Eating as a Neurodevelopmental Process for High-Risk Newborns

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KEYWORDS

• High-risk neonate • Infant feeding behaviors
• Infant development • Attachment • Infant growth

FEEDING DISORDERS IN THE HIGH-RISK INFANT

Discharge of the high-risk newborn from the neonatal intensive care unit (NICU) typically includes successful volume and rate of oral intake by either breast or bottle, and appropriate and consistent weight gain for specified amounts of time.[1] Delay in discharge is often attributed to a lack of attaining success at eating skills and adequate growth. These delays often cause frustration for the parents who are anxious to have their baby home, and frustration for the professional staff, including the case manager, who are also anxious to save hospitalization costs and lengthy stays.

Feeding problems develop through interactions among biological, behavioral, and environmental factors, and preterm infants and their families, especially infants born extremely preterm, are at high risk for feeding problems, developmental delay, and relationship difficulties as well as compromised growth.[2–4] Adequate growth is typically regarded as a positive outcome for high-risk infants but is difficult to achieve in the NICU. The majority of growth faltering occurs in the initial hospitalization for a myriad of infant and medical reasons, including nutrient absorption and gut

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intolerance.[5] Much attention has been focused on the need for improved growth in the initial hospital stay, as the highest rate of growth has been correlated with both a reduced risk of developmental delay and better growth at 18 months corrected age.[6]

Early weight gain is known to be predictive of later growth in term infants, and is likely predictive in the preterm population as well. Ross and colleagues[7] found that term infants who lost a significant amount of weight between their 4- and 6-month well child visits were more likely to have growth faltering when compared with those whose weight for age did not shift as significantly. As low birth weight (LBW) and very low birth weight (VLBW) infants transition to home, in the short term they are likely to have poorer weight gain than their larger counterparts. Deloian[8] found that LBW infants gained an average of 35 g per day and VLBW infants gained only 18.7 g per day. Ross[9] examined preterm infants both at term and 2 weeks corrected age. Weight gain per day between term and 2 weeks ranged from 6.3 to 90.3 g per day, indicating great variability in infant growth. After discharge from the NICU many high-risk infants experience growth faltering.[7] Dusick and colleagues,[10] as part of the National Institute of Child Health and Human Development Neonatal Research Network, evaluated infants within 14 centers for growth problems. At 36 weeks gestational age, 97% of VLBW infants weighed less than the 10th percentile for their age, and of those with birth weights of 501 to 1000 g, 99% had weights less than the 10th percentile. At 18 to 22 months corrected age, 40% of these infants continued to have weight, length, and head circumferences less than the 10th percentile.

Wood and colleagues5 studied infants born at less than 26 weeks' gestation who were AGA, and found weight and head circumference z-scores that fell below the mean at both the estimated due date and at 30 months corrected age. Dodrill and colleagues[10,11] found the mean lengths and weights of preterm, AGA Australian infants were significantly less than their term counterparts across all time points (term, 4 months, 8 months, and 12 months corrected age). Those infants born small for gestational age (SGA) had greater weight faltering (defined as a weight for age less than the 10th percentile) than did those born average for gestational age (AGA), 69% and 42%, respectively.[10]

Feeding problems are even more prevalent than are growth problems in the preterm population. Hawdon and colleagues[12] followed 35 infants with a mean gestational age of 34 weeks at birth, and found 40% of them with poor coordination of sucking, swallowing, and breathing at the time of assessment in the NICU (between 36 and 40 weeks postmenstrual age). At 6 months, these same infants who had poor coordination continued to demonstrate increased feeding difficulties. These infants were 6 times more likely to vomit and 3 times more likely to cough during mealtimes than the infants demonstrating coordinated feeding at the time of discharge. Continued difficulty with textures at 12 months were also found, along with limited enjoyment of mealtimes, further complicating infant growth, development, and family relationships.[12] In a study of 2118 Taiwanese infants born with a birth weight of less than 2.5 kg who were evaluated in the first 5 years of life, more than 90% of the children were identified with some form of feeding problem in each of the years 2005 and 2006.[13] Of a healthy sample of extremely low birth weight (ELBW) infants examined by Mathisen and colleagues,[14] 80% had feeding problems such as poor intake, fatigue, and delayed feeding skills at 6 months corrected age. These infants were more demanding, more easily frustrated, and more likely to have difficulty with textured foods than the full-term controls.[14] Furthermore, 40% had episodes of aspiration with eating, and 85% continued to have gastroesophageal reflux.[14] Cerro and colleagues[15] studied infants born at less than 32 weeks gestational age, with a mean birth weight of 1243 g, at a mean age of 2.5 years of age (range 1.6–3.6 years). At the time of follow-up they found that 78% of parents were concerned about the quality of food their children were eating, and 45% wished to change their child's eating behaviors.[15] Food refusal was reported by 58% of parents, 51% used food rewards, and 69% used coaxing to encourage intake.[15] In addition, parents reported that 28% had poor weight gain, 33% vomited, 32% were treated with reflux medication, 27% had chronic diarrhea, and 67% constantly refused food.[15]

