

Correlates of Lactation in Mothers of Very Low Birth Weight Infants

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ABSTRACT. *Objective.* We sought to determine the correlates of intent to breastfeed and of successful lactation and nursing at the breast in mothers of very low birth weight (VLBW; <1.5 kg) infants.

Methods. We conducted a prospective observational study of 119 mothers of singleton VLBW infants (mean birth weight: 1056 g; mean gestational age: 28 weeks), 87 (73%) of whom intended to breastfeed. Mothers completed questionnaires at 3 weeks' postnatal age and at 35 and 40 weeks' (term) and 4 months' corrected ages (CAs).

Results. Of the 87 mothers who intended to breastfeed, 30 mothers (34%) continued lactation beyond 40 weeks' CA (postmenstrual plus postnatal age). Compared with mothers who discontinued lactation before this time, those who continued were older (31 vs 26 years), more were married (80% vs 39%), they had more than a high school education (70% vs 42%), and they were white (63% vs 35%). There were no significant differences in their infants' birth data or rates of neonatal morbidity. Significant correlates of lactation beyond 40 weeks' CA included beginning milk expression before 6 hours post-delivery, expressing milk ≥ 5 times per day, and kangaroo care. These correlates remained significant after controlling for maternal age, race, marital status, and education beyond high school. At 4 months' CA, 14 mothers (16%) were still lactating, 12 of whom were nursing at the breast.

Conclusions. Increased maternal support specifically directed toward behavioral factors, including early and more frequent milk expression and kangaroo care, may improve the rates of successful lactation among mothers of VLBW infants who choose to breastfeed. *Pediatrics* 2002;109(4). URL: <http://www.pediatrics.org/cgi/content/full/109/4/e57>; lactation, very low birth weight infant, breastfeeding.

ABBREVIATIONS. VLBW, very low birth weight; CA, corrected age; EPDS, Edinburgh Postnatal Depression Scale; CES-D, Center for Epidemiological Studies Depression Scale.

Breast milk is considered the ideal nutrition for full-term infants. Its advantages for the feeding of preterm infants have received increasing attention.¹ Described benefits for premature infants include prevention of infection, a reduction in the rate and severity of necrotizing enterocolitis and retinopathy of prematurity, and a possible beneficial

effect on later intelligence.¹⁻⁹ Because of infant immaturity and/or neonatal morbidity, most mothers of very low birth weight infants (VLBW; <1500 g) need to express breast milk for weeks and sometimes months before their infant is able to nurse at the breast. The reported rates of successful lactation for mothers of preterm infants, especially VLBW infants, are low.^{10,11} We previously reported, in a small observational study, that only 8 (21%) of 39 mothers of VLBW infants made a successful transition to nursing at the breast.¹¹ In the current study, we sought to examine prospectively the determinants of maternal choice to breastfeed and of successful lactation and nursing at the breast among a larger population of mothers of VLBW infants.

METHODS

During the period January 1, 1997, to February 14, 1999, 344 VLBW infants were admitted to the neonatal intensive care unit at Rainbow Babies and Childrens Hospital (Cleveland, OH). Criteria for inclusion in the study were singleton birth; birth weight between 600 and 1499 g; gestational age <33 weeks; absence of positive drug screen, major congenital anomaly, or intrauterine infection; and no overwhelming maternal social factors, such as a custody dispute. Of the 344 infants, 195 (57%) were excluded, 88 because of multiple birth, 36 because of social factors or positive drug screen, 26 because they had a birth weight <600 g, 21 because they had a gestational age >32 weeks, 15 because of critical illness or death before enrollment, 7 because of congenital anomaly or infection, and 2 because of maternal illness.

A total of 119 (80%) of the 149 eligible mothers agreed to participate in the study. They were a mean of 27 years old, 55 (46%) were married, 51 (43%) were white, and 25 (21%) had less than a high school education. Their infants had a mean birth weight of 1056 g and a mean gestational age of 28 weeks, 68 (57%) were male, and 114 (96%) were born at the perinatal center. The 119 participating mothers did not differ from the 30 mothers who did not consent to participate with regard to marital status; race; age; level of education; or their infants' birth weight, gestational age, or gender.

