Donna Dowling PhD, RN ❍ Section Editor

CE 2.5 HOURS Continuing Education

Patterns of Disruptive Feeding Behaviors in Infants With Neonatal Abstinence Syndrome

Denise J. Maguire, PhD, RN, CNL; Meredeth A. Rowe, PhD, FGSA, FAAN; Heather Spring, PhD, ARNP; Amanda F. Elliott, PhD, ARNP

ABSTRACT

Background: Severe irritability in infants with neonatal abstinence syndrome often impacts their ability to feed successfully, which challenges a mother's ability to demonstrate this most basic parenting skill. There is little empiric evidence to guide recommendations for practice in this population.

Purpose: Describe the infant behaviors that disrupt feeding in infants with neonatal abstinence syndrome.

Methods: A mixed-method approach was used to describe digitally recorded infant feeding behaviors. Qualitative methodology was first used to identify categories of behaviors during the feeding. The categories were used as a coding scheme to identify the temporal sequence, duration, and frequency of behaviors observed during a feeding.

Results: The behavior categories that disrupted feeding were identified as fussing, resting, crying, and sleeping/sedated. Infants spent almost twice as much time in fussing as in feeding. The majority of the infants were fussing between 1 and 11 minutes during the feeding, and fussing disrupted feeding in every subject at least once. Feeding behavior occurred only 24% of the time, while fussing and crying occurred 51%. Fussing was the primary transitional behavior from one category to another. Infants who did not complete their feeding had nearly twice the mean number of fussing episodes as those who completed their feeding.

Implications for Practice: Fussing is a transitional state and appears to provide an opportunity to test interventions that help the mothers reengage their infants in feeding. The frequency of the behavioral transitions provides a measure of irritability that has not been previously described in this population.

Implications for Research: Additional study is needed to evaluate the impact and contributions of maternal behaviors and external variables on infant behavioral transition.

Key Words: abstinence, behavior, coding, disruption, feeding, fussing, infant, irritability, NAS, withdrawal

Infants exposed prenatally to opiates are at high risk of developing neonatal abstinence syndrome (NAS) within their first week of life.[1,2] Infants with this condition experience mild to severe disturbances in the central nervous and gastrointestinal systems and demonstrate other signs of metabolic, vasomotor, and respiratory distress.[3] Pharmacologic treatment with an oral opiate such as morphine or methadone[4] is often recommended to alleviate signs of withdrawal or at least reduce them to a level that allows the infant to feed and rest sufficiently. Even when treated with the current standards of care, infants with NAS are irritable, cry inconsolably, sleep poorly, and are often difficult to feed.[5] In addition to pharmacologic interventions, nonpharmacologic interventions (NPIs) are commonly used to treat infants with NAS.[5,6] Interventions include decreasing sources of stimulation that trigger irritable behaviors and implementing soothing and calming techniques.[7,8] Although most experts recommend beginning treatment with NPIs and continuing them concurrently with opioids to treat NAS, there is no empiric evidence that guides specific recommendations for NPIs in this population for either practitioners or parents.[7] Since NPIs are often used during feeding, developing a greater understanding of the needs of NAS infants, particularly regarding feeding, is critical as these infants appear to have different patterns of behavior than healthy, nonaffected infants.

Signs of withdrawal, some of which are behaviors, have been described anecdotally since the 1970s.[3,6,9] Finnegan compiled signs of NAS from her experience and review of literature to develop a "clinically based scoring system"[3(p142)] to evaluate outcomes of pharmacologic therapy. Her efforts resulted in an assessment tool used to capture the signs of withdrawal in infants with NAS.[10] This instrument includes 23 withdrawal signs, many of which can be classified as behaviors. The Finnegan NAS Scoring Tool has become the most widely used instrument in the

Author Affiliations: College of Nursing, University of South Florida, Tampa (Drs Maguire, Spring, and Elliott); Leona and Lewis Hughes Endowed Chair for Nursing Science, College of Nursing, USF, Tampa, Florida (Dr Rowe).

The authors declare no conflicts of interest.

Correspondence: Denise J. Maguire, PhD, RN, CNL, College of Nursing, 12901 Bruce B. Downs Blvd, MDC 22, Tampa, FL 33612 (dmaguire@health.usf.edu).

DOI: 10.1097/ANC.0000000000000204

United States.[10] Using the Finnegan Scoring Tool, D'Apolito and Hepworth[11] reported frequency of NAS behaviors in a sample of 14 infants exposed to methadone, alcohol, heroin, marijuana, and tobacco by maternal history, and barbiturates, benzodiazepines, and methamphetamines by infant urine analyses. Results from 1120 observations over 10 days indicated that the most prominent symptoms of withdrawal were increased tone and respiratory rate, disturbed sleep, fever, and excessive sucking.[11] Maguire and colleagues[12] reported results of a factor analysis of the Finnegan on 33,856 assessments for 171 infants with NAS. The 7 items that loaded on a 2-factor solution (crying, sleeping, increased muscle tone, tremors, increased respiratory rate, sweating, and sucking) were significantly correlated with the total score on the original 21-item Finnegan ($r = 0.917$; $P < .001$). Although the investigators did not report the most frequent signs, the results of the factor analysis suggest that there is consistency in the most common signs among infants exposed to opiates and polydrug use. Considering that the purpose of the Finnegan NAS Tool is to evaluate response to treatment, it cannot be expected to fully describe all the infant behaviors that challenge mothers, especially during a feeding. Infant behaviors that disrupt feedings have not been well studied in this population.

The notion of "difficult feeding" was described in a study of full-term, small-for-gestational-age infants (n = 15).[13] The authors modified a coding system[14] to include only feeding problems, which included refusing or rejecting the nipple, dribbling, coughing or choking, spitting up, grimacing, crying, whimpering, trembling, and body tensing. The coders observed a mother–infant feeding interaction, and coded both mother and infant behaviors as they occurred. They compared the frequency of infant behaviors during feeding to a control group of 15 appropriate-for-gestational-age infants and reported no significant difference in the overall number of difficult feeding behaviors, except for grimace. However, there were significant differences in 3 qualitative ratings that included ease of feeding ($P < .05$), withdrawing or responsive ($P < .05$), and tense or relaxed ($P < .01$). Using the same modified coding scale, LaGasse and colleagues[15] studied feeding behaviors in infants exposed to cocaine and/or opiates (n = 658) against normal controls (n = 730) but did not report or appear to include data about grimacing, whimpering, trembling, or body tensing. The infants exposed to opiates demonstrated significantly fewer feeding problems than infants exposed to cocaine. The feeding problems measured in these 2 studies, however, did not include many of the infant behaviors commonly observed during a feeding, such as irritability, hyperextension, and finger splay, so this instrument has limited usefulness in studies of infants with NAS.

