

Breast milk production and emotional state in mothers of very low birth weight infants

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ABSTRACT

Introduction. There is little evidence regarding the influence of emotional variables on breastfeeding among mothers of very low birth weight infants (VLBWIs). The objective of this study was to measure breast milk production (BMP) at two points in time during neonatal hospitalization and its association with anxiety, depression, and breastfeeding self-efficacy levels among mothers of VLBWIs.

Population and methods. Prospective, observational, and multicenter study in mothers of VLBWIs (500-1500 g) from 9 NEOCOSUR Network centers. BMP was obtained by measuring the amount extracted by each mother. The STAI scale was used for anxiety, the BDI scale for depression, and the ALMA pilot scale for self-efficacy. They were administered at 14 days of life and at 36 weeks of postmenstrual age. The biosocial characteristics of mothers and neonates were also recorded.

Results. A total of 118 mothers participated. Mean BMP was 169 mL (standard deviation [SD]: ± 132.4) at 14 days and 285 mL (SD: ± 266.9) at 36 weeks, and it was significantly associated with the perception of breastfeeding self-efficacy ($p < 0.001$), which was maintained during hospitalization. There was a lower production trend among mothers with higher depression indices at 14 days of life, but not at 36 weeks. No association was observed between BMP and anxiety. No consistently significant associations were observed with biosocial variables.

Conclusion. BMP was positively associated with breastfeeding self-efficacy; no association was observed with anxiety and depression among mothers of VLBWIs.

Key words: breastfeeding, preterm newborn infant, self-efficacy, anxiety, depression.

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INTRODUCTION

Breast milk (BM) provides unparalleled benefits to very low birth weight infants (VLBWIs), given that it reduces the probability of severe comorbidities, such as sepsis, necrotizing enterocolitis, retinopathy, and bronchopulmonary dysplasia.¹ In addition, better neurodevelopmental outcomes have been observed in those receiving BM, which also seems to be associated with greater maternal sensitivity.^{2,3}

In relation to breastfeeding and maternal emotional state, most studies have been conducted in mothers of term newborn infants (TNBIs). Greater maternal anxiety and postpartum depression have been associated with less successful breastfeeding.^{4,5} Mothers of preterm infants face more difficulties at the initiation and continuation of breastfeeding, and perceive more barriers to its success.⁶⁻¹¹ Breastfeeding helps mothers feel a connection with their preterm infant's needs and helps relieve the guilt associated with the preterm birth.¹¹

Neonatal intensive care unit (NICU) hospitalization causes considerable stress among mothers,¹² which may increase the presence of state anxiety and depression.^{13,14} It can negatively affect breast milk production (BMP) or its continuation, and mothers who are more depressed may have a lower BMP.¹⁵⁻¹⁷ In addition, those who say they "have faith" in their milk have increased motivation to continue providing it.¹¹

Bandura defined self-efficacy or perceived self-efficacy as the judgment a person makes about their capabilities and self-confidence, based on which

they may achieve a desired behavior.¹⁸ Self-efficacy is relevant for being a modifiable factor which may lead to more successful breastfeeding. There is currently a breastfeeding self-efficacy scale for mothers of healthy TNBIs,¹⁹ which, in a modified and abridged version, has been used in mothers of hospitalized NBIs, both term and preterm NBIs.²⁰ To our knowledge, no scale has been exclusively developed for mothers of extremely preterm infants. Several maternal and NBI socioeconomic variables and biodemographic characteristics have been associated with BMP in VLBWIs, without being conclusive.²¹

Globally speaking, few studies have assessed emotional factors and BM, but everything suggests that a maternal positive experience is associated with more successful breastfeeding.²² The primary objective of this study was to measure BMP in two stages of neonatal hospitalization and its association with anxiety, depression, and breastfeeding self-efficacy levels among mothers of VLBWIs. The secondary objective was to find associations between BMP and biosocial variables.