All mothers of preterm infants were encouraged to provide breast milk for their infants per nursery policy. In the study population, 87 mothers (73%) decided to breastfeed and 32 (27%) to decide to formula feed. At enrollment 3 weeks after delivery and at 35 weeks', 40 weeks', and 4 months' corrected age (CA; postmenstrual plus postnatal age), mothers completed questionnaires pertaining to intent to breastfeed or formula feed, social supports, and lactation. The questionnaires covered both the factual and emotional aspects of the breast- and bottle-feeding experience of mothers of premature infants. They included details of milk expression, nursing, and bottle and formula feeding; and for mothers who discontinued pumping or nursing, they examined reasons for their decision. The questionnaires were developed by the authors specifically for this study because a previously validated questionnaire that covered all areas of inquiry was not available. The research nurse administered all questionnaires to achieve consistency and reliability and to build with the mother a relationship that facilitated sharing of accurate information.¹² Questions that rated support or opinion used a consistent 1 to 5 Likert scale format. Continued lactation was defined as continuing

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to express or pump breast milk and/or attempting to nurse the infant at the breast.

A sociodemographic questionnaire covered family composition, social supports, and access and travel time to the hospital. Information about maternal employment before and after the infant's birth was obtained. Socioeconomic status was measured with the Duncan score, an index based on occupation.¹³ We averaged the scores of the mother and father when the father was described as involved in the infant's home. Depressive symptoms were examined with the Edinburgh Postnatal Depression Scale (EPDS) at 40 weeks' CA, and the Center for Epidemiological Studies Depression Scale (CES-D) at 4 months' CA.^{14,15} Depression was defined as a score of ≥ 10 on the EPDS and as ≥ 16 on the CES-D. The EPDS consists of 10 items scored from 0 to 3, can be completed in < 5 minutes, and has been extensively validated. For a cutoff score of 10, the published sensitivity for detecting depression ranges from 79% to 100% with specificity ranging from 64% to 85%.^{16,17} The CES-D is a self-report depression scale for use with the general population, consists of 20 items scored from 0 to 3, and has been found to have good test-retest reliability in previous research.¹⁸

Maternal and infant prenatal, birth, and neonatal data were gathered by trained research nurses who abstracted data from the medical record at discharge. Nutritional intake was recorded daily while the infant was hospitalized and included age of first and full enteral feeds, age of first bottle and breast feedings, and frequency of pumping and nursing at the breast. After discharge, mothers were asked to keep a 72-hour food diary of nutritional intake before the 40-week and 4-month CA interviews. It has been shown that mothers' recall of infant feeding, especially breast and solid food feedings, is accurate until the infant is 12 months of age.¹⁹

All 119 mothers were interviewed on intake 3 weeks after delivery and at 35 weeks' CA. Two of the 32 mothers who chose to bottle feed were lost to follow-up by the time of the 40-week interview, and an additional mother was lost by 4 months' CA. All 87 mothers who originally chose to breastfeed were reinterviewed at 40 weeks' CA, but 4 could not be contacted at 4 months' CA (see Fig 1 for participant follow-up summary). Reasons for inability to contact the mothers included move outside the United States, move to another residence without forwarding address or tele-

phone, and disconnected telephone with no answer to mail contact.

The Institutional Review Board of University Hospitals approved this study.

Data Analysis

We used the *t* test to compare continuous measures and the χ^2 or Fisher exact test to compare categorical data. Nonparametric continuous data were analyzed with the Mann-Whitney *U* test. Multiple logistic regression was performed to examine the association between identified univariate correlates of continued lactation beyond 40 weeks' CA while controlling for associated demographic factors (analysis performed using SPSS; SPSS, Inc, Chicago, IL).

