Using the theory of planned behavior model to predict factors influencing breastfeeding behavior among preterm mothers at week 6 postpartum: the mediating effect of breastfeeding intention

Rong Huang[1], Hui Han[2], Lijing Ding[2], Yi Zhou[1], Yanwen Hou[1], Xiao Yao[1], Chenting Cai[1], Xiaohan Li[2], Jianqi Song[2], Shuying Zhang[2]* and Hui Jiang[1]*

[1]Shanghai First Maternity and Infant Hospital, School of Medicine, Tongji University, Shanghai, China,
[2]School of Medicine, Tongji University, Shanghai, China

Background: Exclusive breastfeeding (EBF) in the first 6 weeks postpartum is key to continued breastfeeding. This study aimed to explore the role of EBF-related predictors (particularly breastfeeding intention) in breastfeeding behavior among preterm mothers at week 6 postpartum based on the theory of planned behavior (TPB).

Methods: A total of 352 mothers of preterm infants were recruited, 340 of whom participated in this study. Prior to discharge, participants completed the Chinese versions of the modified Breastfeeding Attrition Predictive Tool, the Breastfeeding Knowledge Questionnaire (BKQ), the Infant Feeding Intention, and the Edinburgh Postnatal Depression Scale. Responses to the items of the Breastfeeding Behavioral Questionnaire (BBQ) were also collected by telephone at week 6 postpartum. The final analyses included 321 participants who completed the full two-wave data collection.

Results: The fitness indices of the modified TPB model were acceptable. Breastfeeding knowledge and EBF before discharge positively impacted breastfeeding intention, whereas depression had a negative impact. Before discharge, breastfeeding intention fully mediated the impacts of breastfeeding attitude, social and professional support, knowledge, depression, and EBF on breastfeeding behavior and partially mediated the influence of perceived breastfeeding control on breastfeeding behavior.

Conclusion: These findings indicate that TPB accurately predicts breastfeeding behavior among preterm mothers at week 6 postpartum, and breastfeeding intention is key to the above-mentioned EBF-related factors and breastfeeding behavior. The findings underline the need for further longitudinal studies and corresponding interventions for preterm mothers with a high risk of EBF attrition.

KEYWORDS

breastfeeding behavior, intention, mediating effect, preterm, theory of planned behavior

Introduction

Breastfeeding plays a significant role in reducing morbidity and mortality (Cleminson et al., 2016) and promoting long-term health for preterm infants (gestational age < 37 weeks; Størdal et al., 2017). Individuals who were not exclusively breastfed as infants have higher rates of health problems as they age, including respiratory infections, allergies, digestive problems, malnutrition, diabetes, obesity (Victora et al., 2016), and childhood and adolescent cancers (Rafizadeh et al., 2019). Breastfeeding has also been associated with the intelligence and academic performance of children (Belfort et al., 2016). The World Health Organization (WHO) recommends exclusive breastfeeding (EBF) for all infants (including preterm infants) because of the significant health benefits to mother–infant dyads (World Health Organization, 2002; Britton et al., 2006). According to WHO, EBF refers to "giving no other food or drink—not even water—except breast milk. It, however, allows the infant to receive oral rehydration salts (ORS), drops, and syrups (vitamins, minerals, and medicines)" (World Health Organization, 2017). However, the rate of EBF in China is currently unsatisfactory, especially in the neonatal intensive care unit (NICU) setting, where fewer than 15% of mothers practice EBF (Shi and Zhang, 2015). Research also found that breastfeeding attrition occurs in 32 to 58% of breastfeeding mothers within the first 6 weeks (Janke, 1992), indicating that EBF in the first 6 weeks postpartum is key to breastfeeding continuation.

Multiple factors contribute to breastfeeding as a social behavior (Guo et al., 2016). Clarifying the factors associated with EBF in mothers of preterm infants is critical to helping educate women on the importance of EBF (World Health Organization, 2002). Factors related to breastfeeding can be generally categorized into demographics (such as age, education, and parity) and psychosocial characteristics of preterm mothers (including previous breastfeeding experience, mother–infant separation, breastfeeding intention, maternal leave time, breastfeeding attitude, breastfeeding self-efficacy, breastfeeding knowledge and skill, family and social support, nipple problems, insufficient milk, EBF before discharge, and depression [per the Edinburgh Postnatal Depression Scale score]; Blyth et al., 2004; Quan and Yang, 2005; Wilhelm et al., 2008; Gilmour et al., 2009; Whalen and Cramton, 2010; Demirci et al., 2013; Manno et al., 2015; Wang et al., 2019). Characteristics of preterm infants also contribute to breastfeeding success and include factors such as gestational age, birth weight, dysphagia, insufficient oral sucking power, and time to start sucking breast milk after delivery (Lou et al., 2014; Sonko and Worku, 2015; Tao et al., 2016; Geddes et al., 2018; Wang et al., 2019). Encouragingly, some of these factors can be improved through intervention (Fishbein and Ajzen, 2010; Insaf et al., 2011; Saffari et al., 2016; Thomas-Jackson et al., 2016; Araban et al., 2018; Suárez-Cotelo et al., 2019), including mothers' breastfeeding intention, attitude, subjective norms, knowledge, depression, perceived level of control over breastfeeding (i.e., perceived behavioral control), and EBF before discharge (Fishbein and Ajzen, 2010; Insaf et al., 2011; Saffari et al., 2016; Thomas-Jackson et al., 2016; Araban et al., 2018; Suárez-Cotelo et al., 2019).

Breastfeeding intention, attitude, perceived behavioral control, and subjective norm are all considered key factors of breastfeeding initiation and duration (Janke, 1992; Bai et al., 2010; Tengku Ismail et al., 2016). Furthermore, interventional studies suggest that breastfeeding knowledge, depression, and EBF before discharge

influence breastfeeding intention (Insaf et al., 2011; Thomas-Jackson et al., 2016; Suárez-Cotelo et al., 2019), although the relationships between each of these factors remain unclear, particularly those surrounding normative beliefs (Göksen, 2002; Kloeblen-Tarver et al., 2002) and perceived behavioral control (Avery et al., 1998; Bai et al., 2010). Therefore, identifying the factors that are significantly associated with breastfeeding intention and behavior and analyzing the interactions between these factors are essential to the development of a tailored breastfeeding promotion intervention for preterm mothers.

Promoting breastfeeding can be strengthened by incorporating health-based behavior theories including the theory of reasoned action (TRA; Ajzen and Madden, 1986), the theory of planned behavior (TPB), and the knowledge, attitude, and practice (KAP) model (Gebeyehu et al., 2023). Although the TRA does not account for personal control factors in the decisions of pregnant women about breastfeeding, a modified version, the TPB (Fishbein and Ajzen, 2010), includes perceived behavioral control (PBC). This addition significantly improved the explanatory and predictive power of behavior (Wang and Jiang, 2021) compared with the KAP. The TPB also considers the effects of social, attitudinal, and behavioral determinants (Esquerra-Zwiers et al., 2022) and is an ideal theoretical framework to understand human behavior (Ajzen, 1991). Briefly, the TPB framework suggests that the intention to perform a behavior is linked to the actual behavioral performance. This framework has been widely used to better understand parent behaviors, including breastfeeding in full-term infants (Khoury et al., 2005; McMillan et al., 2009; Guo et al., 2016). Indeed, a recent study reported that PBC explains 65% of the EBF intention of mothers and predicts 79% of the variance in EBF (Bajoulvand et al., 2019). A previous study explored the factors related to EBF attrition of preterm mothers at week 6 postpartum through binary logistic regression analysis (Huang et al., 2023) and found that breastfeeding attitude, social and professional support, perceived control, and knowledge were associated with breastfeeding attrition. Thus, the purpose of this study was to explore the role of EBF-related predictors (particularly breastfeeding intention) in breastfeeding behavior among preterm mothers at week 6 postpartum based on the TPB. The Infant Feeding Intention Scale (Nommsen-Rivers and Dewey, 2009) and the Breastfeeding Behavioral Questionnaire (Alami et al., 2014; Bajoulvand et al., 2019) were used to assess breastfeeding intention and behavior. Structural equation modeling (SEM) was used to examine the following hypotheses (Figure 1A) via exploration of the paths between the factors (namely breastfeeding attitude, subjective norms, perceived behavioral control, intention, knowledge, EBF before discharge, and depression) related to breastfeeding behavior at week 6 postpartum among mothers of preterm infants.

H1: Breastfeeding attitude, social and professional support (subjective norms), perceived breastfeeding control, social demographics, breastfeeding-related knowledge, EBF before discharge, and depression are directly associated with breastfeeding intention among preterm mothers.

