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Effects of Infant Risk Status and Maternal Psychological Distress on Maternal-Infant Interactions During the First Year of Life

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ABSTRACT. The associations of infant medical risk, prematurity, and maternal psychological distress with the quality of maternal-infant interactions during the first year of life were evaluated in a prospective, longitudinal follow-up from birth. A total of 103 high-risk very low birth weight (VLBW) infants with bronchopulmonary dysplasia, 68 low-risk VLBW infants without bronchopulmonary dysplasia, and 117 healthy term infants were seen at 1, 8, and 12 months of age. Videotaped feedings at each age were rated using the Nursing Child Assessment Feeding Scale, and mothers completed the Brief Symptom Inventory as a measure of psychological distress. VLBW infant status was related to both maternal and infant behaviors as well as to maternal distress, and these relationships varied with infant age. Overall, VLBW infants displayed fewer responsive, clear interactions, with differences from term infants increasing over time. Maternal distress was related to less cognitive growth fostering for all mothers. Because maternal distress is more prevalent in mothers of VLBW infants postpartum, intervention efforts should focus on assessment of maternal distress and the challenges posed by the interactive behaviors of VLBW infants. *J Dev Behav Pediatr 24:233–241, 2003.* Index terms: *very low birth weight, psychological distress, infancy, feeding, maternal-infant interaction.*

Maternal-infant interactions are a major focus of study in preterm and other high-risk infant groups because the quality of maternal-infant interactions has been conceptualized as an important mediating variable between perinatal events that result in biological risk and the later developmental outcome of the infant.[1] Sensitive, responsive, and contingent maternal interactions during feeding and in a variety of other contextual interactions have been related to better cognitive and social competence in studies of both term and preterm infants.[2–6]

Preterm infants differ developmentally from full-term infants[7,8] and possess behavioral characteristics that may cause them to be more difficult partners in dyadic interactions.[9–11] Preterm infants have generally been described as less responsive, less active, and less clear in their communicative and other social interactions than full-term infants,[12–16] although a number of studies have not found differences in the behaviors of preterm infants in interactions with their caregivers.[17–19]

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Likewise, there is considerable controversy about how to characterize maternal responses to preterm infant behaviors, with disagreement about both the amount and quality of interactions.[20] As summarized by Goldberg and DiVitto,[20] mothers of preterm infants have been variously described as both more and less active in their caregiving behaviors, with higher activity also disparately characterized as intrusive or, alternatively, sensitive responsiveness to a less active infant. Thus, despite a large and diverse research base assessing maternal-infant interactions in preterm dyads, there is little consistency among studies in their findings, especially regarding maternal behaviors. These inconsistencies may be attributed to methodological differences, because study samples vary in age, socioeconomic characteristics, sample sizes, observational methodology, and severity of infant risk. Moreover, few studies have assessed maternal-infant interactions over time, although it is well recognized that parental adaptation to high-risk birth is a changing process dependent on multiple factors.[21] Coping with the experience of parenting a low birth weight infant can cause considerable stress as well as provide opportunities for satisfaction.[22–24] In a prior study, we found that the severity of maternal psychological distress after the birth of a very low birth weight (VLBW) infant changed over time and was related to a number of contextual factors including infant age, risk

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status,[24] and developmental outcome.[23] In a longitudinal study, Crnic and colleagues[13] found that mothers of preterm infants changed in their interactive behaviors during the first year of life, from initially more active than term mothers to less active by 12 months, as their preterm infants became less responsive than their term counterparts.

Only three studies have assessed preterm maternal-infant interactions longitudinally while considering the effects of severity of infant medical risk.[17,18,24] The first study used the Nursing Child Assessment Feeding Scale (NCAFS) to compare 16 severely ill preterm infants with 18 preterm infants with less severe respiratory disease and 12 healthy preterm infants at 4 and 8 months of age.[17] No differences were found in infant behaviors, but mothers of the sickest infants were rated as less sensitive and less responsive to their infants than mothers in the other two groups. Mothers of the highest risk infants changed over time from 4 to 8 months, decreasing the frequency of behaviors conceptualized as fostering socioemotional growth, whereas mothers of the less severely ill preterm infants increased the frequency of behaviors, and mothers of the healthiest infants did not change over time.[17]

In contrast, the second study (a large, longitudinal study of low socioeconomic status groups of high-risk VLBW, low-risk VLBW, and term infants compared at 6 and 12 months of age) found no differences in maternal behaviors that were conceptualized to reflect warm sensitivity, stimulation, attention maintenance, and directiveness.[24] Infant groups, however, differed in mental age, language competence, and acquisition of daily living skills.[24]

