

Original Articles

Feeding Interactions in Infants with Very Low Birth Weight and Bronchopulmonary Dysplasia

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ABSTRACT. Infants with very low birth weight (VLBW) are at increased risk for feeding disorders that can affect growth and development. One hundred and forty one mother-infant pairs were compared [55 with infants with high medical risk due to infant VLBW and bronchopulmonary dysplasia (BPD), 34 VLBW without BPD, and 52 term infants] on operationally defined measures of feeding behaviors and maternal self-report of depression and anxiety. Mothers of VLBW infants with and without BPD spent more time prompting their infants to feed when their infants engaged in nonfeeding behavior. Despite increased maternal efforts, infants with BPD took in less formula, spent less time sucking, and spent a greater proportion of time nonfeeding. VLBW infants without BPD were equivalent to term infants in percentage of time sucking and in volume of formula ingested and were more likely to take in higher calories than infants with BPD. Mothers of VLBW infants with and without BPD were also more likely to report clinically significant symptoms of depression and anxiety than mothers of term infants. Because mothers of VLBW infants who were more depressed or anxious were less likely to verbally prompt their infants to eat, maternal psychological symptoms should be considered in assessing interactions of VLBW mother-infant dyads. *J Dev Behav Pediatr* 17:69-76, 1996. Index terms: *bronchopulmonary dysplasia, very low birth weight infant, feeding, maternal depression, prematurity.*

Numerous case reports indicate that preterm infants with very low birth weight (VLBW) and chronic illnesses such as bronchopulmonary dysplasia (BPD) are at increased risk for feeding disorders that can negatively affect growth and development.¹⁻⁴ Medical and biological contributors to feeding disorders in infancy are varied but can include painful oral experiences related to medical procedures, aversive conditioning of illness-related visceral responses, anorexia, fatigue, metabolic changes, feeding-related hypoxemia, and deprivation of normal learning experiences that may be particularly critical during the first 18 months of life.⁵⁻⁸

Parental responses to infant feeding behaviors, including maternal anxiety, also have been implicated as contributing to feeding disorders in clinical reports.^{9,10} Maternal-infant interactions have been a particular focus of studies of preterm infants and have been investigated in preterm populations in both feeding and play contexts. The majority of studies indicate that, in the first year of life, preterm infants and their mothers interact differently than do their full-term or healthier counterparts. Preterm infants have been found to be less responsive and interactive and fussier,¹² with less positive affect and fewer vocalizations¹³ than full-term infants in both feeding and play situations with their mothers.

Mothers of preterm infants have been characterized as overactive and more verbal,¹¹ more attentive, and more physically stimulating^{11,13} than mothers of term infants during the first year of life. There has been some suggestion that these increased interactions may not be optimal; however,

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they also have been noted to be less contingent and playful,¹¹ more controlling,¹⁴ and less sensitive and affectively positive.¹⁵

Severity of illness or risk status might also be a factor in how preterm, VLBW infant-mother dyads interact. Postnatal medical problems and infant chronic illness may lead to increased maternal distress,^{16,17} which might independently affect caregiving behavior in addition to the impact of infant behavioral differences potentially associated with chronic illness. Increased depression, noted in mothers of chronically ill or disabled older children¹⁸ and sick, VLBW infants,¹⁷ also has been shown to affect maternal-infant interactions in healthy term dyads¹⁹ but has not been assessed in preterm dyads.

In studies in which illness has been a differentiating factor, there have been inconsistent findings related to maternal behavior. Field²⁰ found mothers of preterm infants with respiratory distress syndrome to be more stimulating than mothers of full-term infants, but mothers of preterms did not respond contingently to their infants' cues. Goldberg and colleagues²¹ found that, at 8 months of age, preterm infants with a history of respiratory distress syndrome received more parental attention. Similarly, sick infants were found to receive increased caregiving efforts in Beckwith and Cohen's¹⁵ study of 126 preterms at 1 month corrected age. However, in another study,²² when sick and moderately ill VLBW infants were studied neonatally, mothers of sick VLBW infants touched their infants less, smiled less, and engaged them en face less than mothers of healthier VLBW infants. Sixteen severely ill preterms with BPD were compared at 4 and 8 months of age with 18 preterms²³ with respiratory distress syndrome and with 12 healthy preterms using the Nursing Child Assessment Teaching Scales.²⁴ Although infant behavior did not differ across groups, mothers whose infants had BPD were less responsive to infant distress, less sensitive to infant cues, and less fostering of infant social and emotional growth, whereas mothers of infants with respiratory distress syndrome increased in their social-emotional growth-fostering efforts over time.

