1.085; $p = 0.062$) at 1 month, 1.022 (95%CI 0.983, 1.062; $p = 0.277$) at 3 months, and 1.023 (95% CI 0.983, 1.064; $p = 0.272$) at 6 months.

A GEE longitudinal model revealed a near-significant association between baseline knowledge scores and EBF in the crude model (OR 1.027; 95%CI 0.997, 1.058; $p = 0.082$). After adjusting for maternal age and parity, each 1-point increase in baseline knowledge score was significantly associated with a 3.2% higher odds of EBF (OR 1.032; 95% CI 1.002, 1.064; $p = 0.039$). When standardized, each 1 standard deviation (SD) increase in baseline knowledge score was associated with an OR of 1.407 (95% CI 1.017, 1.947; $p = 0.039$) for EBF (see Supplementary file : Table S2).

When baseline knowledge and baseline self-efficacy scores were simultaneously included in a standardized joint GEE model, the association between knowledge and EBF was no longer significant (OR 1.166; 95% CI 0.807, 1.683; $p = 0.414$), whereas the association between self-efficacy and EBF remained statistically significant (OR 1.902; 95%CI 1.204, 3.005; $p = 0.006$) (see Supplementary file: Figure S7). These findings indicate that breastfeeding self-efficacy has a more direct and stable association with EBF outcomes compared to breastfeeding knowledge.

Discussion

This prospective longitudinal cohort study provides compelling evidence for the critical role of breastfeeding self-efficacy in sustaining EBF during the first 6 months postpartum. By employing rigorous non-parametric statistical methods and GEE longitudinal models that account for the repeated-measure nature of EBF outcomes across 1, 3, and 6 months, this study confirms the robustness of breastfeeding self-efficacy as an independent predictor of EBF persistence.

The results of this study showed that the 6-month postpartum EBF rate was 31.2%, which is consistent with the national average in China but significantly lower than the target recommended by the WHO [31,32]. Notably, the EBF rate at 3 months (45.2%) was slightly higher than that at 1 month (43.0%), which may be attributed to the gradual establishment of EBF among some parturients following an initial postpartum adaptation period. However, a significant decline in EBF rates was observed by 6 months postpartum, highlighting the critical need for continuous breastfeeding support during the middle to late postpartum period.

This study found a weak to moderate positive correlation between breastfeeding knowledge and self-efficacy via Spearman's rank correlation analysis, which is consistent with previous research results [33–35]. However, knowledge factors only explained approximately 8.8% of the variance in self-efficacy, indicating that knowledge is not a decisive factor in improving breastfeeding self-efficacy to promote EBF. This result is consistent with Bandura's self-efficacy theory [36]: although knowledge provides a

necessary foundation for behavior change, it is not the main source of self-efficacy. In previous clinical practice, traditional breastfeeding interventions have focused on knowledge education, emphasizing information transmission and cognitive change[37]. However, the results of this study suggest that relying solely on knowledge popularization has a very limited effect on improving breastfeeding self-efficacy, with more than 90% of the variance determined by other factors. According to the four sources of self-efficacy theory, direct breastfeeding experience, vicarious experience (observing others' successful breastfeeding), verbal persuasion and social support, and physical and mental state (e.g., postpartum anxiety, fatigue) play a far more important role in shaping self-efficacy than knowledge itself[12].

Multiple linear regression identified two independent predictors of breastfeeding self-efficacy: pre-pregnancy BMI and parity. Consistent with Amy M. Moore. [38], who reported higher pre-pregnancy BMI correlates with increased breastfeeding persistence, our study found overweight/obese women had significantly higher self-efficacy scores. Additionally, multiparous parturients showed higher breastfeeding self-efficacy than primiparas. This may stem from physiological mechanisms: compared with primiparity, multiparity (even without live birth) repeatedly activates and reshapes the maternal hypothalamic-pituitary-mammary axis, upregulates prolactin/oxytocin receptor expression, and sensitizes the oxytocin system. Concurrently, multiparity reduces cortisol response and alleviates postpartum anxiety. Notably, pregnancy-related hormonal and neuroendocrine remodeling may physiologically enhance breastfeeding confidence (even without prior childbirth/breastfeeding experience), thereby improving self-efficacy[39–41]. Sensitivity analysis with HC3 robust standard errors confirmed result consistency, enhancing findings' reliability and robustness.