POPULATION AND METHODS

This was a prospective, observational, and multicenter study. A total of 9 centers (6 public and 3 private) from the NEOCOSUR Network, a voluntary non-profit association of NICUs from South American countries (www.neocosur.org), participated in the study. Inclusion criteria for centers were having a breast pumping room in the NICU and providing training on BM extraction techniques to all mothers. Inclusion criteria for mothers were being older than 18 years, NBIs weighing between 500 and 1500 g in stable condition, and having received the fact sheets illustrating breastfeeding benefits and advice (developed for this study).

Exclusion criteria: NBIs diagnosed with a genetic condition, mothers who could not provide BM to their children due to biological reasons, mothers with a severe psychiatric diagnosis and/or problematic alcohol and/or drug use. The sample was selected by order of admission (birth of the VLBWI in the corresponding center).

BMP: total BM volume produced by the mother, as recorded in the breast pumping room and/or by the nutritionist the day before the assessment. Mothers were categorized into 3 BMP groups: low, medium, and high. BMP was defined as high when the volume was ≥ 180 mL/kg/day, the most common recommendation for feeding VLBWIs;²³

medium production was defined as 50-99 % of that volume, and low production, below 50 %.

The following instruments were used in this study:

- **Beck Depression Inventory (BDI-I).** Developed by Beck et al., in 1961 (BDI-IA).²⁴ Self-assessment of clinical symptoms of melancholy and intrusive thoughts present in depression. The updated version of the BDI, validated in Spanish, was used.²⁵
- **State-Trait Anxiety Inventory (STAI).** Developed by Spielberg et al. in 1970.²⁶ The scale assessing state anxiety was used;²⁶ state anxiety was defined as a temporary emotional state characterized by a conscious perception of feelings of tension and apprehension, and an increased activation of the autonomic nervous system. The Spanish adapted version was used.²⁷
- **Breastfeeding self-efficacy scale for mothers of hospitalized preterm infants** (*Escala de autoeficacia en lactancia para madres con recién nacidos prematuros hospitalizados [ALMA]*). Self-report questionnaire of maternal perception on breastfeeding self-efficacy in the hospital setting. This scale was developed by 2 authors of this publication for its pilot implementation in this study (see *Annex*). Some of the existing breastfeeding self-efficacy scales were reviewed for its development.^{19,28} Experts assessed the scale, which was then administered to 10 mothers of preterm NBIs (PNBIs) to check its applicability, consistency, and the understanding of items. This scale consists of 10 items with a score from 0 (not capable at all) to 3 (completely capable) and no items with reverse scoring. The scoring ranges from 0 (no self-efficacy) to 30 (complete self-efficacy).

Biosocial and breastfeeding history

NBI history (sex, gestational age [GA] at birth, birth weight, 1- and 5-min Apgar scores). NBI at the time of assessment (weight, respiratory support). Maternal history (mode of delivery, gravidity, antenatal care, hospitalization, age, marital status, education, work situation). BM-related history (use of galactagogues, use of psychotropics).

Data were recorded at 14 days (± 3) of life of the PNBI and at 36 weeks of postmenstrual age (± 7 days) or at discharge. Scales were answered by mothers in the presence of a research team member to clear up possible doubts.

Ethical considerations: This study was approved by the Ethics Committee (EC) of each participating site. Mothers signed an informed consent in order to be included in the study.