It appears that feeding patterns and/or the mechanics of sucking may also be different in infants with NAS.[15-18] For example, Gewolb and colleagues[16] reported that 15 infants exposed to opiates were less efficient feeders and had more apneic swallows than 16 healthy control infants in the first 3 days of life. Kron and colleagues[18] also reported poor sucking performance in 32 infants exposed to methadone, even more so than 18 infants exposed to heroin, when compared with 20 normal controls. In a much larger sample of 1028 infants, LaGasse and colleagues[15] reported that opiate-exposed infants had more feeding problems (rejecting the nipple, dribbling milk, hiccoughing, spitting up, and coughing) than non–drug-exposed infants or those exposed to cocaine. Results of these studies confirm the challenges caregivers face when feeding infants with NAS, but the instrument used was unable to fully describe the range of behaviors, nor did it capture the characteristic irritability. On the basis of the authors' experience with feeding infants with NAS, it was determined that a new coding scheme must be developed to capture the full range of infant behaviors. The purpose of this study, therefore, was to define and describe the behaviors that infants with NAS demonstrate using feeding as the exemplar, and to identify those that facilitate or disrupt feeding. The research questions were as follows:

1. What behavior categories do infants with NAS exhibit during a feeding?
2. Which infant behaviors disrupt active feeding? and
3. What is the pattern of transitions between behavioral categories?

What This Study Adds

- A comprehensive coding scheme to evaluate feeding disruption in infants with NAS that enables descriptive of behaviors unique to individuals.
- An innovative method to assess feeding in infants with NAS.
- An instrument to evaluate the impact of nonpharmacologic interventions designed to improve feeding success.

METHODS

A mixed-methods design was used to derive and describe behavioral categories of infants with NAS during feeding. Infants were video recorded for the length of a feeding, but no more than 30 minutes. Qualitative methodology was used to develop a coding scheme for behavioral categories that infants demonstrated while the mother bottle-fed the infant.

Quantitative analysis was used to describe the frequency and length of each behavioral category as well as examine the pattern of transitions between categories. The relationships between the categories and whether the infant successfully completed the feeding were also examined.

The study was approved by the hospital institutional review board that has reciprocity with the local university board. Mothers signed a single informed consent for themselves and their infants to participate. Mothers were recruited from a tertiary referral center and were eligible if they gave birth to an infant being treated for NAS, intended to parent, were at least 18 years of age, and could speak and read English. Ineligible mothers were those who were incarcerated, and ineligible infants were those with life-threatening illness or not taking nutrition orally. A total of 16 mother–infant dyads participated in the videotaped feeding sessions. In an effort to increase the homogeneity of the sample for the present analyses, 5 dyads (where the infant was breastfed or had completed morphine treatment) were excluded, leaving a total of 11 dyads that were analyzed. One infant, included in the analysis, was a preterm twin, born at 32 weeks, but was 38 weeks' corrected age at the time of the study. All data for this report were collected between June and December 2013.

Measures

Infant Withdrawal

The nursing standard of care at the facility where the research was conducted included infant assessment every 3 hours using the Modified Finnegan Neonatal Abstinence Score[19] to assign a withdrawal score (WS). This instrument is widely used to assess categories of readily observable disturbances in the central nervous and gastrointestinal systems, as well as metabolic, vasomotor, and respiratory signs on 23 parameters. The higher the total score, the more severe the withdrawal; scores greater than 15 were aggressively treated to avoid seizures and considered a medical emergency. Two consecutive scores of 8 or more triggered pharmacologic treatment in this setting. The nursing staff achieved 90% interrater reliability on the instrument in 2010[20] and again in 2013 during the time these data were collected. The WS used for this study was the one reported by the nurse caring for the infant just prior to the start of the feeding.

Definitions

An "episode" was an occurrence of a behavioral category. The "duration of an episode" was the time the category was first coded to the time when the next category was coded. "Feeding time" was measured from the time the infant started actively feeding to the time the infant completed the feeding. "Feeding completion" was determined when the mother removed the bottle from the infant's mouth for the last time, or announced that the feeding was completed. No infant was offered the bottle after 30 minutes. If the infant did not take the minimum volume required, the standard nursery procedure was followed to ensure that the infant had adequate fluid intake.

Procedures

After informed consent, a mutually agreeable appointment was made with the mother, based on the infant's feeding schedule. All infants with NAS in the study facility were fed every 3 hours on a schedule; feeding cues were not used. All infants were fed on schedule, and none became ill or had any invasive procedures in the previous 24 hours. Infant feedings were recorded in their private neonatal intensive care unit (NICU) room from the beginning of the feeding to the end; none were more than 30 minutes in length. Mothers were asked to let the investigators know when the feeding ended. Two synchronized video cameras were used whenever possible to ensure the best view of infant behavior. Occasionally the room configuration did not enable a second camera to be positioned at a different angle. A microphone was placed near the dyad to capture infant vocalizations. Once the recording started, the investigator left the patient room to provide privacy but remained accessible outside the door, available to check on the feeding progress and camera angles. A copy of the video recording was made and given to the mother at the end of the visit, as well as a $25 gift card to a national chain store. All data were downloaded to a secure password-protected network that was backed up daily.

Data Analysis

Demographic Data

Demographic and clinical data about the dyad were retrieved from the infant medical record. Descriptive data about the categories were analyzed in the Noldus Observer XT software.

Qualitative Data Analysis

Initially all the videos were reviewed 5 to 6 times by the principal investigator to identify, list, and describe all the observable infant behaviors. All distinct infant movements, facial expressions, and vocalizations were coded. These behavioral codes were then grouped into 5 mutually exclusive categories: feeding, fussing, resting, crying, and sleeping/sedated. The derived behavioral categories were then checked for accuracy and completeness by reviewing the videos until there were no unclassified behaviors. A second trained rater coded behaviors

occurring in one 5-minute sample of each session, obtaining a moderately strong interrater reliability ($\kappa = 0.88$).

