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The use of non-nutritive sucking to promote functional sucking skills in premature infants: An exploratory trial

Non-nutritive sucking appears to promote an infant's readiness to begin oral feeding. This small pilot study examined a non-nutritive sucking programme to facilitate the transition to full oral feeding in premature infants. The results suggest that the non-nutritive sucking programme implemented by a speech and language therapist positively benefited the feeding development of neonates. Issues raised by the pilot study should be investigated in a larger scale study.

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Keywords

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Key points

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1. In a pilot study of 14 infants, 27-35 weeks' gestation, non-nutritive sucking positively benefitted the feeding development of neonates.
2. Oral motor skills, assessed by the Neonatal Oral Motor Assessment Scale improved significantly more post intervention in the infants exposed to non-nutritive sucking.
3. There was a trend towards earlier achievement of oral feeds and shorter hospital stay in treated infants.

Feeding has long been established as a routine that is important for developing a positive bond between parents and infants and therefore has the potential to make a long-term contribution to the development of well-being in the child¹. As well as being a social activity, feeding involves the use of tactile and olfactory senses that are essential in an infant's early development. Management of these skills in a vulnerable infant population requires a sensitive, multidisciplinary approach to maximise each infant's potential².

Sucking in particular is vital in the early development of the infant whether it involves breast or bottle feeding. It is essential for the means of receiving nutrition, of providing stability in distress and also a means of exploring the environment. Successful and effective feeding is an energetic activity that is described as being complex, requiring the coordination of a suck-swallow-breathe cycle³. There is also evidence that a stable swallow rhythm appears to be established earlier than a suck rhythm⁴. In the high-risk neonatal population, the suck-swallow-breathe sequence is rarely well coordinated before 34 weeks. Premature infants often require approximately 20 postnatal days to achieve a maximal suck rate and their suck-swallow patterns are immature, displaying a dysrhythmic pattern, although individual variation is recognised within this population⁵.

Infants use two types of sucking. Nutritive sucking is the process of obtaining nutrition with a rate of one suck per second, and is constant over the course of feeding. It involves intake of fluid due to the alternation of expression and suction.

Suction is the negative intra-oral pressure which occurs when the tongue and jaw become lower and the soft palate closes the naso-pharynx^{6,7}. In contrast, non-nutritive sucking occurs at two sucks per second, in the absence of nutrient flow and may be used to satisfy an infant's basic sucking urge or as a state regulatory mechanism^{7,8}. The two forms also differ in their influence on respiratory rate. Paludetto et al⁹ and Daniels et al⁸ suggest that increases in transcutaneous oxygen levels occur during non-nutritive sucking. They suggest that there is a higher respiratory rate during pauses in nutritive sucking, whereas in non-nutritive sucking, the respiration occurs during the sucking. Key environmental factors also influence the feeding process. They are the presence/absence of fluid and its viscosity¹⁰ as well as satiation, i.e. the presence of milk in the stomach which inhibits nutritive sucking¹¹.

Breastfeeding is widely recognised as having many benefits for the developing child¹²⁻¹⁴ although there are many cultural, personal and health issues which affect the decision as to whether to breastfeed or not. However, it can prove particularly difficult for premature infants and this has posed something of a challenge for nurses and speech and language therapists who play a specific role in promoting breastfeeding in young infants. Nevertheless the speech and language therapist's principle role is to maximise an infant's functional sucking skills regardless of the mother's choice of feeding. Concerns have been raised on the use of pacifiers and teats during breastfeeding. However, there is no evidence that the inter-changeable use of teats and nipple presentations cause confusion or that

pacifier use influences breastfeeding development¹⁵.

Speech and language therapists often recommend non-nutritive sucking programmes for tube fed preterm infants to hasten the transition to oral feeding and to provide a pattern for nutritive sucking. It may also assist neurodevelopmental organisation, aid neurobehavioural maturation and optimise ventilation in preterm babies who require nasal non-invasive ventilatory support^{5,16-24}. In addition, these programmes may allow critical aspects of oral motor development to receive stimulation and reduce the impact of other necessary procedures such as nasogastric feeding²⁵. These are important considerations as studies show that feeding difficulties within the neonatal population may prolong discharge home^{26,27}. Delayed introduction to oral stimulation and feeding may also lead to longer-term aversions².

Central to the issue of the evidence base related to feeding premature infants is the development of appropriate measures. Healthcare professionals working with neonates have commonly recommended the use of assessments such as the "Neonatal Oral Motor Assessment Scale" (NOMAS)²⁸, to categorise the oral motor patterns that underlie poor feeding behaviour in neonates. The NOMAS has largely been used with bottle fed infants. Meier²⁹ suggests that the terminology used in the NOMAS such as 'transitional sucking' does not translate to breastfeeders as a wide jaw excursion is essential for effective breast feeding. However, given the findings of Collins et al¹⁵, detailed above, that there is minimal evidence of nipple/teat confusion, the NOMAS is regarded as a valuable clinical tool. Furthermore, evaluations have revealed that the NOMAS has a high inter-rater reliability, and is helpful in identification of those infants who present with long term risk^{28,30,31}.