Some of the inconsistencies noted in studies of maternal behavior with preterm infants may reflect differing degrees of infant illness severity and/or biological risk status. Earlier studies of "sick" preterms^{11,15,22} probably are more representative of current healthier preterm groups than of the VLBW, more premature, sicker, and smaller infants with chronic lung disease, such as BPD, and/or hemorrhage that are prevalent in recent cohorts.

VLBW infants with BPD, in particular, can provide models for understanding the development of clinical feeding disorders. BPD is the leading cause of infant lung disease in the United States, affecting 7000 newborn infants annually.²⁵ Infants with BPD have significant biological risk factors that may interfere with the acquisition of normal feeding behaviors^{1,26} and negatively affect long-term growth and developmental outcome. Infants with BPD have been shown to have an elevated resting metabolic rate²⁷ and rapid respiratory rate, resulting in higher energy requirements than the usual growing infant. There have also been multiple reports of recurrent episodes of hypoxemia,²⁶ especially during feedings and sleep,^{28,29} which may result in inadequate oxygen-

ation for metabolic needs and may be responsive to increased oxygen supplementation.³⁰ Neurological abnormalities, difficulties coordinating sucking and swallowing,³¹ and an increased incidence of gastroesophageal reflux³²⁻³⁴ may all interfere with the delivery of adequate nutrition. Simultaneously, these infants are intolerant of fluids, are prone to developing fluid overload, and often require extensive diuretic therapy, with its complications of chloride depletion, gallstone formation, and metabolic alkalosis.^{35,36} Restricting fluids by using high carbohydrate loads in the formula may result in osmotic diarrhea or may worsen respiratory distress. More recently, concern has centered on the use of dexamethasone, with its potential effects on growth.³⁷

The purpose of the present study was to investigate the interrelationships and effects of infant VLBW, with or without BPD, and maternal depression and anxiety on maternal-infant feeding behaviors neonatally. VLBW infants with BPD were hypothesized to show increased feeding difficulties, and their mothers were hypothesized to show increased prompting of feeding behaviors compared with VLBW infants without BPD and with term infants.

METHODS

Sample

This investigation involved 141 mothers and their infants comprising three groups: 55 mothers of sick, very low birth weight (VLBW) infants who had developed bronchopulmonary dysplasia (BPD), 34 mothers of VLBW infants without BPD, and 52 mothers of healthy term infants. Infants with BPD were defined as preterm, VLBW (less than 1500 g at birth) infants who required supplementary oxygen for more than 28 postnatal days and who had radiographic evidence of chronic lung disease.³⁸ VLBW comparison infants required oxygen supplementation for less than 14 days. Term infants had no medical illnesses or abnormalities at birth, were greater than 36 weeks gestational age, and were greater than 2500 g at birth (singleton infants). In all groups, infants whose mothers had known psychiatric illnesses or mental retardation or who had been identified as using drugs during pregnancy were excluded. Screening was implemented through review of medical charts and, for drug use, through clinical interview and urine toxicology screens. For mental retardation, in addition to chart review, mothers also were screened with standardized assessments of vocabulary comprehension and nonverbal intelligence. For all groups, infants also were excluded if they were not in the care of, or fed by, their biological mothers or if they were not yet feeding orally. The sample was recruited from the neonatal intensive care units and newborn nurseries of two tertiary-care and two general hospitals whose combined units treated all infants with BPD within the metropolitan region. Mothers were recruited to be part of a longitudinal study seen at five assessment points until infant age of 3 years.

Demographic and medical data were taken from hospital chart and maternal interview. Infant gestational age was based on combined information from Ballard examination³⁹ and maternal dates of last menstrual period. Ultrasounds were obtained on all infants. In addition, the presence/absence of the following neurological abnormalities was noted:

neurological malformations, seizures, echodense lesions, porencephaly, hydrocephalus, ventriculoperitoneal shunt, meningitis, intraventricular hemorrhages, and periventricular leukomalacia. A summary variable using 0 for absence and 1 for presence of any neurological risk factor was calculated. Although severity of intraventricular hemorrhage was also graded based on standard criteria, only an unweighted sum was used in this analysis because the focus was on overall risk rather than on specific neurological problems.