RESULTS

Table 1 presents a comparison of the demographic descriptors, obstetrical details, and birth data of the 87 mothers who intended to breastfeed and the 32 who intended to formula feed. Significantly more mothers who chose to breastfeed were married, were primiparous, had more than a high school education, and had a higher Duncan score. They did not differ with respect to age, race, or current obstetrical history. The timing of the mothers' decisions to feed by breast or bottle were similar, with 40% versus 38% deciding before pregnancy, 37% versus 34% deciding during pregnancy, and 23% versus 28% deciding after delivery, respectively. Infants of mothers who intended to breastfeed, as compared with infants of mothers who chose to formula feed, had a significantly lower birth weight and gestational age but did not differ with regard to gender, hospital of birth, or intrauterine growth.

Of the 87 mothers who chose to breastfeed, 18

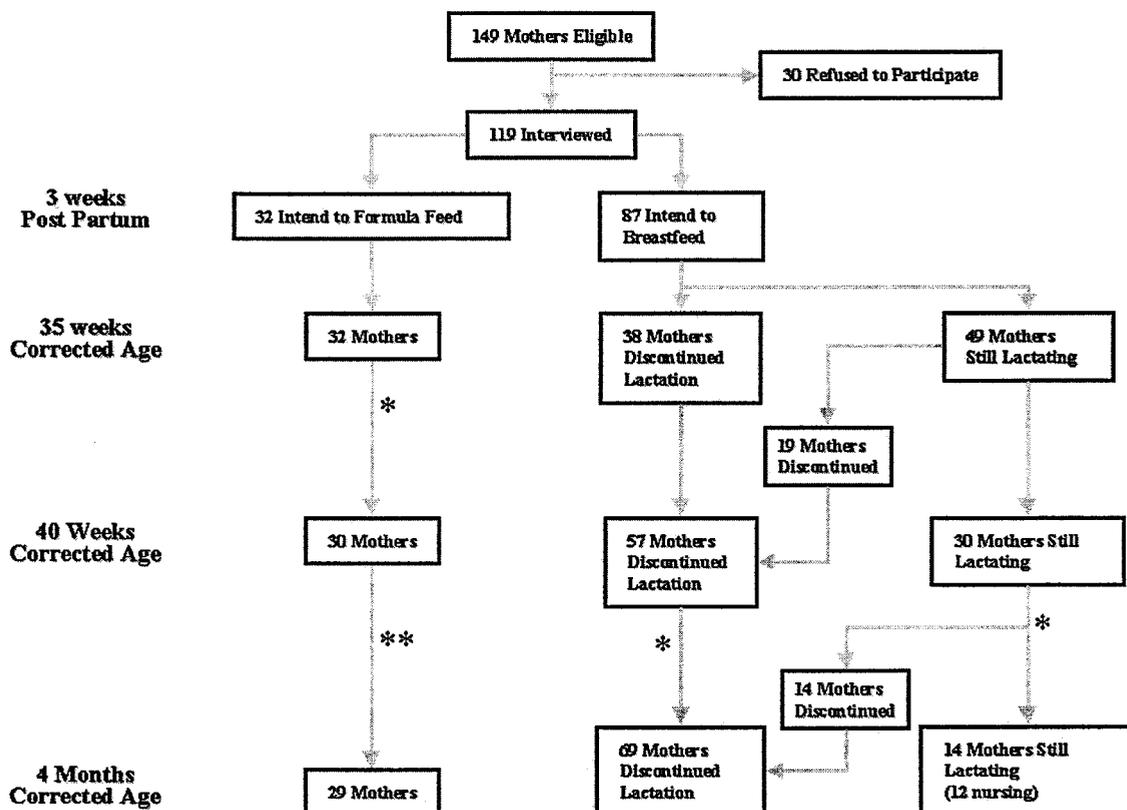


Fig 1. Patient follow-up and tracking.

