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Changes in Oral Feeding in Preterm Infants Two Weeks After Hospital Discharge

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Abstract

The purpose of this analysis was to measure changes in preterm infant feeding skill between discharge and two weeks post-discharge. Data were from two samples – 22 preterm infants who participated in a non-experimental study of feeding readiness and 63 preterm infants who participated in a study of four oral feeding approaches. Both studies were approved by the institutional review board; parents gave informed consent. The Early Feeding Skills Assessment (EFSA) was used to measure feeding skills. Data were analyzed descriptively and by ANOVA and regression. Analysis revealed that feeding skills changed selectively from discharge to post-discharge and that discharge skills were predictive of post-discharge skill. Changes that occur in feeding skills during the immediate post-discharge period have received little attention from researchers. The findings suggest that enhanced pre-discharge assessment and parent teaching maybe necessary to reduce reported parental stress associated with feeding the newly discharged infant and to promote a positive feeding experience.

Keywords

preterm infants; post-discharge; oral feeding

The American Academy of Pediatrics has included competence at nipple feeding, either breast or bottle, as a criterion for preterm infant readiness for hospital discharge,¹ a criterion

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that is often considered achieved if a preterm infant is able to take all feedings orally for 24 to 48 hours and gain weight. While oral feeding is generally started in neonatal intensive care when infants are between 32 and 34 weeks post-menstrual age (PMA),² it remains clear that oral nipple feeding is physiologically challenging because of neurological immaturity, difficulty regulating autonomic functions, and uncoordinated suck-swallow-breathe mechanisms.³ Moreover, because “success” at oral feeding is often judged solely on the basis of oral consumption without full assessment of other components of feeding, such as suck-swallow-breathe coordination, preterm infants are often discharged home prior to 38 weeks post-menstrual age (PMA) with evolving oral feeding skills.⁴ How the preterm infant continues to develop oral feeding skills in the early post-discharge period has been rarely studied. Yet, the variability in achievement of mastery of oral feeding for preterm infants and the risk of feeding disorders post-discharge in this group underscores the importance of this time of transition. In fact, some researchers have shown that up to 15% of preterm infants are re-hospitalized with feeding difficulties in the first two weeks after discharge from the neonatal intensive care unit (NICU).⁵ Other researchers have shown that it is possible to identify hospitalized infants who have normal feeding patterns from those who do not at about 36 weeks PMA and that most of these infants will have been born preterm or who those with the most complex or severe health conditions.⁶ Moreover, the researchers found that a high percentage of parents described feeding problems in their infants discharged from the neonatal unit at 6 and 12 months, including infants who had been assessed as normal feeders while in the NICU. It was not clear to the researchers if this represented true prevalence of feeding difficulty or parental anxiety about feeding and growth.⁶

Preterm infants are generally at risk for poor feeding, nutritional deficiency, and growth limitations.⁷ Adverse behavioral reactions to feeding in preterm infants can include fatigue, agitation, and disorganization and immature cardio-respiratory and neurobehavioral control can result in poor oral feeding performance.^{8,9} Even healthy preterm infants at their expected delivery date are likely to have intermittent decreased minute ventilation, respiratory rate, and tidal volume during oral feeding.¹⁰ During their next few months, infants refine their skills and increase efficiency so that they maintain feeding durations while they consume a greater volume appropriate for their weight gain and growth. For example, researchers have found that at one month corrected age infants born preterm demonstrated coordinated sucking and swallowing with breathing by swallowing liquids without choking most of the time. In addition, the infants will actively participated in feeding by signaling readiness for food by sucking or mouthing when placed in a feeding position. However, only about 50% of the infants fussed when the feeding was interrupted before completion.¹¹ Variability in oral feeding skill among preterm infants may be due to the competence of the adult feeder in supporting the infant during feeding. Difficulty in reading infant signals of readiness and satiation are concerns that have been found by many researchers, especially in the early weeks post hospital discharge-. Moreover, parental anxiety about feeding their infant has been associated with nearly all types of feeding dysfunction even though that anxiety may not have been correlated with later specialized care.¹²

Many factors may influence a preterm infant’s ability to feed orally. Both morbidity and birth gestation have been related to feeding disorders throughout infancy and early childhood.¹³ Suck-swallow-breathe coordination and feeding performance are important early neurodevelopmental milestones, which, when not reached, may further affect feeding skill development.¹⁴ While few studies have examined feeding skill development post-discharge in preterm infants, research has shown that feeding skill, as measured by the volume of formula taken per minute, was related to other feeding outcomes including behavior state and state organization.¹⁰ Moreover, as a preterm infant’s nervous system

matures, the infant's suck, swallow, and breathing skills become more coordinated. In addition, other crucial skills of infants who are more mature, neurologically and behaviorally become more readily apparent and observable.