The third study evaluated maternal-infant interactive behaviors of high- and low-risk preterm and term infants at 2, 4, and 6 months in 278 dyads. Mothers of high-risk full-term infants displayed less sensitivity and involvement and less positive interactions than mothers of low-risk full-term infants, but mothers of preterm infants did not differ from mothers of full-term infants.[18]

One factor with demonstrated importance in its impact on caregiver-infant interactions in healthy term infants that has received little attention in studies of preterm dyadic interactions is maternal psychological distress. Although not all studies are consistent in their findings, maternal psychological distress, as reflected in self-report of symptoms of dysphoric affect, has been related to less positive,[25] less sensitive,[26] and less synchronous maternal behaviors[27] in play and caregiving interactions of healthy term infants. Moreover, maternal psychological distress, especially as reflected in symptoms of depression, has been associated with poorer child cognitive and language outcomes within the first 3 years of life.[23,27–29] In a large diverse sample of mothers and healthy young children followed longitudinally from birth to 3 years, the negative effects of maternal depression on child developmental outcomes were mediated by maternal sensitivity during play interactions,[27] indicating the importance of its effect on child outcomes.

VLBW birth has been found to have a role in precipitating maternal psychological distress, especially symptoms of depression and anxiety.[23,30–33] We have found that mothers of both high- and low-risk VLBW infants reported more severe symptoms of psychological distress than mothers of term infants of similar age, race, marital status, educational level, and socioeconomic status in the postpartum period.[23] These symptoms decreased over the first year of life such that, by 12 months of age, maternal distress did not differ by group.

Given the important relationship of maternal psychological distress symptoms to child developmental outcomes for healthy infants, there has been surprisingly little attention paid to its effects on preterm dyads. In the only study to examine the relationship of severity of maternal psychological distress symptoms to a mother's interactive behaviors, comparing preterm and term groups, we found that VLBW infants moderated the relationship of psychological distress to less optimal maternal feeding behaviors.[15] In that study, mothers of VLBW infants who reported higher symptoms of depression and anxiety were less verbally interactive with their 1-month-old infants and less likely to prompt them to feed, whereas there was no relationship of severity of maternal depressive symptoms to the frequency of these behaviors for term infants.

Because VLBW infants are at greater biological risk, the caregiving context, especially maternal interactive behaviors, may be of greater importance in fostering their developmental competencies.[23,24] Alternatively, infants who are at greater biological risk may be less responsive to their caregiving environment.[34] Because mothers of VLBW infants are more likely to experience psychological distress symptoms early in their infants' lives, an understanding of how such symptoms affect their interactions with their infants over time can provide information important to the design of intervention programs for preterm and other high-risk infants.[35] As part of a study of the sequelae of bronchopulmonary dysplasia (BPD) and VLBW on child development, we have followed groups of high-risk VLBW infants with BPD, low-risk VLBW infants without BPD, and term infants comparable in race, socioeconomic status, gender, and maternal age, education, and marital status longitudinally from birth to 3 years of age. In the present study, infants and their mothers were seen over the first year of life to evaluate the relationships of infant risk status and maternal psychological distress symptoms to maternal and infant behaviors during feeding using a standardized assessment of interaction. On the basis of our previous findings,[15] we hypothesized that mothers of VLBW infants would be more active in their interactions, and that their infants would be less responsive than term dyads over the first year of life. We also hypothesized that maternal distress would be related to less sensitive, less responsive, and fewer cognitive and social-emotional growth-fostering behaviors and would differentially affect the behavior of mothers of VLBW infants.

METHODS

All mothers and infants were seen as part of a longitudinal study on the outcomes of very low birth weight (VLBW) infants with bronchopulmonary dysplasia (BPD).[8] VLBW infants admitted to the neonatal intensive care units of hospitals in the greater Cleveland region were eligible for

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the study and were prospectively and consecutively enrolled at the time of birth.

High-risk VLBW infants were defined as those with all of the following: BPD, weight <1500 g at birth, supplementary oxygen requirement for more than 28 days because of lung immaturity at birth, and radiographic evidence of chronic lung disease.[36] BPD is a chronic lung disease of prematurity and the leading cause of infant lung disease in the United States, affecting 10,000 infants annually. Preterm infants with BPD in the present sample were smaller and sicker, and had more neurological complications and a higher incidence of developmental delay than infants without BPD.[8] A partial stratification sampling strategy was adopted to enroll adequate numbers of subjects without socioeconomic disadvantage or severe neurological risk so that the impact of social class and medical risk factors on outcome could be investigated. Infants with BPD who were free of neurological problems other than grades I and II intraventricular hemorrhage and who were not socially disadvantaged (i.e., Hollingshead classification IV and V) were exhaustively recruited. The remainder was recruited by approaching the family of the next available infant with BPD who could be accommodated in the follow-up schedule. Parents of infants with BPD were approached by a research assistant in the hospital as soon as possible after the diagnosis of BPD was made by the attending neonatologist. Parents were informed that the longitudinal study was investigating the outcomes and family stressors associated with BPD and VLBW.