Longitudinal results showed that breastfeeding self-efficacy was significantly higher in the EBF group than the non-EBF group at all follow-up time points (1, 3, and 6 months postpartum). A 1-point increase in self-efficacy was associated with a 5%–6% higher likelihood of sustained EBF, confirming self-efficacy as an independent protective factor with predictive value for EBF. ROC analysis further indicated moderate predictive value of self-efficacy for EBF, suggesting higher breastfeeding confidence significantly reduces the risk of early breastfeeding cessation. Parturients with high self-efficacy are more likely to maintain confidence and respond positively to breastfeeding challenges, thereby prolonging breastfeeding duration, whereas those with low self-efficacy tend to discontinue breastfeeding early due to frustration.

This study further demonstrated that breastfeeding knowledge has modest predictive value for EBF. In longitudinal analyses adjusting for maternal age and parity, with baseline breastfeeding knowledge and self-efficacy scores (measured within 1 week postpartum) as predictors, a higher knowledge score was associated with increased EBF probability, but its effect size was smaller than that of self-efficacy. A subsequent joint model analysis showed the association of knowledge with EBF was no longer significant, whereas self-efficacy remained statistically significant. These findings suggest that while knowledge-based education is beneficial, breastfeeding sustainability depends more on maternal

confidence and competence; thus, enhancing breastfeeding self-efficacy among parturients may be more critical.

Thus, from the perspective of breastfeeding self-efficacy theory, future breastfeeding support models should shift from a knowledge-centered to an efficacy-centered approach. Strengthening multi-dimensional interventions including practical skills training, peer sharing of successful experiences, family-participatory support, and postpartum psychological counseling can more effectively enhance maternal breastfeeding self-efficacy, thereby extending exclusive breastfeeding (EBF) duration and improving breastfeeding outcomes.

However, this study has several limitations that should be acknowledged. First, the sample was recruited exclusively from a single tertiary hospital in China, which may limit the generalizability of the findings to other cultural or medical contexts. Second, the total sample size was 93, with relatively small subgroups (e.g., overweight/obese participants), which may compromise the stability of some estimates; the confidence intervals for AUC values in the supplementary ROC analyses are also wide. Third, like all observational studies, unmeasured confounding factors (e.g., family support level, partner attitude, workplace breastfeeding policies) may concurrently influence breastfeeding self-efficacy and feeding outcomes. Finally, self-efficacy was only assessed at baseline, failing to capture its dynamic changes over the study period.

Conclusions

Using rigorous nonparametric tests and longitudinal analyses, this study investigated predictors of EBF within 6 months postpartum. Core findings confirm breastfeeding self-efficacy as a key EBF predictor, with its persistent predictive effect validated by the GEE model. Pre-pregnancy BMI and parity are independent predictors of breastfeeding self-efficacy. While breastfeeding knowledge has modest auxiliary predictive value for EBF, its effect is weaker than self-efficacy in concurrent analyses. ROC analysis in the Supplementary Materials provides an initial clinical screening threshold for self-efficacy (43–50 points). Collectively, these findings support risk stratification and personalized breastfeeding care in clinical practice.

Abbreviations

AUC Area Under The Curve

BMI Body Mass Index

BKQ Breastfeeding Knowledge Questionnaire

BSES-SF Breastfeeding Self-Efficacy Scale-Short Form

EBF Exclusive Breastfeeding

GEE Generalized Estimating Equation

ROC Receiver Operating Characteristic

SD Standard Deviation

WHO World Health Organization

Declarations

Author information

Jiayao Li and Qiuyue Liu contributed equally to this work and should be regarded as co-first authors.

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Ethics approval and consent to participate

The study protocol complies with the Declaration of Helsinki and was approved by the Ethics Committee of Chongqing General Hospital (KY S2024-071-01). Informed consent was obtained from all participants.

Consent for publication

Not applicable.

Conflicts of interest

All authors are without conflicts of interest, including specific financial interests, relationships, and affiliations relevant to the subject of their manuscript.