Procedures

Mothers of VLBW infants were approached to join the study while in the hospital before infant discharge. Term mothers who met study criteria were left letters while they were in the hospital at the time of their infant's birth; the letters explained the project and requested that the mothers volunteer for the study. Each mother was paid \$25 for participation, and transportation, if needed, was provided. The present study was approved by the Institutional Review Boards of the participating hospitals, and informed consent was obtained from all mothers.

Feeding Observations. As close to 40 weeks (corrected for prematurity) of age or as soon after term birth as possible, infants were videotaped during a feeding with their mothers. Videotapes were rated by two observers blinded to infant illness status and study hypotheses. Blinding could not be guaranteed across groups, however, because there were obvious physical differences between term and preterm infants. Infants who received oxygen during feeding could be identified as having BPD. However, within the VLBW groups, BPD status was not readily identifiable for the majority of infants with BPD who did not receive oxygen, all of whom were physically similar to the VLBW comparison group. Videotapes were scored for maternal and infant behaviors based on modifications of a method developed by Iwata and

colleagues⁴⁰ to assess and evaluate treatment of a child's individual feeding behaviors.

Response definitions for the six infant and seven maternal behaviors are listed in Table 1. Meals were divided into 30-second intervals, and the number of occurrences of each response was measured using a frequency per interval system for both maternal and child behaviors. Mean percentages of frequency for each infant and maternal behavior were calculated for each subject by dividing the sum of occurrences of responses by the total number of intervals observed for each of the 13 behaviors of interest. Prior studies have indicated that the occurrence of infant feeding behaviors rated through identical or similar definitions was positively correlated with child oral intake and growth, providing validity for these measures.^{4,10,41} Ten randomly selected videotapes were coded independently by the two coders to obtain an estimate of interrater reliability. Mean percentage of exact agreement for each behavior, defined as the total number of agreements divided by the number of intervals scored, ranged from 88 to 100% and averaged $95.4 \pm 4.5\%$ for all behaviors.

The total volume in milliliters of formula consumed over the entire feeding time was measured in a standard measuring cup, and the number of calories consumed during the meal was calculated based on the individual formulas used. Calories lost in emesis were estimated based on weight of infant bib before and after eating. A measure of total calories consumed relative to the infant's weight was also taken. Length of the feeding to the nearest minute was also recorded.

Maternal Distress. At the time of the initial assessment, i.e., 1 month (corrected) infant age, mothers completed the Brief Symptom Inventory (BSI),⁴¹ a widely used, 53-item questionnaire that taps a range of psychiatric symptom patterns. Items are rated on a 5-point scale ranging from "not at all" to "extremely." Two subscales were used: Depres-

TABLE 1. Response Definitions for Neonatal Feeding Observations^a

Infant (% agreement)	
Sucks (96)	Sucking is visible through lip/cheek movement
Spits (100)	Formula expulsion: Any small amount of liquid that had been in infant's mouth and was visible outside the lip and chin area
Nonfeed/avoidance	Any interval in which child ceases sucking behavior or actively avoids sucking/nipple through head-turning, crying, hands-to-mouth, sleeping
Gags (100)	The infant emits gagging sounds or chokes on food
Emesis (100)	Expulsion of a significant amount of formula that appears involuntary; vomiting
Cries/fussy (98)	Infant sobs or sheds tears for at least 5 seconds; infant grimaces
Parent/feeder	
Verbal prompt (91)	Feeder instructs infant to eat, open mouth, chew, swallow
Physical prompt (91)	Feeder jiggles bottle, breast, or infant to facilitate sucking; feeding; models behavior; repositioning for purposes of facilitating feeding
Verbal interaction (88)	Feeder talks to infant about things other than food/eating
Verbal R+ (97)	Feeder verbally praises infant for anything, e.g., good burp
Physical R+ (88)	Feeder hugs, kisses, pats, make physical contact (different from normal holding), burping, rocking, repositioning baby for baby's comfort
Punishment (100)	Feeder reprimands, hits, frowns, makes negative comments; if mother speaks to infant, also score verbal interaction
Verbal/other (95)	Feeder interacts verbally with another person/TV/telephone

^a Items are not mutually exclusive except for sucks and non-feed/avoids nipple. Coder must decide between these two items for a given interval.