Low-risk VLBW infants did not have BPD, were preterm, weighed <1500 g at birth, and required oxygen supplementation for less than 14 days. For each infant with BPD, the next-born VLBW comparison infant without BPD and term infant of the same race and socioeconomic status born during the same period were recruited.

As a control group, term infants were recruited from the newborn nurseries. Term infants had no diagnosed medical illnesses or abnormalities at birth, were >36 weeks gestational age, and weighed >2500 g at birth for singleton infants.

Mothers of VLBW infants were approached to join the study while in the hospital before infant discharge. Information about the study and return addressed postcards were provided to all mothers in the term nurseries.

For all groups, infants with drug exposure or major congenital malformations, who lived more than 2 hours driving distance, or whose mothers had major psychiatric or physical illness, human immunodeficiency virus, or mental retardation were excluded. During the recruitment period (1989–1991), 250 infants with BPD were identified, of whom 89 were excluded (35 for drug and alcohol exposure, 21 for all other exclusions, and 33 who could not be accommodated into the testing schedule and who were, by definition, all of lower socioeconomic status and receiving public assistance), leaving 161 eligible VLBW infants with BPD. Of these, 20 infants' parents (12%) refused the study, 14 infants (9%) died, and 5 infants' parents (3%) were unable to be contacted. Of 122 enrolled infants, 7 died, 1 was withdrawn before 8 months of age, and 4 were lost to follow-up, leaving 110 infants with at least one follow-up visit. Of these infants, 94 (85%) were seen at 1 month, 97 (88%) were seen at 8 months, and 91 (83%) were seen at 12 months.

Of 214 VLBW infants without BPD, 24 were excluded for drug and alcohol exposure, 34 for oxygen supplementation for 21 to 28 days, and 46 for all other exclusions, leaving 110 eligible VLBW infants without BPD; of these, 8 infants' parents (7%) were unable to be contacted and 18 infants' parents (16%) refused the study. Of 84 infants recruited, 2 were withdrawn and 1 was lost. Of 81 infants (96%) with a follow-up visit, 45 (54%) were seen at 1 month, 52 (64%) were seen at 8 months, and 59 (73%) were seen at 12 months. Of 123 term infants, 6 were withdrawn and 5 were lost. Of 112 infants (91%) seen for follow-up, 110 (98%) were seen at 1 month, 97 (87%) were seen at 8 months, and 101 (90%) were seen at 12 months.

Sample Characteristics

As noted in our prior studies,[8] high-risk preterm infants with BPD had lower birth weights and gestational ages than low-risk preterm infants who were smaller and of younger gestational ages than term infants (Table 1). Groups did not differ in race, social class, gender, or maternal educational or marital status. There was a higher percentage of multiple births in the low-risk preterm group compared with the other two groups.

Procedures

At 1, 8, and 12 months (infant ages corrected for prematurity), mothers completed the Brief Symptom Inventory (BSI).[37] The BSI is a standardized, self-report measure that assesses nine psychiatric symptom patterns (somatic complaints, obsessive compulsive behavior, interpersonal sensitivity, depression, anxiety, phobic anxiety, paranoid ideation, hostility, and psychoticism) possessing consensually valid clinical significance.[37] Items are rated on a five-point Likert-type scale. Normative data indicate that Cronbach's alpha for global and individual scales ranges from 0.71 to 0.83. Test-retest reliabilities range from 0.68 to 0.91. Validity has been demonstrated through the scale's relationship to content scales and cluster scores of other measures of psychological distress. Prior studies of this sample have demonstrated the BSI to be sensitive to infant risk status and development during the first 3 years of life and to maternal report of degree of social and spousal support.[22,23,32] A summary score, the Global Severity Index, can be derived that measures overall psychological distress and was used in the current data analyses.

Assessment of Feeding

At three visits during the first year of life, that is, as close to 40 weeks (corrected for prematurity) of age or as soon after term birth as possible, and as part of the 8- and 12-month follow-up visits, infants were videotaped during a regularly scheduled feeding with their mothers. Mothers were asked to feed their infants as they normally did. The quality of mother-infant interaction during feeding was measured with the Nursing Child Assessment Feeding Scale (NCAFS).[38] The NCAFS contains 76 dichotomous items in which the presence or absence of a parent and infant feeding behavior is indicated by a trained coder. The

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Table 1. Demographic and Medical Characteristics