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Author Contribution

Jiayao Li and Qiuyue Liu: Data analysis and interpretation, Writing - original draft. Zhen Zhang and Xingyao Xiao: Data collection and data sorting. Tingting Dai, Cheng Chen and Xiaoyan Liu served as co-corresponding authors, overseeing project supervision, funding acquisition, and manuscript guidance. All authors approved the final manuscript.

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Data Availability

The data and materials supporting the findings in this study are available from the corresponding author upon request.

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Figures

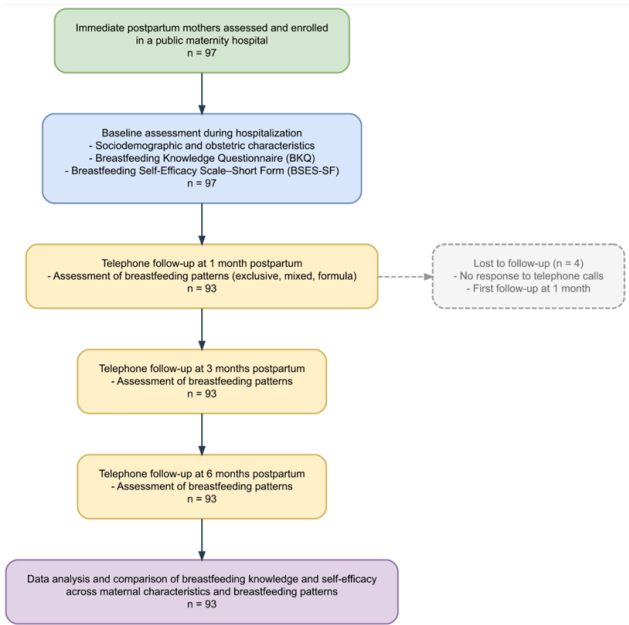


Figure 1

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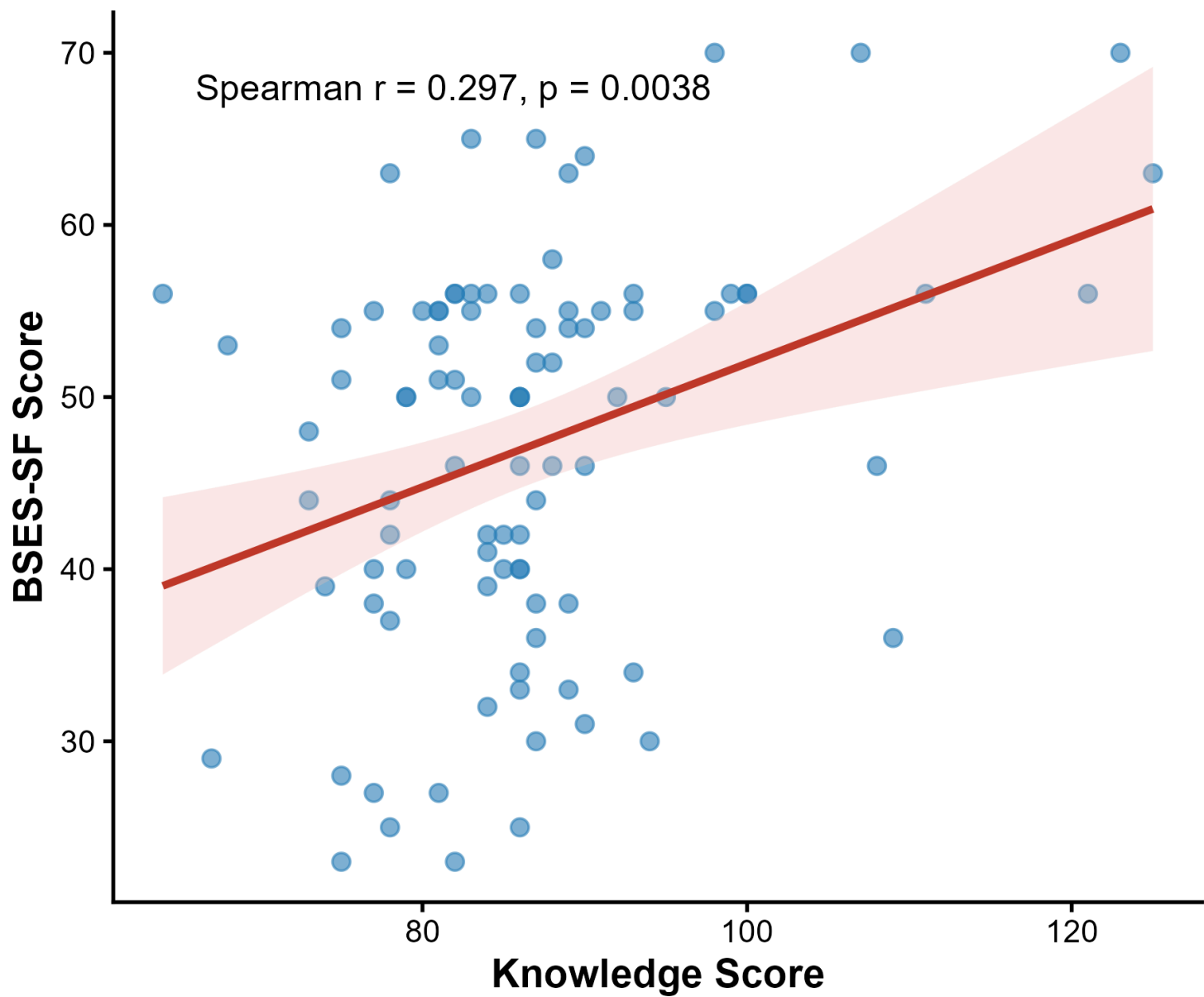