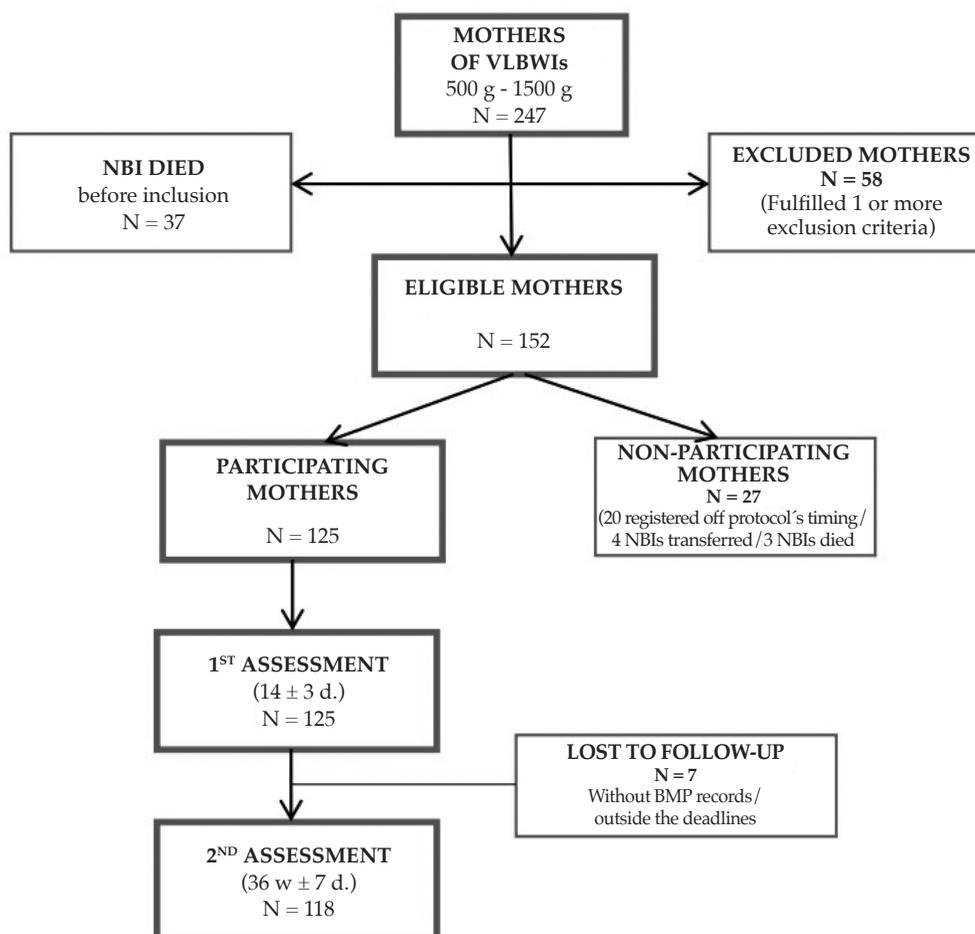
Statistical analysis

A longitudinal study was planned, with the main event being BMP. A daily production of 188.8 mL was considered in the first measurement, with a minimal difference of 21.15 mL from production in the second measurement, according to data by Parker et al.²⁹ Considering a 60 mL standard deviation (SD) for the difference and establishing a 0.05 significance and 0.80 power, the sample size was estimated at 65 cases. Given that this was a multicenter study focused on a higher representativity, a sample size of not less than 100 mothers was determined.

The population of mothers and NBIs was described; and mean and SD were reported for numerical variables, and frequency and percentage for categorical variables. The average BMP between both measurements was compared using Student's *t* test for paired samples. BMP as a categorical variable at both points in time was compared using the Kappa statistic with its corresponding *p* value. To compare the average level of anxiety, depression, and self-efficacy based on BMP categories, Kruskal-Wallis non-parametric tests were used so as to then perform pairwise comparisons using the Mann-Whitney test and applying the Bonferroni correction for multiple comparisons.

In addition, in order to assess the combined association of biosocial variables and emotional factors for each point in time separately, a

FIGURE 1. Flow chart



NBI: newborn infant; VLBWI: very low birth weight infant; BMP: breast milk production.

multinomial logistic regression was performed using mixed models. The response variable was BMP in categories. The considered reference value was that of low production. Biosocial variables and emotional factors were included as explanatory variables. Hospitals were considered as a random effect. The odds ratio (OR) with its corresponding 95 % confidence interval (95 % CI) was reported as a measure of effect size. As part of the initial validation of the proposed scale (ALMA), internal reliability was estimated using Cronbach's alpha.