Although competence at oral feeding is a criterion for hospital discharge for infants who are born preterm, a challenge in meeting this criterion is adequate assessment of oral feeding skills. Using measures such as being able to successfully take a prescribed volume orally and demonstrating adequate weight gain fails to consider the preterm infant's unique developmental feeding patterns. Thus, many infants may be discharged home with marginal competence at feeding, resulting in parental concern and frustration.^{15,16}

The purposes of this analysis were to measure changes in feeding skills from discharge to the early post-discharge period and determine if pre-discharge feeding skills predict post-discharge feeding skills. If early post-discharge feeding skills can be predicted prior to discharge, then more rigorous pre-discharge feeding skill assessment can be used, interventions developed to help promote oral feeding skill development, and anticipatory guidance provided for families to facilitate the transition home.

Methods

Data for the analysis were collected in two studies of preterm infant feeding. The first was a non-experimental study of feeding readiness in 95 preterm infants that included 22 infants who were included in a 2-week, post-discharge follow-up study.¹⁷ The second was an experimental study of four feeding approaches to the transition from gavage to oral feeding in 109 preterm infants that included 63 infants who were retained for the 2-week post-discharge follow-up of feeding skill. Both studies took place in the same level III NICU in a tertiary care, urban university medical center. Both studies were approved by the institutional review board and all parents gave informed, written consent.

The Early Feeding Skills Assessment (EFSA) used to measure pre- and post-discharge feeding skills.¹⁸ The EFSA is designed to measure feeding skill of preterm infants from the initial oral feeding through 52 weeks post-conceptual age (PCA) and includes 29 items assessed by observation. For these studies, minor revisions to the EFSA were made in order to allow feeding skills to be scored. That is, the investigators assigned numerical values to each item on the original EFSA. As seen in Table 1, assessment items were grouped into 5 domains: oral feeding readiness (OFR), oral feeding skill (OFS), coordinated swallowing (CSW), physiologic stability (PS) and oral feeding tolerance (OFT). There were 5 items for OFR scored immediately prior to feeding. This section assessed pre-feeding behavior state, tone and baseline oxygen saturation. Items were scored as yes or no for a potential score range of 0 to 5. OFS consisted was assessed by 10 items examining the ability to maintain engagement during the feeding, oral-motor skill and the quality of the suck and the sucking pattern. Each item was scored on a 0 to 2 or 0 to 3 scale associated with the degree of achievement. Total scale scores ranged from 0 to 24. CSW was assessed by six items focused on the infant's ability to manage a fluid bolus efficiently while protecting the airway. Five items on the CSW were scored on a scale of 0 to 3 and one item assessing choking was score yes or no. The range of scores on the CSW was 0 to 16. There were 11 items assessing PS including various aspects of the infants' oxygen saturations, color, breathing respiratory effort and heart rate throughout the feeding. Items were scored either 0 to 3 or 0 to 2 based on degree of stability. The range of scores on the PS was 0 to 27. The three items on the OFT were scored during the first 5 minutes after feeding and included behavior state, tone, and skill maintenance during the feeding. Items were scored on a 0 to 3 or 0 to 2 scale and the total range of scores was 0 to 8. The total score on the EFSA ranged from 0 to 77. The EFSA was administered by trained observers who maintained inter-rater

reliability at .90. Each subscale and a total score were computed from the subscale totals. Data were entered into a relational data base.

The discharge feeding assessment for both studies was conducted in the NICU. The infant was fed either formula or breast milk by one of the nursing staff. As part of the larger studies, all observation feedings were offered by bottle; for infants who were feeding by breast, observations were conducted at times the mother was not visiting. The post-discharge assessment for both studies was conducted in a room set up for that purpose in a building adjacent to the hospital; the infant was fed either formula or breast milk by the infant's mother.

Results

There were 12 female and 10 male infants in the sample from the first study; 59% were Black/African American. The mean birth weight of these 12 infants was 1322 grams (SD=457) and their mean PMA at birth was 29.6 weeks (SD= 1.9 weeks). The mean weight of the infants at the pre-discharge measurement was 2149 grams (SD=305) and the mean PMA at discharge was 35.3 weeks (SD=1.2 weeks). At the post-discharge observation, the mean weight of the infants was 2834 grams (SD=436.11) and the mean PMA was 38 weeks (SD=9.10). In the second study, there were 34 male and 21 female infants; 86% were Black/African American. The mean birth weight of these 65 infants was 1444 grams (SD=347) and their mean PMA at birth was 30 weeks (SD=2 weeks). The mean weight of these infants at the pre-discharge measurement was 2558 grams (SD=382) and the mean PMA at discharge was 36 weeks (SD=1.5). At the post-discharge observation, the mean weight of the infants was 2819 grams (SD=407).