H2: Breastfeeding intention (and its antecedents) is directly associated with breastfeeding behavior among preterm mothers.
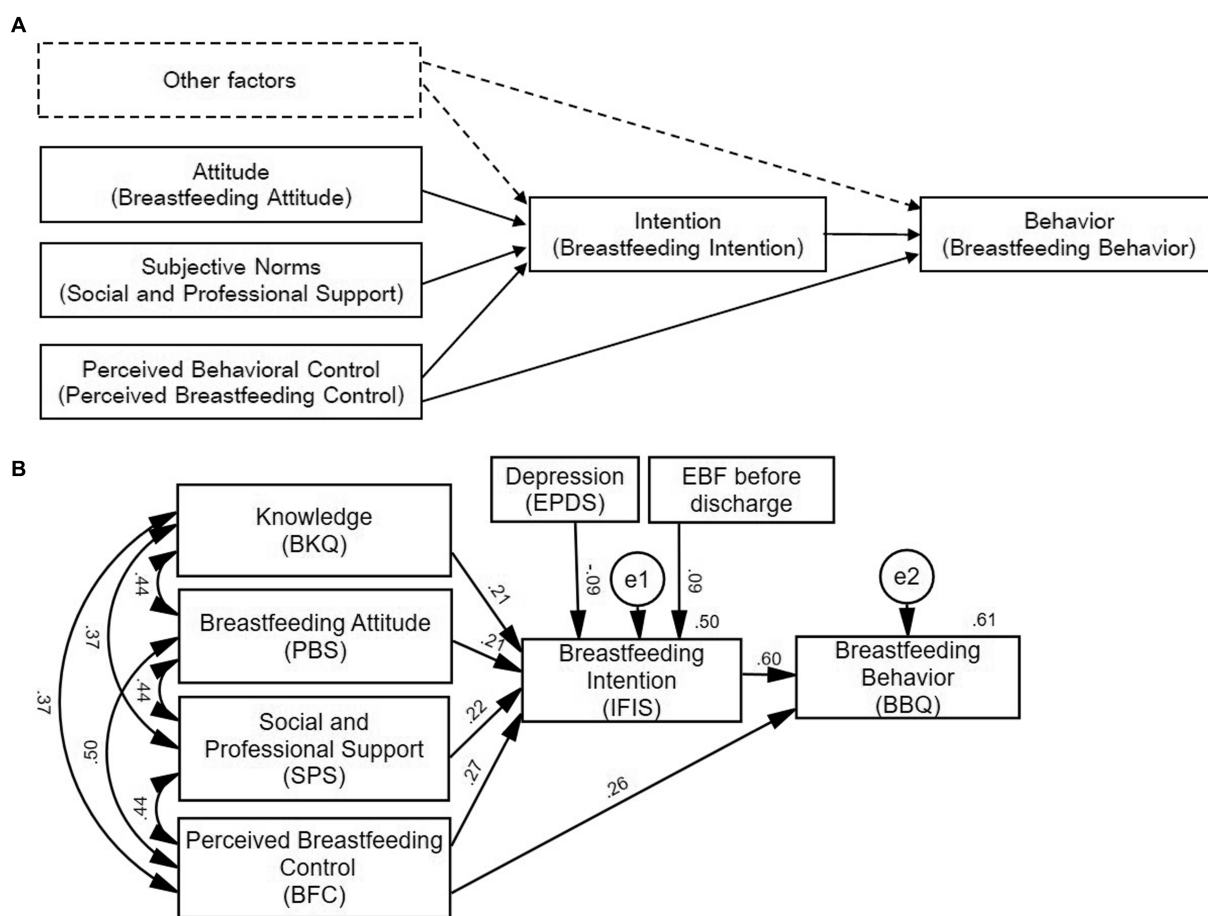
FIGURE 1
(A) Hypothesized model of breastfeeding behavior of preterm mothers based on the theory of planned behavior. The variables in the solid box represent the application of the framework of the theory of planned behavior in this study, while the variables in the dashed box represent the new variables introduced in this study. Other factors include the socio-demographics of the dyads and the preterm mothers' knowledge, EBF before discharge, and depression. **(B)** Modified model of breastfeeding behavior of preterm mothers based on the theory of planned behavior. PBS, SPS, and BFC were the total scores of three subscales of the Chinese version of the Modified Breastfeeding Attrition Predictive Tool (Positive Breastfeeding Sentiment Attitudinal Scale, Social and Professional Support Scale, and Breastfeeding Control Scale, respectively); and BKQ, IFIS, BBQ, and EPDS were the total scores of the Chinese versions of the Breastfeeding Knowledge Questionnaire, the Infant Feeding Intention Scale, the Breastfeeding Behavioral Questionnaire, and the Edinburgh Postnatal Depression Scale, respectively.

H3: Breastfeeding intention mediates the association between seven antecedents of intention and breastfeeding behavior among preterm mothers.

Methods

Study design, setting, and ethical approval

A prospective observational study was designed and conducted from October 2021 to July 2022 in the obstetric wards of Shanghai First Maternity and Infant Hospital in Shanghai, China. This tertiary specialized hospital houses 400 obstetric beds, 14 labor beds, and 110 beds for the neonatal ward; its annual delivery volume is approximately 25,000–30,000 infants. Preterm infants whose gestational age is <36 weeks are routinely admitted to the NICU. Furthermore, those

who are born between 36 weeks and 37 weeks of gestational age are routinely admitted to the NICU for a 6-h observation and returned to their mothers in the obstetric ward if no special condition is detected during their NICU stay. Following vital sign stabilization, fresh breast milk is the preferred choice of enteral nutrition during the stay of a premature infant in the NICU, followed by breast milk refrigerated for less than 24 h. Family members may apply for donated milk due to special conditions of preterm mothers, such as illness, medication-induced prohibition of breastfeeding, lack of milk in the first 3 days, or if their preterm infant has a gestational age ≤34 weeks and/or weight <1,800 g. If the mother has no or insufficient milk, she can also choose preterm infant formula. For preterm infants with clinical gestational age ≤34 weeks, weight <1,800 g, or high-risk factors for malnutrition, human milk fortifiers can be added to breast milk or donated milk to meet nutritional needs. The study was approved by the Ethics Committee of Shanghai First Maternity and Infant Hospital (approval number KS21355).

Sampling

A convenience sampling strategy was used, and eligible participants were recruited from the obstetric ward of the designated hospital. Inclusion criteria of the mothers were (1) aged >20 years old, (2) gestational age ≥28 weeks and <37 weeks, (3) singleton pregnancy, and (4) provided informed consent. Mothers were excluded from the study if they (1) took drugs that may affect breast milk secretion during pregnancy and postpartum, (2) had a diagnosed intellectual disability or endocrine system disease, (3) had at least one type of communication disorder, (4) had a preterm infant with congenital malformations, or (5) had a preterm infant that could not be breastfed due to disease or other reasons.

While various recommendations exist for determining sample size in SEM studies (Gefen et al., 2000; Boomsma and Hoogland, 2001; Hoe, 2008; Iacobucci, 2010), we determined 24 free parameters in this study and a minimum sample size of 120 mother–infant dyads. After taking the probability of outlier data into account, 6 times the number of free parameters was estimated (144 samples) for a calculated sample size of 216. Considering a probable data loss of 30%, we determined the final sample size should match or exceed 281 participants.

Data collection

The researchers (XY, LJD, CTC, and JQS) introduced the purpose of the study to eligible mothers prior to discharge. Interested mothers then provided their contact details to the researchers, and written informed consent was obtained from each participant prior to data collection. Participants completed an initial set of questionnaires, and at week 6 postpartum, researchers followed up with participants to gauge their responses to the Breastfeeding Behavioral Questionnaire.

Measurements

Demographic information of the participants and their preterm infants included (a) maternal information (age at delivery, education level, monthly income, gestational age, gravidity, parity, type of delivery, postpartum depression, EBF before discharge, nipple depression, and history of breastfeeding) and (b) demographic information of preterm infants (sex, birth weight, and time to start suckling breast milk after delivery).

Five surveys were used in the current study following methods previously reported: the Chinese version of the Modified Breastfeeding Attrition Predictive Tool (modified BAPT; Janke, 1994; Dick et al., 2002; Cai et al., 2023), the Breastfeeding Knowledge Questionnaire (BKQ; Ouyang et al., 2012, 2016), the Edinburgh Postnatal Depression Scale (EPDS; Cox et al., 1987; Gibson et al., 2009; Lee et al., 2019; Liu et al., 2020), the Infant Feeding Intention Scale (IFIS; Nommsen-Rivers and Dewey, 2009), and the Breastfeeding Behavioral Questionnaire (BBQ; Alami et al., 2014; Bajoulvand et al., 2019).

Three subscales using 5-point Likert scales from the Chinese version of the modified Breastfeeding Attrition Predictive Tool (BAPT) were utilized—the Positive Breastfeeding Sentiment Attitudinal Scale (PBS, 12 items), the Social and Professional Support Scale (SPS, 11 items), and the Breastfeeding Control Scale (BFC, 10 items)—to measure breastfeeding attitude (ATT), social and

professional support (SPS), and perceived breastfeeding control (PBC), respectively. Cronbach's α coefficients of the PBS, SPS, and BFC scales were 0.878, 0.931, and 0.921, respectively (Cai et al., 2023), and the reliabilities of a 2-week retest were 0.765, 0.778, and 0.530, respectively (Cai et al., 2023). The item-level content validity index (CVI) was 0.80–1.00 (Cai et al., 2023).

The Chinese version of the BKQ (Ouyang et al., 2012, 2016) includes 18 questions evaluating knowledge and awareness of the benefits of breastfeeding and the management of common lactation issues. Cronbach's α was 0.82, and the CVI was 0.87 (Ouyang et al., 2012).

The EPDS (Cox et al., 1987) includes 10 items using 4-point response options to capture symptoms of depression. Cronbach's α for the Chinese version of EPDS was 0.862 (Liu et al., 2020), and the CVI was 0.93 (Lee et al., 2019). A cutoff score of ≥13 was used in this study to indicate major or probable depression (Gibson et al., 2009).