TABLE 1. Comparison of Maternal and Infant Descriptors by Maternal Feeding Choice

	Intent to Breastfeed (n = 87)	Intent to Formula Feed (n = 32)	P Value
Maternal descriptors			
Age (mean y ± SD)	28 ± 7	26 ± 8	.19
Race (n, % white)	39(45)	12 (38)	.61
Marital status (n, % unmarried)	41 (47)	23 (72)	.03
Education (n, % >HS)	45 (52)	8 (25)	.02
Duncan score* (mean ± SD)	35 ± 15	25 ± 8	<.001
Have other child (n, %)	42 (48)	23 (72)	.04
Breastfed previous child? (n, %)	24 (57)	7(30)	.07
Current obstetrical history (n, %)			
Inborn	83 (95)	31 (97)	1.0
Maternal transport	23 (26)	6 (19)	.53
Preeclampsia	11 (13)	6 (19)	.39
Antepartum hemorrhage	10 (11)	7 (22)	.23
Prenatal steroids	71 (82)	25 (78)	.87
Cesarean section	44 (51)	16 (50)	1.0
Birth data			
Birth weight (mean g ± SD)	1025 ± 252	1140 ± 239	.03
Gestational age (mean w ± SD)	27 ± 2	29 ± 2	.01
Gender (n, % male)	51 (59)	17 (53)	.74
Apgar <6 at 5 min (n, %)	11 (13)	5 (16)	.76
SGA† (n, %)	7 (8)	2 (6)	1.0

SD indicates standard deviation; HS, high school; SGA, small for gestational age.

* Duncan score is a socioeconomic index based on occupation.¹³

† Defined as birth weight <2 SD for gestational age.³⁵

discontinued within 3 weeks of delivery and an additional 39 discontinued at or before 40 weeks' CA. Thirty mothers (34%) continued lactation beyond 40 weeks' CA, 14 (16%) of whom were still expressing milk at 4 months' CA. At this time, 12 mothers (14% of the original cohort intending to breastfeed) were nursing the infant at the breast at least 1 time per day.

Table 2 presents a comparison of the 30 mothers who continued lactation beyond 40 weeks' CA and the 39 who had discontinued by this time. Mothers who lactated beyond 40 weeks were older, more were married, were white, and had more than a high school education than those who had discontinued. Current obstetrical history did not differ between the

TABLE 2. Comparison of Mothers Who Continued and Those Who Had Discontinued Lactation by 40 Weeks' CA*

	Lactation at 40 Weeks' CA*		P Value
	Continued (n = 30)	Discontinued (n = 57)	
Maternal descriptors			
Age (mean y ± SD)	31 ± 7	26 ± 7	<.01
Race (n, % white)	19 (63)	20 (35)	.02
Marital status (n, % married)	24 (80)	22 (39)	<.001
Education (n, % >HS)	21 (70)	24 (42)	.02
Duncan score† (mean ± SD)	42 ± 16	31 ± 13	<.01
Current obstetrical history (n, %)			
Inborn	29 (97)	54 (95)	1.0
Maternal transport	11 (37)	12 (21)	.19
Preeclampsia	5 (17)	6 (11)	.50
Antepartum hemorrhage	4 (13)	6 (11)	.73
Prenatal steroids	26 (87)	45 (79)	.55
Cesarean section	16 (53)	28 (49)	.88

* Postmenstrual plus postnatal age.

† Duncan score is a socioeconomic index based on occupation.¹³

groups. Table 3 presents a comparison of birth data and rates of neonatal morbidity for their infants. There were no significant differences between groups.

Table 4 presents a comparison of personal and family factors. Significantly more mothers who continued lactation beyond 40 weeks' CA had decided to breastfeed before the present pregnancy. They expressed a stronger desire to breastfeed and a

TABLE 3. Comparison of Infants Whose Mothers Continued versus Discontinued Lactation by 40 Weeks' CA