RESULTS

A total of 118 mothers of VLBWIs assessed between October 2016 and March 2018 were included in the study, with an average of 13 mothers per center (range: 7-31). The study duration was different across centers (average: 8.8 months), mainly due to the time each EC took to grant study approval. *Figure 1* shows the flow chart of mother participation in this study. *Table 1* describes the biosocial characteristics of mothers and NBIs.

The mean BMP \pm SD at 14 days was 169 ± 132.4 mL, and the median value was 140 mL (range: 0-560 mL). At 36 weeks, the mean BMP was 285 ± 266.9 mL, and the median value was 195 mL (range: 0-1500 mL). The difference in production was 83.9 ± 190.7 mL ($p < 0.001$). A high average BMP at 14 ± 3 days was estimated at ≥ 211 mL, and at 36 weeks ± 7 days, at ≥ 381 mL according to the average weight of NBIs (average weight: 1178 g at 14 ± 3 days and 2100 g at 36 weeks ± 7 days).

TABLE 1. Biosocial characteristics of newborn infants and their mothers ($n = 118$)

A. Mothers	
Age (years); mean (SD)	30 (6.9)
Marital status (single); %	29.0
Work situation (unemployed); %	47.5
Education level (> 12 years); %	47.0
Primiparous; %	47.0
C-section; %	78.0
Multiple pregnancy; %	14.4
B. Newborn infants	
Birth weight (g); mean (SD)	1067 (250)
Gestational age (weeks); mean (SD)	28 (2.4)
Sex (female); %	85.6
1-min Apgar score > 3 ; %	85.6
5-min Apgar score > 3 ; %	98.0

SD: standard deviation.

Table 2 shows the distribution of women based on their BMP in categories and ranges established according to the criteria defined in methods. When comparing BMP between both measurements, 50.5 % of mothers remained in the same category ($kappa = 0.238$, $p < 0.001$).

The scores of the BDI, STAI and ALMA scales at 14 ± 3 days of life of the NBI and at 36 weeks ± 7 days and their association with BMP are described (*Figure 2*). In both measurements, a higher score of depressive symptoms among mothers showed a lower BMP, but this trend was not significant. No association was observed between anxiety symptoms and BMP in neither of both measurements. Maternal self-efficacy showed a significant association with an increased BMP in both measurements ($p < 0.001$). Depression and anxiety decreased significantly ($p < 0.001$) throughout neonatal hospitalization.

The combined relation of emotional and biosocial variables on low BMP (reference category), medium BMP or high BMP was assessed (*Table 3*). For the first measurement, no variables distinguished medium and low BMP. A greater perception of self-efficacy ($p = 0.005$) and a higher NBI weight ($p = 0.018$) were associated with high BMP. In the second measurement, a higher self-efficacy score was associated with a greater BMP, both for medium ($p = 0.005$) and high BMP ($p = 0.002$). Male sex was associated with medium BMP ($p = 0.004$), but not with high BMP.

The self-efficacy scale showed high internal reliability. In the first measurement, Cronbach's alpha was 0.857 (0.832 or higher if one of its items was removed), and in the second measurement, 0.902 (0.883 or higher if one item was removed).

DISCUSSION

Among the studied maternal emotional factors, self-efficacy was the only one which was

TABLE 2. Categories of breast milk production and percentage of mothers according to assessment timing

Time	Production (mL/day)	%
14 \pm 3 days	Low (0-100)	42
	Medium (101-210)	31
	High (≥ 211)	27
36 weeks \pm 7 days or discharge	Low (0-190)	52
	Medium (191-380)	20
	High (≥ 381)	28