The IFIS (Nommsen-Rivers and Dewey, 2009) quantitatively measures maternal breastfeeding intentions. The scale includes five items using 5-point response options ranging from 0 to 4, although only three of these items relevant to the purpose of the study were used: "I am planning to only formula feed my baby (I will not breastfeed at all)." "I am planning to at least give breastfeeding a try." "When my baby is 6 weeks postpartum, I will be breastfeeding without using any formula or other milk." Cronbach's α for the IFI was 0.90, and the CVI of items 1 to 3 was 0.70, 0.76, and 0.67, respectively (Nommsen-Rivers and Dewey, 2009).

Finally, the BBQ (Alami et al., 2014) utilizes TPB to evaluate actual breastfeeding behavior. The questionnaire consists of four items, each of which has a score ranging from 1 to 5 points. The total score ranges from 5 to 20, with higher scores indicating more stable exclusive breastfeeding behavior. Cronbach's α for the BBQ was 0.79, the intra-group correlation coefficient (ICC) was 0.81, and the CVI was 0.65 to 0.99 (Bajoulvand et al., 2019).

Statistical analysis

SPSS statistics version 21.0 software (Statistics 21, SPSS, IBM, United States) was used for the preliminary analysis. The relationships between mean scores of breastfeeding intention and behavior with dichotomous and polychotomous demographic variables were tested by the independent-sample t-test and variance analysis, respectively, and Cohen's d and η_p^2 were used for effect size estimates, respectively (Cohen, 1988). The relationship between continuous variables of breastfeeding behavior and PBC, ATT, SPS, knowledge, and intention were tested using Pearson correlation analyses, and the r-value was used for effect size estimate (Cohen, 1988).

The study was based on the basic framework of the TPB and included additional factors such as socio-demographics of the dyads, preterm mothers' breastfeeding knowledge, depression, and EBF before discharge (Quan and Yang, 2005; Zhang, 2014; Suárez-Cotelo et al., 2019) for the development of the hypothesized model. SEM using maximum-likelihood estimations was performed through AMOS 26.0 (IBM SPSS Amos 26 Graphics) to examine this model, and the fitness indices were confirmed using the χ^2/df, the root mean square error of approximation (RMSEA), the goodness-of-fit index (GFI), the adjusted goodness-of-fit index (AGFI), the Tucker–Lewis coefficient (TLI), the comparative fit index (CFI), the relative fit index (RFI), the normed fit

index (NFI), and the incremental fit index (IFI). Fit was considered acceptable if the following cutoffs were met: χ^2/df < 3.0; RMSEA <0.08; and TLI, CFI, RFI, NFI, and IFI > 0.90 (Hu and Bentler, 1999; Byrne, 2010; Jansen et al., 2016; Hwang and Sim, 2021). The mediating effect of breastfeeding intention was evaluated using 2000 bootstrapping samples and 95% bias-corrected confidence intervals (CIs; Lei et al., 2022). When the CI excluded zero, the effect was considered significant. When the total effect of a variable was significant, if both the indirect and direct effects were significant, the variable had a partial mediating effect. Conversely, if the direct effect was not significant and the indirect effect was significant, the variable had a full mediating effect (Hayes and Scharkow, 2013). The significance level of all variables was set to $\alpha = 0.05$.

Results

Demographic characteristics and evaluations of breastfeeding intention and behavior

A total of 352 mothers of preterm infants were recruited, 340 of whom participated in this study and completed the questionnaires before discharge. A total of 321 participants completed the telephone survey with the Chinese version of the BBQ at week 6 postpartum; 19 participants withdrew from the study due to withdrawal of consent ($n = 5$) and loss of follow-up ($n = 14$; Figure 2).

Table 1 outlines the demographics, psychosocial characteristics, and evaluations (including EBF before discharge, nipple depression, and total score of EPDS) of the dyads ($n = 321$), as well as the
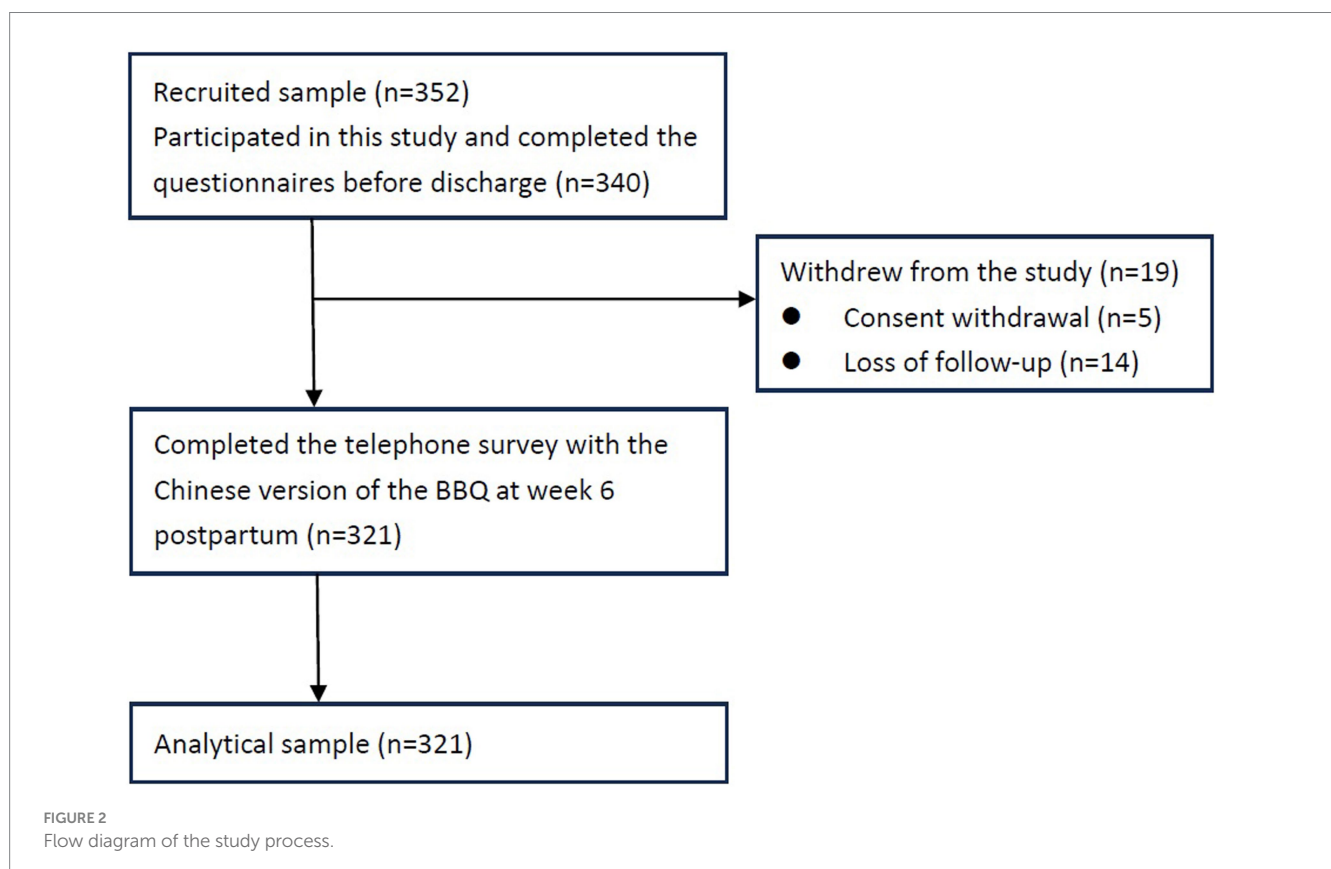
relationships between demographic and psychosocial data and evaluations with breastfeeding intention and behavior of the participants. The participants with higher EPDS scores (total score ≥ 13) were less likely to have breastfeeding intentions (Cohen's d: −1.009) and behavior (Cohen's d: −0.732) at week 6 postpartum ($p < 0.01$), with large and medium effects, respectively. The participants with EBF before discharge had higher breastfeeding intention (Cohen's d: 0.752) and behavior (Cohen's d: 0.715) at week 6 postpartum ($p < 0.01$; Table 1). No significant relationships between other socio-demographic factors were found with breastfeeding intention and behavior ($p > 0.05$).

Correlation analysis with PBC, ATT, SN, knowledge, breastfeeding intention, and behavior

Significant correlation coefficients ($p < 0.01$) were identified between variables of PBC, ATT, SPS, knowledge, breastfeeding intention, and behavior (Table 2), with large ($r > 0.5$) or medium effects ($0.3 \leq r < 0.5$). Thus, all structural variables of TPB were related and included in the model testing.

Model construction, examination, and adjustment

The hypothesized model was adjusted according to the modified index and the inconspicuous paths (the direct impact of other factors on breastfeeding behavior) were deleted ($p > 0.05$); the modified model

FIGURE 2
Flow diagram of the study process.

TABLE 1 Socio-demographics and the relationships between preterm infants and their mothers at week 6 postpartum with breastfeeding intention and behavior.