The risk of poor feeding outcomes appears to increase as gestational age decreases.[14,15] Of ELBW infants weighing 600 g or less, 62% had continued eating problems at 2 years corrected age, and 29% had gastrostomy tubes.[16] These findings justify Thoyre's[17] conclusions that extremely preterm infants may eat sufficiently for discharge but are not yet skilled eaters, and may continue to have major challenges with eating for months and years after discharge from the NICU.

Late preterm (LPT) infants do not escape feeding issues, even though their development is further along than their earlier-born counterparts. Infants born LPT look deceptively vigorous at feeding times, but easily lose state organization and energy to finish eating. These infants typically are less able to achieve effective sucking and swallowing, and may need multiple feeding methods during the transition to oral feeding.[18,19] Breastfeeding is particularly challenging, as these infants are sleepier and have less stamina to latch on and to finish eating. Challenges for feeding are dominant reasons for delayed discharge.[20]

Parents often evaluate their baby's health and their own competency as parents before and after discharge by feeding success and weight gain. Much of an infant's time awake is spent eating in the first year of life. Thoyre[4] found that parents' concerns regarding feeding their infants centered around ensuring adequate intake of volume and calories, safety during feeding, and making changes to the feeding plan once they were home with their infant. Parents report not enjoying the feeding experience,[12] and feeling less confident in caregiving in general and feeding in particular.[21,22] Parents also report having to deal with their infant's variable interest in eating, fatigue, and low intake.[3,4,17,23,24] Feeding disorders in infancy significantly affect the mother-infant interaction,[23] with a higher degree of dysfunction especially when feeding disorders do not have an obvious organic reason. Early feeding disorders contribute more significantly than other regulatory problems to long-term mental health and behavior problems, establishing difficult interaction patterns between parents and children.[25–27] Ongoing infant feeding issues also affect the relationship between the parents themselves.

EATING AS A NEURODEVELOPMENTAL PROCESS

Early infant eating behavior of the infant is thought to be neurologically based and developmental in nature. Several scientists who study the maturational sequence of eating (suck rhythm stability, aggregation of sucks and swallows into runs, length of suck run, and suck-suck interval) suggest that assessment of early eating competence and coordination could predict longer-term neurodevelopmental outcomes,[28–30] and that the coordination of breathing and eating could reflect an "intrinsic calendar of neurodevelopment rather than experiential or learned behavior."[29]

For the purposes of the following discussion, eating refers to the infant's role and feeding refers to the actions taken by the person who provides support for the baby to eat/drink. To eat effectively, infants must sense and react to a variety of tactile, kinesthetic and proprioceptive, olfactory, auditory, and visual inputs at the same time they have to coordinate sucking, swallowing, and breathing. Preterm infants must manage the amount, duration, and timing of sensory input that a feeding demands. In addition, they must maintain an alert state, maintain energy for the duration of feeding, and maintain body as well as oral-motor tone to achieve successful eating. Most early-born infants are not initially able to simultaneously manage these neurodevelopmental demands such that they accomplish successful eating.

