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The Relationship between Behavioral States and Oral Feeding Efficiency in Preterm Infants

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Abstract

Background—The relationship between behavioral states (alert, sleep, drowsy, and crying) and oral feeding efficiency in preterm infants is not well understood.

Purpose—To determine the relationship between behavioral states and feeding efficiency in preterm infants.

Method—This correlational study was conducted as a secondary analysis from a randomized controlled trial (RCT). Medically stable preterm infants born between 29 and 34 weeks gestational age participated. Baseline data from the RCT (week 0), 1-minute prior to feeding were used. Behavioral states were coded by two blinded coders. Oral feeding efficiency (ml/min) was calculated as the amount of intake over the first 10 minutes of feeding.

Results—Data from 147 infants were included. The proportion of time spent in alert states ($\beta = .76$, $F = 11.29$, $p = .05$), sleep states ($\beta = -1.08$, $F = 25.26$, $p = .05$), and crying ($\beta = 1.50$, $F = 12.51$, $p = .05$) uniquely predicted oral feeding efficiency.

Implications for Practice—Comprehensive assessment of behavioral states and infant characteristics for oral feeding readiness is crucial. Alert states are optimal for oral feeding. Forced oral feeding when infants are sleeping should be avoided. Infants in crying or drowsy states prior to feeding should be closely evaluated. Sleeping or drowsy infants may benefit from interventions (e.g. oral sensory stimulation, non-nutritive sucking, or multisensory intervention) to support transition to alert states prior to feeding.

Implications for Research—Future research should evaluate behavioral states prior to and during feeding and their relationship to oral feeding efficiency.

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There is no conflict of interest.

Keywords

preterm infants; behavioral states; oral feeding efficiency

Background and Significance

There are approximately half of a million infants born prematurely (< 37 week gestational age) each year in the U.S.^{1,2} Many of them are admitted to the Neonatal Intensive Care Unit (NICU).^{1,2} One of the gold standards for hospital discharge is the ability of infants to achieve full oral feedings.² Although breastfeeding may present fewer physiologic challenges and is encouraged for preterm infants,^{3,4} many preterm infants are bottle-fed either formula or expressed breastmilk.⁵ In this study, we primarily focused on bottle feeding which will be referred to as “oral feeding” or “feeding”.

The ability to fully oral feed while maintaining high oral feeding efficiency (ml/min) remains a challenge, leading to prolonged hospitalization and increased healthcare cost.^{6–11} Oral feeding efficiency (ml/min) may be reflective of the infant’s feeding skills and is crucial for oral feeding success.^{11–14} Oral feeding success is defined as the ability of infants to consume full oral feeding while maintaining physiologic stability.^{15–17} Improved oral feeding skills may be demonstrated when the infant achieves a feeding efficiency of more than 1.5 mL per minute and ingests 30% of the prescribed amount during the first 5 minutes of oral feeding.¹¹ There are numerous factors that may influence oral feeding efficiency for preterm infants, including maturation, alert behavioral states, pre-feeding cues, and physiologic stability.^{15,17} Nonetheless, the relationship between other behavioral states (including sleep, drowsy, and crying) and oral feeding efficiency in preterm infants is still not well understood.

A common problem in the NICU is the need to provide adequate caloric intake and oral feeding experiences. Unfortunately, this requirement sometimes leads to “forced oral feeding” when the infant is not exhibiting pre-feeding cues, not alert, or not mature enough to successfully oral feed. Furthermore, there is no consensus regarding demand versus scheduled oral feeding for preterm infants, especially when the infant is just beginning oral feeding.^{18–23} Despite the challenge of providing oral feeding experiences, there remains little evidence regarding the different behavioral states and how these influence oral feeding efficiency.

For preterm infants, the proportion of time spent in a 24-hour period in each behavioral state changes with maturation.^{24,25} The distribution of behavioral states in extremely early born preterm infants (born 24–27 week gestational age)²⁶ is characterized by predominately active sleep.²⁶ The amount of time in active sleep states decreases as the infant matures, allowing for more quiet sleep and alert states.^{26,27} Alert states are defined as the infant’s eyes are open/scanning the environment, there is evidence of motor activity, and the infant has bright/shining appearance.^{25,28–31} Alert states may occur briefly from 3 to 5 seconds in extremely early born preterm infants, and this duration increases with maturation.^{26,32–34} Compared to full-term infants, early preterm infants (born < 34 week gestational age)³⁵ spend more time in transitional states (change from active to quiet sleep, or sleep to alert)

and less time in alert states.^{31,36} The infants' ability to transition smoothly between behavioral states is demonstrative of the infants' self-regulation.^{31,37} The infants' ability to self-regulated in response to internal and external stimuli may also influence oral feeding efficiency.^{31,37}