TABLE 2. Medical and Demographic Characteristics by Illness Group

	VLBW with BPD		VLBW without BPD		Term		F/ χ^2	p
	Mean	SD	Mean	SD	Mean	SD		
Infant								
Birth weight (g)	934	252	1260	173	3415	495	769	<.001
Weeks gestation	27.1	2	30.4	2	39.8	1	596	<.001
Days on oxygen	76	45	4.3	4	0		113.9	<.001
Neurological risk score	1.4	2	.2	.5	0		18.6	<.001
Race (% white)		55		56		63		NS
Sex (% male)		49		44		51		NS
Singleton birth (%)		89		71		91		<.02
Corrected age (wks)	43.1	4	43.3	5	43.5	3		NS
Family								
Maternal education (yr)	13.1	2	13.6	3	13.6	2		NS
Maternal age (yr)	28.1	6	27.5	6	27.8	6	.10	NS
Socioeconomic status	3.6	1	3.5	1	3.2	1	1.66	NS
Married (%)		57		68		68		NS

VLBW, very low birth weight; BPD, bronchopulmonary dysplasia; NS, not significant.

sion (six items), reflecting a representative range of the indications of clinical depression, including dysphoric mood, suicidal ideation, and lack of motivation ("feeling blue"); and Anxiety (six items), comprising symptoms associated clinically with high levels of manifest anxiety ("nervousness or shakiness").

Normative data indicated that Cronbach's α for global and individual scales ranged from .71 to .83. Test-re-test reliabilities ranged from .68 to .91. Validity has been demonstrated through its relationship to content scales and cluster scores of other measures of psychological distress.

Analyses

Two separate multivariate analyses of variance, (MANOVA), with group as the independent variable, were first conducted separately on the mean percentages of occurrence of the 13 maternal and child feeding behaviors and on the two maternal distress scores (Depression and Anxiety) of the BSI. These were followed by univariate ANOVA with post hoc comparisons. There were significant overall effects for maternal and infant feeding behaviors and maternal distress (Tables 4, 5, and 6). To evaluate the relative contributions of infant VLBW, infant behavior, and maternal distress to maternal and infant feeding behaviors, a series of hierarchical, step-wise multiple regression analyses were also conducted.

RESULTS

Table 2 shows the demographic and medical characteristics of the three groups, indicating that they differed only on factors reflecting illness severity and neurological risk. Infants with bronchopulmonary dysplasia (BPD) had lower birth weights, lower gestational ages, and higher neurological risk. Groups did not differ on other potentially confounding factors, including maternal education, social class, race, age, marital status, or infant age or sex. Very low birth weight (VLBW) infants without BPD were less likely to be of singleton birth.

Group Differences in Feeding Interactions and Growth

As noted in Table 3, weights, lengths, and head circumferences did not differ between VLBW infants with and without BPD, but both groups were significantly smaller on all growth parameters than term infants.

Total time of feeding was increased for VLBW infants with BPD, who required 5 minutes more on average than term infants (Table 4). At the same time, volume of formula taken was less for VLBW infants with BPD than for VLBW infants without BPD and term infants, and VLBW infants with BPD ingested fewer calories than VLBW infants without BPD. Almost half (48%) of VLBW infants without

TABLE 3. Growth Parameters By Group

	VLBW with BPD		VLBW without BPD		Term		F	p
	Mean	SD	Mean	SD	Mean	SD		
Weight (kg)	3.4	1	13.4	1	4.3	1	19.2	<.001 ^a
Length (cm)	49.4	6	49.3	4	54.1	3	17.9	<.001 ^a
Head circumference (cm)	36.2	3	35.6	3	37.3	2	4.3	<.02 ^b

^a BPD and VLBW < Term, $p < .05$.

^b VLBW < Term, $p < .05$.

VLBW, very low birthweight; BPD, bronchopulmonary dysplasia.