	Lactation at 40 Weeks' CA*		P Value
	Continued (n = 30)	Discontinued (n = 57)	
Birth data			
Birth weight (mean g ± SD)	1072 ± 235	1000 ± 259	.20
Gestational age (mean wk ± SD)	28 ± 2	27 ± 2	.43
Gender (n, % male)	19 (63)	32 (56)	.68
SGA (n, %) [†]	1 (3)	6 (11)	.41
Neonatal morbidity			
Chronic lung disease‡ (n, %)	11 (37)	23 (40)	.92
Ventilator dependence (mean d ± SD)	14 ± 14	17 ± 17	.37
Apnea of prematurity (n, %)	30 (100)	53 (93)	.29
Sepsis (n, %)	6 (20)	22 (39)	.13
Necrotizing enterocolitis (n, %)	0 (0)	5 (9)	.16
Abnormal cranial ultrasound§ (n, %)	5 (17)	11 (19)	.99
Hospital stay (mean d ± SD)	73 ± 27	80 ± 32	.31

* Postmenstrual plus postnatal age.

† Defined as birth weight <2 SD for gestational age.³⁵

‡ Defined as oxygen dependence at 36 weeks' CA.³⁶

§ Defined as grade 3 or 4 intraventricular hemorrhage, periventricular leukomalacia, and/or ventricular dilation at discharge.

TABLE 4. Comparison of Family, Personal, and Behavioral Factors Between Mothers Who Continued and Those Who Had Discontinued Lactation by 40 Weeks' CA

	Lactation at 40 Weeks' CA*		P Value
	Continued (n = 30)	Discontinued (n = 57)	
Family			
Have other children	15 (50%)	27 (47%)	.99
Breastfed previous child	12 (80%) of 15	12 (44%) of 27	.06
One or more children ≤age 6 y at home	11 (37%)	21 (37%)	1.0
Father of the baby			
Involved	28 (93%)	50 (88%)	.71
Employed	27 (90%)	45 (79%)	.32
Supports breastfeeding	22 (73%)	34 (60%)	.30
Kangaroo care			
Heard of kangaroo care	28 (93%)	40 (70%)	.03
Tried kangaroo care	25 (89%) of 28	24 (60%) of 40	.02
Decision to breastfeed			
Timing			<.01
Before pregnancy	19 (63%)	16 (28%)	
During pregnancy	9 (30%)	23 (40%)	
After delivery	2 (7%)	18 (32%)	
Desire to breastfeed†	1.1 ± 0.5	1.8 ± 1.0	<.001
Breastfeeding satisfaction‡	1.2 ± 0.4	1.8 ± 0.9	<.001

* Postmenstrual plus postnatal age.

† Likert scale 1-5, 1 = very much, 5 = not at all.

‡ Likert scale 1-5, 1 = very satisfied, 5 = not at all.

greater satisfaction with their choice than the mothers who discontinued. There were no differences in family factors; however, mothers who continued lactation beyond 40 weeks tended to have breastfed a previous child ($P = .06$). Significantly more mothers who continued lactation beyond 40 weeks had used kangaroo care (skin-to-skin care).

The mothers who lactated beyond 40 weeks and those who had discontinued reported similar levels of support for breastfeeding from nurses, doctors, fathers, and family or friends at both the initial and the 35-week interviews. Mothers who continued lactation beyond 40 weeks' CA were more likely to have access to a working car at the initial interview (97% vs 77%; $P = .03$). There were no differences between the groups in mean travel time to the hospital or in the level of family support reported for getting to the hospital. There were also no differences in maternal ratings of general health, personal energy level, and amount of pain persisting from delivery (data not shown).

Table 5 presents a comparison of details pertaining to milk expression and bottle feeding. Compared with mothers who discontinued, mothers who continued lactation beyond 40 weeks' CA reported expressing significantly more milk at each pumping at both the initial and the 35-week interviews, and more reported beginning milk expression at <6 hours after delivery and expressing ≥ 5 times per day. There was no difference between groups in electric breast pump ownership or availability. Both groups of mothers reported sufficient availability of breast pumps and places to pump privately at both the initial and 35-week interviews (data not shown). The age of first bottle feeding did not differ between the infants of mothers who continued lactation beyond 40 weeks

TABLE 5. Comparison of Factors Related to Milk Expression and Bottle Feeding Between Mothers Who Continued and Those Who Had Discontinued Lactation by 40 Weeks' CA