Multiple researchers have attempted to describe the influence of behavioral states on oral feeding success in preterm infants. Prior to feeding, alert states were associated with greater oral feeding success.^{12,38} In the model of oral feeding readiness for preterm infants, Pickler emphasized the importance of alert states prior to feeding in achieving oral feeding success.³⁹ During feeding, "unsuccessful feeders" spent more than half of their feeding in sleep states, while "successful feeders" were observed in sleep states less than one-third of their feeding time.²⁷ Robust alertness during feeding was positively associated with better transition and attainment of competence with oral feeding in preterm infants.²⁶ Alert behavioral states during feeding significantly predicted high feeding efficiency.⁴⁰ However, little is known regarding the other behavioral states (including sleep, drowsy, and crying) and how they may influence oral feeding efficiency in preterm infants.

A comprehensive understanding regarding the role of behavioral states prior to feeding in oral feeding efficiency is vital for designing interventions that support oral feeding success in preterm infants. Thus, the purpose of this study was to determine the relationship between behavioral states prior to feeding and oral feeding efficiency in preterm infants.

Methods

Design

This associational study was conducted as a secondary analysis from a randomized clinical trial (RCT) of a maternally administered developmental intervention for preterm infants.^{13,14,41–43} The intervention included the ATVV (auditory, tactile, visual, & vestibular) with the maternal participatory guidance, referred as "H-HOPE" (Hospital to Home: Optimizing the Preterm Environment).^{13,14,41–43} Infants were video recorded weekly for the RCT. Baseline data of the RCT (week 0), 1-minute prior to feeding (before infants latched on the bottle), were used for this secondary analysis.

The Institutional Review Boards at the two clinical sites and the lead researcher's university approved the RCT. Written informed consents were obtained from the mothers at the time of enrollment into the RCT.

Sample and Setting

Baseline data from 147 infants were included in this secondary analysis. The RCT was conducted in 2 inner-city community-based medical centers, one with a Level II and one with a Level III NICU. The target population was medically stable premature infants born between 29 and 34 weeks gestational age (GA), whose mothers had 2 or more social-environmental risks, e.g. self-identified as Black or Latina, less than high school education, less than 18 years old, history of current mental illness, family income less than 150% of poverty, more than one child under 24 months, four or more children under four in the household, or residing in a disadvantage neighborhood.^{41,42} Infants were excluded if they

had congenital anomalies, necrotizing enterocolitis, positive finding on head ultrasound (e.g. cystic PVL or grade III or IV IVH), receiving assisted ventilation at the time of enrollment, chronic lung disease, and/or prenatal drug exposure.

Measures

Infant Characteristics—Infant characteristics were collected via medical records or from maternal reports. Infant characteristics were infant sex, plurality (singleton or twin/triplets), type of delivery (non-spontaneous vaginal delivery/cesarean section), gestational age (GA) at birth, small for gestational age (yes/no), birthweight, Apgar score at 5-minute, Problem-Oriented Perinatal Risk Assessment System score at birth (POPRAS at birth)), post-menstrual age at the baseline feeding observation (PMA at observation), maternal race/ethnicity (Black/Latina), and study site (A & B). POPRAS score was designed to predict medical risk for mortality in the perinatal and neonatal period, with higher POPRAS scores indicating more severe neonatal morbidity.^{44–47}

Behavioral States—Originally, eight categories of behavioral state (quiet sleep, active sleep, sleep-wake transition, drowsy, quiet alert, active alert, non-alert waking activity, and crying) developed by Thoman and modified by Holditch-Davis^{25,28–31} were examined (Table 1). These categories exhibit reliable individual differences and accurately profile the behavioral states of young preterm infants during the neonatal period.^{48,49} For this study, the behavioral states were combined into alert states (active and quiet), sleep states (quiet and active), drowsy states (sleep-wake transition, drowsy, and non-alert waking), and crying (Table 1).