DEVELOPMENTAL PRECURSORS FOR SUCCESSFUL EATING

As described in Lickliter elsewhere in this issue, sensory systems develop in an orderly manner, emerging through gestation. Inappropriate inputs at a given developmental stage may interfere with other emerging sensory development.[31] Precursors to infant eating are present early in fetal development. As early as 7 to 8 weeks' gestation there is avoidance in response to perioral stimulation, and by 11 weeks perioral stimulation results in global movement and swallowing. By 16 weeks mouthing can be detected,[31] and by 24 to 25 weeks reflexes such as sucking and rooting can be elicited. By 28 weeks, the fetus can produce a weak suck and palmar grasp,[32] yet stable nonnutritive sucking is not well identified until 34 weeks.[33] Chemosensory development emerges early in gestation, with responsiveness to taste in the amniotic fluid detected by 16 weeks. From 28 to 29 weeks the fetus/newborn can detect, discriminate, and learn about taste and odor (see the articles by Mennella Sullivan elsewhere in this issue, and the reviews by Graven and Browne[34,35]). Newborns orient first to lactating mothers, but quickly begin to differentiate their own mother's breast milk from other breast milk odor.[36,37] Schaal and colleagues[38] examined behavioral responsivity in preterm infants, finding selective response to a mother's familiar odor with orienting to the familiar mother's odor. These contributions to the attachment relationship and to eating success are well documented (see review by Browne and Graven[34] and the article by Sullivan elsewhere in this issue). It is not until the infant is 34 to 36 weeks that safe oral feeding is recommended,[39] and sucking, swallowing, and breathing coordination is not well established until 37 weeks or later.[40]

Successful eating requires coordination of breathing with sucking and swallowing, and involves functional interaction of jaw, tongue, soft palate, pharynx, larynx, and esophagus.[41] Although term infants have appropriate rhythmicity of sucking and swallowing at birth, they continue to show improvement of efficiency over the first month post term age with increased volume per suck.[42,43]

Emerging physiologic studies of eating in preterm infants show a developmental progression with oral-motor skill development between 30 and 45 weeks postmenstrual age. These skills require suction and compression, and the ability to move fluid back into the pharyngeal area and into the esophagus for swallowing. Preceding this skill is nonnutritive sucking (eg, on a finger or a pacifier), which is typically 2 sucks per second, whereas a nutritive suck rhythm and coordination is 1 suck per second. As demonstrated by Mizuno and Ueda,[44] 24 preterm infants studied at 32 weeks postconceptional age had poor sucking pressures, frequencies, duration, and efficiency, with maturation weekly through 36 weeks postconceptional age of all variables. Several other studies similarly have identified a developmental progression of transfer of increasing volumes of milk, rate of transfer, and number of successful oral feedings in preterm infants as they mature to term and postterm ages.[42,45] Gewolb and colleagues[29] found that suck runs in preterm infants were a function of postmenstrual age, not postnatal age, adding to the perspective that success in eating is a neurodevelopmental process. Lau and colleagues[42] demonstrated that preterm infants began nutritive sucking using a weak compression of the nipple, followed by the emergence of negative suction, with a gradual integration and strengthening of both compression and suction noted between 32 and 36 weeks gestational age.

Ultrasound studies show some variability, but most infants mature to a typical ratio of one suck, one swallow, one breath after reaching 37 weeks postconceptional age.[40] The relationship between sucking, swallowing, and breathing matures with increasing postconceptional age.[28,33,44] Infant ventilation stops during swallowing,[46–49] and Durand and colleagues[47] postulate that eating may override respiratory chemical control, further complicating feeding success for infants with respiratory compromise. Hanlon and colleagues[50] examined the effects of feeding on ventilation, and found frequent deglutition apneas with preterm infant feeding and fewer apneas as infants reached term. However, in the infants studied, deglutition apnea was still detected during feeding at term age. Gewolb and Vice[28] further examined respiratory rhythm, integration of swallows, respiratory rhythms, and apneic swallows with feeding preterm infants, finding significant relationships of each with postmenstrual age and not postnatal age.

Taken together, these data indicate that the integration of sucking, swallowing, and breathing is significantly delayed in most infants born preterm compared with infants born at term, that eating skills mature depending on postmenstrual rather than postnatal age regardless of exposure to eating experiences in the preterm infant, that swallows resulting in apnea are typical in early-born infants during eating episodes (potentially setting up a negative reaction to being fed), and that preterm infants may not be able to manage coordinated eating until well after term, especially if they have medical compromise.

