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Identification of premature infant states in relation to introducing oral feeding

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Background: Recognising oral readiness signs in infants is vital when planning the introduction of oral feeding. However, with premature infants, this can be difficult to gauge accurately because of immature development.

Methods: Twenty three staff from a level 2 neonatal unit participated. A questionnaire elicited knowledge about oral readiness and other factors related to oral feeding with premature infants. Participant knowledge of the written Als (1986) infant state descriptors was completed. A comparison was made of the skills in identification of the various infant states on video without and with written descriptors (Als; 1986). Correlations investigated if years of experience and grade had any relation to accurate infant state identification.

Results: There was wide variation in the type of training about premature infant feeding participants had received. Participants (65%) recognized the importance of oral readiness signs in relation to feeding development. A Wilcoxon signed ranks test revealed no significant differences in ability to identify infant states without and with the written Als (1986) descriptors when observing infant video materials. When not using the written descriptors, there was a strong negative correlation between grade and the identification of the [Active sleep] state, ($p < 0.01$), and a strong positive correlation between grade and the identification of the [Drowsy] state, ($p< 0.05$). There were no strong correlations between grade and years working when using the written descriptors.

Conclusion: Oral readiness signs are important when introducing oral feeding with premature infants. However, accurate identification of oral readiness remains challenging.

Key words: *premature; infant feeding; oral readiness; oral feeding; interaction*

Introduction

Premature infants are at risk of feeding difficulties, both establishing feeding, and maintaining competent feeding skills over time (Harding et al, 2015; Hawdon et al, 2000). For feeding to be successful, sucking, swallowing and breathing need to be coordinated, but is rarely established before 34 weeks gestation (Gewolb et al, 1999; Jadcherla, 2016). As premature infants develop,

they begin to show oral readiness signs of either crying or becoming awake or alert before they are due their feed (Kish, 2013).

Introducing oral feeding with premature infants is influenced by a variety of factors including post menstrual age, variability with demonstration of infant behavioural states and physiologic stability (Eichenwald et al. 2001; Jadcherla et al, 2010; Ludwig, 2007). Premature infants with low gestational ages are more at risk of having a range of additional health needs and medical conditions (Moore et al, 2012). Significant health difficulties can delay the establishment of oral feeding with longer term implications for motor and sensory development during a period of critical brain development (Browne, 2008; Gewolb & Vice, 2006; Jadcherla, 2016; Mizuno et al, 2007; Moore et al, 2012).

Oral readiness

As an infant matures, oral readiness signs are emerging although these signs may initially be variable (White -Traut et al, 2005). *Alert* states are associated with being an indicator of maturity as well as supporting successful oral feeding (Howe, 2007; Kish, 2013; Thoman, 1990; McCain et al, 1992; Pickler et al, 2006). Specifically, developments with both sucking and *alert* behaviours in older premature infants lead to better oral feeding (Kirk et al, 2007; White –Traut et al, 2013). There is variation in the identification of the most appropriate oral readiness state that supports successful oral feeding. Some authors comment that *alert* states, including *quiet alert* increase feeding efficiency (Griffith et al, 2017; Harding et al, 2014; McCain & Gartside, 2002; Medoff – Cooper et al, 2000), in contrast to the *active awake* state (McCain et al, 1992; Pickler et al, 2006). More recently, *crying* prior to a feed has been identified as a good predictor of feeding success (Griffith et al, 2017).

Published descriptors are available that define and describe the variety of infant states. Als (1986) refers to two sleep states, *active sleep* and *deep sleep*, as well as a distinct *drowsy* state. Alert states include *active awake*, *quiet alert* and *crying*. Similarly, Brazelton & Nugent (1995) also describe awake states as *alert*, *active alert* and *crying*. In addition, they describe the sleep states as *drowsy*, *deep sleep* and *light sleep*. Other researchers have used different ways of describing infant states in reference to their own work, and although Holditch – Davis (1990) refers to similar alert and sleep states as Als (1986) and Brazelton & Nugent (1995), she also describes additional drowsy states, namely, *sleep – wake transition*; *drowsy* and *non – alert waking* activity. Although these descriptive differences appear small, it possibly suggests that different practitioners identify similar infant states in qualitatively different ways.