Quantitative Data Analysis

The 5 behavioral categories were loaded as the coding scheme in the Observer XT software (Version 11.5, Noldus Information Technology, Wageningen, the Netherlands). Each video recording was coded using the coding scheme. Each instance of a behavioral category was coded as an event with defined start and stop times, which enabled their duration to be measured in milliseconds. The software output provided the frequency and temporal sequence of all coded events as well as the total and mean duration of each event. The behavior codes for each infant were displayed visually in a colored bar graph and checked for accuracy against the video to confirm that the codes were correct. We also calculated the "feeding time" and classified infants as either completing the feeding or not.

RESULTS

Demographic and clinical data for mothers and infants are listed in Table 1. In addition, 8 mothers were single, one was married, one divorced, and one undeclared. Four were first-time mothers, while the others had previous experience with 1 to 4 other children. Most infants were administered oral morphine just before the feeding, but 3 infants were given morphine after the feeding started by the nurse caring for the infant. All but 1 WS was 8 or less ($M = 4.4$; SD = 2.6).

Behavior Categories Observed During Feeding

Across all behavioral categories, the one with the highest number of episodes was fussing (n = 297), followed by feeding (n = 178), sleeping/sedated (n = 90), resting (n = 92), and crying (n = 89) (Figure 1).

TABLE 1. Demographic Data of Mothers and Infants (n = 11)

	Range	Mean (SD)
Mothers		
Age, y	21-36	28.9 (4.5)
Gravida	1-12	3.9 (3.3)
Para	1-5	2.3 (1.4)
Infants		
Age, d	7-32	16 (8.3)
Gest age	32-40	37.6 (2)
WS	2-9	4.4 (2.6)
Feeding, min	5-30	20.9 (7.3)
Morphine dose, mg	0.04-0.65	0.25 (0.2)

Abbreviation: WS, withdrawal score.

Fussing

Behaviors that defined fussing included averting face, pulling or turning away, or otherwise resisting; grimacing or frowning; hyperextending arms or legs; flailing arms; splaying fingers; pushing or spitting out the nipple; and vocal objections like whimpering, but not a robust cry.

Fussing behavior accounted for 40.2% of the feeding period, with episode duration ranging from 14.7 seconds to 11 minutes ($M = 281$ seconds; SD = 237 seconds). The frequency of individual fussing episode ranged from 2 to 62 fussing episodes ($M = 22.4$; SD = 20.1), with the mean range of duration from 4.8 seconds to 17.2 seconds ($M = 10.2$ seconds; SD = 4.5 seconds) (Table 2). Fussing had very short mean length of episodes indicating that infants transitioned very quickly in and out of fussing. Infants with less than 4 fussing episodes were more likely to complete their feeding within 15 minutes. In total, the majority of the infants were fussing between 1 and 11 minutes during the feeding.

Feeding

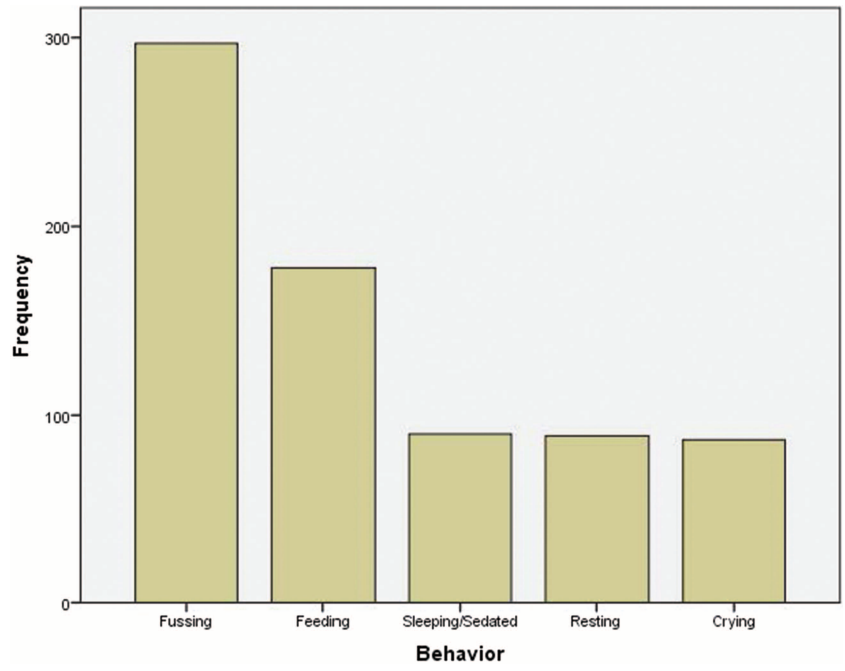
Feeding consisted of a constellation of 3 behaviors: latched on the nipple; sucking and swallowing in a rhythmical pattern; and occasional, brief (up to 5 seconds) pauses. If the pause exceeded 5 seconds, a transition to a different behavioral category was scored. The infant's eyes could be open or closed, the extremities were usually flexed, the infant's face had a calm appearance, and the infant appeared to be focused on the task of feeding.

Feeding behavior accounted for 24% of the videotaped feeding period for these infants, with episode duration ranging from 2 to 34 feeding episodes ($M = 16.1$; SD = 9.6) (Table 2). The average time infants spent feeding was about 8.5 minutes ($M = 59.9$ seconds; SD = 70 seconds), from barely 4 minutes to a maximum of about 15 minutes. Some infants were fed for very short periods (12-24 seconds) before transitioning to resting, fussing, crying, or sleeping/sedated.

Sleeping/Sedated

It was difficult to differentiate, from viewing videos alone, whether the infants were sleeping naturally or in a state of sedation from the opiates they had been administered to alleviate signs of withdrawal. Therefore, sleeping and sedated were grouped into one behavioral category. In this state, the infant's eyes were usually closed. If their eyes were open, they had a glassy appearance. This category was coded if the mother verbalized that the infant was asleep, or when the infant's extremities or facial expressions were limp or hypotonic and the eyes were glassy when open.

FIGURE 1



Number of obscured episodes of behavior categories.