For the RCT, behavioral state data were collected weekly during the infants' hospitalization. Infants were video recorded for 30 minutes immediately prior to oral feeding. Each 30-minute video recording was processed through the Mangold Interact software (Mangold Interact, Germany) that offers the ability to customize coding schemes, time code, and enter the coded data directly into a database that captures all subjects. The weekly videos were segmented into four segments: before intervention (3 minutes), during intervention (13 minutes), immediately after intervention (1 minute), and immediately prior to feeding (1 minute).

For the RCT, behavioral states were assessed by the two coders who were blinded to the purpose of the study. The dominant (8 seconds) behavioral state was coded for each 15-second interval. From these codes, the proportion of time spent in alert states (quiet alert and active alert), sleep states (quiet sleep and active sleep), drowsy states (sleep-wake transition, drowsy, and non-alert waking), and crying were calculated for the 1-minute immediately prior to feeding segment of each weekly observation. For this secondary analysis, we only used the baseline data (week 0), 1-minute prior to feeding.

For the RCT, to establish inter-rater reliability prior to initiation of the study, the two coders were trained to criterion (> 85% agreement). The primary coder coded all of the observations for the entire RCT. A random sample of 25 infants was drawn and behavioral states for the second weekly observations were re-coded by the secondary coder. Inter-rater reliability was determined using the intraclass correlation coefficient (ICC).⁵⁰ Inter-rater

reliability can be interpreted as very good to excellent when the ICC is 0.75 or higher, and moderate to good with ICCs between 0.50 and 0.75.⁵⁰ The inter-rater reliability resulted in an ICC of 0.986 (95% CI = 0.968, 0.994).

Feeding Efficiency—At each weekly observation, the amount of intake over the first 10 minutes of feeding was recorded. Feeding efficiency (ml/min) was calculated as the amount of intake over the first 10 minutes of feeding. Often after 10 minutes, infants began to fatigue. Thus, we evaluated feeding efficiency for the first 10 minutes because we wanted to capture the infants' best performance.

Procedure

For the RCT, after confirming the infant and the mother's eligibility and willingness to participate, written informed consent was obtained from the mother for both herself and her infant. Infant characteristics were obtained from the medical record or maternal reports. The weekly data collection sessions were conducted prior to the routinely scheduled late morning feeding. Infants remained on their cardiac monitors during the weekly observation. Prior to the weekly observation, the infant was moved from the NICU to an adjacent observation room and placed under a radiant warmer. Infants were in different behavioral states when moved to the warmer, including alert, sleep, drowsy, and crying. Infants were video recorded for 30 minutes immediately prior to feeding.

The research nurse or mothers (if mothers were there) applied the intervention if infants were in the intervention group.^{13,14,41–43} Infants in the control group were left untouched under the radiant warmer. All infants received the standard of care, including soothing for distress.

For consistency of the oral feeding, all infants were fed by the same research nurse. Infants were moved from the radiant warmer to the research nurse's arms prior to feeding. Infants were positioned upright and held closely by the research nurse. Oral feeding was introduced at the conclusion of the 30-minute period. The amount of intake over the first 10 minutes of oral feeding was recorded.

Statistical Analysis

For this secondary analysis, the issue of non-independence and the effect of intervention were avoided since only data from baseline (week 0), 1-minute prior to feeding were included. Data analyses were conducted using Stata/IC 13.1. Two-sided tests were used for all hypothesis testing, controlling for a type I error of $\alpha = .05$. Descriptive statistics were computed for infant characteristics, behavioral states, and oral feeding efficiency.

To check for potential confounders prior to building multiple regression models, the relationship between oral feeding efficiency and infant characteristics were performed. *Pearson's* correlation was used for continuous infant characteristics, and *t-tests* were used for categorical infant characteristics. Significant variables in these steps were included in the model building process.

Multiple *regression models* were built to examine the effects of behavioral states (alert, sleep, drowsy, and crying) on oral feeding efficiency, controlling for significant infant characteristics (identified in the above steps). For each behavioral state, a *reduced model* (included only infant characteristics) and a *full model* (included behavioral state and infant characteristics) were built. If the behavioral state significantly predicted oral feeding efficiency when controlling for infant characteristics in the full model, we then conducted partial *F-tests* to determine whether that behavioral state uniquely predicted oral feeding efficiency. A behavioral state “uniquely predicted” oral feeding efficiency when it predicted oral feeding efficiency regardless of the infant characteristics. If the partial *F-test* yielded a significant result ($p < .05$), we conducted a final multiple regression model with only the behavioral state.

