Neurodevelopmental Profile, Growth, and Psychosocial Environment of Preterm Infants with Difficult Feeding Behavior at Age 2 Years

Tara L. Crapnell, OTD[1], Lianne J. Woodward, PhD[2], Cynthia E. Rogers, MD[3,4], Terrie E. Inder, MD[2], and Roberta G. Pineda, PhD[1,3]

Objective To examine the association of difficult feeding behaviors in very preterm infants at age 2 years with growth and neurodevelopmental outcomes and family factors and functioning.

Study design Eighty children born ≤30 weeks gestation were studied from birth until age 2 years. Feeding difficulties were assessed using the Eating Subscale of the Infant-Toddler Social Emotional Assessment at age 2 years, along with growth measurement and developmental testing. Maternal mental health and family factors were assessed using standardized questionnaires. ANOVA and χ^2 analyses were performed to determine associations between feeding difficulties and growth, neurodevelopmental outcomes, and family characteristics.

Results Twenty-one children (26%) were at risk for feeding difficulties, and an additional 18 (23%) had definite feeding difficulties at age 2 years. Those with feeding difficulties were more likely to be subject to a range of neurodevelopmental problems, including impaired cognition ($P = .02$), language ($P = .04$), motor ($P = .01$), and socioemotional ($P < .007$) skills. Compared with the parents of children with fewer feeding difficulties, parents of the children with feeding difficulties had higher parenting stress ($P = .02$) and reported more difficulty managing their child's behavior ($P = .002$) and more frequent parent–child interaction problems ($P = .002$). No associations were found between difficult feeding behaviors and growth, maternal mental health, or family factors.

Conclusion Difficult feeding behaviors in children born very preterm appear to be highly comorbid with other developmental and family challenges, including neurodevelopmental impairment and parent–child interaction difficulties. Focusing on improving feeding skills, in conjunction with supporting positive parent–child interactions, may be beneficial for improving outcomes. *(J Pediatr 2015;167:1347-53)*.

Preterm infants often experience neurophysiological immaturity and decreased tone, affecting their ability to develop the skills needed for successful and enjoyable oral feeding.[1-4] Previous studies have identified early medical factors that can influence feeding experiences[5-7] and have shown links between developmental impairment and feeding difficulties.[8-10] With the exception of our previous work that defined relationships between feeding difficulties and socioeconomic status,[4] few studies have considered relationships between family factors and the development of successful or problematic feeding behavior in very preterm infants.

Early childhood feeding difficulties can be viewed as a transactional disorder, involving complex interactions between a child and his or her social environment.[11-13] Feeding is an important part of growth and development, and can be a major source of social interaction within the family system. Caring for a child with feeding difficulties can be distressing for parents and may alter the parent–child relationship.[14,15] Reactions and responses to feeding difficulties can also further exacerbate an existing feeding problem.[16] Key to developing effective interventions is a better understanding of the neurodevelopmental profile of problem feeders and the broader psychosocial context in which feeding difficulties occur. The objectives of the present study were to identify growth and neurodevelopmental characteristics of a cohort of very preterm infants with varying levels of feeding difficulty at age 2 years and examine the relationships between early childhood feeding difficulties and family characteristics and functioning. We hypothesized that infants with more feeding difficulties would have poorer growth and higher rates of comorbid neurodevelopmental difficulties. We also anticipated that the families of infants with feeding difficulties would be characterized by higher levels of maternal psychological distress and problems with parent–child interaction.

Bayley-III	Bayley Scales of Infant and Toddler Development, Third Edition
HADS	Hospital Anxiety and Depression Scale
ITSEA	Infant-Toddler Social Emotional Assessment
PSI-SF	Parenting Stress Index-Short Form

From the [1]Program in Occupational Therapy, Washington University School of Medicine, St Louis, MO; [2]Department of Pediatric Newborn Medicine, Brigham and Women's Hospital, Harvard Medical School, Boston, MA; and Departments of [3]Pediatrics and [4]Psychiatry, Washington University School of Medicine, St Louis, MO

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Methods

The study sample comprised 136 children born very preterm who were part of an overarching study investigating brain development. Consecutive new admissions to a level III-IV neonatal intensive care unit were recruited by the third day of life between 2007 and 2010.

Inclusion criteria were birth at ≤30 weeks estimated gestational age and no documented congenital anomaly. At age 2 years, infants returned for developmental testing, and physical growth was assessed. Parents were also asked to complete a battery of standardized assessments about their child's health and social emotional adjustment, as well as their own well-being and family situation. All study procedures were approved by the Human Research Protection Office at the study site. Written informed consent was obtained from all parents/guardians.