Characteristics	N (%; n = 321)	Breastfeeding intention score[a] ($\bar{x} \pm s$)	t/F	Cohen's d/η_p^2	Breastfeeding behavior score[b] ($\bar{x} \pm s$)	t/F	Cohen's d/η_p^2
Age at delivery (years)							
<35	246 (76.6)	6.193 ± 1.282	0.559	0.074	15.95 ± 2.686	1.153	0.152
≥35	75 (23.4)	6.100 ± 1.219			15.55 ± 2.575		
Education level							
Higher education	40(12.5)	5.775 ± 1.160	2.288	0.014	15.73 ± 2.418	0.057	0.000
Bachelor degree	210 (65.4)	6.239 ± 1.279			15.87 ± 2.703		
Master degree	71 (22.1)	6.197 ± 1.263			15.89 ± 2.702		
Monthly income (RMB)							
≤5000元	11 (3.4)	6.455 ± 1.214	0.398	0.004	15.82 ± 2.926	0.823	0.003
5,001–10000元	72 (22.4)	6.078 ± 1.261			15.83 ± 2.512		
10,001–15000元	76(23.7)	6.243 ± 1.210			16.11 ± 2.543		
>15000元	162 (50.5)	6.160 ± 1.304			15.75 ± 2.778		
Gestational age (weeks)							
28–31^{+6}	26 (8.1)	6.173 ± 1.216	0.006	0.001	16.31 ± 2.558	0.901	0.187
32–36^{+6}	295 (91.9)	6.172 ± 1.273			15.82 ± 2.671		
Gravidity							
1 time	161 (50.2)	6.153 ± 1.322	0.057	0.000	15.97 ± 2.656	0.420	0.003
2 times	77 (24.0)	6.169 ± 1.266			15.86 ± 2.822		
3 times or above	83 (25.8)	6.211 ± 1.166			15.64 ± 2.535		
Parity							
Primipara	241 (75.1)	6.158 ± 1.283	−0.333	−0.044	15.85 ± 2.645	−0.071	−0.011
Multipara	80 (24.9)	6.213 ± 1.222			15.88 ± 2.730		
Type of delivery							
Vaginal	85 (26.5)	6.341 ± 1.292	1.442	0.181	16.09 ± 2.869	0.959	0.117
Cesarean section	236 (73.5)	6.111 ± 1.254			15.77 ± 2.584		
Postpartum depression							
Yes (EPDS score ≥ 13)	301 (93.8)	6.103 ± 1.260	−5.231**	−1.009	15.74 ± 2.639	−3.064**	−0.732
No (EPDS score < 13)	20 (6.2)	7.200 ± 0.880			17.60 ± 2.437		
EBF before discharge							
Yes	45 (14.0)	6.933 ± 1.101	4.479**	0.752	17.42 ± 2.482	4.374**	0.715
No	276 (86.0)	6.047 ± 1.250			15.60 ± 2.606		
Nipple depression							
Yes	43 (13.4)	6.012 ± 1.193	−0.890	−0.149	16.12 ± 2.683	0.687	0.012
No	278 (86.6)	6.196 ± 1.278			15.82 ± 2.661		
History of breastfeeding							
Yes	75 (23.4)	6.227 ± 1.231	0.429	0.057	16.05 ± 2.726	0.730	0.093
No	246 (76.6)	6.155 ± 1.279			15.80 ± 2.645		
Preterm infant's sex							
Male	172 (53.6)	6.227 ± 1.287	0.846	0.095	15.97 ± 2.664	0.784	0.090
Female	149 (46.4)	6.107 ± 1.243			15.73 ± 2.663		
Preterm infant's birth weight							
<1,500 g	21 (6.5)	6.214 ± 1.251	0.159	0.036	16.43 ± 2.481	1.018	0.237
≥1,500 g	300 (93.5)	6.169 ± 1.269			15.82 ± 2.673		
Time to start sucking breast milk after delivery							
Within 2h postpartum	11 (3.4)	5.773 ± 1.232	1.255	0.014	14.45 ± 2.382	2.415	0.018
After 2h postpartum	83(25.9)	6.325 ± 1.170			16.17 ± 2.556		
Maternal–infant separation	227 (70.7)	6.135 ± 1.300			15.81 ± 2.698		

[a]Breastfeeding intention score is the total score of the Infant Feeding Intention Scale.
[b]Breastfeeding behavior score is the total score of the Breastfeeding Behavioral Questionnaire. * Means $p < 0.05$, and ** means $p < 0.01$.

TABLE 2 Correlation coefficients of the relationships between breastfeeding behavior and PBC, ATT, SPS, knowledge, and breastfeeding intention (*r*-values).

Variables	PBC[a]	ATT[b]	SPS[c]	Knowledge[d]	Intention[e]	Behavior[f]
PBC	1	--	--	--	--	--
ATT	0.498**	1	--	--	--	--
SPS	0.444**	0.437**	1	--	--	--
Knowledge	0.374**	0.441**	0.374**	1	--	--
Intention	0.562**	0.555**	0.533**	0.492**	1	--
Behavior	0.602**	0.506**	0.440**	0.440**	0.757**	1

[a]PBC score is the total score of the Breastfeeding Control Scale.
[b]ATT score is the total score of the Positive Breastfeeding Sentiment Attitudinal Scale.
[c]SPS score is the total score of the Social and Professional Support Scale.
[d]Knowledge score is the total score of the Breastfeeding Knowledge Questionnaire.
[e]Intention score is the total score of the Infant Feeding Intention Scale.
[f]Behavior score is the total score of the Breastfeeding Behavioral Questionnaire. **Means *p* < 0.01, and --represents duplicate data.

TABLE 3 Path coefficients of the modified model.

Path hypothesis	Standardized coefficient (ß)	SE	CR	*p*-value	Results
Intention[a] ➜ Behavior[b]	0.604	0.089	14.401	<0.01	Support
PBC[c] ➜ Behavior[b]	0.262	0.016	6.254	<0.01	Support
PBC[c] ➜ Intention[a]	0.269	0.008	5.564	<0.01	Support
ATT[d] ➜ Intention[a]	0.214	0.001	4.331	<0.01	Support
SPS[e] ➜ Intention[a]	0.222	0.001	4.738	<0.01	Support
Knowledge[f] ➜ Intention[a]	0.210	0.019	4.587	<0.01	Support
Depression[g] ➜ Intention[a]	−0.091	0.202	−2.296	0.022	Support
EBF before discharge ➜ Intention[a]	0.094	0.141	2.382	0.017	Support

[a]Intention score is the total score of the Infant Feeding Intention Scale.
[b]Behavior score is the total score of the Breastfeeding Behavioral Questionnaire.
[c]PBC score is the total score of the Breastfeeding Control Scale.
[d]ATT score is the total score of the Positive Breastfeeding Sentiment Attitudinal Scale.
[e]SPS score is the total score of the Social and Professional Support Scale.
[f]Knowledge score is the total score of the Breastfeeding Knowledge Questionnaire.
[g]Depression score is the total score of the Edinburgh Postnatal Depression Scale.

was obtained with a path coefficient $p < 0.05$ (Figure 1B). The predictive constructs of intention explained 50% of its variance and the constructs of intention and PBC predicted 61% of the variance of behavior. The results of fitness indices suggest an acceptable modified model (RMSEA = 0.076, χ^2/df = 2.851, GFI = 0.969, AGFI = 0.919, NFI = 0.954, RFI = 0.908, IFI = 0.969, TLI = 0.938, CFI = 0.969).

Table 3 shows the path coefficients of the modified model. Breastfeeding intention was positively influenced by PBC ($\beta = 0.262$, $p < 0.01$), ATT ($\beta = 0.214$, $p < 0.01$), SPS ($\beta = 0.222$, $p < 0.01$), knowledge ($\beta = 0.210$, $p < 0.01$), and EBF before discharge ($\beta = 0.094$, $p < 0.05$). However, depression negatively influenced breastfeeding intention ($\beta = -0.091$, $p < 0.05$), supporting *H1*.

The modified model showed that only PBC ($\beta = 0.262$, $p < 0.01$) and intention ($\beta = 0.604$, $p < 0.01$) directly positively impacted breastfeeding behavior, partially supporting *H2*.

Mediating effect analysis

Table 4 shows the standardized effects of the modified breastfeeding behavior model in total, direct, and indirect states. The indirect effect

value of PBC on breastfeeding behavior was 0.162 (95% CI 0.104, 0.227; $p < 0.01$), and the direct effect was 0.262 (95% CI 0.174, 0.351; $p < 0.01$), indicating that breastfeeding intention partially mediates PBC and breastfeeding behavior; the intermediary effect accounted for 38.1% (0.162/ 0.425) of the total effect. The indirect effect of ATT on breastfeeding behavior was 0.129 (95% CI 0.066, 0.201; $p < 0.01$), and the direct effect was insignificant ($p > 0.05$), indicating that breastfeeding intention fully mediates ATT and breastfeeding behavior. The indirect effect values of SPS, knowledge, depression, and EBF before discharge on breastfeeding behavior were 0.134 (95% CI: 0.076, 0.195), 0.127 (95% CI: 0.059, 0.192), −0.055 (95% CI −0.094, −0.019), and 0.057 (95% CI: 0.014, 0.104), respectively. The *value of p* of these relationships was <0.01, and breastfeeding intention fully mediated SPS, knowledge, depression, and EBF before discharge on breastfeeding behavior via breastfeeding intention, supporting *H3*.