Results

Baseline data (week 0), 1-minute prior to feeding of 147 infants were included in this secondary analysis. Descriptive statistics of the infant characteristics are reported (Table 2).

Means proportion of time spent in each behavioral state included: alert = .28, sleep = .33, drowsy = .32, and crying = .07 (Table 3). Mean oral feeding efficiency (amount of intake over the first 10 minutes of feeding) was 1.09 ml/min (Table 3).

Pearson's correlation tests yielded significant correlations between oral feeding efficiency and birthweight ($r = 0.16$, $p < .05$), POPRAS score at birth ($r = -0.16$, $p < .05$), and PMA at feeding observation ($r = 0.18$, $p < .05$). Thus, birth weight, POPRAS score at birth, and PMA at feeding observation, were included in the multiple regression models.

When we tested the *reduced models* (included only infant characteristics) and *full models* (included a specific tested behavioral state and infant characteristics), alert states ($\beta = .76$, $F = 4.17$, $p < .05$), sleep states ($\beta = -1.05$, $F = 7.84$, $p < .05$), and crying ($\beta = 1.32$, $F = 11.29$, $p < .05$) were significantly associated with oral feeding efficiency (see Table, Supplemental Digital Content 1, which reported the multiple regression full model results). When we conducted the *partial F-test*, alert states (*partial F-test* = 11.49, $p < 0.05$), sleep states (*partial F-test* = 23.32, $p < 0.05$) and crying (*partial F-test* = 9.35, $p < 0.05$) uniquely predicted oral feeding efficiency. Specifically, alert states positively associated with oral feeding efficiency ($\beta = .76$, $F = 11.29$, $p < .05$) (Figure 1); sleep states negatively associated with oral feeding efficiency ($\beta = -1.08$, $F = 25.26$, $p < .05$) (Figure 2); and crying positively associated with oral feeding efficiency ($\beta = 1.50$, $F = 12.51$, $p < .05$) (Figure 3) (see Table, Supplemental Digital Content 2, which reported the multiple regression final model results).

Discussion

In this study, we evaluated the relationship between four behavioral states (alert, sleep, drowsy, and crying) on oral feeding efficiency. Except for the drowsy states, all other behavioral states prior to feeding significantly predicted oral feeding efficiency. Oral feeding efficiency increased with more time spent in alert states or crying while oral feeding efficiency decreased when infants spent more time in sleep states prior to feeding. Several infant characteristics have been shown to be associated with feeding outcomes, including

patterns of weight gain in both preterm and full-term infants.⁵¹ Maturity at birth and sex are significant predictors of weight gain and growth rates.⁵¹ In the current study, it was not surprising that the infants' birthweight, POPRAS score at birth, and PMA at feeding observation were significant predictors of oral feeding efficiency. Therefore, they were incorporated in the analytic models to better explicate and understand the role of each behavioral state on oral feeding efficiency.

Our findings support previous reports that alert states prior to feeding are significant predictors of oral feeding efficiency.^{12,38,39} Prior to feeding, alert states were associated with greater oral feeding success.^{12,38} In the model of feeding readiness for preterm infants, Pickler emphasized the importance of alert states prior to feeding in achieving oral feeding success.³⁹ In our previous research,¹³ we were not able to identify the relationship between alert states and oral feeding efficiency due to a small sample size. In this research, with a sample of 147 infants (compared to 26 infants in our previous research),¹³ the influence of alert states on oral feeding efficiency was identified.

Additionally, there were a few studies that reported alert states during feeding as the predictor of oral feeding success. During feeding, "unsuccessful feeders" spent more than half of their feeding in sleep states, while "successful feeders" were observed in sleep states less than one-third of their feeding time.²⁷ Robust alertness during feeding was positively associated with better transition and attainment of competence with oral feeding in preterm infants.²⁶ Alert behavioral states during feeding significantly predicted high feeding efficiency.⁴⁰ This evidence regarding the positive relationship between alert states during feeding and oral feeding success may support the hypothesis that increased alertness prior to feeding might have prepared infants to remain alert during feeding.

Crying also was related to oral feeding efficiency, and was shown to have a stronger association with oral feeding efficiency than alert states. This is the first study that identified the positive relationship between crying prior to feeding and oral feeding efficiency. This finding is relevant to clinical practice because infant crying has been used anecdotally in clinical settings as a late indicator of hunger.