Only 5 infants had sleeping/sedated behavior during the recording (45%) and for those infants, it accounted for 12.1% of the feeding period, ranging from 0.5 to 12 minutes (M = 436 seconds, SD = 293 seconds). The number of sleeping/sedated episodes ranged from 2 to 34 (M = 14.8, SD = 12). Most slept less than 1 minute at a time (M = 41.7 seconds; SD = 39.8 seconds). One infant had 2 long (2-minute) episodes of sleeping. The majority of the transitions from sleeping/sedated were to fussing (n = 49), although the infants also transitioned to feeding about half as many times (n = 24) (Table 3).

TABLE 2. Total Number of Episodes (Mean/SD) and Duration (Mean/SD) of Fussing, Feeding, Sleeping/Sedated, Resting, and Crying by Feeding Group and All Infants

	Completed Feeding (n = 8)	Did Not Complete Feeding (n = 3)[a]	All Infants
Fussing			
Episode number (mean/SD)	177 (22.4/20.1)	120 (40.3/22.5)	297 (27/21.3)
Episode duration (mean/SD)	(10.2 s/4.5 s)	(10 s/2.9 s)	(10.1 s/3.9 s)
Feeding			
Episode number (mean/SD)	107 (13.4/8.6)	71 (23.7/8.9)	178 (16.1/9.6)
Episode duration (mean/SD)	(77.4 s/75.6 s)	(13.4 s/1.3 s)	(59.9 s/70 s)
Sleeping/sedated			
Episode number (mean/SD)	52 (2.7/4.9)	38 (18.5/7.8)	90 (14.8/12)
Episode duration (mean/SD)	5.2 s/10.7 s	40 s/15.5 s	41.7 s/39.8 s
Resting			
Episode number (mean/SD)	56 (7.7/6.6)	36 (12/19.1)	92 (9.8/10.4)
Episode duration (mean/SD)	45.7 s/43.6 s	14.5 s/13.9 s	40.2 s/33.9 s
Crying			
Episode number (mean/SD)	45 (7.3/8.5)	42 (14/17.3)	89 (14.5/13.5)
Episode duration (mean/SD)	5.9 s/12.6 s	6.6 s/5.4 s	10.6 s/9.3 s

[a]*Infants who did not complete their feeding.*

TABLE 3. Number of Transitions From Feeding, Fussing, and Sleeping/Sedated to Other Behaviors by Infant

Infant	2	3	4	5	8	9	10	11	1[a]	6[a]	7[a]	Total
From feeding to:												
Resting	2	0	4	1	1	3	4	0	0	0	2	**17**
Fussing	1	17	7	1	1	21	11	9	19	28	2	**117**
Crying	0	0	0	0	0	2	0	0	0	0	0	**2**
Sleeping/sedated	0	0	0	10	0	3	1	8	0	6	14	**42**
From fussing to:												
Resting	2	14	10	1	0	4	1	0	21	0	0	**53**
Feeding	2	15	7	2	2	25	9	11	10	31	4	**118**
Crying	0	18	0	0	0	21	1	0	31	3	4	**78**
Sleeping/sedated	0	0	0	2	0	2	2	27	0	7	9	**49**
From sleeping/sedated to:												
Feeding	0	0	0	9	0	2	2	6	0	3	13	**24**
Resting	0	0	0	0	0	0	0	0	0	0	0	**0**
Fussing	0	0	0	2	0	3	0	28	0	10	9	**49**
Crying	0	0	0	0	0	0	0	0	0	0	1	**1**

[a]*The infants who did not complete their feeding.*

Resting

Infants were considered resting when they were not feeding for greater than 5 seconds but appearing to remain awake. When they were resting, infants' eyes were open and they had relaxed facial features. Alternatively, their eyes could be closed as long as they had other indications of wakefulness such as flexed or general movement of extremities. A relaxed face was a critical element in scoring the period as resting behavior. Some mothers used a pacifier to calm the infant, and when the infant met the criteria, resting was coded.

Resting behavior accounted for 12% of the feeding period, with episode duration ranging between 14 seconds and 15.5 minutes (M = 339.8 seconds; SD = 304.7 seconds). Of the 9 infants who demonstrated resting (82%), the range of episodes was between 2 and 34 (M = 9.8; SD = 10.4). The infants spent between less than 1 and 2 minutes in each resting episode (M = 40.2 seconds; SD = 33.9 seconds).

Crying

Crying, a loud outburst of cry, was differentiated from "vocal objection" by its robustness. Crying could appear alone, or with behaviors associated with fussing, such as frowning, hypertonia, fisting, and flailing. When crying, the infants' faces changed in color from pink to pale or reddened, and appeared angry and upset, losing all characteristics of being calm and content. Crying episodes were considered terminated when the infant's cries de-escalated to vocal objections, as in fussing, or the infant resumed feeding.

For the 6 infants who demonstrated crying behavior (55%), crying behavior accounted for 11.7% of the feeding period. The number of episodes ranged between 1 and 34 (M = 8.5; SD = 11.1). These infants cried between less than 10 seconds and 9 minutes (M = 197.3 seconds; SD = 223.8 seconds), each episode lasting between 3 and 28 seconds (M = 10.6 seconds; SD = 9.3 seconds). Of the infants who cried, 3 accounted for the majority of the crying time (50%), from a minimum of 3 minutes up to nearly 9 minutes of the feeding time. When combined with fussing, crying and fussing accounted for 51% of the time in which the infants were recorded.

Infant Behaviors That Disrupted Active Feeding

The transition from feeding to not feeding was largely characterized by fussing (n = 117) (Table 3). Infants who transitioned frequently from feeding to fussing tended to have brief feeding episodes ranging from 13.3 to 33.9 seconds (M = 18.2; SD = 5.8). Of the 6 infants with 17 or more transitions to fussing, only 3 finished the feeding. Fussing disrupted feeding in every subject at least once (Table 3), and almost 3 times as often as the next most frequent behavior (sleeping/sedated, n = 42). Among the 5 infants who transitioned from feeding to sleeping/sedated more than once, the range was 3 to 14 times (M = 6; SD = 5). Crying was the behavior least likely to disrupt feeding, occurring only twice in 1 infant.

