Journal of Neonatal Nursing 25 (2019) 111–115

Contents lists available at ScienceDirect

Journal of Neonatal Nursing

journal homepage: www.elsevier.com/locate/jnn

Original Article

Oral feeding readiness and premature infant outcomes

Atiat Osman

Department of Pediatric Nursing, Faculty of Nursing, South Valley University, PhD Candidate at Faculty of Nursing, Assiut University, Egypt

ARTICLE INFO

Keywords:
Preterm infant
Feeding
Readiness
NOMAS
Hospital discharge

ABSTRACT

Background: Preterm infants develop a coordinated suck and swallow depending upon their postmenstrual age and neurological status. However, criteria to determine when to best initiate oral feeding are unclear. Yet, infant readiness for oral feeding is essential for successful transition from enteral tube to oral feeding.

Aim: This study aimed to (a) identify infant characteristics associated with feeding readiness assessed with the Neonatal Oral Motor Assessment Scale (NOMAS)1 and (b) examine the relationship between readiness and preterm infants' time to reach full oral feeding and length of hospital stay.

Study design: This is a secondary descriptive analysis from a randomized controlled study to determine the effect of a premature infant oral motor intervention on feeding progression and length of hospital stay. Seventy-five stable premature infants were recruited from five neonatal intensive care units in Assiut city, Assiut governorate, Egypt. Eligible infants' gestational age ranged from 30 to 32 weeks gestational age (GA). Readiness was assessed individually for each infant during non/nutritive sucking using NOMAS.

Result: Preterm infants who demonstrated greater oral feeding readiness achieved full oral feeding sooner ($P < 0.0001$) and were discharged earlier from the hospital ($P < 0.0001$) than those with less readiness. Gender, gestational age at birth, birth weight, number of intervention days were not related to infant oral feeding readiness.

Conclusion: Readiness for oral feeding in premature infants is related to earlier feeding progression and shorter hospital stays.

1. Introduction

Safe and efficient oral feeding is a challenge for both preterm infants and their caregivers (Rocha et al., 2007). Premature infants have neurodevelopmental immaturity, physiologic instability, and altered behavioral state disorganization (Gennattasio and Baranek, 2015) that impact caregivers' decisions about how and when the infant is ready for oral feeding. Oral feeding readiness can be defined as readiness to initiate oral feeding (Kish, 2013), yet oral feeding readiness is a complex concept. Unfortunately, little is known about the criteria for the optimal time to initiate oral feeding (Gennattasio and Baranek, 2015).

Gestational age and current weight are often listed as the indicators of feeding readiness (Amaizu et al., 2008; Hwang et al., 2012; Lau and Smith, 2011; Medoff-Cooper et al., 2009). Some studies suggest that 34 weeks postmenstrual age is an appropriate age to initiate oral feeding in preterm infants (Mizuno and Ueda, 2003; Fucile et al., 2002; McCain et al., 2001), while another study concluded that oral feeding can be safely initiated earlier by assessing sucking performance with better health outcomes (Nyqvist, 2008). Measurement of preterm readiness has also been based upon an infant's ability to consume a designated milk volume or to empty the bottle, regardless of the infant's behavioral indicators or whether caregiver manipulation of the bottle was necessary to complete the feeding (Ludwig and Waitzman, 2007). In addition, the number of oral feedings offered per day is often based on an infant's current weight or ability to gain weight (Pickler et al., 2015). Consequently, infants' readiness skills are often overshadowed by pressure to "get" the infant to eat, thereby forcing them to a trial and error approach that may have been highly stressful (McGrath, 2004). In this framework, preterm infants can be pushed to orally feed before they are physiologically or behaviorally ready, leading to delayed transitioning to full oral feeding and longer hospitalizations (Premji et al., 2004).