Discussion

The hypotheses of this study were confirmed using model testing with acceptable fitness indices. These findings support a

TABLE 4 Bootstrap results of the mediating effects of breastfeeding intention.

Path relationships	Estimate	Bias-corrected 95% CI			Percentile 95% CI		
		Lower	Upper	P	Lower	Upper	P
Standardized indirect effect							
PBC[a] ➔ Intention[b] ➔ Behavior[c]	0.162	0.104	0.227	0.001	0.112	0.215	0.001
ATT[d] ➔ Intention[b] ➔ Behavior[c]	0.129	0.066	0.201	0.001	0.075	0.187	0.001
SPS[e] ➔ Intention[b] ➔ Behavior[c]	0.134	0.076	0.195	0.001	0.085	0.183	0.001
Knowledge[f] ➔ Intention[b] ➔ Behavior[c]	0.127	0.059	0.192	0.001	0.069	0.183	0.001
Depression[g] ➔ Intention[b] ➔ Behavior[c]	−0.055	−0.094	−0.019	0.003	−0.087	−0.023	0.004
EBF before discharge ➔ Intention[b] ➔ Behavior[c]	0.057	0.014	0.104	0.008	0.022	0.095	0.009
Standardized direct effect							
Intention[b] ➔ Behavior[c]	0.604	0.530	0.676	0.001	0.544	0.665	0.001
PBC[a] ➔ Behavior[c]	0.262	0.174	0.351	0.001	0.186	0.337	0.001
Standardized total effect							
Intention[b] ➔ Behavior[c]	0.604	0.530	0.676	0.001	0.544	0.665	0.001
PBC[a] ➔ Behavior[c]	0.425	0.343	0.502	0.001	0.356	0.490	0.001
ATT[d] ➔ Behavior[c]	0.129	0.066	0.201	0.001	0.075	0.187	0.001
SPS[e] ➔ Behavior[c]	0.134	0.076	0.195	0.001	0.085	0.183	0.001
Knowledge[f] ➔ Behavior[c]	0.127	0.059	0.192	0.001	0.069	0.183	0.001
Depression[g] ➔ Behavior[c]	−0.055	−0.094	−0.019	0.003	−0.087	−0.023	0.004
EBF before discharge ➔ Behavior[c]	0.057	0.014	0.104	0.008	0.022	0.095	0.009

[a]PBC score is the total score of the Breastfeeding Control Scale.
[b]Intention score is the total score of the Infant Feeding Intention Scale.
[c]Behavior score is the total score of the Breastfeeding Behavioral Questionnaire.
[d]ATT score is the total score of the Positive Breastfeeding Sentiment Attitudinal Scale.
[e]SPS score is the total score of the Social and Professional Support Scale.
[f]Knowledge score is the total score of the Breastfeeding Knowledge Questionnaire.
[g]Depression score is the total score of the Edinburgh Postnatal Depression Scale.

previous study investigating factors that contribute to breastfeeding attrition (Huang et al., 2023) and further identified that perceived breastfeeding control, breastfeeding attitude, social and professional support, knowledge, depression, and EBF before discharge are factors related to both breastfeeding intention and behavior. Prior study by our group determined that breastfeeding intention is a key factor in attrition; here, we further investigated the mechanisms of factors related to breastfeeding behavior and the mediating role of breastfeeding intention. Notably, we confirmed that breastfeeding intention is a key factor in breastfeeding behavior in preterm mothers and further identified that it fully mediates breastfeeding attitude, social and professional support, knowledge, depression, and EBF before discharge on breastfeeding behavior. Therefore, the results of the model testing further confirmed the theory of TPB, which generally suggests that the intention to perform goal-driven behaviors is critical to actually performing that behavior (Ajzen, 2011). Hence, preterm mothers' breastfeeding attitude, social and professional support, perceived breastfeeding control, and other factors (including their knowledge,

depression, and EBF before discharge) significantly influenced their breastfeeding behavior via fully or partially influencing breastfeeding intention.

These findings suggest that perceived breastfeeding control is the strongest predictor of breastfeeding intention, followed by social and professional support and breastfeeding attitude. Recent studies (Dodgson et al., 2003; Bajoulvand et al., 2019) also report that perceived breastfeeding control is the best predictor of breastfeeding intention, and the central role of perceived breastfeeding control is reflective of the realistic understanding of participants of the limitations placed on the likely success of breastfeeding efforts (Dodgson et al., 2003). Indeed, preterm mothers with enhanced perceived breastfeeding control and breastfeeding skills after discharge should be able to cope with various problems that arise in breastfeeding even after 6 weeks postpartum, which might further influence EBF intention and behavior. Early intervention to promote breastfeeding may include strategies to enhance perceived breastfeeding control, practice correct breastfeeding techniques, and solve EBF problems (Gu et al., 2016).

Subjective norm, primarily regarded as social and professional support, was also a significant factor of breastfeeding intention in the current study. Research (Bar-Yam and Darby, 1997; Arora et al., 2000; Sullivan et al., 2004) suggests that breastfeeding decisions are largely influenced by intimate partners, particularly the father of the baby. Indeed, the beliefs of partners seem to matter *more* than the mother's own beliefs in predicting breastfeeding intention and behavior (Rempel and Remple, 2004). Regardless of the partner's beliefs, general support during breastfeeding initiation is critical for continued success, as mothers receiving support during breastfeeding initiation and beyond promote a calm and relaxed environment, which helps them produce prolactin and oxytocin for continued production and excretion of breast milk (Lawrence and Lawrence, 2005). As preterm mothers face increased challenges with breastfeeding, they usually receive specific support from family members and hospital staff (i.e., family integrated care, FICare). In the FICare programs, preterm mothers and their partners participate in educational sessions that increase their knowledge of EBF and help them understand the importance and benefits of breastfeeding, especially for preterm infants (Ding et al., 2023). While this support is beneficial to the breastfeeding decisions and intentions of the parents (Ding et al., 2023), more parents may attempt breastfeeding if supported through bedside teaching and deep involvement by hospital staff in daily feeding (breastfeeding or bottle feeding) in the NICU (Zielińska et al., 2017). Therefore, the influence of subjective norms on breastfeeding intention needs further clarification via qualitative, observational, and interventional studies.

This study also confirmed that breastfeeding attitude is influential to breastfeeding intention. Preterm infants often face a variety of breastfeeding dilemmas, such as maternal–infant separation (Victora et al., 2016), uncoordinated sucking swallowing–respiratory function (Hair et al., 2016), and failure to create appropriate negative pressure during sucking (Mangili and Garzoli, 2017). If mothers recognize these difficulties and realize that breast milk is the optimal nutrition for their preterm infants, they may establish a positive attitude toward breastfeeding and be more inclined to opt for EBF. Notably, this study found that breastfeeding knowledge positively impacts breastfeeding intention, while a previous study suggests that the level of breastfeeding knowledge influences both intention and type of feeding of the newborn (Suárez-Cotelo et al., 2019). Indeed, the positive attitude of mothers toward breastfeeding may be associated with their perceived knowledge about the benefits of breastfeeding to the growth and development of preterm infants. Mothers who receive education regarding the health and emotional benefits of EBF often improve their attitude toward breastfeeding (Bai et al., 2010). Moreover, knowledge of breastfeeding skills may promote perceived control of mothers on pumping, storage, and transportation of breast milk. Thus, when encountering difficulties in breastfeeding preterm infants, mothers should then seek a solution using their adequate breastfeeding knowledge.

This study found that EBF before discharge positively impacts breastfeeding intention. EBF before discharge depends on lactation amount, and insufficient lactation is the primary factor leading to low breastfeeding rates of preterm infants after discharge (Fewtrell et al., 2016). Lactogenesis stage II usually occurs between the 3rd and 8th day postpartum. A stratified study on the lactation volume of preterm mothers on the 4th day postpartum found that mothers whose lactation volume was at level I ($<140 \, \text{mL}$) had a 9.5-fold probability of insufficient lactation at week 6 postpartum, compared with those at level II ($140–394 \, \text{mL}$) and level III ($\geq 395 \, \text{mL}$; Hill, 2005). A cross-sectional study conducted in China further reported that the rate of EBF during hospitalization positively correlated with the rate of EBF at week 6 postpartum (Quan and Yang, 2005). These findings may partially explain the results of the current study, although the rate (only 14%) of EBF before discharge was low among preterm mothers in this study. However, the low rate of EBF before discharge does suggest that nurses should strengthen breastfeeding education during hospitalization to avoid delayed initiation of lactogenesis stage II, which is the key to the success of EBF.