	Lactation at 40 Weeks' CA*		P Value
	Continued (n = 30)	Discontinued (n = 57)	
Milk expression			
Began <6 h after delivery	9 (30%)	5 (9%)	.02
Expressed ≥ 5 x/d			
Initial interview	26 (87%)	36 (63%)	.04
35 wk CA	24 (80%)	15 (79%)†	1.0
Mean volume ± SD (mL)			
per pumping			
Initial interview	126 ± 75	66 ± 45	<.001
35 wk CA	132 ± 75	54 ± 40†	<.001
Owned or rented an electric pump			
Initial interview	26 (87%)	40(70%)	.15
35 wk CA	28 (93%)	17 (89%)†	.64
Electric pump covered by insurance	17 (74%)	28 (72%)	1.0
Bottle feeding			
First nipple fed by bottle			
Postnatal age (mean ± SD)	43 ± 19 d	47 ± 20 d	.43
Corrected age (mean ± SD)	34 ± 1 wk	34 ± 2 wk	.67

* Postmenstrual plus postnatal age.

† $n = 19$ (of the 57 mothers who discontinued lactation by 40 weeks' CA, 19 were still lactating at 35 weeks' CA).

and those who discontinued. The main reason cited for discontinuing lactation was a low milk supply. This was despite reporting expressing a mean of 57 mL 6 times per day the week before discontinuing lactation (the equivalent of >150 mL/kg/d for a 2-kg infant). Additional reasons given by the mothers for discontinuing were that they had no time, were exhausted, and were tired of pumping.

TABLE 6. Comparison of Nursing Factors Between Mothers Who Continued and Those Who Had Discontinued Lactation by 40 Weeks' CA

	Lactation by 40 Weeks' CA*		P Value
	Continued (n = 30)	Discontinued (n = 19)†	
Nursing			
Always a let-down sensation with pumping	18 (60%)	8 (42%)	.35
Infant to breast by 35 wk CA	29 (97%)	14 (74%)	.03
Always a let-down sensation with nursing	15 (52%)	8 (57%)	.99
First breastfeed			
Postnatal age (mean ± SD)	41 ± 16 d	38 ± 21 d	.64
CA (mean ± SD)	33 ± 1 wk	34 ± 2 wk	.57
Postnatal age of first latch-on (mean ± SD)	44 ± 16 d	38 ± 22 d	.39
Infant always latches on	21 (72%)	8 (57%)	.49
Frequency of breastfeeds (mean per day ± SD)	1.4 ± 1.0	0.8 ± 0.6	.04

* Postmenstrual plus postnatal age.

† Of the 57 mothers who discontinued lactation by 40 weeks' CA, 18 discontinued by 3 weeks of age and 20 discontinued before 35 weeks' CA; thus, only 19 mothers were still lactating at 35 weeks' CA and able to respond to questions regarding nursing factors.

Of the 57 mothers who discontinued lactation by 40 weeks' CA, 18 discontinued by 3 weeks of age, and 20 discontinued before 35 weeks; therefore, only 19 of the 57 mothers were still lactating at 35 weeks' CA and able to respond to questions regarding nursing factors. Table 6 presents a comparison of factors related to nursing among the 19 mothers who discontinued between 35 and 40 weeks' CA and the 30 mothers who continued lactation beyond 40 weeks. The rates of reporting a consistent infant latch-on and a let-down sensation with pumping and nursing, and the mean age at first breastfeeding and at first successful infant latch-on did not differ between groups. However, mothers who lactated beyond 40 weeks' CA were putting their infants to the breast more frequently, and more had already put the infant to breast by 35 weeks.

Multiple logistic regression analysis was performed to examine the association between the identified univariate correlates of continuing lactation beyond 40 weeks' CA while controlling for demographic factors shown to be associated with continuing lactation, including maternal age, race, marital status, and education beyond high school. The correlates examined each continued to be significantly associated with continuing lactation beyond 40 weeks' CA: practice of kangaroo care ($P < .01$), beginning milk expression before 6 hours after delivery ($P < .02$), expressing milk ≥ 5 times per day at initial interview ($P < .04$), mean ounces expressed per day at initial interview ($P < .001$), and putting the infant to the breast by 35 weeks; CA ($P < .001$; regression models available on request).