TABLE 4. Differences in Infant Feeding Behaviors and Consumption by Illness Group

	VLBW with BPD		VLBW without BPD		Term		F/ χ^2	p
	Mean	SD	Mean	SD	Mean	SD		
Total time (min)	20.4	9	18.7	9	15.3	8	5.17	<.01 ^a
Volume	73.6	47	100.4	51	94.0	44	2.79	<.05 ^b
Calories	52.3	31	67.9	37	63.2	30	2.15	<.10
Calories per kilogram	16.1	10	19.2	11	14.6	7	1.68	NS
Greater than 18 Kcal/kg (%)	31		48		21	8	2.21	<.05 ^d
Feeding behaviors ^e								
Sucks (%)	57.1	23	64.6	17	68.5	22	4.07	<.02 ^b
Spits (%)	.7	2	1.3	2	.3	2	2.75	<.07 ^d
Nonfeed (%)	42.1	23	35.2	17	29.4	20	7.3	<.01 ^c
Cries (%)	8.2	11	4.4	8	5.5	10	1.94	NS
Gags ^f	18		21		19		.64	NS
Emesis ^f	4		3		4		.40	NS

^a BPD and VLBW > Term, $p < .05$.

^b BPD < VLBW and Term, $p < .05$.

^c BPD > Term, $p < .05$.

^d VLBW > Term, $p < .05$.

^e Wilk's Lambda = .86; $F = 1.8$; $df = 12, 266$; $p < .05$.

^f Percentage of group with behavior.

VLBW, very low birthweight; BPD, bronchopulmonary dysplasia; NS, not significant.

BPD ingested more than 18 Kcal/kg during the feeding in comparison with 31% of VLBW infants with BPD and 21% of term infants. VLBW infants with BPD spent less time sucking than VLBW infants without BPD and term infants and a greater proportion of time in nonfeeding behaviors than term infants. Although only a small proportion of VLBW infants without BPD and term infants spent more than half the feeding time in nonfeeding behaviors, 30% of VLBW infants with BPD did so. Groups did not differ in other feeding difficulties.

Mothers of VLBW infants, both with and without BPD, spent a greater percentage of time than mothers of term babies verbally and physically prompting their infants to feed and giving verbal interactions not specific to feeding (Table 5). There were no differences among groups in other categories of behavior.

Maternal Distress. Consistent with our hypothesis, mothers of infants with BPD and of VLBW infants experienced more depression and anxiety symptoms (Table 6). When

clinically significant levels of symptoms were compared, mothers of both infants with BPD and of VLBW infants had an increased incidence of severe (>98th percentile) depressive symptoms (9% vs 0%, $Z_c = 2.1, 2.2$, $ps < .05$), and mothers of infants with BPD had a higher incidence of moderate (>84th percentile) anxiety symptoms, (24% vs 14%, $Z_c = 1.4$, $p < .05$).

Intercorrelations of Infant and Maternal Feeding Behaviors and Maternal Depression and Anxiety for Preterm and Term Groups

The relationships between infant and maternal feeding behaviors and maternal depression and anxiety differed dependent on whether an infant was VLBW or term (Table 7).

Mothers of both preterm and term infants increased their verbal interactions in response to infant nonfeeding behavior. However, only mothers of both groups of VLBW infants were more likely to verbally prompt their infants to feed when infants stopped feeding. Likewise, maternal depres-

TABLE 5. Comparisons of Maternal Feeding Behaviors by Illness Group

Maternal Behavior (Percent Time) ^a	VLBW with BPD		VLBW without BPD		Term		F	p
	Mean	SD	Mean	SD	Mean	SD		
Verbal prompt	10.6	12	9.3	9	7.4	12	1.2	<.05 ^b
Physical prompt	33.3	21	36.7	20	21.5	17	8.6	<.001 ^b
Verbal interaction	44.9	25	48.2	30	35.6	29	2.7	<.05 ^b
Verbal reinforcement	6.9	9	9.9	12	5.9	9	2.1	NS
Physical reinforcement	56.1	26	50.9	21	54.4	27	.4	NS
Punish	.7	2	.4	2	.2	1	1.0	NS
Verbal other	28.6	22	25.2	24	32.3	29	.9	NS

^a MANOVA = Wilk's Lambda = .79; $F = 2.7$; $df = 14, 264$; $p < .005$.