In this study, 93.8% of preterm mothers had an EPDS incidence score ≥ 13 during hospitalization, and their level of depressive symptoms negatively impacted their intention to breastfeed. Preterm birth is a traumatic event for preterm mothers (Gulamani et al., 2013), and these women often have higher levels of depressive symptoms than mothers of full-term infants up to 12 weeks postpartum (Vigod et al., 2010). These results are in concordance with prior studies that reported heightened levels of stress, anxiety, and depressive symptoms both during and beyond the NICU stay of premature infants (Zhang et al., 2014). Indeed, studies have confirmed that depression affects the endocrine and metabolic functions of the body, inducing a variety of hormone-level disorders. Lactation regulation depends on prolactin, oxytocin, and other neurohormones and is vulnerable to adverse emotions. At the same time, depressed mothers are prone to fatigue, and have poor initiative to actively empty the breast, resulting in a further decline in lactation, which affects breastfeeding confidence, reduces breastfeeding intention, and leads to early breastfeeding cessation (Cohen, 1988; Dennis and McQueen, 2007; Insaf et al., 2011). Therefore, the negative experiences preterm mothers endure may be associated with high levels of depressive symptoms, which continuously weaken breastfeeding intention until and through week 6 postpartum. This study also indicates that effective intervention strategies to improve breastfeeding intention and behavior for the target population (such as parent support, psychological and emotional counseling, parent training, and infant developmental support) are essential to reducing negative emotions and further promoting prolactin secretion (Cohen, 1988; Dennis and McQueen, 2007; Zhang et al., 2014). The role of breastfeeding intention also indicates that multifaceted intervention strategies to improve breastfeeding behavior should be considered for the preterm mother, including adopting individual instruction and support on breastfeeding techniques and problem-solving to improve breastfeeding knowledge and perceived breastfeeding control of mothers; implementing group education to emphasize the benefit of EBF; rectifying cognitive misconceptions of preterm mothers regarding nutrition needs for infants to enhance maternal attitude toward breastfeeding; and sharing successful breastfeeding experiences or stories from other mothers or nursing staff to enhance subjective norms (Gu et al., 2016). In addition, the breastfeeding intention–behavioral gap should not be neglected. Previous studies have shown that implementation intention is a key strategy that helps to transform behavioral intention into behavior (Latimer et al., 2006). In other words, once an intention is formed, it is necessary to adopt an action plan, which includes the specific steps of "when, where, and how" for initiating the behavior, as well as the identification of anticipated barriers and setbacks with corresponding coping plans (Martinez-Brockman et al., 2017). Therefore, it is necessary to evaluate the role of implementation intention to promote the transformation of breastfeeding intention into breastfeeding behavior in future intervention studies.

Study limitations and future research

This study is not without its limitations. First, the surveys utilized here were self-reports that included questions regarding breastfeeding behavior at week 6 postpartum. While prior research has shown that maternal self-reporting of breastfeeding is a reliable measure (Li et al., 2005), there is an inherent risk in this measure: Social desirability bias may lead to over-reporting. Indeed, each of the participants in the current study was aware of the optimal behavior as reported by study investigators and was later asked to report their intention to practice the behavior (Wallenborn et al., 2019). Second, no significant influence of the demographic factors of the dyads was identified on breastfeeding intention and behavior. Although this finding is consistent with that of a prior study (Tengku Ismail et al., 2016), additional longitudinal studies will help elucidate the contribution of demographic factors to breastfeeding intention. Third, the contributions of the variance in breastfeeding behavior in this study were lower than those in a study of full-term mothers (79%; Bajoulvand et al., 2019), indicating that other factors related to breastfeeding behavior need to be evaluated. Finally, the participants were recruited from one hospital in Shanghai (the largest city in China), and a random sampling approach was not used in this study. Thus, sample representativeness and generalizability of the findings could be biased. A multicentered study with a more geographically diverse sample should be considered in future studies.

Conclusion

This study preliminarily confirmed that TPB predicts breastfeeding behavior among mothers with preterm infants at week 6 postpartum. The crucial mediating role of breastfeeding intention was also identified between breastfeeding attitude, subjective norms, perceived control, knowledge, depression, and EBF before discharge with breastfeeding behavior. The findings of this study indicate that standardized questionnaires should be included in the health information system to identify preterm mothers with a high risk of EBF attrition. The tailored intervention led by nurses should focus on the breastfeeding intention and behavior of high-risk mothers with preterm infants.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Author contributions

RH contributed to conceptualization, methodology, and original drafts. HH, XY, and LD contributed to the acquisition of data and data analysis with the assistance of YZ, YH, CC, and JS. XL and HH participated in making SEM. SZ and HJ participated in project administration, supervision and review. All authors contributed to the article and approved the submitted version.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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References

Ajzen, I. (1991). The theory of planned behavior. *Organ. Behav. Hum. Decis. Process.* 50, 179–211. doi: 10.1016/0749-5978(91)90020-T

Ajzen, I. (2011). The theory of planned behaviour: reactions and reflections. *Psychol. Health* 26, 1113–1127. doi: 10.1080/08870446.2011.613995

Ajzen, I., and Madden, T. J. (1986). Prediction of goal-directed behavior: attitudes, intentions, and perceived behavioral control. *J. Exp. Soc. Psychol.* 22, 453–474. doi: 10.1016/0022-1031(86)90045-4

Alami, A., Moshki, M., and Alimardani, A. (2014). Development and validation of theory of planned behavior questionnaire for exclusive breastfeeding. *J Neyshabur Univ Med Sci.* 2, 45–53.

Araban, M., Karimian, Z., Kakolaki, Z. K., McQueen, K. A., and Dennis, C. L. (2018). Randomized controlled trial of a prenatal breastfeeding self-efficacy intervention in primiparous women in Iran. *J. Obstet. Gynecol. Neonatal. Nurs.* 47, 173–183. doi: 10.1016/j.jogn.2018.01.005

Arora, S., McJunkin, C., Wehrer, J., and Kuhn, P. (2000). Major factors influencing breastfeeding rates: mother's perception of father's attitude and milk supply. *Pediatrics* 106:E67. doi: 10.1542/peds.106.5.e67

Avery, M., Duckett, L., Dodgson, J., Savik, K., and Henly, S. J. (1998). Factors associated with very early weaning among primiparas intending to breastfeed. *Matern. Child Health J.* 2, 167–179. doi: 10.1023/a:1021879227044

Bai, Y., Middlestadt, S. E., Peng, C. Y., and Fly, A. D. (2010). Predictors of continuation of exclusive breastfeeding for the first six months of life. *J. Hum. Lact.* 26, 26–34. doi: 10.1177/0890334409350168

Bajoulvand, R., González-Jiménez, E., Imani-Nasab, M. H., and Ebrahimzadeh, F. (2019). Predicting exclusive breastfeeding among Iranian mothers: application of the theory of planned behavior using structural equation modeling. *Iran. J. Nurs. Midwifery Res.* 24, 323–329. doi: 10.4103/ijnmr. IJNMR_164_18

Bar-Yam, N. B., and Darby, L. (1997). Fathers and breastfeeding: a review of the literature. *J. Hum. Lact.* 13, 45–50. doi: 10.1177/089033449701300116

Belfort, M. B., Rifas-Shiman, S. L., Kleinman, K. P., Bellinger, D. C., Harris, M., Taveras, E. M., et al. (2016). Infant breastfeeding duration and mid-childhood executive function, behavior, and social-emotional development. *J. Dev. Behav. Pediatr.* 37, 43–52. doi: 10.1097/DBP.0000000000000237

Blyth, R. J., Creedy, D. K., Dennis, C. L., Moyle, W., Pratt, J., de Vries, S. M., et al. (2004). Breastfeeding duration in an Australian population: the influence of modifiable antenatal factors. *J. Hum. Lact.* 20, 30–38. doi: 10.1177/0890334403261109

Boomsma, A., and Hoogland, J. J. (2001). "The robustness of LISREL modeling revisited" in *Structural equation models: Present and future*. eds. R. Cudeck, S. duToit and D. Sörbom. *1st* ed (Lincolnwood: Scientific Software International), 139–168.

Britton, J. R., Britton, H. L., and Gronwaldt, V. (2006). Breastfeeding, sensitivity, and attachment. *Pediatrics* 118, e1436–e1443. doi: 10.1542/peds.2005-2916

Byrne, B. (2010). *Structural Equation Modeling with AMOS: Basic Concepts, Applications, and Programming*. New York, NY: Routledge.

Cai, C. T., Huang, R., and Wang, Y. T. (2023). Reliability and validity evaluation of the Chinese breastfeeding attrition prediction tool. *J Nurs Admin.* 23, 52–56. doi: 10.3969/j.issn.1671-315x.2023.01.011

Cleminson, S. J., Zalewski, S. P., and Embleton, N. (2016). Nutrition in the preterm infant: What's new? *Curr. Opin. Clin. Nutr. Metab. Care* 19, 220–225. doi: 10.1097/MCO.0000000000000270

Cohen, J. W. (1988). *Statistical Power Analysis for the Behavioral Sciences* (*2nd*). Hillsdale, NJ: Lawrence Erlbaum Associates.