Current practice in relation to the introduction of oral feeding

Timing for the introduction of oral feeding with premature infants varies because of differing rates of maturation and the range of additional problems that the infants may experience (Griffith et al, 2017; McCain et al, 2003; Simpson et al, 2002). Neonatal practitioners may focus on an infant's ability to manage oral stimulation in readiness to trial breast or bottle feeds, toleration of enteral feeding, weight gain and monitoring of infant states (Kirk et al, 2007). An important approach is cue based feeding, where the feeder is guided by the infant's responsiveness to feeding rather than volume (Ludwig & Waitzman, 2007). The cues that infants therefore produce are important for both carer interpretation and responsiveness, and can result in quicker discharge home (Chrupala et al, 2005; Kirk et al, 2007; Wellington & Perlman, 2015).

There are some published assessment tools to support the assessment of neonatal feeding skills (Neonatal Oral Motor Assessment Schedule, NOMAS; Palmer, 1993; Early Feeding Skills Assessment; Thoyre et al, 2005; The SOFFI, Supporting Oral Feeding in Fragile Infants, Ross & Philbin, 2011). Currently, no randomized controlled trials have evaluated any of these assessment tools or those which are for determining oral readiness (Crowe et al, 2012; Da Costa et al, 2008).There are few studies which investigate healthcare practitioner and carer ability to identify infant oral readiness signs and states.

Objectives

The aim of this study was to assess nurses' understanding, knowledge and ability to identify infant oral readiness signs with premature infants.

It was hypothesised that nursing staff would:

1. Demonstrate knowledge of factors related to the development of oral feeding with premature infants
2. Not be aware of any standard published protocols relating to oral readiness and oral feeding
3. Be confident in identifying both written descriptors and video recordings of infant oral readiness states

4. Be able to accurately identify both written descriptors and video recordings of infant oral readiness states better compared to their peers with fewer years' experience and those on lower grades

Methods

Design

This study sought to investigate neonatal nursing practitioner understanding of the importance and identification of infant oral readiness signs when preparing a premature infant for oral feeding. A questionnaire was devised for the purpose of this study. The questions were formulated following discussion with the senior neonatal team about important factors to consider when introducing oral feeding with premature infants.

A total of ten questions were developed and included the following: demographic characteristics of the participants; training undertaken about feeding the premature infant; knowledge of premature infant feeding and any specific protocols; and understanding of infant states. Participants were asked to ; i) match written infant states with Als (1986) written descriptors; ii) watch video clips of 5 infant states , (each state was of 1 min duration) and to identify the infant state they observed without the Als (1986) written descriptors; and iii) repetition of the video task with the Als (1986) written descriptors as an aid.

The initial questionnaire designed was piloted by three healthcare practitioners (one a nurse, a speech and language therapist and an occupational therapist) to evaluate and agree that the concepts and wording used would be relevant and meaningful to the participants. The study protocol was confirmed as being a Clinical Audit, and therefore, an application to the local NHS Research Ethics Committee was not required. However, as this was a collaborative project with City, University of London, ethics approval was sought and was approved by the Division of Language and Communication Science Ethics Committee, City, University of London. All potential participants were provided with an information sheet explaining the project rationale. They were informed that to protect confidentiality, all data collected would be allocated a code rather than including names. Participants were aware that they could withdraw from the project at any time without any risk of being penalised. In addition, if they had any concerns about the conduct of the study, they were provided with details of relevant contact personnel at City, University of London. Written consent was obtained from participants prior to data collection.