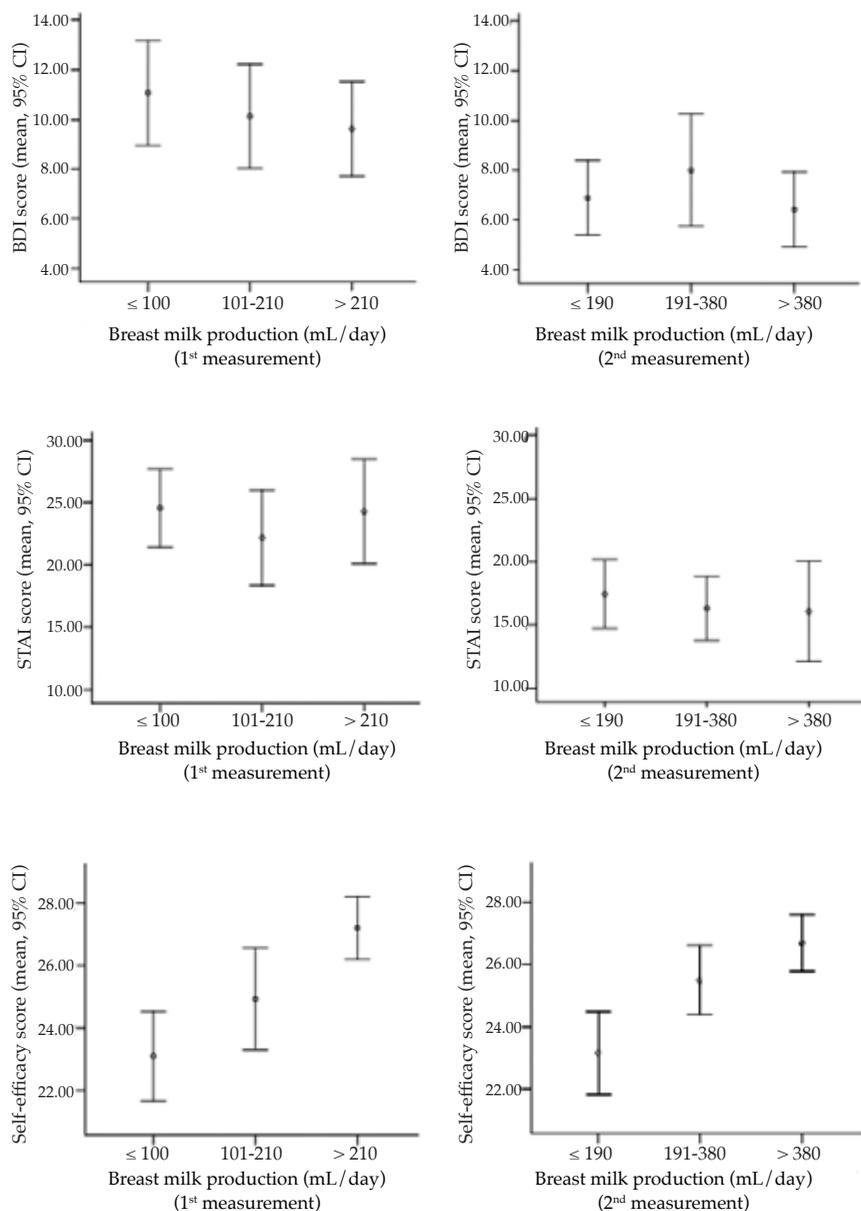
positively associated with BMP in mothers of hospitalized VLBWIs, even when adjusting for biosocial variables.

Breast milk production and very low birth weight infants

There is little information about BMP among mothers of VLBWIs. Fewtrell et al., observed an

average BMP of 332 mL with a median value of 245 mL per day among mothers of NBIs < 34 weeks of GA.³⁰ In addition, they proposed a BMP ≥ 500 mL/day as an adequate goal for mothers of VLBWIs. In our study, only 6.3 % of mothers reached that volume at 14 ± 3 days, and 17 % at 36 weeks. Undoubtedly, further studies are required in this area.