^b BPD, VLBW > Term, $p < .05$.

VLBW, very low birthweight; BPD, bronchopulmonary dysplasia; NS, not significant.

TABLE 6. Maternal Distress Symptoms by Group

Brief Symptom Inventory Subscale	VLBW with BPD		VLBW without BPD		Term		F	<i>p</i>
	Mean	SD	Mean	SD	Mean	SD		
Depression	.7	.9	.7	.9	.3	.4	2.9	<.06
Anxiety	.7	.7	.6	.7	.3	.5	5.1	<.01*

* BPD and VLBW > Term, $p < .05$.

VLBW, very low birthweight; BPD, bronchopulmonary dysplasia.

sion and anxiety were unrelated to maternal feeding behaviors for mothers of term infants. However, mothers of infants with BPD and of VLBW infants who were more anxious and depressed decreased, rather than increased, their verbal prompting during the feeding.

Maternal Psychological and Infant Behavioral Predictors of Maternal Feeding Behavior

Whether maternal depression and anxiety predicted maternal feeding behaviors beyond that of infant medical risk was examined (Table 8). Three pairs of hierarchical multiple regression analyses were conducted with the three maternal feeding behaviors noted above as the dependent variables, evaluating the contribution of VLBW status (group) and, alternatively, maternal depression and anxiety to maternal behaviors, after accounting for infant race, social class, and multiple birth status. As expected, infant VLBW predicted a significant portion of the variance in all three maternal feeding behaviors. Beyond infant VLBW, maternal depression and anxiety significantly increased prediction of maternal verbal prompting. For all three maternal behaviors, infant VLBW remained significant after controlling for maternal psychological distress.

Second, whether maternal depression and/or anxiety predicted maternal feeding behaviors beyond infant nonfeeding behaviors was assessed. Another series of hierarchical regressions was included using maternal feeding behaviors as dependent variables and, alternatively, entering into the equation, after the three control variables, first either depression or anxiety and then infant nonfeeding behavior. Neither depression nor anxiety contributed to prediction of any maternal behavior, once control variables were accounted for, within the term group. Within the combined VLBW group,

however, depression, anxiety, and nonfeeding behaviors were all significant predictors of maternal verbal prompts and verbal interactions after accounting for control factors. Depression accounted for 7% ($p < .03$) and anxiety accounted for 8% ($p < .01$) of the variance in verbal prompting and of 3% ($p < .10$) and 5% ($p < .05$) of the variance in verbal interaction, with increased maternal distress predicting less maternal verbal interaction.

DISCUSSION

It was found that very low birth weight (VLBW) infants with bronchopulmonary dysplasia (BPD) were more difficult to feed than VLBW infants without BPD or than term infants and spent less time sucking and more time in non-feeding behaviors. VLBW infants with BPD took longer to feed, and their mothers exerted increased verbal efforts in feeding, but infants ingested less volume and fewer calories than VLBW infants without BPD. Of interest, VLBW infants without BPD ingested the greatest number of calories, suggesting "catch-up" caloric intake.

Mothers of both groups of VLBW infants, consistent with prior studies,^{11,16} were more verbally interactive and directive with their infants. Stevenson and colleagues¹² have suggested that mothers of preterm infants adapt strategies designed particularly to encourage infant food consumption, as can be noted in this study in the increased prompting of feeding shown by mothers of VLBW infants with and without BPD. What is problematic is understanding the motivation for the increased interaction of mothers whose VLBW infants did not have BPD because those infants did not differ from term infants in feeding behaviors. One possibility is that increased interactive strategies are successful for lower risk, VLBW infants, whereas such strategies may not be effective for sicker infants, such as those with BPD, because of biological and medical constraints such as neurological problems and tendency to have oxygen desaturation during feedings.²⁶ Supporting this latter premise is the finding in the study that increased maternal prompting was related to

TABLE 7. Correlations Among Infant Nonfeeding, Maternal Feeding Behaviors, and Maternal Distress for Very Low Birth Weight and Term Groups

	Verbal Prompt	Depression	Anxiety
Very low birth weight (n = 89)			
Infant Nonfeed	.24*	-.01	.14
Maternal			
Verbal prompt		.27*	-.28*
Depression			.84**
Term (n = 52)			
Infant Nonfeed	.09	-.07	.03
Maternal			
Verbal prompt		-.17	-.05
Depression			.56**

* $p < .05$; ** $p < .001$.