As part of the study involved observing video recordings of a variety of infant states, the investigators identified five recordings including one *quiet alert* recording of an infant breast

feeding, and one *quiet alert* recording of an infant bottle feeding. The *quiet alert* state was selected as it is often described as a state that is important in relation to infant feeding (McCain & Gartside, 2002; Griffin et al, 2017). In contrast, a clip of an infant in a *deep sleep* state, another in an *active sleep* state, and a *drowsy* infant were selected. To establish agreement of the states selected, interrater reliability was established by the first researcher coding the recordings independent from the second researcher. Interrater reliability was determined using Cohen's Kappa coefficient. Interrater reliability can be interpreted as very good to excellent if the observed Kappa coefficient is 0.75 or higher. The observed Kappa between the two researchers was 0.9048, SE = 0.0657, with a 95% confidence interval from 0.776 – 1, indicating a high level of agreement for the video materials used.

Sample and setting

This study was conducted in an inner city level 2 neonatal unit. Staff are trained in Developmental Care (Als, 1986) Nurses were informed that the study was taking place and had the opportunity to discuss the project before undertaking completion of the questionnaire. Participants were told that they could voluntarily withdraw at any time, both before starting and on completion of the questionnaire. Written consent was gained before participants took part.

Twenty four nurses were approached, and twenty three consented to take part in the study.

Statistical analysis

Data collected were non – parametric. To check for correlations between number of years working and grade of the participants in relation to ability to correctly identify the written infant states (Als, 1986), a Spearman's rho rank – order correlation was performed.

A Wilcoxon signed ranks test was completed to compare participant ability to identify infant states without, and then with a written guideline.

Results

Questions 1 and 2 of the questionnaire collected demographic information about the participants (Table 1 & Table 2).

Table 1: Demographic information about the number of years working as a nursery nurse or nurse with infants

Number of years worked	**Number of participants (N =23)**
0	6 (26%)
1-4	3 (13%)

5-14	4 (17%)
15-25	8 (35%)
Over 25	2 (9%)

Table 2: Demographic information identifying Band level of participants

Band	**Number of participants (N =23)**
Student midwives	4 (17%)
4	4 (17%)
5	3 (13%)
6	8 (35%)
7	1 (5%)
8	3 (13%)

Participants were asked if they had received training specifically related to introducing oral feeding to premature infants. Of the twenty three participants, fifteen reported that they had received training. Six participants reported that they had received training from a speech and language therapist working on the neonatal unit. Three staff, had learnt about feeding and oral readiness through case discussions and with colleagues as well as observing more experienced staff. Other participants mentioned attending a breastfeeding course (two participants); a college course about infant feeding (two participants); new-born behaviour observation training (one participant; a conference (one participant; a two day course on infant feeding (one participant), and self – directed reading (one participant).

When asked if a specific protocol was used to help with decision making when introducing oral feeding with a premature infant, eighteen reported they did not, but five commented that they did. Those who reported that they did use a policy were asked to define which one they used. Participants stated that they used a "hospital policy", or guidelines based on gestational age and cues, whilst another assumed that the policy referred to recommendations from the doctors in the team. There currently is a speech and language therapy policy for intervention on the neonatal unit, but no overall policy related to the introduction of oral feeding. When asked if they would use a policy, 26% reported that they would be *[extremely likely]* to use this, and 30% *[very likely].* For the rest of the participants, 13 % reported that they were *[not so likely]* to use a policy, whilst 17% did not answer the question.

Sixty five percent of participants agreed that oral reflexes, muscle tone & movement patterns, weight gain, gestational age, oral readiness signs, gastric problems and the infant's overall health needs were important factors when preparing an infant to feed orally. Additionally, 48% considered [*actual weight gain*] in comparison with 30% who felt [*weight in relation to gestational age*] was an important factor.

Most participants reported that they would be [*extremely likely*] or [*very likely*] to use infant states during their decision making. However, one participant reported that she would not refer to the infant states when planning oral feeding (Table 3).

Table 3: Likelihood of participants of using infant states.

Likelihood of using infant states	**Number of participants (N =23)**
Extremely likely	10 (43%)
Very likely	9 (39%)
Somewhat likely	3 (13%)
Not so likely	0 (0%)
Not at all likely	1 (5%)

Table 4 shows that most participants highlighted that the [*active awake*] state was the most important for infant feeding.