FIGURE 2. Association of maternal emotional factors and breast milk production at two points in time during the neonatal hospitalization of very low birth weight infants



CI: confidence interval; STAI: State-Trait Anxiety Inventory; BDI: Beck Depression Inventory.

Mothers tended to maintain the same BMP category for both measurements. This is consistent with a recent study which points out that continued breastfeeding among mothers of preterm NBIs can be predicted at 14 days after delivery.³¹

Breast milk production and emotional variables

One of the few studies in VLBWIs found a negative correlation between maternal depression and BMP.¹⁷ In contrast, Furman et al., did not find a correlation between depression and BMP among mothers of VLBWIs.³² Another study including mothers of term and preterm NBIs observed a higher incidence of negative mood states, such as anxiety, depression, hostility, and dysphoria, among mothers of PNBIs.³³ Nevertheless, they were not correlated with the milk volume produced. These results are consistent with those of our study.

In relation to breastfeeding self-efficacy, studies conducted in TNBIs show that it affects the initiation and duration of breastfeeding,³⁴ and that it is a modifiable factor that can be targeted to improve BMP in late PNBIs.³⁵ A qualitative study conducted in 19 mothers of PNBIs concluded that developing self-efficacy together with behavior change techniques improves maternal confidence in order to achieve a higher BMP.³⁶ This is consistent with our results and helps to keep the emphasis on what has been described as the best practices for initiating, establishing, and maintaining BMP in the NICU setting.³⁷

Breast milk production and biosocial variables

Even if BM has a very important cost-benefit for VLBWIs, there is not a great deal of information regarding biosocial variables that may affect BMP. Our study did not observe a continuous and direct incidence of studied biosocial variables on BMP. At

TABLE 3. Multinomial logistic regression for breast milk production in very low birth weight infants

		1 st measurement			2 nd measurement		
		OR	95% CI	p value	OR	95% CI	p value
Medium BM production*	Birth weight (every 100 g)	1.21	(0.87-1.67)	0.265	0.87	(0.62-1.22)	0.424
	GA (weeks)	0.90	(0.62-1.30)	0.567	0.91	(0.61-1.36)	0.650
	Apgar at 1 min	0.88	(0.56-1.40)	0.598	1.02	(0.64-1.64)	0.936
	Apgar at 5 min	1.79	(0.75-4.27)	0.190	1.27	(0.59-2.70)	0.544
	Male sex	0.83	(0.23-3.06)	0.782	10.8	(0.09-54.9)	0.004
	Singleton pregnancy	6.27	(0.58-67.8)	0.130	2.28	(0.44-18.9)	0.447
	Maternal age (years)	0.93	(0.83-1.05)	0.240	0.93	(0.83-1.04)	0.189
	Maternal education > 12 years	1.07	(0.23-4.92)	0.930	1.91	(0.52-7.92)	0.372
	Primiparous	1.62	(0.37-7.19)	0.522	0.29	(0.06-1.42)	0.126
	Use of galactagogues	0.28	(0.05-1.71)	0.170	0.89	(0.22-3.63)	0.866
	STAI**	1.04	(0.95-1.12)	0.395	0.99	(0.91-1.10)	0.975
	BDI**	0.90	(0.79-1.03)	0.129	1.13	(0.97-1.32)	0.111
	Self-efficacy**	1.07	(0.92-1.24)	0.364	1.23	(1.02-1.50)	0.033
High BM production*	Birth weight (every 100 g)	1.56	(1.08-2.26)	0.018	1.04	(0.78-1.40)	0.769
	GA (weeks)	0.96	(0.66-1.38)	0.808	1.01	(0.70-1.44)	0.984
	Apgar at 1 min	0.95	(0.58-1.57)	0.844	0.90	(0.58-1.40)	0.639
	Apgar at 5 min	0.77	(0.30-1.97)	0.586	1.03	(0.53-1.99)	0.937
	Male sex	2.62	(0.59-11.6)	0.205	1.20	(0.83-4.25)	0.776
	Singleton pregnancy	0.27	(0.04-1.76)	0.172	0.95	(1.06-5.26)	0.949
	Maternal age (years)	0.94	(0.82-1.06)	0.305	0.93	(0.84-1.04)	0.222
	Maternal education > 12 years	0.81	(0.19-3.51)	0.774	2.36	(0.42-9.50)	0.227
	Primiparous	0.91	(0.17-4.94)	0.914	0.38	(0.08-1.86)	0.235
	Use of galactagogues	0.41	(0.05-3.17)	0.392	0.26	(0.06-1.24)	0.092
	STAI**	1.07	(0.98-1.17)	0.142	1.02	(0.94-1.11)	0.594
	BDI**	0.93	(0.80-1.07)	0.318	1.12	(0.97-1.29)	0.117
	Self-efficacy**	1.38	(1.10-1.72)	0.005	1.46	(1.15-1.85)	0.002