Our findings showed that oral feeding efficiency was reduced when infants spent more time in sleep states prior to feeding. Therefore, oral feeding when infants are sleeping should be avoided. It must be emphasized that prioritizing nursing tasks and procedures around oral feeding time is crucial, ensuring that infants are not exhausted or sleeping prior to oral feeding.

Recognizing the importance of behavioral states in relationship to oral feeding in preterm infants, sensory interventions have been designed and tested to facilitate alert behavioral states prior to and during feeding. The interventions include but are not limited to oral sensory stimulation,⁵² non-nutritive sucking,^{38,53–55} and multisensory intervention.^{42,43,56} While these interventions have been shown to improve alert states, little research has identified sleep states or crying in response to these interventions. The findings from this research confirm the influence of behavioral states immediately prior to feeding on oral

feeding efficiency, and thus may be instrumental in future designing and testing of interventions that facilitate optimal behavioral states for oral feeding in preterm infants.

Implications for Practice and Research

Clinicians have long used infant characteristics to evaluate infants' oral feeding readiness and should continue to use them in conjunction with assessment of behavioral states. It is important to keep in mind that preterm infants are challenged to transition from sleep to alert states and spend very little time in alert states.^{26,31–34,36} Thus, clinicians should prioritize nursing tasks and other procedures around oral feeding. It is recommended to offer oral feedings when infants are alert and avoid oral feeding when infants are sleeping. Although crying is associated with improved oral feeding efficiency, crying is a late indicator of hunger. Clinicians should exercise caution when the infant is crying and assure that infant is not crying vigorously, which may lead to inability self-regulate or becoming fatigued. Thus, it is recommended to closely evaluate the infant if the feeding is started when the infant is crying. In this study, drowsy was not significantly related to oral feeding efficiency. However, the drowsy states may send mixed signals, e.g. waking/sleep, to the clinician making it challenging to determine whether or not the infant should be fed. If the infant is drowsy, it is recommended that clinicians assess the infant carefully. Sleeping or drowsy infants may benefit from interventions to support transition to alert states prior to feeding. Interventions that have been shown to increase alertness include but not limited to oral sensory stimulation,⁵² non-nutritive sucking,^{38,53–55} and multisensory intervention.^{42,43,56} Offering oral feeding only when infants are alert will support high oral feeding efficiency and oral feeding success.

The study design had several limitations. Data were analyzed retrospectively for this secondary analysis. Previous research has indicated that the alert state prior to feeding is related to improved oral feeding efficiency. Thus, we only evaluated behavioral states during 1-minute prior to feeding. We recognize that behavioral states during feeding may also strengthen the influence on oral feeding efficiency. Therefore, it is a limitation that we did not measure behavioral states during feeding. We also recognize that the amount of intake prescribed to infants varies between infants. Thus, the proportion between the amount of intake during the first 10 minutes of feeding and the amount of intake prescribed to infants may also be reflective of the infant's oral feeding efficiency. Therefore, it another limitation that we did not measure the amount of intake prescribed to infants. Future research should evaluate behavioral states prior to and during feeding, as well as the amount of intake prescribed. Standardized measures of oral feeding efficiency are also needed. Additional measures such as sucking patterns and pressures, overall intake, and number of adverse events would strengthen the measurement of oral feeding efficiency. Infant characteristics, including birthweight, sex, GA, PMA, health status, etc. are also important clinical indicators and should be included as covariates in the study of oral feeding efficiency. Understanding the factors that may support or alter oral feeding efficiency is critical and will eventually guide the designing and testing of interventions that facilitate oral feeding success in preterm infants.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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What This Study Adds

- This study identified the positive association between alert behavioral states prior to feeding and oral feeding efficiency in preterm infants. This finding confirmed the importance of alertness in the achievement of oral feeding success.
- This study identified the influence of other behavioral states (sleep, drowsy, and crying) prior to feeding and their relationship to oral feeding efficiency. Sleep states prior to feeding was negatively associated with oral feeding efficiency while crying prior to feeding was positively associated with oral feeding efficiency.
- Infant characteristics and behavioral states should be evaluated as criteria for oral feeding readiness. Alert states are optimal for oral feeding. Forced oral feeding when infants are sleeping should be avoided.
- Infants in crying or drowsy states prior to feeding should be closely evaluated. Sleeping or drowsy infants may benefit from interventions (e.g. oral sensory stimulation, non-nutritive sucking, or multisensory intervention) to support transition to alert states prior to feeding.