Appropriate early oral feedings could have economic benefits to the hospital and families by reducing tube feeding time and its related complications, promoting mother-child interaction (mother can breast feed or assist in bottle feeding), and decreasing hospital stay (Lau, 2002; Pimenta et al., 2008; Kirk et al., 2007a). Yet, early oral feeding in infants who are not ready to feed could result in serious complications

Abbreviations: NOMAS, neonatal oral motor assessment scale; GA, gestational age; NICU, neonatal intensive care unit; NNS, nun-nutritive sucking; NEC, necrotizing enterocolitis; NS, nutritive sucking; PMA, postmenstrual age

E-mail address: Drattiyat.osman@nurs.svu.edu.eg.

https://doi.org/10.1016/j.jnn.2018.11.005
Received 1 September 2018; Received in revised form 7 November 2018; Accepted 22 November 2018
Available online 08 December 2018

such as 1) aspiration pneumonia, 2) hypoxia, 3) bradycardia, 4) deglutition apnea, and 5) readmission (Hill, 2002). Therefore, optimal timing of the initiation of oral feeding is necessary to ensure favorable infant health and developmental outcomes (McGrath, 2004).

Infant behaviors including robust rooting responses, crying near scheduled feeding times, maintenance of a flexed posture (McGrath, 2015), irritability or increased general activity level turning to alert behavior, ability to engage in nonnutritive sucking (NNS) for 3 min without negative impact on the respiratory or heart rate (Gennattasio and Baranek, 2015; Kirk et al., 2007b), and maintenance of a quiet alert state for variable periods of time (White-Traut et al., 2005) were found to be a better predictor of oral feeding readiness than either weight or postmenstrual age (White-Traut et al., 2005; Medoff-Cooper, 2005). Yet, readiness can be promoted or hindered by other factors such as the caregiver's feeding technique and the infant prior feeding experience (Howe et al., 2007a). Cardiorespiratory instability is another factor that would delay initiation of oral feeding (Crowe et al., 2012). Therefore, the introduction of oral feeding should be based on an individual infant's feeding readiness behavior. In this secondary analysis we identify factors associated with feeding readiness as assessed with the Neonatal Oral Motor Assessment Scale (NOMAS) and evaluate the relationship between feeding readiness and preterm infants' time to reach full oral feeding and length of hospital stay.

2. Methods

2.1. Design

We used a secondary descriptive analysis of data collected as part of a randomized controlled trial that evaluated the effect of a premature infant oral motor intervention on feeding progression and length of hospital stay (Osman et al., 2016). Approval for the study was obtained from School of Nursing, Assuit University at Egypt.

2.2. Sample and setting

The original sample and this analysis included 75 preterm infants born at 30–32 weeks gestational age (GA) who were recruited from five neonatal intensive care units (NICUs) in different public hospitals in Assuit Governorate, Egypt. In the period from April to October 2015. The mean numbers of beds in each NICU was 15 beds. All hospitals were public supported and delivered similar care. In the study settings, oral feeding was initiated with 3–4 feedings per day in 8 to 6 h intervals and progressed up to 8 feedings pre day in 3 h intervals. The amount and frequency of feeding was increased as tolerated. To participate in the study, infants had to be medically stable and appropriately grown for gestational age. Infants were excluded from study participation if they: (a) had documented or suspected congenital anomalies; (b) were experiencing necrotizing enterocolitis (NEC); (c) had a brain injury (including intraventricular hemorrhage); or (d) were receiving assistive ventilation or high-flow nasal cannula at > 4 L per hour; (e) breast feed infants (breast feeding not introduce before 32 weeks of age according to internal policy of the included NICUs); (f) low weight infants, inappropriate infant's weight could interfere with his ability to consume oral feeding early. As the exploratory nature of the original study design, it's recommended to start with infants had normal weight for their age.

2.3. Measures

Infant characteristics: Gestational age at birth, gender, and birth weight was used to describe the sample and explore predictors of feeding readiness.

Days of the intervention: The parent study randomized infants to one of three intervention groups (n = 25/groups). A 5-min intervention entails techniques of touching and stimulate internal and external oral structure used in order to enhance infant's oral skills. A low dose intervention group received the intervention up to 7 days, while a high dose intervention group continued to receive the intervention until they reached full oral feeding (Osman et al., 2016). A third control group did not receive oral stimulation; they received a sham intervention through touch infants and pretend making of oral stimulation to keep nurses blind to the assigned groups. Days of intervention was calculated from the beginning of the intervention to up to 7 days in the low dose group or until full oral feeding was reached in the high dose group. While, days to intervention was zero for the control group.