In addition to these physiologic aspects of eating, the infant is expected to manage the organization of arousal, which is not well developed until well after term. Motor tone and smooth movements are also not well organized in the preterm infant. Physiologic, state, and motor reactivity to typical sensory input, handling, and social bids can further compromise the infant's availability, vigor, and organization of developing skills for eating and being fed. Repeated negative experiences during eating may lead to feeding aversions, as neuronal mapping is occurring rapidly at this age.[51]

A NEURODEVELOPMENTAL APPROACH TO SUPPORTING EMERGING EATING SKILLS IN HIGH-RISK INFANTS

Adverse short-term and long-term outcomes may be in part attributable to not only a failure of the infant to organize him or herself for successful eating but also to being pushed to eat earlier than they may be able to manage given their level of developmental organization. The emerging understanding of the development of eating skills in high-risk preterm infants and clinical observations of feeding practices in NICUs prompted the development of an approach based on the baby's ability to regulate his or her physiology, level of arousal, motor movements, and management of sensory input as they develop eating skills. Based on the Synactive Theory as an overarching paradigm,[52] the Baby Regulated Organization of Subsystems and Sucking (BROSS) approach encompasses observation of the infant's emerging stability or instability, his or her sensitivity to the physical and handling environment, and determination of the infant's ability to manage skills at 6 consecutive developmental levels of eating. Starting on the first day of admission to the NICU, observation of the infant's organization and vulnerabilities during feeding opportunities is performed, with suggestions for how to support early behavioral organization precursors of emerging pre-eating and eating skills.

At each developmental level of the approach the infant's physiologic, motor, and state systems, or so-called subsystems referred to in the Synactive Theory, are evaluated. Without optimal physiologic organization, appropriate arousal, and robust tone and movement, the infant will not be able to manage appropriate and organized eating skills. During the first phase of the hospitalization, infants born VLBW or ELBW or who are very ill and who are not yet being fed are evaluated for overall stability in these subsystems, and suggestions are made to enhance subsystem organization as described in the Newborn Individualized Developmental Care and Assessment Program (NIDCAP) approach.[53] Positioning, comfort, cyclicity of caregiving, and availability of the familiar mother's sensory offerings is essential at each stage, but in particular when the baby is critically ill and typically disorganized. The first stage of the BROSS is thus described as Subsystems Stability in Bed, during typical NICU interactions and procedures.

As the baby becomes more stable and is able to be handled and perhaps held by his or her parents or professional staff, the same evaluation is made of Stability of Subsystems when Handled. This stage typically occurs when the infant has developed some medical stability but is still not robust enough for any introduction of oral feedings. Transfer from the bed to the lap, holding by a sensitive caregiver, and provision of feeding-related cues such as smells of milk, elicitation of the rooting reflex, and sound of the caregiver's voice can assist the infant in foundational readiness for eating. Holding during all feedings once stability is achieved, even if the infant receives gavage feedings, supports the infant as he or she develops an expectation of organized external sensory input from the caregiver, and assists with organization of the infant's competence during feeding. Often infants who can manage to have some stability while held are unable to manage multiple sensory inputs at the same time, much less being prompted to suck either nutritively or nonnutritively. Mosca[54] demonstrated that holding stable premature infants during gavage feedings helped the infant to increase the time they spent in more desirable, quiet alert, and drowsy infant behavioral states, resulted in less apnea at the beginning of feedings than seen when infants were fed prone in bed, and did not compromise infant physiologic stability. Behavioral states become significantly more organized across the 31-week to term gestational ages.[55]

Once the infant is predictably able to show subsystem stability while held and shows more robust and consistent indications of hunger through the rooting reflex, mouthing, increased activity, and responsiveness to the mothers voice and odor, they are able to progress to Stability of Subsystems During Nonnutritive Sucking on a finger, pacifier, or a mother's empty breast as the next developmental phase. As the infant matures, nonnutritive sucking (NNS) becomes more robust and stable, optimally organizing at around 34 weeks.[33] When first introduced, NNS may be weak or disorganized, with the infant rarely able to keep the pacifier in his or her mouth. As the baby's subsystems become more stable and they can organize their arousal, breathing, and motor tone, a stronger and more rhythmic sucking pattern will emerge with 5 to 10 or more sucks per burst. During NNS there is no need for the baby to swallow, making it easier to breathe while sucking.