Cox, J. L., Holden, J. M., and Sagovsky, R. (1987). Detection of postnatal depression. Development of the 10-item Edinburgh postnatal depression scale. *Br. J. Psychiatry* 150, 782–786. doi: 10.1192/bjp.150.6.782

Demirci, J. R., Sereika, S. M., and Bogen, D. (2013). Prevalence and predictors of early breastfeeding among late preterm mother-infant dyads. *Breastfeed. Med.* 8, 277–285. doi: 10.1089/bfm.2012.0075

Dennis, C. L., and McQueen, K. (2007). Does maternal postpartum depressive symptomatology influence infant feeding outcomes? *Acta Paediatr.* 96, 590–594. doi: 10.1111/j.1651-2227.2007.00184.x

Dick, M. J., Evans, M. L., Arthurs, J. B., Barnes, J. K., Caldwell, R. S., Hutchins, S. S., et al. (2002). Predicting early breastfeeding attrition. *J. Hum. Lact.* 18, 21–28. doi: 10.1177/089033440201800104

Ding, L. J., Chen, Y. L., Zhang, W. Y., Song, J. Q., Yao, X., Wan, Y., et al. (2023). Effect of family integrated care on breastfeeding of preterm infants: a scoping review. *Nurs. Open* 10, 5950–5960. doi: 10.1002/nop2.1888

Dodgson, J. E., Henly, S. J., Duckett, L., and Tarrant, M. (2003). Theory of planned behavior-based models for breastfeeding duration among Hong Kong mothers. *Nurs. Res.* 52, 148–158. doi: 10.1097/00006199-200305000-00004

Esquerra-Zwiers, A., Goris, E. D., and Franzen, A. (2022). Explaining variance in breastfeeding intentions and behaviors among a cohort of Midwest mothers using a theory of planned behavior-based structural model. *BMC Pregnancy Childbirth* 22:314. doi: 10.1186/s12884-022-04628-9

Fewtrell, M. S., Kennedy, K., Ahluwalia, J. S., Nicholl, R., Lucas, A., and Burton, P. (2016). Predictors of expressed breast milk volume in mothers expressing milk for their preterm infant. *Arch. Dis. Child. Fetal Neonatal Ed.* 101, F502–F506. doi: 10.1136/archdischild-2015-308321

Fishbein, M., and Ajzen, I. (2010). *Predicting and Changing Behavior: The Reasoned Action Approach*. New York: Psychology Press.

Gebeyehu, N. A., Tegegne, K. D., Shewangashaw, N. E., Biset, G., Abebaw, N., and Tilahun, L. (2023). Knowledge, attitude, practice and determinants of exclusive breastfeeding among women in Ethiopia: systematic review and meta-analysis. *Public Health Pract.* 5:100373. doi: 10.1016/j.puhip.2023.100373

Geddes, D., Kok, C., Nancarrow, K., Hepworth, A., and Simmer, K. (2018). Preterm infant feeding: a mechanistic comparison between a vacuum triggered novel teat and breastfeeding. *Nutrients* 10:376. doi: 10.3390/nu10030376

Gefen, D., Straub, D., and Boudreau, M. (2000). Structural equation modeling and regression: guidelines for research practice. *Comm Assoc Inform Syst.* 4, 1–70. doi: 10.17705/1CAIS.00407

Gibson, J., McKenzie-McHarg, K., Shakespeare, J., Price, J., and Gray, R. (2009). A systematic review of studies validating the Edinburgh postnatal depression scale in antepartum and postpartum women. *Acta Psychiatr. Scand.* 119, 350–364. doi: 10.1111/j.1600-0447.2009.01363.x

Gilmour, C., Hall, H., McIntyre, M., Gillies, L., and Harrison, B. (2009). Factors associated with early breastfeeding cessation in Frankston, Victoria: a descriptive study. *Breastfeed. Rev.* 17, 13–19.

Göksen, F. (2002). Normative vs. attitudinal considerations in breastfeeding behavior: multifaceted social influences in a developing country context. *Soc. Sci. Med.* 54, 1743–1753. doi: 10.1016/s0277-9536(01)00145-9

Gu, Y. H., Zhu, Y., Zhang, Z. H., and Wan, H. W. (2016). Effectiveness of a theory-based breastfeeding promotion intervention on exclusive breastfeeding in China: a randomized controlled trial. *Midwifery* 42, 93–99. doi: 10.1016/j.midw.2016.09.010

Gulamani, S. S., Premji, S. S., Kanji, Z., and Azam, S. I. (2013). A review of postpartum depression, preterm birth, and culture. *J. Perinat. Neonatal Nurs.* 27, 52–59. doi: 10.1097/JPN.0b013e31827fcf24

Guo, J. L., Wang, T. F., Liao, J. Y., and Huang, C. M. (2016). Efficacy of the theory of planned behavior in predicting breastfeeding: meta-analysis and structural equation modeling. *Appl. Nurs. Res.* 29, 37–42. doi: 10.1016/j.apnr.2015.03.016

Hair, A. B., Peluso, A. M., Hawthorne, K. M., Perez, J., Smith, D. P., Khan, J. Y., et al. (2016). Beyond necrotizing enterocolitis prevention: improving outcomes with an exclusive human milk-based diet. *Breastfeed. Med.* 11, 70–74. doi: 10.1089/bfm.2015.0134

Hayes, A. F., and Scharkow, M. (2013). The relative trustworthiness of inferential tests of the indirect effect in the statistical mediation analysis: does method really matter? *Psychol. Sci.* 24, 1918–1927. doi: 10.1177/0956797613480187

Hill, P. D. (2005). Milk volume on day 4 and income predictive of lactation adequacy at 6 weeks of mothers of nonnursing preterm infants. *J. Perinat. Neonatal Nurs.* 19, 273–282. doi: 10.1097/00005237-200507000-00014

Hoe, S. L. (2008). Issues and procedures in adopting structural equation modeling technique. *J Appl Quant Meth.* 3, 76–83.

Hu, L., and Bentler, P. (1999). Cutoff criteria for fit indexes in covariance structure analysis: conventional criteria versus new alternatives. *Struct. Equ. Model.* 6, 1–55. doi: 10.1080/10705519909540118

Huang, R., Wan, Y., Yao, X., Wang, H., Cai, C. T., Xu, Y. T., et al. (2023). Predictive factors of exclusive breastfeeding attrition at week 6 post-partum among mothers of preterm infants based on the theory of planned behaviour. *Matern. Child Nutr.* 19:e13470. doi: 10.1111/mcn.13470

Hwang, E. J., and Sim, O. (2021). The structural equation modeling of personal aspects, environmental aspects, and happiness among older adults living alone: a cross-sectional study. *BMC Geriatr.* 21:479. doi: 10.1186/s12877-021-02430-4

Iacobucci, D. (2010). Structural equations modeling: fit indices, sample size, and advanced topics. *J Cons Psychol.* 20, 90–98. doi: 10.1016/j.jcps.2009.09.003

Insaf, T. Z., Fortner, R. T., Pekow, P., Dole, N., Markenson, G., and Chasan-Taber, L. (2011). Prenatal stress, anxiety, and depressive symptoms as predictors of intention to breastfeed among Hispanic women. *J. Women's Health* 20, 1183–1192. doi: 10.1089/jwh.2010.2276

Janke, J. R. (1992). Prediction of breast-feeding attrition: instrument development. *Appl. Nurs. Res.* 5, 48–53. doi: 10.1016/s0897-1897(05)80086-2

Janke, J. R. (1994). Development of the breast-feeding attrition prediction tool. *Nurs. Res.* 43, 100–104. doi: 10.1097/00006199-199403000-00008

Jansen, E., Mallan, K. M., Byrne, R., Daniels, L. A., and Nicholson, J. M. (2016). Breastfeeding duration and authoritative feeding practices in first-time mothers. *J. Hum. Lact.* 32, 498–506. doi: 10.1177/0890334415618669

Khoury, A. J., Moazzem, S. W., Jarjoura, C. M., Carothers, C., and Hinton, A. (2005). Breastfeeding initiation in low-income women: role of attitude, support, and perceived control. *Womens Health Issues* 15, 64–72. doi: 10.1016/j.whi.2004.09.003

Kloeblen-Tarver, A. S., Thompson, N. J., and Miner, K. R. (2002). Intent to breastfeed: the impact of attitudes, norms, parity, and experience. *Am. J. Health Behav.* 26, 182–187. doi: 10.5993/ajhb.26.3.3

Latimer, A. E., Ginis, K. A. M., and Arbour, K. P. (2006). The efficacy of an implementation intention intervention for promoting physical activity among individuals with spinal cord injury: a randomized controlled trial. *Rehabil. Psychol.* 51, 273–280. doi: 10.1037/0090-5550.51.4.273

Lawrence, R. A., and Lawrence, R. M. (2005). *Breastfeeding: A Guide for the Medical Profession*. *6th* Philadelphia, PA: Elsevier Mosby.