Oral feeding readiness; The revised version of the NOMAS (Palmer et al., 1993) was used to evaluate readiness for oral feeding in premature infant within 24 h from the beginning of oral feeding. The NOMAS is a flexible scale that can be used to assess either bottle feeding or breastfeeding in both preterm and full-term infants (Howe et al., 2008). The scale has adequate psychometric properties including; test retest reliability (0.67–0.82) (Braun and Palmer, 1985); interrater reliability (0.93–0.97) (Case-Smith, 1988); and acceptable internal consistency (Howe et al., 2007b). Construct validity was supported by several authors (Howe et al., 2007b; Braun, 1985; Case-Smith et al., 1989) while predictive validity was confirmed in one study (Palmer and Heyman, 1999). In the current study, high internal consistency was identified through a pilot study included 10 infants (0.937 by Cronbach's alpha test). The NOMAS has more stability and consistency than other readiness measurements (Matthews, 1988; Riordan and Koehn, 1997; Riordan et al., 2001; Schlomer et al., 1999; Nyqvist et al., 2001; Hedberg Nyqvist and Ewald, 1999; Bingham et al., 2012).

The NOMAS contains four major categories of normal and abnormal characteristics of jaw and tongue movements (see Table 1) Infant's tongue and jaw behaviors are identified and quantified during a 1 min trial of nonnutritive sucking and through a 2 min trial of nutritive sucking (Braun, 1985). Using the Gaebler scoring system (Gaebler and Hanzlik, 1996), normal characteristics for each item were scored as

Table 1
Neonatal oral-motor assessment scale.

Normal characteristics
Jaw
1 Rhythmical excursions with consistent degree of depression
2 Movement occurring at the rate of 1/second; NNS approximately 2/second
3 Spontaneous excursions upon tactile presentation of nipple up to 30 min prior to feed.
4 Sufficient closure to express fluid from the nipple.
Tongue
1 Cupped tongue configuration (tongue groove) maintained during sucking
2 Extension-retraction movement in a ventral-dorsal plane.
3 Rhythmical movements occurring at a rate of approximately 1/second; NNS approximately 2/second.
4 Liquid is sucked sufficiently into oropharynx for swallow.
Abnormal characteristics
Jaw
1 Inconsistent degree of jaw depression.
2 Lack or rhythmical movement.
3 Minimal excursions clenching.
4 Difficulty initiating movement.
5 Excessively wide excursions that interrupt the intra-oral seal on the nipple.
6 Asymmetry; lateral jaw deviation.
7 Absence of movement.
Tongue
1 In coordination of suck/swallowing and respiration causing choking, sputtering and gagging.
2 Lack of rhythmical movement.
3 Excessive protrusion (beyond labial border) during extension phase of sucking.
4 Flaccid; flattened with absent tongue groove.
5 Retraced; humped; pulled back.
6 Asymmetry; lateral tongue deviation.
7 Absence of movement.

0 = not at all, 1 = brief-l0%, 2 = 11–50%, 3 = 51–100% of the total time, while abnormal characteristics were scored as 1 = absent, 0 = present (see Table 1). Scale development did not include a cutoff point or total score calculation for readiness (27, 32), therefore for this study, a total score was obtained by summing the score of normal and abnormal characteristics categories, with a higher score representing greater readiness. Infants were video recorded once immediately before their first oral feeding. The first author assessed the infant during the 1 min of NNS using a thumb and then during 2-min of nutritive sucking (NS) with a bottle feeding for immediate scoring on a checklist. The videos were then coded to confirm the data on the original assessment checklist.

Feeding progression and length of hospital stay. Both feeding progression and length of hospital stay were the outcome variables of interest. Feeding progression was calculated as the time in days from the introduction of oral feedings at one feeding per day to full oral feedings of eight feedings per day was achieved. Introduction of oral feeding was physician decision; the researcher was not authorized to start oral feeding for the included infants. However, introduction of oral feeding depends on infant's sucking power and weight. Once infants initiated oral feeding, their progression status was measured daily and infants could progress and regress before full oral feedings were maintained. Total oral feeding was defined as consuming 100% of 8 oral bottle feedings (one bottle = 30 ml of milk) per day without feeding or physiologic problems. Length of hospital stay was defined as the numbers of days from the admission day to the date of discharge.