Figure 2

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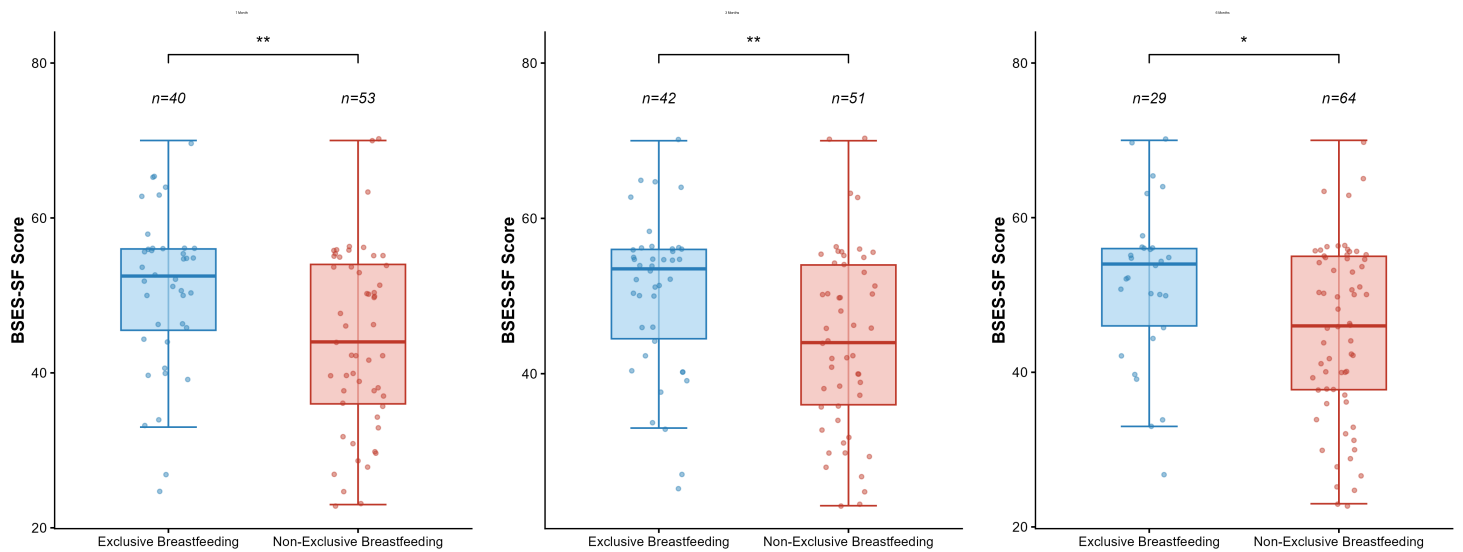