Patterns of Behavioral Transitions

Infants transitioned between categories between 6 and 149 times (M = 67; SD = 45) (Table 4), but infant 1 had about 20% more transitions than any other infant. Infant 1 had a WS of 4 and was 32 days old. Even with that outlier removed, the average was 59 (SD = 38) behavioral changes during a feeding. Fussing emerged as an important transitional

TABLE 4. Frequency of Behavior Category Episodes by Subject

Infant	2	3	4	5	8	9	10	11	Total for Completers	1[a]	6[a]	7[a]	Total for Noncompleters[a]	Total
Fussing	4	47	17	5	2	51	13	38	177	62	41	17	120	297
Feeding	3	17	11	12	2	29	16	17	107	19	34	18	71	178
Sleeping/ sedated	0	0	0	11	0	3	3	35	52	0	14	24	38	90
Resting	4	15	15	3	2	7	6	1	53	34	0	2	36	89
Crying	0	19	0	0	0	25	1	0	45	34	3	5	42	87
Infant totals	11	98	43	31	6	115	39	91	434	149	92	66	307	741

[a]*The infants who did not complete their feeding.*

behavior and was the most frequent behavior disrupting feeding (Table 3). Fussing transitioned to each of the other behavior categories between 49 and 118 times. When infants were resting, they transitioned to fussing 3 times more frequently than to feeding, and infants with the most episodes of resting had the most transitions to fussing. Those who were the most fussy had the most disrupted feeding. Infants who did the most crying also spent the most time fussing.

Results by Group

As shown in Table 2, infants who did not complete their feeding had nearly twice the mean number of fussing episodes as completers. Two of the 3 infants who did not complete their feeding each spent about 11 minutes sleeping during the feeding. They also had 3 times as many resting episodes as infants in the completed group, and the average length of the feeding episodes in the completed group was about 80% longer. Infants who did not complete the feeding transitioned from feeding to fussing proportionally twice as frequently as the completers and had the lowest mean number of seconds per feeding episode (12.1 and 14.7 seconds), indicating that they had very short episodes of feeding that were frequently interrupted.

DISCUSSION

The major findings of this study were (1) the behavior categories exhibited by infants with NAS during a feeding, (2) the predominance of fussing that occurred during feeding, (3) the majority of transitions to and from nonfeeding behaviors was preceded by fussing, and (4) an understanding of the characteristics of infants who did not complete the feeding during the allotted 30-minute time period.

Behavior Categories Observed During Feeding

Although the behaviors that emerged from the qualitative video review have been previously described by many clinicians[4,5,7] and investigators,[21,22] they have not been categorized and used to quantify the bottle-feeding experience of infants with NAS. Previous investigators identified specific behaviors observed during feeding of infants with NAS,[13,15] but did not develop a reproducible coding system. Many of the behaviors that we commonly observed were not included in that early assessment, such as hyperextension, arm flail, finger splay, vocal objections, glassy eyes, sleeping, hypotonia, and resting. We believe that it is unusual to find so much fussing, sleeping/sedated, resting, and crying behaviors during a bottle-feeding, confirming the notion that infants with NAS are challenging to feed.

Predominance of Fussing During Feeding

In this study, fussing emerged as an important behavior, which lends support to numerous observations that infants with NAS are irritable and difficult to feed, even when being treated with oral morphine.[5,23,24] During these feeding sessions, infants spent more time fussing than in any other behavior category, on average more than one third of the feeding period. Fussing combined with crying accounted for half the time dedicated to a feeding. The infants with the fewest fussing episodes were more likely to complete their feeding within 15 minutes (Table 4). The time infants spent fussing was time not devoted to actively feeding, and that has the potential to cause distress for caregivers. Although the duration of an individual fussing episode was relatively short, every infant had at least 2, and as many as 62 in a single feeding. These results reflect findings of previous investigators,[15,16,18] who reported significantly greater feeding problems (nipple rejection/refusal, dribbling, splitting up, and coughing) in opioid-exposed infants. Mentro and colleagues defined *feeding responsiveness* as the "manifestation of physiologically influenced visual, expressive, vocal and motor reactive behaviours expressed by an infant in reaction to a caregiver's feeding attempts."[25(p210)] Their extensive review of the literature indicated that infant cues include negative

(crying, grimacing, large body movements, arching, resisting, tenseness, restlessness) and positive behaviors (smiling, babbling, alertness, wakefulness) behaviors, as well as physiologic response patterns.

Transitioning Between Fussing to and From Other Behaviors

Not only was fussing the most common behavior among these infants, it was also found to be transitional to and from all other behaviors. More often than not, fussing was more likely to precede and follow instances of every other behavior. Since we did not code the mother's behavior, we can only hypothesize that fussing's brief duration may suggest that the infant was communicating a need that either was quickly met as evidenced by transition to feeding or resting, or was a need not met as evidenced by transition to crying. The infant must be able to clearly communicate behavioral cues, and the mother must be able to understand and respond to the cues to provide opportunities for growth and learning.[26] In this study, one third of the mothers had no previous experience with NAS, so may have not been sensitive to their infants' cues. It has been hypothesized that drug-exposed infants may not be able to give clear cues, which can cause interference in the adaptive process.[26] In this study, however, there were numerous examples of infants transitioning from fussing to feeding, indicating that the infant can be directed back to feeding. French and colleagues[27] demonstrated that when mothers with substance abuse history are taught how to read their infants' cues within the first 24 hours of delivery, interaction with their infant improves.

Infants Who Did Not Complete the Feeding

Nearly 25% of the infants in this study did not complete their feeding during the feeding episode, spending almost twice as much time fussing as feeding. While this percentile only represents 3 infants because of our small sample size, they had notably shorter feeding episodes than the rest of the sample. The WS of these infants were 3, 4, and 6, and it was the first baby for only 1 mother. It may be important for mothers to attend to these short episodes of feeding, because it might indicate that something is distracting the infant from feeding, such as excessive light or noise, or even lack of swaddling. Furthermore, feeding experts recommend waiting for the infant to demonstrate feeding readiness cues before offering the feeding,[26] but that was not the practice in this clinical setting.