Summary of Recommendations for Practice and Research

What we know

- The ability to fully oral feed while maintaining high feeding efficiency is an important developmental milestone for preterm infants.
- Successful oral feeding is one of the gold standards for hospital discharge.
- Alert behavioral states are crucial for oral feeding success.
- Oral feeding efficiency is influenced by behavioral states.
- Interventions, such as oral sensory stimulation, non-nutritive sucking, and multisensory intervention, etc. may improve alertness prior to and during feeding in preterm infants.

What needs to be studied

- The relationship of behavioral states and oral feeding efficiency prior to and during feeding.
- Effects of interventions (e.g. oral sensory stimulation, non-nutritive sucking, and multisensory intervention) on behavioral state (alert, sleep, drowsy, and crying) prior to and during feeding.
- Standardize measurements of oral feeding efficiency.

What we can do today

- Support oral feeding to achieve full oral feeding prior to discharge.
- Assess infant characteristics and behavioral states prior to initiation and advancement of oral feeding.
- Implement interventions (oral sensory stimulation, non-nutritive sucking, or multisensory intervention) to assist the transition to alertness prior to oral feeding.

Figure 1.

Figure 2.

Figure 3.

Table 1Description of Behavioral States^{25,28–31}

Combined States	Original States	Description
Alert states	Quite alert	The infant's eyes are open, minimal motor activity, bright and shining appearance, visually focusing in on one person or thing in the environment, respirations are regular.
	Active alert	The infant's eyes are open and scanning the environment, more motor activity, and respirations are irregular.
Sleep states	Quiet sleep	The infant's eyes are closed, respiration is regular, slow and abdominal. Motor activity is limited to occasional startles, sigh sobs, or other brief discharges. Motor tone is maintained at a tonic level.
	Active sleep	The infant's eyes are closed. Respiration is uneven and primarily costal. Motor movements are sporadic. Muscle tone is low between motor movements.
Drowsy states	Sleep-wake transition	The infant shows behaviors of both wakefulness and sleep. There is generalized motor activity, and although the eyes are typically closed, there may be a rapid opening and closing of the eyes. Brief fussy vocalizations may occur.
	Drowsy	The infant's eyelids are "heavy lidded". There may be opening and closing slowly, or open but dazed in appearance. The level of motor activity is typically low and respiration fairly even.
	Non-alert waking activity	The infant's eyes are usually open, dull, and unfocused. Motor activity varies but is typically high. The eyes may close during periods of high-level activity.
Crying	Fuss or cry	The infant is either fussing or crying. The intensity of the vocalizations ranges from at least two brief fuss sounds to breathless crying.

Table 2

Descriptive Statistic of Infant Characteristics (N = 147)

Infant Characteristics	Percentage (%)	Mean (SD)
Infant Sex		
Female	51.02	
Male	48.98	
Plurality		
Singleton	84.35	
Twin/Triplets	15.65	
Type of delivery		
NSVD	55.78	
C-SEC	43.54	
Small for gestational age		
Yes	29.25	
No	70.75	
Maternal race/ethnicity		
Latina	48.30	
Black	51.70	
Site		
A	53.06	
B	46.94	
GA at birth, weeks ^a		32.65 (1.46)
Birthweight, grams		1842.50 (358.67)
Apgar score at 5-minute		8.29 (1.08)
POPRAS score at birth ^a		67.10 (18.55)
PMA at feeding observation ^a		34.03 (1.03)

^aSignificantly related to feeding efficiency (p .05).

Abbreviations: NSVD, non-spontaneous vaginal delivery; C-SEC, cesarean section; GA, gestational age; POPRAS, Problem-Oriented Perinatal Risk Assessment System (ranged from 36–136); PMA, post-menstrual age.

Table 3

Descriptive Statistic of Behavioral States and Feeding Efficiency (N = 147)

Variables	Mean (SD)	Min,Max
Alert ^a	.28 (.39)	0,1
Sleep ^a	.33 (.40)	0,1
Drowsy ^a	.32 (.36)	0,1
Crying ^a	.07 (.21)	0,1
Feeding efficiency ^b	1.09 (1.12)	0,5

^aProportion of time spent.^bmL/min.