Figure 3

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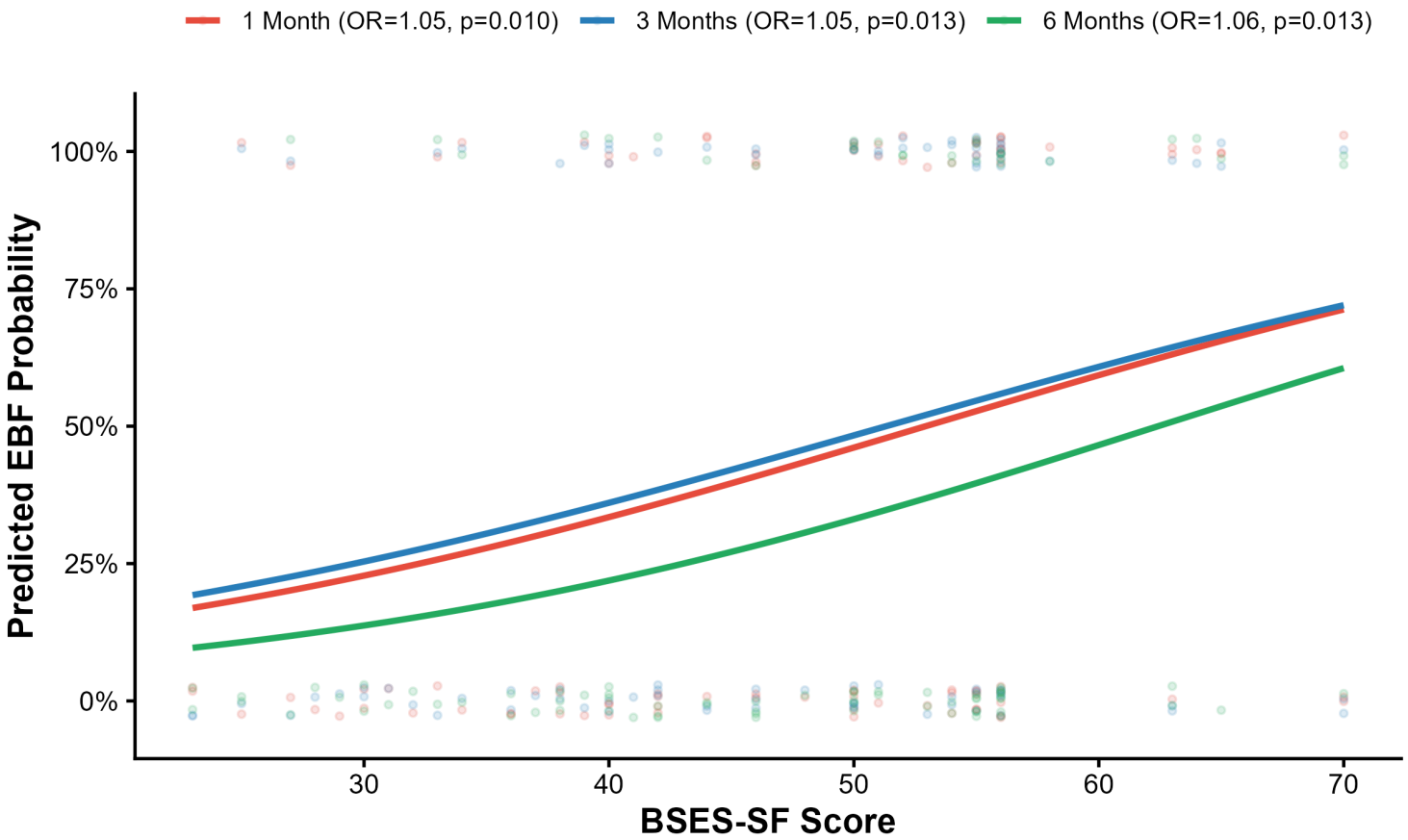


Figure 4

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