Table 4: Participant identification of the most important infant states.

Infant state	**Number of participants**
Active awake	12
Quiet alert	7
Crying	7
All are important	2
Active alert	1
Very alert	1
Wide awake	1
Calm	1
Quiet state	1
Mood alertness to suck	1
Deep sleep	1
Not sure	1

Participants were asked to match the six infant states as described by Als (1986) to the written descriptors. All 23 participants correctly identified the descriptors for [*crying*]. For [*deep sleep*], 93%

of participants were able to correctly identify the description of this state. For [*drowsy*] and [*quiet alert*] state descriptors, 83% accurately identified these states, with 74% correctly identify [*active awake*].*Finally,* [*active sleep*] was the least consistently identified state descriptor (70% accuracy), being confused with [*drowsy*], [*sleep*], or [*quiet alert*] written descriptors.

Identification of states observed on video clips

Participants were asked to observe five video clips, first without, and then with the Als (1986) written descriptors. The accuracy of participants' identification of states on video clips with and without a written guide are shown in Table 5.

Table 5: Accuracy of identification of states on video clips

Infant state (N =23)	**Video without written guidelines - % correct**	**Video 2 with written guidelines - % correct**
Deep sleep	91	96
Active sleep	61	70
Drowsy	52	43
Quiet Alert(Bottle feed)	52	48
Quiet alert(Breast feed)	30	30

A Wilcoxon Signed Ranks test revealed no significant differences in the ability of participants to identify infant states from the video materials without and with a written guide. (See Table 6).

Table 6: Comparison of identification of video materials of infant states without and with a written guide: Wilcoxon signed ranks test

Infant state (N =23)	**Z score**	**Asymp. Sig. (2 tailed)**	**r value**	**Strength of effect size**
Quiet alert (with bottle)	-.816	.414	.12	Small effect
Deep sleep	.000	1.000	----	No effect
Drowsy	-.378	.705	.05	Minimal effect
Active sleep	-1.000	.317	.15	Small effect
Quiet alert (breast feed)	-1.000	.317	.15	Small effect

To explore whether there were significant relationships between the grade and years working of participants without the written descriptors when looking at the video recordings of infant states, and then with written descriptors, a series of Spearman's *r* were calculated.

Identification of infant states on video <u>without</u> a written guide

There were weak to very weak positive correlations between the number of years participants had been working with the identification of the [*Deep sleep*] state, (rs = .11, (n = 23), p = .60); the identification of the [*Drowsy*] state, (rs = .18, (n = 23), p = .39); and the [*Quiet alert*] state when breast feeding, (rs = .08, (n = 23), p = .68) (Table 7). A strong negative correlation between grade and the identification of the [*Active sleep*] state, (*r*s = -.53, (n = 23), $p < 0.01$), and a strong positive correlation between grade and the identification of the [*Drowsy*] state, (rs = .52, (n = 23), $p< 0.05$) was seen (Table 7).

Table 7: Correlations of grade and number of years working with the identification of infant states on video without a written guide- Spearman's R

Infant state	*Grade*	*Number of years working*
Quiet alert (bottle feed)	-.17	-.16
Deep sleep	-.11	.11
Drowsy	.52*	.18
Active sleep	-.55**	-.31
Quiet alert (breast feed)	-.05	.08

** Correlation is significant at 0.05 level (2 – tailed)

*Correlation is significant at 0.01 level (2 - tailed)

Identification of infant states on video <u>with</u> a written guide

There was a strong correlation between grade and the identification of the [*Quiet alert*] state when bottle feeding, (rs = .57, (n= 23), $p < 0.01$), and a moderately strong negative correlation between grade and identification of the [*Active sleep*] state, (rs = -.49, (n = 23), $p < 0.05$). (Table 8). It was seen that there was a moderately positive correlation between years working and identification of the [*Quiet alert*] state when bottle feeding (rs = .36, (n = 23), p = .09) (Table 8).