Infants were also classified according to their severity of illness using the Neonatal Morbidity Index (NMI), which assesses how ill infants are during the hospital stay. NMI scores at 32 weeks PMA have been reported to be predictive of PMA at full oral feedings.¹⁹ NMI classifications range from 1 to 5, with 1 describing preterm infants without serious medical problems and 5 describing infants with the most serious complications; birth weight but not gestation is factored into the scale. The NMI was scored at 32 weeks PMA. The mean of NMI of the 22 infants in the first sample used for this analysis was 2.79 (SD=1.1) and 2.8 (SD=1.2) for the 65 infants in the second sample.

Since the EFSA had not been used as a measure of feeding skill in a research study prior to our use of the tool, we examined the reliability of the subscales and the total scale. Using a sample of 78 feeding observations from the first study that included the two observations from each of the 22 infants involved in this analysis as well as data from the 36 infants on whom we had only pre-discharge feeding, we computed Cronbach's α for each of the subscales. The Cronbach's α for OFR, OFS, CSW, PS, and OFT were 0.74, 0.76, 0.73, 0.74, and 0.76, respectively. The Cronbach's α for the total EFSA from the first sample was 0.72. We completed this same assessment for the 65 infants on whom we had both pre- and post-discharge data from the second study. The Cronbach's α for OFR, OFS, CSW, PS and OFT were 0.79, 0.77, 0.49, 0.69, and 0.63, respectively. The Cronbach's α for the total EFSA from the second sample was 0.80.

Table 2 shows the mean values and standard deviations for both samples on all domains of the EFSA and on the total EFSA score at discharge and two weeks post-discharge. Table 1 also shows the results of the ANOVA test for differences in domain and total EFSA scores from discharge to two weeks post-discharge. There were significant differences between pre-discharge and post-discharge EFSA measurements for both samples. In the first sample, significant differences were detected for OFS ($F= 9.78, p=0.0046$) and CSW ($F= 4.81,$

$p=0.038$), and the total EFSA ($F=10.78$, $p=0.0031$). For the second sample, significant differences were found for OFR ($F=3.8$, $p=0.05$), OFS ($F=9.3$, $p=0.003$), and the total EFSA ($F=6.6$, $p=0.0113$). The EFSA score at discharge was predictive of the EFSA score at post-discharge for both the first ($F=9.0$, $p=0.007$, $R^2=.28$) and second ($F=6.9$, $p=0.01$, $R^2=.12$) samples. No other variables including birth gestation, birth weight, sex, PMA at discharge or post-discharge, contributed significantly to the prediction of post-discharge EFSA.

Discussion

The EFSA demonstrated good reliability in all five domains in both samples, supporting its potential usefulness for both research and clinical practice. Various domains on the EFSA in both samples were found to be significantly different from discharge to two weeks post-discharge, supporting that infants' feeding skills continue to change and mature after discharge. In particular, the domains that demonstrated significant changes over time were associated with the infants' abilities to remain engaged with the feeding, the level of oral-motor skill and the ability to coordinate swallowing. This suggests that infants continue to develop these important oral feeding skills after hospital discharge and that these skills may develop rather quickly during that transition. Interestingly, the items related to maintaining physiologic stability were not significantly different from discharge to post-discharge. This may be because of the general criterion that infants must demonstrate physiological stability before for going home; generally, infants who demonstrate respiratory compromise (nasal flaring, color change, grunting) are not considered ready for discharge. Additionally, items measuring feeding tolerance did not show significant changes from discharge to post-discharge perhaps indicating tolerance – state stability, tone, and skill maintenance – was relatively stable at discharge.

In both samples, the global assessment of feeding skill changed over time and the discharge feeding skills were predictive of the post-discharge feeding skills. Other variables that might be expected to contribute to the continuing development of feeding skills during the early post-discharge period were not predictive of post-discharge feeding skill. Thus, it is possible that the EFSA may be a useful measure for the assessment of feeding skills at discharge, providing a basis for identifying infants who may be at risk for poor feeding in the early discharge period. The potential utility of the EFSA for such measurement is that the parents of infants who are identified as being at risk for poor feeding could receive additional, directed discharge preparation as well as daily assessments by phone or some other mechanism during the first few days or weeks following discharge. In this manner, potential problems, including re-hospitalization for weight gain failure, could be avoided.