* The reference category is low breast milk production: ≤ 100 mL/day for the first measurement and ≤ 190 mL/day for the second measurement. Medium breast milk production: 101-210 mL/day for the first measurement and 191-380 mL/day for the second measurement. High breast milk production: > 210 mL/day for the first measurement and > 380 mL/day for the second measurement.

** For each point in time, the instrument's corresponding measurement was considered.

GA: gestational age; BM: breast milk; OR: odds ratio; CI: confidence interval; STAI: State-Trait Anxiety Inventory; BDI: Beck Depression Inventory.

36 weeks, male sex and, at 14 days, a higher birth weight were associated with a higher BMP. Studies in mothers of PNBIs have associated BMP with maternal education and age, respiratory distress, Apgar score, sex, race, GA, late-onset sepsis, and household income, among others.^{38,39}

Our study did not find a significant association between the use of galactagogues and BMP. A recent review on the use of galactagogues in mothers of PNBIs concluded that their usefulness was limited and were only recommended for the initial phase of breastfeeding.⁴⁰

One of the limitations of our study is that mothers were only assessed at two points in time during neonatal hospitalization and no follow-up was done after discharge. In addition, a self-efficacy pilot scale that had not been validated yet was used. Nevertheless, given that the scale consists of only 10 items, it was easy to administer and comprehensible to mothers in the hospitalization setting. Moreover, it showed high internal reliability.

In relation to the strengths of this study, it is worth noting its multicenter nature and consistent results. Furthermore, it included a higher number of mothers compared to similar studies and contributed to a relatively unexplored area of research. Our findings call for training and empowering mothers to provide their own milk to their children and should be part of the knowledge of the health care team accompanying VLBWIs and their families.

CONCLUSION

BMP was positively associated with breastfeeding self-efficacy, and no significant association was observed with anxiety and depression among mothers of VLBWIs. ■

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ANNEX

ALMA: Breastfeeding self-efficacy scale for mothers of hospitalized preterm infants*

Self-efficacy refers to how capable people feel of achieving certain results. The objective of this scale is to find out how capable you feel about the breastfeeding of your preterm infant in the neonatal hospitalization setting. We invite you to answer this questionnaire by scoring from 0 to 3 as appropriate.

ITEM	Not at all 0	Somewhat 1	Enough 2	Very 3
1 I feel capable of producing the milk my baby needs.				
2 I feel capable of identifying when my baby needs to be fed.				
3 I feel capable of solving the difficulties that arise in relation to breastfeeding.				
4 I feel capable of persisting in breast milk extraction for my baby.				
5 I feel capable of staying motivated about breastfeeding.				
6 I feel capable of devoting the necessary time to extract milk and/or breastfeed my baby.				
7 I feel capable of experiencing gratification during breastfeeding.				
8 I feel capable of switching from pumping milk to directly breastfeeding my baby.				
9 I feel capable of continuing breastfeeding for an extended period of time.				
10 I feel capable of receiving my family's support to continue with breastfeeding.				

* Wormald F, Tapia JL. 2016.