Table 8: Correlations of grade and number of years working in the identification of infant states on video with a written guide Spearman's R

Infant state (N =23)	*Grade*	*Number of years working*

Quiet alert (bottle feed)	.58**	.36
Deep sleep	-.11	.11
Drowsy	.11	.05
Active sleep	-.49*	-.21
Quiet alert (breast feed)	-.24	-.03

- ** Correlation is significant at 0.05 level (2 – tailed)
- *Correlation is significant at 0.01 level (2 - tailed)

Spearman's rho correlations revealed variable outcomes, with no specific pattern between the number of years' experience and grade of staff members with the ability to accurately identify infant states.

Comparing participants' abilities to identify infant states through written descriptors only compared with identification of video recordings of infant states both without and with a written guide

Participants' scores on the video tasks were considered in relation to their ability to match the infant state to the written descriptions. Table 9 shows video scores by the number of correct matches. This table shows that there is variability in the scores with no clear pattern emerging. This could be due to the small numbers of participants recruited to this study.

Table 9: Number of correct identification of states on video without and with a guide by number of states matched correctly to written description

No of correct matches to description (N =23)	**5/5 states on video No guide**	**5/5 states on video with guide**	**4/5 states on video No guide**	**4/5 states on video with guide**	**3/5 states on video No guide**	**3/5 states on video with guide**	**2/5 states on video No guide**	**2/5 states on video with guide**	**1/5 states on video No guide**	**1/5 states on video with guide**	**0/5 states on video No guide**	**0/5 states on video with guide**
6/6	0	0	3	3	3	2	4	5	0	0	0	0
5/6	1	0	0	1	0	1	1	1	1	0	0	0

4/6	0	0	2	1	1	3	3	1	0	2	1	0
3/6	0	0	1	2	1	0	0	0	0	0	0	0
2/6	0	0	0	0	0	0	1	1	0	0	0	0

Finally, participants were asked to comment on anything they felt was relevant about the introduction of oral feeding which had not been specifically mentioned in the questionnaire. One participant commented on how important positioning was when supporting infant feeding. Another participant highlighted that feeding intervention should always be infant led as *"feeding can be a very individual thing and rather than assume because an infants of a certain gestation in order to succeed oral feeding either breastfeeding or bottle feeding, we need to carefully assess these key aspects prior to introduce (sic) oral feeding at each attempt".* Others discussed the importance of preparing the mother for either breast and / or bottle feeding, along with an up to date awareness of different milk formulas. All participants highlighted the importance of oral readiness signs and made comments acknowledging the importance of supporting carers to identify "…*these signs and we as a team would make a clear plan how to introduce oral feeding to babies and mum/dad will understand their baby more".* Participants valued opportunities to discuss and learn about the expected outcomes for premature infants who had difficulties developing feeding skills.

Discussion

The aim of this study was to investigate nurse practitioner understanding, knowledge and ability to identify infant oral readiness. The results highlighted variation in understanding and interpretation of oral readiness states with premature infants. However, these findings are tentative due to the small sample size, and therefore the limited power of the sample.

The first hypothesis stated that nurses would demonstrate knowledge of physiological and developmental factors related to the development of oral feeding with premature infants. This was indeed the case, with over half the group (65%) recognising the importance of a range of factors including oral reflexes, muscle tone, movement patterns, weight gain, gestational age, oral readiness signs, gastric problems, feed tolerance and overall health. Weight and its influence on improved feeding outcomes was regarded as important, particularly actual weight gain (48%) (Pridham et al,

2001). It is interesting to note that a fewer number of participants (30%) regarded weight in relation to gestational age as important, especially as small for gestational age infants are at higher risk of long term problems, including feeding difficulties compared to infants whose weight is correct for their gestational age (Moore et al, 2012). Participants commented that supporting mothers to make informed choices about feeding methods, i.e. breast or bottle feeding, and taking an infant led approach were additionally important when planning oral intake. Many participants, 83%, reported that they would be [extremely likely] or [very likely] to observe infant states when implementing oral feeding. This reflects the literature in that oral readiness, and its role in implementing oral feeding is not an isolated factor in infant management (Kish, 2013).