	Very Low Birth Weight							
	High Risk (n = 103)		Low Risk (n = 68)		Term (n = 117)			
	Mean	SD	Mean	SD	Mean	SD	F	*p*
Birth weight, g	960	235	1262	176	3463	520	1451.6	.0001[a]
Gestational age, wk	27.2	2	30.3	2	39.8	1	1342.8	.0001[a]
Social class	3.5	1	3.6	1	3.6	1	0.8	.44
Race (% white)	57 (55)		34 (50)		60 (51)		6.0	.75
Gender (% male)	52 (51)		27 (40)		58 (50)		22.2	.33
Multiple birth (%)	22 (21)		29 (43)		10 (9)		393.0	.0001[b]
Maternal marital status (% married)	62 (60)		38 (56)		64 (55)		72.0	.70
Maternal education, yr	13.4	2	13.2	2	13.3	2	0.1	.90
Maternal age	27.9	5	28.0	5	26.8	6	1.4	.26
Mental Development Index, 1 yr	91	29	104	20	113	15	24.1	.001

[a]High risk < low risk < term, $p < .05$.
[b]High risk and low risk > term, $p < .05$.

NCAFS includes four subscales rating caregiver behavior (Sensitivity to Cues, Response to Distress, Social-Emotional Growth Fostering, and Cognitive Growth Fostering) and two subscales related to the infant's behavior (Responsivity to Parent and Clarity of Cues), which can be summed into Total Parent and Total Child scores, as well as a Total score for the dyad. Subscale and total scores reflect the sum of items in which a specified feeding behavior occurred, with higher scores implying more positive behavioral capacities. Validity and reliability data are excellent, with Cronbach's alphas of 0.73 for Total Child scores, 0.83 for Total Parent scores, and alphas for specific subscales ranging from 0.56 to 0.69.[10]

Sensitivity to Cues includes such items as "caregiver slows the pace of feeding when child shows subtle disengagement cues," or "smiles, verbalizes, or makes eye contact in en face position." The Response to Distress subscale notes the caregiver's soothing efforts and avoidance of punitive behaviors in response to infant disengagement cues. The Social-Emotional Growth Fostering scale identifies parental behaviors that convey positive emotional signals and reinforcement of child behaviors, and the Cognitive Growth Fostering subscale notes behaviors providing stimulation appropriate to infant level of understanding. Of the two child subscales, Clarity of Cues rates whether an infant's cues are "easy" or "difficult" for the caregiver to understand (e.g., "child vocalizes") and the Responsiveness to Caregiver subscale rates child behaviors in response to caregiver cues.

Videotapes were rated by observers masked to infant illness, maternal distress, and study hypotheses. Masking 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 and being higher risk. However, within the preterm group, risk status was not readily identifiable for most high-risk infants who did not receive oxygen and who were similar physically to the lower-risk comparison group.

The two primary coders were trained through the Nursing Child Assessment Satellite Training program at the University of Washington (Seattle, WA), and a third coder served as a secondary or reliability coder. Interrater reliability was established for each NCAFS item for 5% to 10% of the sample. At 1 month, mean percent agreement across all items was 91% ($r = 88–93\%$); at 8 months, it was 97% ($r = 86–100\%$); and at 12 months, it was 92% ($r = 88–93\%$).

Each mother was given $25 for participation, and transportation (if needed) was provided. The study was approved by the institutional review boards of the participating hospitals, and informed consent was obtained from all caregivers.

Data Analysis

For cases in which distributions were significantly skewed, scores were normalized using logarithm (x + 1) transformations before data analyses. Group differences and changes over time for parent and child behaviors were examined using a mixed model approach with restricted maximum likelihood estimation procedures (SAS, PROC Version MIXED, SAS Institute Inc., Cary, NC).

Spearman rank-order correlations were computed to assess the relationship of severity of maternal psychological symptoms with each maternal and child behavior and summary score. For those behaviors that were significantly related to maternal distress symptoms, models were rerun with maternal distress as a time-dependent covariate to assess whether maternal distress symptoms mediated or moderated the effects of infant risk status on either infant or maternal interactions during feeding.[39] Mediating variables are those that can be part of a causal chain between the independent and dependent variables. For example, the experience of VLBW birth leads to maternal distress that causes differences in maternal behaviors, whereas moderators are those factors or conditions that change the relationship of the independent variable to the outcome (i.e., psychological distress may influence maternal interactions differently for VLBW vs term infant dyads). Mediating variables are tested by entering the mediator into an equation if it is related to both the independent and dependent variable. Mediators remove or significantly

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reduce the relationship of the independent variable to the outcome. Moderator variables are tested by entering an interaction term (e.g., distress × VLBW status) into the model.