Out-of-home employment, personal health ratings, and rates of depressive symptoms were compared between mothers who continued lactation beyond 40 weeks' CA and those who had discontinued. The percentage of mothers who were working outside the home and the hours worked per week did not differ between groups at either 40 weeks' or 4 months' CA. Mothers from both groups rated their health and energy levels similarly. There were no differences in the rates of maternal depression at 40 weeks' CA (6 [20%] vs 17 [30%]; $P = .44$) or at 4 months' CA (6 [22%] vs 10 [19%]; $P = .92$). The significance of this result did not change when corrected for whether the infant was still hospitalized.

Fourteen mothers were still lactating at 4 months' CA. Employment outside the home did not seem to have an effect on continuing lactation at this time (4 of 14 who continued vs 6 of 14 who discontinued). Twelve of the 14 mothers were nursing the infant at the breast. They reported nursing an average of 5.4 times per day (range: 1.5–9) for an average of 21 minutes per feeding (range: 10–35 minutes). None of the infants was fully breastfed. They received an average of 3.5 formula feedings per day (range: 1–6.5). Nine of the 12 nursing mothers were white, 11 were married, and 9 had more than a high school education. Because the total number of nursing mothers was small, we did not analyze comparative demographic, neonatal, or lactation data for this group.

The results of this observational study revealed that 73% of mothers of VLBW infants intended to breastfeed; 34% continued lactation beyond 40 weeks, and only 14% ultimately nursed the infant at the breast at 4 months. Intent to breastfeed before delivery and maternal factors indicative of higher socioeconomic status were significantly associated with the decision to breastfeed and its success beyond 40 weeks. Other important factors related to lactation beyond 40 weeks included initiating milk expression at < 6 hours after delivery, expressing 5 or more times per day, practicing kangaroo care, and putting the infant to the breast more often. Perinatal factors, generalized social supports, access to a breast pump, depressive symptoms, and rate of maternal employment did not seem to affect continuation of lactation beyond 40 weeks' CA. Although our rates of nursing at the breast seem low, no published data are available from similar urban perinatal centers with a high proportion of inner-city mothers for comparison.

Little information has been available regarding correlates of the choice to breastfeed and its success among mothers of VLBW infants. In studies of full-term infants, mothers who chose to breastfeed have tended to be white, be older, be married, have a high school or greater education, and have a middle or upper income.²⁰ We similarly found that mothers of VLBW infants who intended to breastfeed were more likely to have more than a high school education, be primiparous, be married, and have a higher socioeconomic Duncan score than those who bottle fed, but they were not older and there was no difference with respect to ethnicity. Bier et al²¹ also found that mothers who intended to breastfeed came from a higher social class but were not older than mothers who intended to feed formula. Our 73% rate of intent to breastfeed is within the range of 47% to 84% reported for mothers in the United States, although rates outside the United States may be higher.^{11,21–24} Similar to mothers of full-term infants, 41% or more of whom decide on a feeding method before pregnancy, 40% of the mothers in our study had made their choice to breastfeed before pregnancy.^{25,26}

Among mothers of VLBW infants, reported rates of discontinuation of lactation before discharge or within 3 months postdischarge range from 23% to 80%.^{11,21,22,27} We chose to examine the rate of discontinuation of lactation by 40 weeks' CA rather than by hospital discharge, because timing of discharge may be influenced by social, local, and insurance factors rather than solely by infant or maternal factors, and hence comparison between studies is difficult.