None of the participants were aware of any of the available standard published protocols as described in the literature review. Levels of alertness are stated in the speech and language therapy neonatal policy as being important when beginning the process of introducing oral feeding, with relevant strategies to help an infant achieve this state (Harding et al, 2014; McGrath & Medoff-Cooper, 2002; Pickler et al, 2006). None of the participants discussed the use of non – nutritive sucking in relation to infant alert states. It is sometimes used to promote an alert state pre feeds, and to promote feelings of satiation during tube feeding (Harding et al, 2012; 2014; McGrath & Medoff – Cooper, 2002; Pickler et al, 2006), and the fact that participants did not mention this is perhaps indicative of not understanding that it could be used for oral readiness purposes. The literature for non – nutritive sucking focuses mainly on the promotion of motor and / or oral sensory skills, rather than as a tool to promote suitable states pre a feed (Harding et al, 2014).

The third and fourth hypotheses stated that participants would be confident in the identification of both the written descriptors (Als, 1986) and video recordings of infant states, and that those at a higher grade and / or with more years' experience would be more competent in their identification of infant states compared to participants of a lower grade, or with less years' experience. Participants rated that identification of infant states in relation to oral readiness cues was important, with 83% either [extremely likely] or [highly likely] to use this knowledge in relation to introducing oral feeding, the ability to identify both written descriptors and videos of infants in different states was variable. There was no distinct pattern of results in relation to years of experience or grade, and it is difficult to attribute any reason for this. Kish (2013) acknowledges that the process of identifying oral feeding readiness states is complex, and recommends that further investigations are undertaken to develop a more valid assessment tool. Participants were most confident with more tangible concepts such as weight, weight gain and gestational age, for example, but infant states, in particular those which benefit the development of competent oral feeding are less tangible as they are fleeting in their presentation (White –Traut et al, 2005). Perhaps this is a

reason why confident identification of states is hard. Identifying oral readiness states can support carers to learn to read their infant's hunger signs, as well as other cues throughout the day, and therefore support better parent – child interaction (Harding et al, 2012). At 30 weeks gestational age, active listening, with attunement to the maternal voice is developing, and parents who are encouraged to communicate with their infants have better outcomes (Caskey et al, 2014). Given the complexities of an infant's development, communicating with them by identifying non-verbal cues is important for introducing oral feeding. This study indicates that there is variability in how participants interpreted infant states and oral readiness cues in particular. This could impact on how nurses work with parents. The implications are that parents may receive differing messages when attempting to develop their own infant's feeding abilities, and that this may delay transition to full oral feeding (Ludwig & Waitzman, 2007).

There are limitations when considering the potential impact of these variable results in terms of clinical applications and practice. The study recruited a small sample size; a larger sample may reduce variation in results. The video materials might have been more challenging to "read" rather than a live observation, and the quality could have impaired some participants' interpretation. Repeated presentations for the videos or materials relating to infants familiar to staff may have gained improved responses. Reading the printed materials and completing largely a paper based task may have been less conducive to gain relevant information on practitioner knowledge of infant states for some participants. Possibly semi – structured interviews exploring nurse practitioner knowledge in more depth could reap more relevant information to help develop a clearer understanding of the difficulties with identifying oral feeding readiness signs.

Conclusion

For premature infants to be able to feed successfully, they need to be able to either demonstrate alert or crying states. Success with developing oral feeding competence is strongly influenced by many factors including developing oral readiness signs. At present, there are no standard approaches for clear identification of infant states, and the use of typical approaches such as use of non – nutritive sucking to prepare infants to be alert and ready to feed have not been adequately investigated. Further investigations which study the development of infant states alongside the introduction of oral feeding would be useful to enable the development of protocols which are infant – led, and which promote early carer involvement in the care of the infant. Health care practitioners need to be able to identify infant states confidently so that they can support carers to learn to be competent and interactive communication partners.

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