RESULTS

Maternal-Infant Interactions

Maternal Behaviors. There were significant interaction effects of infant age with risk status on the Total Parent score, indicating a differential rate of change by risk group from 1 to 12 months (Table 2). At 1 month, mothers of high-risk very low birth weight (VLBW) infants exhibited more cognitive and social-emotional growth-fostering parenting behaviors than mothers of term infants, and there was a nonsignificant trend ($p < .10$) for mothers of low-risk VLBW infants to show more cognitive and social-emotional growth-fostering parenting behaviors than mothers of term infants. The VLBW groups did not differ from each other. By 8 and 12 months, there were no group differences. Mothers of term infants significantly increased in their cognitive and social-emotional growth-fostering interactions from 1 to 8 and 12 months, whereas the mothers of both high- and low-risk preterm infants did not change.

Examination of the individual Parent subscales indicated no relationship of infant risk status with maternal response to distress or sensitivity to infant cues. There were no effects of infant age on maternal response to infant distress, but there were significant effects of infant age on maternal sensitivity to cues, indicating that all mothers decreased in their sensitivity to infant cues from 1 to 8 and 12 months.

However, there were significant moderator effects of infant risk status and age on the subscales of Social-Emotional Growth Fostering and Cognitive Growth Fostering. Mothers of both high- and low-risk VLBW infants displayed more social-emotional growth-fostering behaviors at 1 month (Table 3) compared with mothers of term infants. Whereas all mothers increased in their use of social-emotional growth-fostering behaviors from 1 to 12 months, term mothers increased in their use of these behaviors at a faster rate than the other two groups, so that by 8 and 12 months, there were no group differences.

Mothers of high-risk preterm infants also displayed significantly more cognitive growth-fostering interactions than mothers of term infants at 1 month, but by 8 months there were no differences between groups (Figure 1). All mothers increased in their use of cognitive growth-fostering behaviors over time. Mothers of term infants, however, had faster increases in their use of such behaviors over time than mothers of VLBW infants; by 12 months, they used significantly more cognitive growth-fostering behaviors than mothers in both VLBW groups.

Infant Behaviors. There were significant effects of infant risk and age and their interaction on the Total Child score. Behavioral differences among risk groups were not apparent at 1 month, but by 8 months, term infants were rated as more responsive and clear in their cues than high-risk VLBW infants, and by 12 months, they were rated more responsive and clear in their cues than both high- and low-risk VLBW infants. All infants increased in their frequency of these behaviors over time, but term infants increased at a faster rate than the preterm groups.

Examination of the child subscales indicated that the VLBW groups differed in both clarity and responsivity from the term infants (Tables 4 and 5). Increasing differences were apparent between groups over time with both high- and low-risk VLBW infants rated as less responsive and less clear in their cues than term infants by 12 months (Figure 2).

Maternal Psychological Distress. There was a nonsignificant trend for a group-by-age interaction, and significant

Table 2. Total Parent Scores by Group and Age

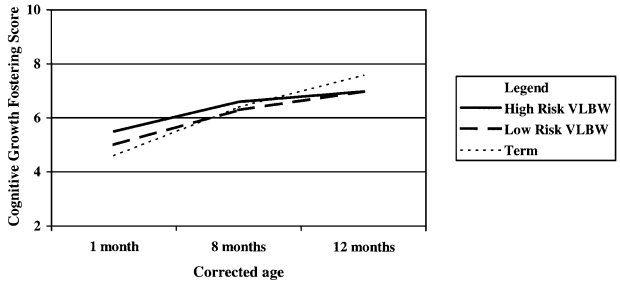
	Very Low Birth Weight					
	High Risk		Low Risk		Term	
Age	Mean	SE	Mean	SE	Mean	SE
1 mo	39.5	0.7	38.6	0.9	36.7	0.6
8 mo	38.8	0.7	39.3	0.8	39.2	0.6
12 mo	39.7	0.6	39.6	0.8	40.9	0.6

Group (2301), F = 0.2, $p < .80$; age (2365), F = 6.7, $p < .001$. Group × age (4365), F = 4.4, $p < .002$; 1 mo (2365), F = 5.5, $p < .005$; high risk > term, $p < .001$; low risk > term, $p < .08$; 8 mo (2365), F = 0.1, $p < .89$; 12 mo (2365), F = 1.3, $p < .27$.

Table 3. Socioemotional Growth Fostering

	Very Low Birth Weight					
	High Risk		Low Risk		Term	
Age	Mean	SE	Mean	SE	Mean	SE
1 mo	10.8	0.3	10.5	0.4	9.6	0.2
8 mo	11.3	0.3	11.1	0.4	11.0	0.3
12 mo	11.4	0.3	11.1	0.3	11.6	0.2

Group (2301), F = 1.5, $p < .24$; age (2365), F = 16.0, $p < .0001$. Group × age (4365), F = 3.6, $p < .01$; 1 mo (2361), F = 6.4, $p < .001$; high risk > term, $p < .001$; low risk > term, $p < .04$; 8 mo (2361), F = 0.3, $p < .71$; 12 mo (2361), F = 1.3, $p < .29$.