TABLE 8. Predictors of Maternal Verbal Prompting For Very Low Birth Weight Infants

Predictors	R ²	R ² Change	F	<i>p</i>
Verbal prompt				
Step 1				
Race				
Socioeconomic status				
Multiple birth	.07	.07	3.5	<.01
Step 2	.09	.02	3.8	<.05
Group				
Step 3	.14	.05	3.8	<.05
Depression/anxiety				

infant nonfeeding behaviors only for the preterm groups. Also supporting this premise is the finding that VLBW infants without BPD achieved oral intake significantly higher than VLBW infants with BPD, likely due to their mothers' increased efforts.

Both findings indicate that biological risk factors exert a significant effect on neonatal behaviors likely to influence caregiving interactions in VLBW dyads. Infants with BPD in the present study were those at relatively lower risk for feeding disorders, in that infants who were not yet on oral feedings were excluded from study, so the findings suggest that feeding problems warrant further investigation as a potential influence on the long-term growth problems widely noted in VLBW survivors with BPD.¹

In general, these findings are consistent with previous reports of increased fussiness and less adaptive behavior in preterm infants.^{11,16} One other study of VLBW infants with BPD²⁴ found, using a teaching task at 4 and 8 months of age, no differences in infant behaviors among healthy preterms and those with BPD. However, the small sample size or the measures used in that study may have been inadequate to detect differences in infant behavior. Alternatively, infants, by 4 months of age, may have recovered from earlier difficulties.

Better understanding of how mothers adapt to feeding their high risk preterm infants may also be gained from investigating how psychological distress influences maternal feeding behavior in VLBW dyads. The present data indicate that maternal depression and anxiety are related to decreased maternal encouragement of feeding and are consistent with data from other studies of maternal interactions of depressed mothers and healthy infants.²⁰

Both infant nonfeeding behaviors and maternal anxiety and depression exerted significant, independent effects on maternal verbal encouragement of infant feeding, but only for VLBW infants. Our findings have implications for current theorizing related to whether mothers of preterm infants are noncontingently overstimulating or compensating for the preterm infant's unresponsive behavior. Our data suggest that both processes may be occurring and that difficult infant behaviors, severity of infant illness status, and maternal psychological distress each have an impact on maternal behavior.

Some limitations to the present study should be considered. Only one meal was videotaped and coded for each infant, limiting the representativeness of the data because infant and maternal behavior may vary significantly from one feeding to another. However, this limitation is not likely to affect the validity of findings of group differences because

each group sustained similar limitations. Also, similarly, although knowledge of being videotaped may have affected maternal behavior, "halo" effects would only be a problem if they differentially affected the three groups. Finally, the measures of depression and anxiety used are screening measures and should not be construed to reflect a clinical diagnosis. Nevertheless, the screening measure used in the present study has excellent validity in identification of clinical risk status. In so far as maternal self-report of depressive or anxious affect is reflective of clinical status, these symptoms were relevant to her behavior with her infant. Finally, as a group, infants with BPD had lower birth weights, lower gestational ages, and higher neurological risk status than VLBW infants without BPD, precluding attribution of feeding problems to BPD independent of other risk factors.

Our findings indicate that VLBW infants with BPD present increased difficulty to mothers during feeding interactions in the neonatal period. The impact of the small clinical differences in efforts required during an individual feeding should be considered in light of the frequency of early neonatal feedings. Feedings may occur from 6 to 10 times daily, so even small differences can produce a cumulative effect. Maternal adaptation to feeding a VLBW infant, with or without BPD, appears to include an increased directive and verbally interactive strategy that may or may not be successful depending on the degree of infant medical risk. Mothers of VLBW infants used significantly more verbal and physical prompting during feedings. The success of maternal promptings varied depending on the severity of neurological complications and on whether the infant suffered from respiratory illness. Psychological factors that are related to maternal feeding behaviors, such as depression and anxiety, also appear to have differential impact dependent on the severity of infant medical risk. Future studies should address whether these differences persist over time and whether they have long-term effects on infant growth.

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