Infants may become very predictable and robust in their NNS patterns and may use NNS for calming. However, robustness of NNS is not predictive of infants' ability to transition to managing fluid,[56] as they then must protect their airway and coordinate sucking, swallowing, and breathing. Many infants approach a nutritive bottle with an NNS pattern, but when the fluid is introduced into their posterior pharynx they exhibit deglutition apnea, as described previously. This Obligatory phase can be very challenging for the infant, as it is a significant developmental transition in the progression to oral feeding. It can be particularly challenging if the person feeding the infant is not in tune with the infant's sucking, and lack of breathing and can result in severe physiologic compromise. Many infants suck in 10- to 20-suck bursts without breathing, as if they were sucking nonnutritively without the need to coordinate swallowing and breathing. Once the infant starts to breathe he or she often cannot manage the fluid that has been expressed during the sucking burst. Attunement of the feeder to the subsystem organization is essential in helping the infant avoid decompensation and, importantly, avoid a negative experience with eating. Often infants need a slowed flow from the nipple, frequent rest periods, and significant pacing to manage even minimal amounts of fluid, all of which have been shown to be beneficial when an infant is struggling to manage the suck-swallow-breathe coordination.[57–59] However, many infants who exhibit extreme physiologic, state, or motor compromise consistent with this phase should not be orally fed, but should instead be allowed to mature for several days to weeks at the NNS phase to allow for development of skills.

As infants mature, they develop an increasingly adaptive response to managing the flow of fluid from the nipple, and show an Alternating Pattern of sucking and breathing. That is, they suck for a burst of 3 to 5 sucks and alternate with breathing, albeit tachypneically. In this phase, initially there frequently are longer sucking bursts accompanied by mild desaturations, with recovery during the tachypneic catch up. Later in this phase the sucking bursts and tachypneic catch-up breaths are shorter in duration as the infant begins to better manage the suck, swallow, and breathe coordination. Typical of this phase is limited state availability and motor robustness to complete the amount expected to be fed.

The Intermittent Sucking Phase indicates further developmental organization and management of subsystems during eating. The infant inserts brief catch breaths once every 2 to 3 sucks, and longer sucking bursts appear with the catch breaths imbedded. Suction on the nipple becomes stronger, and there is an integration of suction and expression. Ultimately, there is a longer burst and more efficient sucking, with greater volumes of fluid transferred to be swallowed. The infant begins to have a more robust alert state for eating, and may be available for some mild social interaction.

The hallmark of the Coordinated Phase is when the infant develops a mature and coordinated sucking pattern with sucking bursts of 20 to 30 sucks, seamlessly integrating breathing with sucking and swallowing. Although many infants have a pattern of one suck, one swallow, and one breath, most babies develop their own coordinated pattern with modulated suction and expression. The alert state becomes more robust for the entire feeding, and more predictable availability for social interaction begins to emerge. This phase is typically seen in infants after transitioning home from the NICU.

Further eating organization, smoothness, and predictability of eating routines and social relationship development occurs well after term for most infants. The Integrated Phase is described as having full coordination of sucking/swallowing and breathing without increased work of breathing or tachypnea, clear demands to be fed and enjoyment of eating, and unique social interaction characteristics between the baby and the primary caregiver.

Pilot data collected for 30 preterm infants (not adjusted for medical morbidity) in a cross-sectional pilot study reveals a correlation between increasing postmenstrual age and increasing feeding score (Spearman's correlation yielded a rho of 0.68 [$P<.0001$]).[60] This correlation suggests that an increasingly organized feeding score is correlated with increasing postmenstrual age at the time of the observation.

CHALLENGES TO EMERGING EATING COMPETENCE FOR HIGH-RISK INFANTS

The described phases of the development of eating skills are typically observed in preterm infants who have medical histories with few complications. However, no ranges of gestational ages are offered because of the unique individual developmental course that each infant experiences. In general, the descriptors follow the findings of physiologic and behavioral developmental studies. Although most infants follow this general pattern of development of eating skills, many infants have a slower progress than others and may take days, weeks, or months until they achieve the same level of eating that other infants born at the same conceptional age achieve. Contributions to these delays may include the medical condition of the infant, including early birth, invasive and noninvasive interventions in the NICU that may disturb the organization of the already compromised infant, and the environment in which the infant is developing. Infants with more medical comorbidities are most at risk for delayed attainment of oral feedings.[61] Dodrill and colleagues[62] studied 472 infants born at less than 37 weeks gestational age, and found that preterm infants who were less mature at birth, or who had a greater number of medical comorbidities, were delayed in their transition to full oral feedings and were more mature at attainment of full oral feedings. The earlier born or medically fragile the infant and the longer he or she is exposed to these 3 factors, the more likely it is that eating organization will be affected. For example, studies on outcomes of chronically ill and hospitalized groups of children show several similar findings; that the smaller the infant was at birth and the longer he or she was ventilated or had major surgery, the less weight they gained after discharge.[7] For infants with bronchopulmonary dysplasia, successful full oral feedings typically not only delayed but are negatively correlated with the gestational age of the infant, with later development occurring for those infants born more prematurely.[61] Similarly, infants with cardiac defects had significant delays with feeding readiness, successful gastric feeding, oromotor readiness, and oromotor skills.[61,63]