Continuation of lactation beyond 40 weeks' CA, similar to the decision to breastfeed, was associated with being older, being married, being white, having more than a high school education, and having a higher Duncan score. Mothers who continued lactation beyond 40 weeks expressed a stronger desire to breastfeed and greater satisfaction with their choice than those who discontinued by 40 weeks. Significantly more of these mothers had decided to breast-

feed before pregnancy. The majority in both groups reported excellent support. Pinelli et al²⁷ in Ontario, Canada, performed a randomized trial of breastfeeding support for parents of VLBW infants who intended to breastfeed, which included a video on the technique of breastfeeding preterm infants, counseling by a lactation consultant, and weekly in-hospital and frequent postdischarge contact. The intervention had no influence on the duration of breastfeeding, and the authors postulated that this could be explained by the high motivation to breastfeed in both groups as well as the availability of community resources. Kaufman and Hall²⁸ found that the number of supports that a mother reported strongly influenced duration of lactation; however, they studied mothers of larger preterm infants who had a mean birth weight of 1701 g for whom determinants of lactation may be different. Our results and those of Pinelli suggest that motivation and previous commitment rather than obstetric, delivery, or neonatal factors are major determinants of duration of lactation in mothers of VLBW infants.

Mothers who continued lactation beyond 40 weeks' CA also differed with respect to milk expression and nursing frequency. They began expressing earlier, pumped more frequently, and expressed significantly more milk at each pumping session. Hill et al¹⁰ showed that mothers of VLBW infants who produced adequate milk volumes at 5 weeks postpartum pumped at least 45 times per week (>6 times per day). The most frequent reason given for discontinuing lactation in our study was a low milk supply, despite that mothers reported expressing adequate milk volumes the week before discontinuing. This suggests that maternal anxiety about the quantity expressed rather than the actual volume was the most important factor. Pinelli et al²⁷ similarly found a low milk supply to be the most frequent reason for discontinuing lactation. The most frequent concern of mothers breastfeeding a premature infant after discharge has also been reported to be insufficient milk. Hill et al²⁹ found that previous breastfeeding experience predicted greater milk yield in mothers of VLBW infants. We found a similar trend in our study. We also found that mothers who continued lactation beyond 40 weeks' CA were putting their infants to the breast significantly more often. However, the postnatal and gestational ages at which the infants were first put to the breast and first nipple fed by bottle did not differ from that of infants whose mothers had discontinued lactation. This suggests that in our population, earlier bottle feeding, which might be hypothesized to result in "nipple confusion," was not a factor in failure to sustain lactation.

The apparent beneficial effects of kangaroo care found in our study have been previously reported. Whitelaw et al³¹ found that mothers of VLBW infants who practiced kangaroo care lactated on average 4 weeks longer than a control group. Bier et al³² similarly found that mothers of VLBW infants were less likely to discontinue lactation before discharge if they practiced skin-to-skin care.

We found that these behavioral correlates of continued lactation beyond 40 weeks' CA remained sig-

nificant even after controlling for factors associated with higher maternal socioeconomic status, including maternal age, race, marital status, and education beyond high school. Specifically, early and frequent milk expression, expressing a larger volume of milk per day at initial interview, putting the infant to the breast by 35 weeks' CA, and kangaroo care each was independently associated with successful lactation beyond 40 weeks' CA. This result suggests that focused interventions specifically directed toward these factors might benefit mothers who seek to breastfeed their VLBW infant.

Out-of-home employment and earlier return to work have been associated with decreased duration of breastfeeding among mothers of full-term infants.³³ However, in our population, the rates of maternal employment outside the home did not seem to influence whether mothers continued lactation beyond 40 weeks. It is possible that mothers of VLBW infants are so practiced in milk expression and tolerating separation from the infant that the added effect of out-of-home employment is minimal. We also did not find an effect of rates of depressive symptoms on continuing lactation beyond 40 weeks' CA. The percentage of mothers who screened as being clinically depressed in our population seems high (19%–30%) but is not different from other studies of mothers of premature infants.³⁴

CONCLUSION

Although higher socioeconomic status was significantly associated with the decision to breastfeed and its success beyond 40 weeks' CA, behavioral factors, including early and frequent milk expression and kangaroo care, were independently associated with lactation beyond 40 weeks' CA. We speculate that increased maternal support directed toward these factors might improve the rates of successful lactation among mothers of VLBW infants who choose to breastfeed.

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