Group (2301), F = .47, $p < .63$
Age (2365), F = 77.4, $p < .0001$
GxA (4365), F = 6.2, $p < .0001$
1 month (2365), F = 6.5, $p < .002$
High risk > Term, $p < .001$
8 months (2365), F = 0.1, $p < .98$
12 months (2365), F = 2.3, $p < .03$
High risk < Term, $p < .05$
Low risk < Term, $p < .02$

FIGURE 1. The relationship of infant risk status to change in maternal cognitive growth-fostering behaviors from 1 to 12 months corrected age.

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Table 4. Clarity

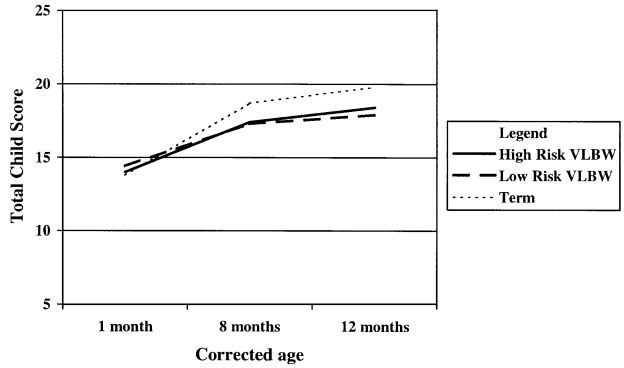
	Very Low Birth Weight					
	High Risk		Low Risk		Term	
Age	Mean	SE	Mean	SE	Mean	SE
1 mo	9.5	0.3	9.6	0.4	9.5	0.2
8 mo	11.2	0.3	11.1	0.3	11.7	0.2
12 mo	11.2	0.3	11.3	0.3	12.1	0.2

Group (2301), F = 3.3, $p < .04$; age (2364), F = 50.1, $p < .0001$. Group × age (4364), F = 1.4, $p < .22$; 1 mo (2364), F = 0.02, $p < .98$; 8 mo (2364), F = 1.7, $p < .20$; 12 mo (2364), F = 4.7, $p < .01$; high risk < term, $p < .01$; low risk < term, $p < .025$.

age effects, on maternal psychological distress symptoms. In post hoc analyses, mothers of high- and low-risk VLBW infants had more distress symptoms than mothers of term infants at 1 month postpartum. All mothers decreased in distress symptoms from 1 to 12 months (Table 6).

Correlations of maternal distress symptoms with maternal and infant behaviors at each follow-up age were calculated. Because correlations did not differ between groups, all groups were combined. There were no significant relationships at 1 month. At 8 months, there was a nonsignificant trend for higher maternal psychological distress to be related to less optimal Total Parent behaviors ($r = -.12$, $p < .10$) and a significant relationship of higher maternal distress to less frequent use of cognitive growth-fostering behaviors ($r = -.15$, $p < .05$). Both of these relationships became significant by 12 months ($r = -.14$, $p < .05$ for Total Parent and $-.19$, $p < .01$ for cognitive growth fostering). Maternal distress was unrelated to any infant behavior at any age, however.

To assess whether there were mediating or moderating effects of maternal distress on the relationship of infant risk status to maternal cognitive growth-fostering behaviors, maternal distress level as a time-dependent covariate was entered into the model for cognitive growth fostering. Maternal distress did not reduce the relationships of infant risk status to maternal cognitive growth-fostering behaviors (F = 4.9, $p < .0001$), and therefore it was not a mediating variable. The effect of maternal distress also remained significant after control for infant risk status and age and their interaction (F = 9.7, $p < .002$), indicating an additional effect of maternal psychological distress to infant risk status and age in predicting maternal cognitive growth-fostering



Group (2301), F = 3.6, $p < .03$
1 month (2301), F = .4, $p < .72$
8 months (2301), F = 2.9, $p < .03$
High risk < Term, $p < .04$
12 months (2301), F = 5.8, $p < .005$
High risk < Term, $p < .02$
Low risk < Term, $p < .003$
Age (2301), F = 87.6, $p < .0001$
GxA (4301), F = 2.6, $p < .05$

FIGURE 2. Total Child Score change across the three infant risk groups from 1 to 12 months.

behaviors. There were no interaction effects of maternal distress with infant age or risk status (F < 1.0, p = not significant); thus, it did not moderate the effects of these factors on maternal behavior.