Feeding skill development is an important issue for neonatal health care providers and for parents of preterm infants during hospitalization and for parents in the post-discharge period.²⁰ Parents and hospital staff, in good faith effort to discharge infants home as soon as possible, may fail to consider the potential effect of still-developing-skills on the success of feeding during the immediate post-discharge period. Mothers in the early discharge period have reported that they valued the discharge preparation they received when their infant was in the NICU but that they also thought that a more structured and individualized approach to discharge planning was needed and that the discharge teaching might well include members of the mother's support system.²¹ Other researchers have found that mothers of newly discharged preterm infants experience apprehension that is largely the result of a lack of confidence in their ability to independently care for their infants and that this apprehension is compounded by their sense of increased responsibility about their infants' well-being.²² Apprehension over infant feeding, and thus, infant weight gain, is part of mothers' experience, although this is counter-balanced by a sense of competence when all is going

well. These researchers have also suggested that pre-discharge intervention to provide support for mothers as they learn important caregiving responsibilities, such as infant feeding, may reduce post-discharge apprehension and increase mothers' confidence.

Directed intervention to support parents in the first two weeks at home should be tailored to the specific needs of parent and child. For example, it has been shown the both maturation and experience as factors influencing feeding behaviors.²³ At the same time, researchers have found that mother's mental framework, or internal working model, for feeding will also influence her level of concern and her ability to support her infant through the first year of the infant's life.²⁰ A mother's working model of feeding involves her motivations, feelings, and thoughts about feeding and operates during a feeding to aid mothers in their work. In addition, little attention has been paid to assisting mothers in their efforts to interact in synchronous, developmentally supportive ways with their infants during feeding.²⁴

Conclusion

This analysis has demonstrated that the EFSA has adequate internal consistency and moderate predictability of post-discharge outcomes. The tool, while somewhat lengthy, is not difficult to use or score. Moreover, there are opportunities to learn how to use the tool at various short-course training sessions offered by the tool's authors.

The use of reliable measures of feeding skill, such as the EFSA, may provide needed data to determine when an infant's feeding skills are competent enough to consider discharge. Additionally, the use of such tools may assist in developing final discharge teaching plans for families who are taking home a still-learning-to-feed infant. Finally, the predictive value of such pre-discharge assessments may assist in planning appropriate post-discharge intervention and follow-up.

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Table 1

Early Feeding Skills Assessment

Domains	Item Number and Description	Range of Scores
Oral Feeding Readiness (OFR)	5 items; pre-feeding behavior state, tone and baseline oxygen saturation.	0–5
Oral Feeding Skill (OFS)	10 items; ability to maintain engagement during the feeding, oral-motor skill and the quality of the suck and the sucking pattern.	0 to 24
Coordinated Swallowing (CSW)	6 items; ability to manage a fluid bolus efficiently while protecting the airway.	0 to 16
Physiologic Stability (PS)	11 items; oxygen saturation, color, breathing respiratory effort and heart rate throughout the feeding	0 to 27
Oral Feeding Tolerance (OFT)	3 items; behavior state, tone, and skill maintenance during the feeding	0 to 8

Table 2

Changes in Feeding Skill from Discharge to Two Weeks Post-discharge

Domains	Discharge (M, SD)	2 Weeks Post-Discharge (M, SD)	F, p values			
	Sample 1	Sample 2	Sample 1	Sample 2	Sample 1	Sample 2
Feeding Readiness (OFR)	4.3, 0.88	4.8, 0.55	4.24, 0.91	4.9, 0.25	0.02, 0.88	3.8, 0.05
Feeding Skill (OFS)	20, 4	20.7, 3.7	21.79, 4.42	22.3, 2.1	9.78, 0.0046	9.3, 0.003
Coordinated Swallow (CSW)	9.9, 2.1	12.6, 1.7	10.76, 1.92	12.9, 1.6	4.81, 0.038	1.7, 0.20
Physiologic Stability (PS)	19.9, 3.8	22.6, 1.7	21.03, 2.81	23, 1.3	3.78, 0.063	1.9, 0.17
Feeding Tolerance (OFT)	3.5, 1.2	5.3, 1.7	4, 0.96	5.1, 1.2	3.95, 0.058	0.42, 0.52
Total EFSA	57.6, 8.8	66.1, 6.9	61.8, 8.52	68.6, 3.8	10.78, 0.0031	6.6, 0.0113