Lee, K. W., Ching, S. M., Hoo, F. K., Ramachandran, V., Chong, S. C., Tusimin, M., et al. (2019). Prevalence and factors associated with depressive, anxiety and stress symptoms among women with gestational diabetes mellitus in tertiary care centres in Malaysia: a cross-sectional study. *BMC Pregnancy Childbirth* 19:367. doi: 10.1186/s12884-019-2519-9

Lei, M., Deeprasert, J., Li, R. Y. M., and Wijitjamree, N. (2022). Predicting Chinese older adults' intention to live in nursing homes using an integrated model of the basic psychological needs theory and the theory of planned behavior. *Front. Public Health* 10:947946. doi: 10.3389/fpubh.2022.947946

Li, R. W., Scanlon, K. S., and Serdula, M. K. (2005). The validity and reliability of maternal recall of breastfeeding practice. *Nutr. Rev.* 63, 103–110. doi: 10.1111/j.1753-4887.2005.tb00128.x

Liu, Y., Guo, N. F., Li, T. T., Zhuang, W., and Jiang, H. (2020). Prevalence and associated factors of postpartum anxiety and depression symptoms among women in Shanghai, China. *J Affect Disord.* 274, 848–856. doi: 10.1016/j.jad.2020.05.028

Lou, Z., Zeng, G., Huang, L., Wang, Y., Zhou, L., and Kavanagh, K. F. (2014). Maternal reported indicators and causes of insufficient milk supply. *J. Hum. Lact.* 30, 466–473. doi: 10.1177/0890334414542685

Mangili, G., and Garzoli, E. (2017). Feeding of preterm infants and fortification of breast milk. *Pediatr. Med. Chir.* 39:158. doi: 10.4081/pmc.2017.158

Manno, L. D., Macdonald, J. A., and Knight, T. (2015). The intergenerational continuity of breastfeeding intention, initiation, and duration: a systematic review. *Birth* 42, 5–15. doi: 10.1111/birt.12148

Martinez-Brockman, J. L., Shebl, F. M., Harari, N., and Pérez-Escamilla, R. (2017). An assessment of the social cognitive predictors of exclusive breastfeeding behavior using the health action process approach. *Soc. Sci. Med.* 182, 106–116. doi: 10.1016/j.socscimed.2017.04.014

McMillan, B., Conner, M., Green, J., Dyson, L., Renfrew, M., and Woolridge, M. (2009). Using an extended theory of planned behavior to inform interventions aimed at

increasing breastfeeding uptake in primiparas experiencing material deprivation. *Br. J. Health Psychol.* 14, 379–403. doi: 10.1348/135910708X336112

Nommsen-Rivers, L. A., and Dewey, K. G. (2009). Development and validation of the infant feeding intentions scale. *Matern. Child Health J.* 13, 334–342. doi: 10.1007/s10995-008-0356-y

Ouyang, Y. Q., Su, M., and Redding, S. R. (2016). A survey on difficulties and desires of breast-feeding women in Wuhan, China. *Midwifery.* 37, 19–24. doi: 10.1016/j.midw.2016.03.014

Ouyang, Y. Q., Xu, Y. X., and Zhang, Q. (2012). Survey on breastfeeding among Chinese female physicians and nurses. *Nurs. Health Sci.* 14, 298–303. doi: 10.1111/j.1442.2018.2012.00699.x

Quan, X. Z., and Yang, H. H. (2005). Analysis of factors influencing breastfeeding during hospitalization and 42 days after delivery. *J Wenzhou Med Coll* 35, 149–151.

Rafizadeh, R., Heidari, Z., Karimy, M., Zamani-Alavijeh, F., and Araban, M. (2019). Factors affecting breast-feeding practice among a sample of Iranian women: a structural equation modeling approach. *Ital. J. Pediatr.* 45:147. doi: 10.1186/s13052-019-0724-9

Rempel, L. A., and Remple, J. K. (2004). Partner influence on health behavior decision-making: increasing breastfeeding duration. *J. Soc. Pers. Relat.* 21, 92–111. doi: 10.1177/0265407504039841

Saffari, M., Pakpour, A. H., and Chen, H. (2016). Factors influencing exclusive breastfeeding among Iranian mothers: a longitudinal population-based study. *Health Promot. Perspect.* 7, 34–41. doi: 10.15171/hpp.2017.07

Shi, S. P., and Zhang, Y. X. (2015). The strategies of breastfeeding promotion in NICU. *Chin. J. Nurs.* 50, 608–613. doi: 10.3761/j.issn.0254-1769.2015.05.021

Sonko, A., and Worku, A. (2015). Prevalence and predictors of exclusive breastfeeding for the first six months of life among women in Halaba special Woreda, southern nations, nationalities and People's region/ SNNPR/, Ethiopia: a community based cross-sectional study. *Arch Public Health.* 73:53. doi: 10.1186/s13690-015-0098-4

Størdal, K., Lundeby, K. M., Brantsæter, A. L., Haugen, M., Nakstad, B., Lund-Blix, N. A., et al. (2017). Breast-feeding and infant hospitalization for infections: large cohort and sibling analysis. *J. Pediatr. Gastroenterol. Nutr.* 65, 225–231. doi: 10.1097/MPG.0000000000001539

Suárez-Cotelo, M. D. C., Movilla-Fernández, M. J., Pita-García, P., Arias, B. F., and Novío, S. (2019). Breastfeeding knowledge and relation to prevalence. *Rev. Esc. Enferm. U.S.P.* 53:e03433. doi: 10.1590/S1980-220X2018004503433

Sullivan, M. L., Leathers, S. L., and Kelly, M. A. (2004). Family characteristics associated with duration of breastfeeding during early infancy among primiparas. *J. Hum. Lact.* 20, 196–205. doi: 10.1177/0890334404263732

Tao, Y. Q., Ma, L., Lin, H., and Liu, W. H. (2016). Research on influencing factors of breastfeeding for premature infants in NICU. *Chin J Mod Nurs.* 22, 4955–4958. doi: 10.3760/cma.j.issn.1674-2907.2016.34.018

Tengku Ismail, T. A., Wan Muda, W. A., and Bakar, M. I. (2016). The extended theory of planned behavior in explaining exclusive breastfeeding intention and bahavior among women in Kelanta, Malaysia. *Nutr Res Pract.* 10, 49–55. doi: 10.4162/nrp.2016.10.1.49

Thomas-Jackson, S. C., Bentley, G. E., Keyton, K., Reifman, A., Boylan, M., and Hart, S. L. (2016). In-hospital breastfeeding and intention to return to work influence mothers' breastfeeding intentions. *J. Hum. Lact.* 32:NP76-NP83. doi: 10.1177/089033441559636

Victora, C. G., Bahl, R., Barros, A. J., França, G. V., Horton, S., Krasevec, J., et al. (2016). Breastfeeding in the 21st century: epidemiology, mechanisms, and lifelong effect. *Lancet* 387, 475–490. doi: 10.1016/S0140-6736(15)01024-7

Vigod, S. N., Villegas, L., Dennis, C. L., and Ross, L. E. (2010). Prevalence and risk factors for postpartum depression among women with preterm and low-birth-weight infants: a systematic review. *BJOG* 117, 540–550. doi: 10.1111/j.1471-0528.2009.02493.x

Wallenborn, J. T., Perera, R. A., Wheeler, D. C., Lu, J., and Masho, S. W. (2019). Workplace support and breastfeeding duration: the mediating effect of breastfeeding intention and self-efficacy. *Birth* 46, 121–128. doi: 10.1111/birt.12377

Wang, Y., Briere, C. E., Xu, W. L., and Cong, X. M. (2019). Factors affecting breastfeeding outcomes at six months in preterm infants. *J. Hum. Lact.* 35, 80–89. doi: 10.1177/0890334418771307

Wang, Y., and Jiang, N. (2021). Study on the influence factors of breastfeeding based on theory of planned behavior. *Chin J Health Educ.* 37, 1028–1032. doi: 10.16168/j.cnki.issn.1002-9982.2021.11.015

Whalen, B., and Cramton, R. (2010). Overcoming barriers to breastfeeding continuation and exclusivity. *Curr. Opin. Pediatr.* 22, 655–663. doi: 10.1097/MOP.0b013e32833c8996

Wilhelm, S. L., Rodehorst, T. K., Stepans, M. B. F., Hertzog, M., and Berens, C. (2008). Influence of intention and self-efficacy levels on duration of breastfeeding for Midwest rural mothers. *Appl. Nurs. Res.* 21, 123–130. doi: 10.1016/j.apnr.2006.10.005

World Health Organization. (2002). *Infant and Young Child Nutrition: Global Strategy for Infant and Young Child Feeding. Exclusive Board Paper. Report No.: EB 109/12.* World Health Organization; Geneva.

World Health Organization. (2017). *Guidelines: Protecting, Promoting and Supporting Breastfeeding in Facilities Providing Maternity and Newborn Services.* World Health Organization; Geneva.

Zhang, Y. (2014). Effect of information support on lactation and uterine involution of parturients with postpartum depression. *Chin J Modern Nurs.* 20, 309–311. doi: 10.3760/j.issn.1674-2907.2014.03.024

Zhang, X., Kurtz, M., Lee, S. Y., and Liu, H. (2014). Early intervention for preterm infants and their mothers. *J Perinat Neonat Nurs.* 35, E69–E82. doi: 10.1097/JPN.0000000000000065

Zielińska, M. A., Sobczak, A., and Hamułka, J. (2017). Breastfeeding knowledge and exclusive breastfeeding of infants in first six months of life. *Rocz. Panstw. Zakl. Hig.* 68, 51–59.

Glossary

EBF	Exclusive breastfeeding
NICU	Neonatal intensive care unit
WHO	World Health Organization
ATT	Attitude
SN	Subjective norms
SPS	Social and Professional Support (Scale)
PBC	Perceived breastfeeding control
BAPT	Breastfeeding attrition predictive tool
PBS	Positive Breastfeeding Sentiment Attitudinal Scale
BFC	Breastfeeding Control Scale
EPDS	Edinburgh Postnatal Depression Scale
BKQ	Breastfeeding Knowledge Questionnaire
IFIS	Infant Feeding Intention Scale
BBQ	Breastfeeding Behavioral Questionnaire
SEM	Structural equation modeling
RMSEA	Root mean square error of approximation
GFI	Goodness-of-fit index
AGFI	Adjusted goodness-of-fit index
TLI	Tucker–Lewis coefficient
CFI	Comparative fit index
NFI	Normed fit index
RFI	Relative fit index
IFI	Incremental fit index