Relationship of Demographic Characteristics to Maternal Behaviors. Although controlled by design in the assessment of risk status effects, several demographic factors are of interest that also bore significant relationships to the quality of maternal interaction behaviors at all ages. Higher maternal socioeconomic status, educational level, and older age were related to greater cognitive growth fostering at all ages and were also related, with the exception of maternal age at 1 month, to greater social-emotional growth fostering (r .14–.35, $p < .05$). At 1 and 8 months of age only ($r = .24$, $p < .001$ and .14, $p < .05$, respectively), mothers of male infants were more likely to use cognitive growth-fostering behaviors, and at 1 month ($r = .14$, $p < .05$), mothers of male infants were more likely to demonstrate social-emotional growth-fostering behaviors. Older mothers were also generally more sensitive at each age ($r \geq .14$, $p < .05$). Demographic factors were unrelated to maternal response to distress, and

Table 5. Responsivity

	Very Low Birth Weight					
	High Risk		Low Risk		Term	
Age	Mean	SE	Mean	SE	Mean	SE
1 mo	4.6	0.2	4.9	0.3	4.4	0.2
8 mo	6.5	0.2	6.2	0.3	7.0	0.2
12 mo	6.9	0.2	6.7	0.3	7.7	0.2

Group (2301), F = 3.3, $p < .04$; age (2301), F = 95.2, $p < .0001$. Group × age (4301), F = 3.3, $p < .005$; 1 mo (2301), F = 0.9, $p < .40$; 8 mo (2301), F = 2.7, $p < .06$; 12 mo (2301), F = 5.7, $p < .001$; high risk < term, $p < .006$; low risk < term, $p < .004$.

Table 6. Global Severity Index Scores

	Very Low Birth Weight					
	High Risk		Low Risk		Term	
Age	Mean	SE	Mean	SE	Mean	SE
1 mo	0.41	0.03	0.39	0.04	0.29	0.03
8 mo	0.31	0.03	0.31	0.04	0.29	0.03
12 mo	0.29	0.02	0.26	0.03	0.25	0.02

Group (2286), F = 1.8, $p < .17$; age (2286), F = 15.0, $p < .001$. Group × age (2286), F = 2.0, $p < .10$; 1 mo (2286), F = 4.6, $p < .01$; high risk > term, $p < .005$; low risk > term, $p < .05$; 8 mo (2286), F = 0.2, $p < .85$; 12 mo (2286), F = 0.7, $p < .49$.

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multiple birth status was unrelated to any maternal behavior.

DISCUSSION

This study investigated the relationships of infant risk status and maternal psychological distress to the quality of maternal-infant interactions during the first year of life. Several findings emerged. First, some, but not all, maternal and infant interactive behaviors were affected by infant risk status, and these effects varied with the age of the infant and the type of behavior assessed. In the neonatal period, mothers of both high- and low-risk very low birth weight (VLBW) infants provided more social-emotional growth fostering during feeding than mothers of term infants. Mothers of high-risk VLBW infants provided more cognitive growth fostering as well, supporting prior studies and our hypothesis that mothers of preterm infants would be more active and stimulating with their infants than mothers of term infants.[12,14,15] The greater stimulation provided by the mothers of VLBW infants has been interpreted in some studies to be intrusive, insensitive, and overstimulating to the preterm infant.[14] On the other hand, mothers of preterm infants may be motivated to provide more active stimulation because of concerns about their infant's developmental outcome. As VLBW infants are less responsive than full-term infants, they may require more stimulation from mothers to elicit responses. The increased stimulation may then be appropriate, given the context, rather than intrusive.

Contrary to our hypothesis, however, by 8 and 12 months of age the frequency of social-emotional growth-fostering behaviors of mothers of VLBW did not differ from the behavior of mothers of term infants. Similarly, the initially higher rates of cognitive growth fostering of the mothers of the VLBW infants increased at a slower rate than the behaviors of term mothers, and by 12 months, mothers of VLBW infants actually provided lower amounts of such stimulation than term mothers. This pattern of change from more active to less active interactive behavior was also noted by Crnic and colleagues[13] in a study that compared healthy preterm with term dyads from 1 to 12 months. They attributed the lower levels of stimulation to maternal adaptation to their less responsive preterm infants, also consistent with the present study.

Notably, and contrary to our expectations, mothers of VLBW infants in this study were not rated as less sensitive or less responsive to their infants' distress.

Compared with other longitudinal studies assessing the behavioral interactions of preterm infants, our findings of differences between mothers of preterm infants and mothers of term infants differ from those of Smith et al[24] and Schermann-Eizirik et al[18] but are consistent with other longitudinal[13,17] and cross-sectional studies.[14,20,40] As noted previously, there are few longitudinal studies of maternal-infant interactions of VLBW infants that consider the effects of medical risk, and these have all differed in their definition of risk, the context of dyadic interaction, the age of the infant, and the measurement of maternal and infant behaviors. In addition, the two studies that did not find differences in maternal behaviors used separate nonstandardized and non-normative assessments.