Limitations

Care was taken to maintain the integrity of both the observational and quantitative data in this study; however, limitations still exist involving the number and selection of subjects and the lack of psychometric properties of the behavioral coding. Because we did not find an instrument that measured infant behavior in enough detail, we used qualitative method to identify all behaviors observed during a feeding. Although agreement was reached on the descriptors of each category, the behavior categories were developed using a small sample and must be validated with a larger sample size in the future. In fact, those standard deviations that are close to or greater than the mean in Tables 1 and 2 reflect a small sample size. There is, however, a lack of standardized measures to evaluate behaviors that disrupt infant feeding. The modified scale used by Mullen and colleagues[13] to compare feeding behaviors between normal newborns and small-for-gestational-age infants did not include a description of how the behaviors were chosen or tested for inclusion in the instrument, and it is unclear why LaGasse and colleagues[15] further modified it to eliminate some very common behaviors. However, the behavior categories that we described share many characteristics found in other scales of infant behavior and maternal–child interaction.[13,21,22,28] This was a small convenience sample of infants who were enrolled at different points in their treatment, so data were collected at the beginning of treatment for some, while others had been treated for 2 to 3 weeks and were recovering. The mothers had different levels of experience; some were primiparas, while 1 had 5 infants who had experienced NAS. Efforts to obtain a larger sample size are under way to provide better control for variability in para, age, severity of withdrawal, opiate dosage, and the environmental conditions that might influence infant behavior.

IMPLICATIONS OF FINDINGS

Despite the limitations, these results have implications for practice and research.

Preparing Mothers for Fussiness

Most mothers expect feeding to be a pleasurable experience in the newborn period, but these findings suggest that feeding is also a time with much fussiness in infants with NAS. Although "fussing" is not specifically assessed in the Modified Finnegan Neonatal Abstinence Score, it is reflected under the subscore of Central Nervous System Disturbances.[29] In this category, infants are assessed for items such as the extent of crying, sleeplessness, tremors, and increased muscle tone. The range of scores in this subscore is 0 to 26, and at least 1 report demonstrates that these signs can be found in normal newborns.[30] Many of the fussing behaviors identified in this sample included increased muscle tone and tremors. Mothers can be taught to expect a lot of fussing, and that it will probably interfere with feeding. Fussing may be interpreted as an opportunity for mothers to help the infants transition back to

feeding. These mothers will need guidance from their nurse to recognize and respond to fussing to help the infants successfully complete the feeding. Mothers can also be counseled that withdrawal signs will occasionally prevent their infants from being successful in feeding, relieving them of anxiety that could further compromise feeding success. The findings also suggest that short feeding episodes may be associated with not completing the feeding. Recognizing this pattern might provide an opportunity for the mother (or nurse) to evaluate whether the infant is ready to feed.

Establishing Evidence to Support Nursing Interventions in Infants With NAS

Very few studies are available to guide evidence-based practice in this population.[7,8] We believe, however, that investigation of the maternal–infant interaction is a priority to help these mothers be successful parents. Much is known about the importance of maternal–infant interactions during feeding. Feeding is often chosen as an opportunity to study dyadic interactions because of its potential rich experience for both participants. The ability of the caregiver to interpret infant behavior and respond contingently, as well as the infant's ability to give clear behavioral cues, influences the quality of caregiver–infant interactions.[31] Early studies found that maternal–infant interactions were good predictors of IQ and language in the child's future development.[32] Mothers who respond quickly to their infants' distress generally have infants who are easily soothed, and they gain confidence in their ability to recognize and alleviate the distress.[31] This is an important finding, considering that mothers of infants with NAS are struggling with their own addiction,[33] including depression, which is a common diagnosis among women addicted to drugs.[34] Other challenges these women face include few financial resources, unstable housing, history of abuse, legal problems, and lack of social support from family and friends.[35] Two important areas not yet addressed are the maternal actions and environmental factors that may impact feeding. Therefore, we suggest studies similar to ours that focus upon defining and describing the specific maternal behavior categories noted during feeding of infants with NAS and the environmental conditions that may also impact feeding experiences. Since environmental accommodations are often included in NPI, collecting data about lighting and noise such as loud voices and background music may provide additional insight into feeding success. It may then be possible to determine how the infant and mother behaviors, and environmental conditions, are interrelated and to predict which combinations result in the most favorable feeding situations.

It is also possible that detailed comparisons between feeding sessions of infants with NAS and those of both normal and preterm infants could prove useful in providing both mothers and caregivers with more realistic expectations of feeding patterns for infants with NAS. Zimmermann-Baer and colleagues[30] reported frequency of NAS signs in a study of 128 normal newborns who were not exposed to opiates, confirmed by meconium and urine analysis. The presence of signs changed over time (3 days to 6 weeks) and included high pitched cry, tremors, fever, nasal stuffiness, sneezing, tachypnea, frantic sucking, poor feeding, and vomiting.

Instruments such as the Nursing Child Assessment Satellite Training Feeding Scale[31] (NCAFS), which quantifies interactions that occur between caregiver and infant feeding, could be used in this regard. The NCAFS takes into account the infant's clarity of cues and responsiveness to the caregiver, as well as caregiver characteristics of sensitivity to infant cues, alleviation of distress, and the ability to provide growth-fostering situations. It has been used with normal and preterm infants, as well as other high-risk infant populations to demonstrate differences between healthy newborns and other groups. High-risk infants and their mothers consistently score lower on the NCAFS than normal newborn–mother dyads. For example, Lobo and colleagues[36] reported that mother–preterm infant dyads with failure to thrive scored lower on the NCAFS than healthy controls. The NCAFS has also been used to quantify outcomes of hospital-based interventions. White-Traut and colleagues[37] tested the impact of Hospital to Home: Optimizing the Infant's Environment (H-HOME) in 142 preterm infants. The

Summary of Recommendations for Practice and Research	
What we know:	• Infants with NAS are difficult to feed and extremely fussy, even when withdrawal symptoms are controlled with medication.
What needs to be studied:	• There is a need for research regarding the impact of maternal use of NPIs on the behaviors of infants with NAS, particularly as it relates to infant feeding. • There is also a need to identify and describe the specific maternal behaviors and the environmental conditions that may also impact feeding experiences in infants with NAS.
What we can do today:	• Assess infants for fussiness and teach mothers to expect it, and how to manage it during a feeding.