2.4. Statistical analysis plan

Descriptive statistics were used to detail infant characteristics, days of intervention, oral feeding readiness, feeding progression and length of hospital stay. Non-directional statistical tests were performed with the level of significance set 0.05 for all tests due to the exploratory nature of this secondary analysis. Spearman or Spearman point-by serial correlational analyses were conducted to examine the relationship between the infant characteristics (including days of intervention) and NOMAS oral readiness total scores. Partial Spearman was used to examine the relationship between NOMAS oral readiness total scores and the two infant outcomes, feeding profession and length of hospital stay after partially out the effects of number of intervention days. Non-parametric methods were applied due to non-normality of data distributions. Log transformation methods and Poisson regression for count data were considered to examine the relationship between NOMAS total score and outcomes, but were not conducted due the small sample size.

3. Results

3.1. Infant characteristics and outcomes

Table 2 details the characteristics of the 75 preterm infants in the study. The gestation age at birth of the infants was 30–32 weeks. The NOMAS oral readiness total score ranged from 11 to 38. The median birth weight was 1500 g and 29 (38.7%) were female. Days of intervention ranged from 0 to 16. Infant outcomes, the days needed to gain full oral feeding ranged from 4 to 19 days and length of hospital stay ranged from 4 to 31 days. Infants had a median NOMAS score of 28 with a range of 11–38.

Table 3 presents the results for the Spearman correlational analyses. Infant characteristics and number of intervention days were not significantly related to NOMAS oral readiness total scores. The readiness total scores, however, were inversely related to time to full oral feeding ($r_s = -0.54$, $P < 0.0001$) and length of hospital stay ($r_s = -0.56$, $P < 0.0001$). A partial Spearman correlation analysis was also conducted to determine the relationship between readiness total scores and infant outcomes, after controlling for the number of intervention days

Table 2
Infant characteristics and outcomes (N = 75).

Infant Characteristic	Statistic
Gestational age, in weeks	
Week 30, n (%)	30 (40%)
Week 31, n (%)	8 (10.7%)
Week 32, n (%)	37 (49.3%)
Female gender, n (%)	29 (38.7)
Birth weight, in grams	
Median (25th, 75th)	1500 (1300,1680)
Minimum, maximum	1100, 2140
NOMAS readiness score	
Median (25th, 75th)	28 (Kirk et al., 2007a; Case-Smith et al., 1989)
Minimum, maximum	11.0, 38.0
Intervention days	
Median (25th, 75th)	5 (10.0, 0.0)
Minimum, maximum	0.0, 16.0
Infant Outcomes	*Statistic*
Feeding progression, in days	
Median (25th, 75th)	10 (8.0, 13.0)
Minimum, maximum	4.0, 19.0
Length of hospital stay, in days	
Median (25th, 75th)	15 (12.0, 18.0)
Minimum, maximum	10.0, 31.0

Table 3
Spearman correlation coefficients.

Infant Characteristics	NOMAS Readiness Scores	P-value
Female gender	0.06	0.5861
Birth weight, in grams	0.11	0.3094
Gestational age, in weeks	−0.08	0.4460
Intervention period, in days	0.00	0.9504
Infant Outcomes	**NOMAS Readiness Scores**	**P-value**
Feeding progression, in days	−0.61	< .0001
Length of hospital stay, in days	−0.60	< .0001

Female: Spearman point-biserial coefficient with female coded as 0 = no, 1 = yes.

(time to full oral feeding: $r_s = -0.61$, $P < 0.0001$; length of hospital stay: $r_s = -0.60$, $P < 0.0001$).

4. Discussion

Transitioning to full oral feeding remains a major milestone in preparation for discharge home for preterm infants (Ahnfeldt et al., 2015). The findings from this study revealed that higher readiness behaviors, assessed prior to initiation of feeding, was an indicator of earlier full oral feeding success as well as earlier hospital discharge. To our knowledge we are the first study to confirm an association between feeding readiness and early full oral feeding. However, White-Traut and colleagues found that in preterm infants born at 29–35 weeks, feeding readiness behaviors predicted feeding efficacy (feeding intake to feeding duration). Our findings of a positive relationship between feeding readiness and length of hospital stay is expected given that the timing of hospital discharge is often based on when an infant achieves full oral feeding. Early attainment of full oral feeding and earlier hospital discharge may also reduce the financial burden associated with prolonged hospitalization.