Infant risk status was related to severity of maternal psychological distress, but only in the neonatal period, when mothers of VLBW infants reported experiencing greater distress, a finding consistent with the prior literature.[23,30,38] Contrary to our hypothesis, the behaviors of mothers of VLBW infants were not differentially affected by maternal distress symptoms, because the effects of distress were similar for all groups. For all mothers, higher levels of psychological distress symptoms were related to lower frequency of cognitive growth fostering at 8 and 12 months, a finding also consistent with previous studies of term infants but that has not been examined in studies of preterm infants. In a separate study of this cohort, we demonstrated that the psychological distress symptoms reflected in the Global Severity Index for this sample consisted primarily of depressive and anxious symptoms.[23] Thus, this study is consistent with others indicating that depressed mothers are more likely to have impaired interactions with their infants, having been shown to be notably less active, less engaged, less sensitive, and less positive with them.[15,26,26] Further, maternal depressive symptoms have been related to poorer socioemotional, cognitive, and linguistic development in healthy term offspring,[8,27,29] indicating that VLBW infants may be at greater risk than term infants because of the accumulating risk factors associated with VLBW birth.

Consistent with many prior studies, VLBW predicted lower infant clarity and responsivity, and VLBW infants showed slower rates of growth in these attributes than term infants during the first year of life, with increasing behavioral differences from term infants over time. Lower responsivity and provision of less-interpretable behavioral cues have been noted in many studies of preterm infants,[9,13,39] and are consistent with the lower mental development indices, smaller size, and greater number of medical complications of the VLBW infants. Although the study of Jarvis et al[17] of VLBW infants did not find differences in infant behaviors by risk group, sample sizes (<20) may have been too small to detect differences.

In the present study, VLBW, in addition to maternal psychological distress, contributed independent variance to the prediction of maternal cognitive growth-fostering behaviors. Thus, VLBW infants whose mothers experienced psychological distress symptoms beyond the immediate postpartum period received less cognitive stimulation from their mothers. Prior studies support the belief that accumulated risk factors increase the likelihood of negative child outcomes.[41,42] The experience of VLBW birth, especially in the context of high infant medical risk, is accompanied by parenting and financial strains that may affect the mother's psychological status and her interactive behaviors adversely.[24,42–44] Alternatively, the additional risk that maternal psychological distress conveys for VLBW infants is of particular interest because during the first year of life, certain maternal behaviors may be more important for and have differential effects on the development of preterm infants than for healthy term infants.[24,45] Alternatively, the lower levels in amount and frequency of stimulation of mothers of VLBW infants compared with mothers of term

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infants in the latter half of the first year of life may reflect a sensitive adaptation to the lower responsivity and less clear cues of their more medically compromised infants.[14,15]

Although the high- and low-risk VLBW groups differed in developmental outcome, birth size, and medical complications, there were no differences between them in maternal or infant interactive behaviors in this study. This lack of differences may indicate that, within the first year of life, mothers of VLBW infants view their infants similarly despite their differences in medical risk. The lack of differences in infant behaviors during the neonatal period may reflect the smaller available repertoire of neonatal behaviors that diminishes differences across groups. Alternatively, this may indicate a lack of sensitivity of the assessment scale at this age, because significant behavioral differences were noted between infant groups when the videotapes were rated using a more quantitative behavioral assessment.[15]

Not surprisingly, higher maternal age, socioeconomic status, and education level were related to more cognitive and social stimulation, as has been demonstrated in other studies.[46] Of some note, however, mothers were more emotionally stimulating when their infants were aged 1 month and more cognitively stimulating when their male infants were aged 1 and 8 months. Previous studies have been inconsistent in evaluating whether parents provide different socialization experiences for boys and girls. Parents have been shown to exhibit sex-differentiated attitudes from an early age,[47] and in studies of emotional responsiveness, mothers of babies and toddlers were more emotionally responsive to daughters.[48] Yet Bornstein and Tamis-LeMonda, examining language interactions, found no sex differences in maternal behaviors before 6 months of age.[49]

Some limitations to the present study should be considered. Obvious physical differences between term and preterm infants may have affected observer ratings, but it is unlikely that inadvertent biases would have affected specific ratings differentially. Moreover, the consistency of our findings with those of smaller prior studies using similar rating scales allows greater confidence in the findings. Although some physical aspects of infant health, such as incidence of intrauterine growth retardation, were not considered, the notable differences between the high- and low-risk VLBW groups in size, neurological complications, and developmental status did not differentiate either maternal or infant behaviors in these groups.

As the present data show, in a feeding context, VLBW birth affects specific maternal and infant behaviors, and the effect of risk on these behaviors changes over time. In addition, maternal psychological distress impacts certain maternal interactive behaviors negatively. Because maternal distress is more prominent in mothers of VLBW infants postpartum, intervention efforts for VLBW infants should focus on both assessment of maternal psychological distress and the challenges posed by the less responsive and clear interactive behaviors of VLBW infants.

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