66 infants in the intervention group had significantly higher maternal Social-Emotional Growth Fostering subscale scores, as well as higher infant Clarity of Cues subscale scores than the 76 in the attention control group. Their intervention helped mothers identify and respond appropriately to infant cues and also helped the infant organize his or her behaviors providing further evidence of the need for intervention in a high-risk group. Similarly, Brown and Talmi[38] tested a hospital intervention in 84 mother–preterm infant dyads, confirming that even short-term hospital-based interventions can provide lasting benefits to high-risk populations as measured by the NCAFS. French and colleagues[27] used it to demonstrate improvement in a population of infants primarily exposed to marijuana.

Interaction between mothers and infants during feeding is described as bidirectional, and shaped by each other's signals.[39(p258)] As the mother learns her baby's cues, she adapts her responses to meet the baby's needs. The goal is to achieve synchrony, so that each adapts and responds to the other or modifies the other's behavior.[31] NICU nurses play an important role in teaching mothers with a history of substance abuse about how to interpret and respond to behaviors of their infants with NAS. Several investigators have demonstrated that a simple teaching intervention improves interactions of these mothers and infants with NAS.[27,40] Since others have demonstrated that infants who are perceived as difficult by their caregivers often exhibit poor growth,[41] it is important to support the mother through the infant's withdrawal process so she can form strong attachment behaviors that enable growth-fostering interactions.[31]

CONCLUSION

Feeding is a very meaningful and important parental task in the newborn period, especially when the infant is hospitalized in the NICU. It often represents one of the few things a mother can do for her infant, and she is anxious to do it well. Moreover, a mother in substance abuse recovery must demonstrate the ability to successfully feed her infant to earn the right to take that infant home. In this study, we found that infants demonstrated severe irritability by spending the majority of the time fussing, with frequent behavioral changes to and from fussing, and in some instances, inability to complete the feeding. Some infants had patterns of very short feeding episodes, which seemed to be associated with not completing the feeding. We also found that some infants returned to feeding after a fussing episode, which might be related to the experience of the mother, although that was not specifically studied. There is much to learn about the interactions between infants with NAS and their mothers. Our goal is to understand the nature of it and develop nursing interventions that will have a positive impact on the mother–baby relationship and help preserve the family.

Acknowledgments

The authors thank the Southern Nurses Research Society for providing funding for this study and the Leona & Lewis Hughes Endowed Chair for Nursing Science at the University of South Florida for additional support. We thank our valuable team members: Betsy Adams, RN; Donna Wertheim, RN, MS; Rhonda Walker, RN; Dr Susan Givens Bell, ARNP, DNP; Dr Mary Webb, PhD, RN; and Angela Davis.

References

1. Dryden C, Young D, Hepburn M, Mactier H. Maternal methadone use in pregnancy: factors associated with the development of neonatal abstinence syndrome and implications for healthcare resources. *BJOG*. 2009;116(5):665-671.
2. Seligman NS, Almario CV, Hayes EJ, Dysart KC, Berghella V, Baxter JK. Relationship between maternal methadone dose at delivery and neonatal abstinence syndrome. *J Pediatr*. 2010;157(3):428-433, 433 e421.
3. Finnegan LP, Connaughton JF, Jr Kron RE, Emich JP. Neonatal abstinence syndrome: assessment and management. *Addict Dis*. 1975;2(1/2):141-158.
4. Hudak ML, Tan RC. Neonatal drug withdrawal. *Pediatrics*. 2012;129(2):e540-e560.
5. Velez M, Jansson LM. The opioid dependent mother and newborn dyad: non-pharmacologic care. *J Addict Med*. 2008;2(3):113-120.
6. Finnegan LP, Kron RE, Connaughton JF, Emich JP. Assessment and treatment of abstinence in the infant of the drug-dependent mother. *Int J Clin Pharmacol Biopharm*. 1975;12(1/2):19-32.
7. Maguire D. Care of the infant with neonatal abstinence syndrome: strength of the evidence. *J Perinat Neonatal Nurs*. 2014;28(3):204-211.
8. Casper T, Arbour M. Evidence-based nurse-driven interventions for the care of newborns with neonatal abstinence syndrome. *Adv Neonatal Care*. 2014;14(6):376-380.
9. Finnegan LP, MacNew BA. Care of the addicted infant. *Am J Nurs*. 1974;74(4):685-693.
10. D'Apolito KC. Assessing neonates for neonatal abstinence: are you reliable? *J Perinat Neonatal Nurs*. 2014;28(3):220-231.
11. D'Apolito K, Hepworth JT. Prominence of withdrawal symptoms in polydrug-exposed infants. *J Perinat Neonatal Nurs*. 2001;14(4):46-60.
12. Maguire D, Cline G, Parnell L, Tse C. Validation of the finnegan neonatal abstinence syndrome tool: short form. *Adv Neonatal Care*. 2014;6(3):430-437.
13. Mullen MK, Coll CG, Vohr BR, Muriel AC, Oh W. Mother–infant feeding interaction in full-term small-for-gestational-age infants. *J Pediatr*. 1988;112(1):143-148.
14. Brown JV, Bakeman R. *Mother–Infant Behavior Cues, Birth Through Three Months*. Atlanta, GA: Georgia State University; 1975.
15. LaGasse LL, Messinger D, Lester BM, et al. Prenatal drug exposure and maternal and infant feeding behaviour. *Arch Dis Child Fetal Neonatal Ed*. 2003;88(5):F391-F399.
16. Gewolb IH, Fishman D, Qureshi MA, Vice FL. Coordination of suck–swallow–respiration in infants born to mothers with drug-abuse problems. *Dev Med Child Neurol*. 2004;46(10):700-705.
17. Kron RE, Litt M, Eng D, Phoenix MD, Finnegan LP. Neonatal narcotic abstinence: effects of pharmacotherapeutic agents and maternal drug usage on nutritive sucking behavior. *J Pediatr*. 1976;88(4, Pt 1):637-641.
18. Kron RE, Litt M, Finnegan LP. Narcotic addiction in the newborn: differences in behavior generated by methadone and heroin. *Int J Clin Pharmacol Biopharm*. 1975;12(1/2):63-69.
19. Finnegan LP, Kaltenbach K. Neonatal abstinence syndrome. In:Hoekelman R, Friedman S, Nelson N, Seidel H, eds. *Pediatric Primary Care*. 2nd ed. St Louis: Mosby; 1992;1367-1368.
20. Maguire D, Cline GJ, Parnell L, Tai C. Validation of the Finnegan Neonatal Abstinence Syndrome Tool–Short Form. *Adv Neonatal Care*. 2013;13(6):1-8.
21. Als H, Lester BM, Tronick E, Brazelton TB. Assessment of preterm infant behavior (APIB). In:Lester BM, Yogman MW, eds. *Theory and Research in Behavioral Pediatrics*. Vol 1. New York: Plenum; 1982;65-132.
22. Brown LF, Thoyre S, Pridham K, Schubert C. The mother–infant feeding tool. *J Obstet Gynecol Neonatal Nurs*. 2009;38(4):491-503.
23. Hambleton MT, Reynolds EW, Sithisarn T, et al. Autonomic nervous system function following prenatal opiate exposure. *Front Pediatr*. 2013;1:27.