Infant readiness scores the day before oral feedings were initiated were generally high in our study and GA at birth, birth weight, and gender did not explain any of the variability in readiness scores. Although there is no standard age gestational age or postmenstrual age (PMA) to initiate oral feedings in preterm infants, many clinicians use 34 weeks as a developmental indicator of oral feeding readiness among

premature infants (White-Traut et al., 2005; Thoyre and Brown, 2004; Pickler et al., 2009; Lau and Schanler, 1996; Bertoncelli et al., 2012; McGrath, 2002; Simpson et al., 2002). Given the lack of association between readiness and GA at birth and the fact that over 50% of the infants experienced oral feeding before 34 weeks PMA infants may be able to safely begin oral feeding before 34 weeks. White and colleagues recommended assessing an infant's gestational age at birth, current age (PMA), gender, and birth weight as indicators of feeding readiness behavior (White-Traut et al., 2005).

In Egypt, the decision making around when to initiate oral feedings is typically left to the discretion of the attending physician who may or may not consider indicators of readiness. Some physicians believe that birth weight and weight gain are adequate indicators of feeding readiness. However, as in most developed countries, nurses often contribute information about infant alertness and non-nutritive oral motor skills that influences the physicians' decision to initiate oral feeding.

While our study indicates that readiness behaviors may be important in making decisions about when to initiate oral feeding, assessment of readiness behaviors can be a challenge because the behaviors may occur at irregular intervals and be subtle and fleeting. In addition, during sleep these readiness behaviors are absent and therefore infants can only be reliably assessed while awake (Peters, 2001). Caregivers have the responsibility to recognize factors that might have impact on the introduction or progression of oral feeding. Feeding readiness assessment should be included in the skill development needed of all bedside clinicians. Replication of this study with large sample size is recommended. Also, more attention need for assessment of readiness sign for oral feeding among low birth weight infant's. For, the experimental exploratory nature of the original study, we were not able to include low birth weight infants (safety issues). Excluding of breast feeding infants cause limitation for refer our result to all preterm infants, this raises question whether bottle and breast feeding infants have the same signs or readiness for oral feeding?

5. Conclusion

Oral feeding is an essential skill that premature infants must acquire for adequate health and development, especially in developing countries. Readiness is one of these factors, which can support early full oral feeding, shorten hospitalization period, and eliminate cost burned for the hospitals and parents as well. While technological advances have assisted care providers to improve premature infants' outcomes, accurate assessment of readiness remains a challenge. Based on our findings readiness for oral feeding could expect efficiency of oral feeding regardless of infant's gestational age and early discharge. So, further research should address the best methods to assess feeding readiness and the frequency of assessment to best identify readiness.

Acknowledgments

We want to thank the participating hospitals, NICUs nurses and physicians for their important contributions to the conduct of this research and are special thanks goes to all the parents and infants who participated in the study.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jnn.2018.11.005.