Effects of the infant medical condition on successful eating outcomes include pain and discomfort that is internally generated, such as abdominal pain or headaches, which are difficult to understand in the preverbal infant; nausea or gastrointestinal upset such as gastroesophageal reflux; respiratory distress and what adults would describe as breathlessness; pharmacologic side effects; neurochemical imbalance; and nutritional deficits, among others. The extent to which infants associate discomfort and pain with being fed is not known. However, what is known is that infants with gastrointestinal issues as well as those with respiratory disease are overrepresented in tertiary feeding clinics.[64–66]

Procedures can also affect the infant's success at eating. Infants typically undergo unpredictable interventions, which often override the infant's physiologic stability; timing of procedures that either interrupt or do not take into consideration the infant's sleep state; pain and discomfort from procedures with limited or no pain management; lack of basic comfort measures such as positioning for self-regulation; and prolonged intubation and feeding tubes. Prolonged use of nasogastric tubes, for instance, is correlated with increased episodes of gastroesophageal reflux, as well as feeding problems and increased facial defensive behaviors in infants well after discharge from the NICU.[67,68]

Accumulating evidence of the impact of environments on infant organization primarily highlights the lack of the regulating environment of the mother's body, so important for most infants during feeding interactions (see the articles by Mennella, Sullivan, and Champagne elsewhere in this issue). Furthermore it has long been known that environments filled with unpredictable and intrusive sound, light, and activity can affect the infant's physiologic and state organization.[69] Other factors that influence the infant's organization for eating are nonsupportive bedding and handling that do not allow for self-regulation and deep sleep, and multiple caregivers who present a variety of unfamiliar odors, voices, touch, and rhythm to which the infant must adjust.

RECOMMENDATIONS FOR FEEDING HIGH-RISK INFANTS IN THE NICU AND BEYOND

Although many challenges to successful feeding of premature and high-risk newborns have been identified, and more information is available about the neurodevelopmental processes that contribute to eating success, there still is no consistent approach to intervention strategies that may ameliorate the short-term and long-term adverse outcomes of feeding high-risk infants.[7,55] However, the developmental sequence of infant organization for eating is now being recognized, and an informed approach to supporting development of infant organization in all areas of development seems prudent. Support for early and individualized organization of physiology, state, and motor tone and movement, the substrates of all developmental skills is necessary both in the NICU and while the infant and family are followed at home.

In the NICU, protection from an intrusive environment, provision of a familiar and consistent caregiver (in most instances the parents), provision of uninterrupted rest periods, attention to the infant when he or she is available behaviorally, protection from unwarranted and disorganizing procedures, and attention to organizing procedures such as holding while eating are foundations for successful eating. Recognition of the developmental nature of acquisition of eating skills, and not pushing the infant further than he or she is developmentally capable of at any given time, is essential. To accomplish this sensitivity, a thorough knowledge of infant behavioral communication of his or her capabilities and challenges is necessary, along with a willingness to modify the expectations of successful eating from the amount the baby is fed to the quality of the feeding.

Finally, and likely most importantly, supporting the parent-infant relationship and assisting the parents to feel competent with the feeding their baby is of utmost importance. As detailed earlier, much of the development of eating skills is accomplished after discharge from the NICU. Coupled with the significant incidence of both short-term and long-term growth and feeding failures in high-risk infants, more attention needs to be given to the development of eating and feeding competence of the parent-infant dyad, both in the NICU and as they transition to their family home.

SUMMARY

The short-term and long-term adverse growth and eating behavior outcomes of early-born and high-risk babies reveal major challenges for professionals, infants, and parents in both the NICU and community settings. Research indicates that eating is a complex and ongoing physiologic and behavioral achievement for growing neonates, and that recognition of this neurodevelopmental process can inform current feeding practices. A clinically informed approach to recognition of infant behavioral organization by development of the subsystems of physiologic, arousal, and motor areas is presented as a means by which professionals and parents can assist the infant's ability to have more organized eating experiences. Finally, recommendations for practices that recognize the neurodevelopmental processes and the need for competent, relationship-based eating opportunities between parents and infants are proposed.

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