One hundred thirty-six infants were enrolled, of whom 7 withdrew, 1 transferred to another hospital, and 1 was withdrawn after diagnosis of a congenital anomaly. Of the remaining 127 infants, 20 died during their stay in the neonatal intensive care unit. Following discharge, an additional 2 infants died and 1 infant withdrew, leaving 104 in the cohort eligible for follow-up testing. Out of these 104 infants, 86 returned for follow-up at age 2 years. Eighty infants (77%) had feeding outcome measured using the Infant-Toddler Social Emotional Assessment (ITSEA) Eating Subscale at age 2 years. There were no missing data points for the Eating Subscale among parents who completed it. There were no significant differences in medical and social factors between the infants whose parents did complete the ITSEA and those whose parents did not.

Feeding Difficulties

Feeding difficulties were assessed at age 2 years using the Eating Subscale of the ITSEA.[17] This subscale consists of 9 items assessing typical eating behaviors (eg, picky eating, reluctance to accept new foods) and atypical eating behaviors (eg, spitting out food, holding food in cheeks, refusing to eat foods requiring chewing, gagging and choking on food).[17] Parents rated the frequency with which their child engaged in each feeding behavior on a scale ranging from 0 (never/rarely) to 2 (often). Parents were also able to document "no opportunity." Missing responses, as well as items with "no opportunity," were coded as missing data. A score was not calculated if there were 2 or more missing data points. Children with a mean score exceeding 0.95 for girls and 0.97 for boys (≤10th percentile of the normative sample) were defined as "of concern" or as having atypical feeding behaviors.[2]

Based on the ITSEA manual, feeding difficulties, such as picky eating or food refusal, may be associated with sensory sensitivities or may reflect a relational disturbance between the parent and child.[17] Associations between the ITSEA and evaluator ratings and parental ratings of child behaviors and parental distress demonstrate acceptable validity of the ITSEA.[17] Based on feeding data generated by this cohort, a Cronbach α value of 0.82 was computed for the Eating Subscale, demonstrating high internal consistency.

To better understand the extent of feeding difficulties in this sample, we transformed raw scores from the ITSEA Eating Subscale into a 3-level ordinal variable: no feeding difficulties (n = 41; >50th percentile) with a cutoff of <0.44; at risk for feeding difficulties (n = 21; 20th-50th percentile) with a cutoff score between 0.45-0.99 (true scores from the sample were 0.56-0.89); and definite feeding difficulties (n = 18; <20th percentile), with a cutoff of >0.99. Children identified as "of concern" (n = 18) based on standard ITSEA scoring[17] were all represented in the definite feeding difficulties group using the new ordinal variable.

To determine the relationships between feeding difficulties and growth, neurodevelopmental outcomes, family characteristics, and parent perceptions of parent–child interaction, we investigated a wide range of measures using the 3-level ordinal feeding variable. Key measures found to be important and included in this analysis are described below.

Growth

At birth and term equivalent, length and weight were recorded and converted into *z*-scores using Lambda-Mu-Sigma growth software (Microsoft, Redmond, Washington).[18,19] Height and weight were measured at age 2 years and entered into a World Health Organization anthropometric program (WHO Anthro, version 3.2.2; World Health Organization, Geneva, Switzerland) to obtain *z*-scores for weight-for-age. Growth from birth to age 2 years was determined by subtracting *z*-scores at birth from *z*-scores at age 2 years. Growth from term equivalent age to age 2 years was determined by subtracting *z*-scores at term from *z*-scores at age 2 years.

Neurodevelopmental Outcomes

At age 2 years, development was assessed using the Bayley Scales of Infant and Toddler Development, Third Edition (Bayley-III).[20] Composite scores for the Cognitive, Language, and Motor domains of the Bayley-III were computed. Information about the child's social and emotional adjustment was also collected with the parent-reported ITSEA, which provided Internalizing, Externalizing, and Competence domain scores.[17] The Dysregulation domain was not examined, because the Eating Subscale is contained within this domain.

Family Characteristics

Family factors investigated for relationships to feeding difficulties included maternal age, ethnicity (Caucasian or non-Caucasian), family structure (married, separated with dual custody, or single parent), level of education of primary caregiver (college education, completed high school, or completed less than 12 years of school), occupation of primary income earner (professional/skilled, semiskilled, or unskilled), and employment status (full-time, part-time, or unemployed). Maternal depression was assessed using the 21-item Beck Depression Inventory, second edition,[21] with a score >13 indicating clinical depression. Maternal anxiety was assessed using the Hospital Anxiety and Depression Scale