References

Ahnfeldt, A.M., Stanchev, H., Jorgensen, H.L., Greisen, G., 2015. Age and weight at final discharge from an early discharge programme for stable but tube-fed preterm infants. Acta Paediatr. 104 (4), 377–383.
Amaizu, N., Shulman, R., Schanler, R., Lau, C., 2008. Maturation of oral feeding skills in preterm infants. Acta Paediatr. 97 (1), 61–67.
Bertoncelli, N., Cuomo, G., Cattani, S., Mazzi, C., Pugliese, M., Coccolini, E., et al., 2012. Oral feeding competences of healthy preterm infants: a review. Int. J. Pediatr. 2012, 896257.
Bingham, P.M., Ashikaga, T., Abbasi, S., 2012. Relationship of neonatal oral motor assessment scale to feeding performance of premature infants. J. Neonatal Nurs. 18 (1), 30–36.
Braun, Palmer, 1985. A pilot study of oral-motor dysfunction in "At-Risk" infants. Phys. Occup. Ther. Pediatr. 5 (4), 13–26.
Braun, M.A., Palmer, M.M., 1985. A pilot study of oral-moto dysfunction in " at risk" infants. Phys. Occup. Ther. Pediatr. 5 (4), 13–25.
Case-Smith, J., 1988. An efficacy study of occupational therapy with high-risk neonates. Am. J. Occup. Ther. 42 (8), 499–506.
Case-Smith, J., Cooper, P., Scala, V., 1989. Feeding efficiency of premature neonates. Am. J. Occup. Ther. 43 (4), 245–250.
Crowe, L., Chang, A., Wallace, K., 2012. Instruments for assessing readiness to commence suck feeds in preterm infants: effects on time to establish full oral feeding and duration of hospitalisation. Cochrane Database Syst. Rev.(4), Cd005586.
Fucile, S., Gisel, E., Lau, C., 2002. Oral stimulation accelerates the transition from tube to oral feeding in preterm infants. J. Pediatr. 141 (2), 230–236.
Gaebler, C.P., Hanzlik, J.R., 1996. The effects of a prefeeding stimulation program on preterm infants. Am. J. Occup. Ther. : Official Pub. Am. Occup. Ther. Assoc. 50 (3), 184–192.
Gennattasio, Perri, Baranek, Rohan, 2015. Oral feeding readiness assessment in premature infants. MCN Am. J. Matern./Child Nurs. 40 (2), 96–104 e9-10.
Hedberg Nyqvist, K., Ewald, U., 1999. Infant and maternal factors in the development of breastfeeding behaviour and breastfeeding outcome in preterm infants. Acta Paediatr. 88 (11), 1194–1203.
Hill, A.S., 2002. Toward a theory of feeding efficiency for bottle-fed preterm infants. J. Theor. Construct. Test. 6 (1), 75.
Howe, T.H., Sheu, C.F., Hinojosa, J., Lin, J., Holzman, I.R., 2007a. Multiple factors related to bottle-feeding performance in preterm infants. Nurs. Res. 56 (5), 307–311.
Howe, T.H., Sheu, C.F., Hsieh, Y.W., Hsieh, C.L., 2007b. Psychometric characteristics of the neonatal oral-motor assessment scale in healthy preterm infants. Dev. Med. Child Neurol. 49 (12), 915–919.
Howe, T.H., Lin, K.C., Fu, C.P., Su, C.T., Hsieh, C.L., 2008. A review of psychometric properties of feeding assessment tools used in neonates. J. Obstet. Gynecol. Neonatal Nurs. : JOGNN 37 (3), 338–349.
Hwang, Y.S., Ma, M.C., Chen-Sea, M.J., Kao, H.M., Tsai, W.H., 2012. Factors affecting early feeding performance in preterm infants below 32 weeks gestation. J. Trop. Pediatr. 58 (1), 77–78.
Kirk, A.T., Alder, S.C., King, J.D., 2007a. Cue-based oral feeding clinical pathway results in earlier attainment of full oral feeding in premature infants. J. Perinatol. 27 (9), 572–578.
Kirk, A.T., Alder, S.C., King, J.D., 2007b. Cue-based oral feeding clinical pathway results in earlier attainment of full oral feeding in premature infants. J. Perinatol. 27 (9), 572–578.
Kish, M.Z., 2013. Oral feeding readiness in preterm infants: a concept analysis. Adv. Neonatal Care : Official J. Natl. Assoc. Neonatal Nurses 13 (4), 230–237.
Lau, C., 2002. The effect of stress on lactationits significance for the preterm infant. Adv. Exp. Med. Biol. 503, 91–97.
Lau, C., Schanler, R.J., 1996. Oral motor function in the neonate. Clin. Perinatol. 23 (2), 161–178.
Lau, C., Smith, E.O., 2011. A novel approach to assess oral feeding skills of preterm infants. Neonatology 100 (1), 64–70.
Ludwig, S.M., Waitzman, K.A., 2007. Changing feeding documentation to reflect infant-driven feeding practice. N.born Infant Nurs. Rev. 7 (3), 155–160.
Matthews, M.K., 1988. Developing an instrument to assess infant breastfeeding behaviour in the early neonatal period. Midwifery 4 (4), 154–165.
McCain, G., Gartside, P., Greenberg, J., Lott, J., 2001. A feeding protocol for healthy preterm infants that shortens time to oral feeding. J. Pediatr. 139 (3), 374–379.
McGrath, Medoff, 2002. Alertness and feeding competence in extremely early born preterm infants. N.born Infant Nurs. Rev. 2 (3), 174–186.
McGrath, Braescu, 2004. State of the science: feeding readiness in the preterm infant. J. Perinat. Neonatal Nurs. 18 (4), 353–368.
McGrath, Vittner, 2015. Behavioral Assessment. In Physical Assessment of the Newborn: A comprehensive Approach to the Art of Physical Exmaination, 5 th ed. NICU INK, Petaluma.
Medoff-Cooper, B., 2005. Nutritive sucking research: from clinical questions to research answers. J. Perinat. Neonatal Nurs. 19 (3), 265–272.
Medoff-Cooper, B., Shultz, J., Kaplan, J., 2009. Sucking behavior of preterm neonates as a predictor of developmental outcomes. J. Dev. Behav. Pediatr. 30.
Mizuno, K., Ueda, A., 2003. The maturation and coordination of sucking, swallowing, and respiration in preterm infants. J. Pediatr. 142 (1), 36–40.
Nyqvist, K.H., 2008. Early attainment of breastfeeding competence in very preterm infants. Acta Paediatr. 97 (6), 776–781.
Nyqvist, K.H., Farnstrand, C., Eeg-Olofsson, K.E., Ewald, U., 2001. Early oral behaviour in preterm infants during breastfeeding: an electromyographic study. Acta Paediatr. 90 (6), 658–663.
Osman, A., Ahmed, E., Mohamed, H., Hassanein, F., Brandon, D., 2016. Oral motor intervention accelerates time to full oral feeding and discharge. Int. J. Adv. Nurs. Stud. 5 (2), 228.
Palmer, M.M., Heyman, M.B., 1999. Developmental outcome for neonates with dysfunction and disorganized sucking patterns: preliminary fi ndings. Infant-Toddler Interv. Transdiscipl. J. 9, 299–308.
Palmer, M.M., Crawley, K., Blanco, I.A., 1993. Neonatal Oral-Motor Assessment scale: a