24. Behnke M, Smith VC Committee on Substance Abuse, Committee on Fetus and Newborn. Prenatal substance abuse: short- and long-term effects on the exposed fetus. *Pediatrics*. 2013;131(3): e1009-e1024.
25. Mentro AM, Steward DK, Garvin BJ. Infant feeding responsiveness: a conceptual analysis. *J Adv Nurs*. 2002;37(2):208-216.
26. Ravn IH, Smith L, Smeby NA, et al. Effects of early mother–infant intervention on outcomes in mothers and moderately and late preterm infants at age 1 year: a randomized controlled trial. *Infant Behav Dev*. 2012;35(1):36-47.
27. French ED, Pituch M, Brandt J, Pohorecki S. Improving interactions between substance abusing mothers and their substance-exposed newborns. *J Obstet Gynecol Neonatal Nurs*. 1998;27(3):262-269.
28. Meyer EC, Coll CT, Lester BM, Boukydis CF, McDonough SM, Oh W. Family-based intervention improves maternal psychological well-being and feeding interaction of preterm infants. *Pediatrics*. 1994; 93(2):241-246.
29. Finnegan LP. Neonatal abstinence syndrome: assessment and pharmacotherapy. In: Nelson N, ed. *Current Therapy in Neonatal–Perinatal Medicine*. 2nd ed. Toronto, Ontario, Canada: BC Decker. 1989;262-270.
30. Zimmermann-Baer U, Notzli U, Rentsch K, Bucher HU. Finnegan neonatal abstinence scoring system: normal values for first 3 days and weeks 5-6 in non-addicted infants. *Addiction*. 2010;105(3): 524-528.
31. Sumner G, Spietz A. *NCAST Caregiver/Parent–Child Feeding Manual*. Seattle, WA: NCAST Publications, University of Washington, School of Nursing; 1994.
32. Bee HL, Barnard KE, Eyres SJ, et al. Prediction of IQ and language skill from perinatal status, child performance, family characteristics, and mother–infant interaction. *Child Dev*. 1982;53(5):1134-1156.
33. Maguire DJ. Mothers on methadone: care in the NICU. *Neonatal Netw*. 2013;32(6):409-415.
34. Skinner ML, Haggerty KP, Fleming CB, Catalano RF, Gainey RR. Opiate-addicted parents in methadone treatment: long-term recovery, health, and family relationships. *J Addict Dis*. 2011;30(1):17-26.
35. Conners NA, Grant A, Crone CC, Whiteside-Mansell L. Substance abuse treatment for mothers: treatment outcomes and the impact of length of stay. *J Subst Abuse Treat*. 2006;31(4):447-456.
36. Lobo ML, Barnard KE, Coombs JB. Failure to thrive: a parent–infant interaction perspective. *J Pediatr Nurs*. 1992;7(4):251-261.
37. White-Traut R, Norr KF, Fabiyi C, Rankin KM, Li Z, Liu L. Mother–infant interaction improves with a developmental intervention for mother–preterm infant dyads. *Infant Behav Dev*. 2013;36(4):694-706.
38. Browne JV, Talmi A. Family-based intervention to enhance infant–parent relationships in the neonatal intensive care unit. *J Pediatr Psychol*. 2005;30(8):667-677.
39. Guo Y, Leu S, Barnard KE, Thompson EA, Spieker SJ. An examination of changes in emotion co-regulation among mother and child dyads during the strange situation. *Infant Child Dev*. 2015;24:256-273.
40. Bowie BH. Interventions to improve interactions between drug abusing mothers and their drug-exposed infants: a review of the research literature. *J Addict Nurs*. 2005;15:153-161.
41. Bithoney WG, Van Sciver MM, Foster S, Corso S, Tentindo C. Parental stress and growth outcome in growth-deficient children. *Pediatrics*. 1995;96(4, Pt 1):707-711.

CE Test Instructions:

- Read the article. The test for this CE activity can only be taken online at www.nursingcenter.com/ce/ANC. Tests can no longer be mailed or faxed . You will need to create (its free!) and login to your personal CE Planner account before taking online tests. Your planner will keep track of all your Lippincott Williams & Wilkins online CE activities for you.
- There is only one correct answer for each question. A passing score for this test is 13 correct answers. If you pass, you can print your certificate of earned contact hours and access the answer key. If you fail, you have the option of taking the test again at no additional cost.
- For questions, contact Lippincott Williams & Wilkins: 1-800-787-8985.

Registration Deadline: October 31, 2017

Disclosure Statement: The authors and planners have disclosed that they have no financial relationships related to this article.

Provider Accreditation:

Lippincott Williams & Wilkins, publisher of *Advances in Neonatal Care,* will award 2.5 contact hours for this continuing nursing education activity.

Lippincott Williams & Wilkins is accredited as a provider of continuing nursing education by the American Nurses Credentialing Center's Commission on Accreditation.

This activity is also provider approved by the California Board of Registered Nursing, Provider Number CEP 11749 for 2.5 contact hours. Lippincott Williams & Wilkins is also an approved provider of continuing nursing education by the District of Columbia, Georgia, and Florida, CE Broker #50-1223. Your certificate is valid in all states.

This article has been approved by the National Association for Neonatal Nurses Certification Board for Category B credit toward recertification as an NNP.

Payment:

The registration fee for this test is $15.95 for NANN members and $22.95 for nonmembers.

DOI: 10.1097/ANC.0000000000000241