reliability study. J. Perinatol. : Official J. Calif. Perinat. Assoc. 13 (1), 28–35.
Peters, K.L., 2001. Association between autonomic and motoric systems in the preterm infant. Clin. Nurs. Res. 10 (1), 82–90.
Pickler, R.H., Best, A., Crosson, D., 2009. The effect of feeding experience on clinical outcomes in preterm infants. J. Perinatol. 29.
Pickler, R.H., Reyna, B.A., Wetzel, P.A., Lewis, M., 2015. Effect of four approaches to oral feeding progression on clinical outcomes in preterm infants. Nurs. Res. Pract. 2015, 716828.
Pimenta, H.P., Moreira, M.E.L., Rocha, A.D., Junior, S.C.G., Pinto, L.W., Lucena, S.L., 2008. Effects of non-nutritive sucking and oral stimulation on breastfeeding rates for preterm, low birth weight infants: a randomized clinical trial. J. Pediatr. 84 (5), 423–427.
Premji, S.S., McNeil, D.A., Scotland, J., 2004. Regional neonatal oral feeding protocol: changing the ethos of feeding preterm infants. J. Perinat. Neonatal Nurs. 18 (4), 371–384.
Riordan, J.M., Koehn, M., 1997. Reliability and validity testing of three breastfeeding assessment tools. J. Obstet. Gynecol. Neonatal Nurs. 26 (2), 181–187.
Riordan, J., Bibb, D., Miller, M., Rawlins, T., 2001. Predicting breastfeeding duration using the LATCH breastfeeding assessment tool. J. Hum. Lactation 17 (1), 20–23.
Rocha, A.D., Moreira, M.E., Pimenta, H.P., Ramos, J.R., Lucena, S.L., 2007. A randomized study of the efficacy of sensory-motor-oral stimulation and non-nutritive sucking in very low birthweight infant. Early Hum. Dev. 83 (6), 385–388.
Schlomer, J.A., Kemmerer, J., Twiss, J.J., 1999. Evaluating the association of two breastfeeding assessment tools with breastfeeding problems and breastfeeding satisfaction. J. Hum. Lactation 15 (1), 35–39.
Simpson, C., Schanler, R.J., Lau, C., 2002. Early introduction of oral feeding in preterm infants. Pediatrics 110 (3), 517–522.
Thoyre, S.M., Brown, R.L., 2004. Factors contributing to preterm infant engagement during bottle-feeding. Nurs. Res. 53 (5), 304–313.
White-Traut, R.C., Berbaum, M.L., Lessen, B., McFarlin, B., Cardenas, L., 2005. Feeding readiness in preterm infants: the relationship between preterm behavioral state and feeding readiness behaviors and efficiency during transition from gavage to oral feeding. MCN Am. J. Matern./Child Nurs. 30 (1), 52–59.