Studies have evaluated the impact of non-nutritive sucking on oral feeding. However, none have clearly addressed the link between non-nutritive sucking and nutritive sucking, nor have they proposed an intervention strategy for use in a neonatal environment. Measel and Anderson⁵ randomly assigned infants aged 28-34 weeks' gestation to a treatment group, (use of pacifier during non-oral feeding to provide an association between sucking and satiation), or control group,

Pair number and birth weight: Control	Pair number and birth weight: Intervention	Gestational age	APGAR score: Control	APGAR score: Intervention
Pair 1 1085g	Pair 1 1325g	27 weeks	7 ₁ 8 ₅	7 ₁ 7 ₅
Pair 2 1420g	Pair 2 1325g	29 weeks	6 ₁ 9 ₅	4 ₁ 8 ₅
Pair 3 1650g	Pair 3 1500g	30 weeks	7 ₁ 7 ₅	6 ₁ 7 ₅
Pair 4 1925g	Pair 4 1920g	32 weeks	8 ₁ 10 ₅	8 ₁ 9 ₅
Pair 5 1925g	Pair 5 1900g	34 weeks	8 ₁ 10 ₅	7 ₁ 9 ₅
Pair 6 1930g	Pair 6 1875g	34 weeks	6 ₁ 9 ₅	9 ₁ 10 ₅
Pair 7 2205g	Pair 7 2050g	35 weeks	8 ₁ 9 ₅	9 ₁ 10 ₅

TABLE 1 Infants participating in the study.

(no pacifier). Specific details of the treatment protocol are not given, but the treatment group of infants were ready for bottle feeds earlier, had fewer tube feeds, gained more weight and were discharged earlier. Both Field and colleagues¹⁸ and Seghal and colleagues³² obtained similar results.

Recent studies such as those by Fucile, Gisel and Lau^{19,20} have described the non-nutritive programme used more precisely. In their 2005 study, thirty two preterm infants were randomly assigned to a treatment or control group. The treatment group received a daily 15-minute oral stimulation programme (stroking the peri- and intra-oral structures), for ten days prior to oral feeding and achieved full oral feeding seven days sooner than the control group. This is an impressive result given the relatively undemanding treatment programme.

Clinically, therapists are aware of developing positive oral experiences to promote both interaction and to encourage and maximise oral skills^{33,34}. Early oral motor stimulation is encouraged to maintain and develop the sucking reflex. Authors such as Harris³⁵ and Wolf and Glass²⁴ recommend perioral and intraoral touch-pressure and nipple and finger sucking experiences before bottle or breastfeeding. Bazyk³³ suggests that non-nutritive interventions for premature infants who receive tube feeds are justified and can accelerate the transition from tube to oral feeding by allowing infants to practise using their oral motor musculature.

Although the literature cited in this article varies considerably in its methodology and the outcomes measured, it appears that non-nutritive sucking promotes an infant's readiness to begin oral feeding. In the following pilot study a non-nutritive sucking programme was devised that can be carried out by parents and carers in collaboration with a therapist. Use of a set method of intervention contributes towards evidence-based strategies to enhance an infant's well-being and contributes to good practice within the neonatal environment. The common use of a strategy can also increase understanding of the links between non-nutritive and nutritive sucking.

Method

Participants

Participants were recruited from the neonatal unit of a district general hospital based in the south of England. Ethical approval was granted by the local Health Trust. All parents gave informed consent after reading information prepared for them and after discussion with the speech and language therapist and nursing staff. They were advised that they could withdraw consent at anytime without their decision affecting the treatment that they received.

Fourteen infants participated, eleven boys and three girls. Infants were included if they were born between 27-35 weeks' gestation. They were required to have a minimum Apgar score of 3 at one minute and 5 at 5 minutes. Infants with chronic

medical problems (cardiac difficulties, unresolved respiratory problems requiring oxygen, renal sepsis, surgery, or medications with central effects, intra-ventricular haemorrhages, and general congenital or neurological anomalies) were excluded.

Design

A matched-pairs design was used. Infants were matched for gestational age and as closely as possible for birth weight (TABLE 1). A member of each pair was randomly allocated to a treatment or control group. Infants were assigned to groups using a stratified random sampling technique to ensure that the groups were similar in mean gestational age and birth weight. Allocation to the intervention or control group was completed by a computer generated random number system. The groups were compared on the length of their stay in hospital, the number of days taken to transfer to full oral feeding and the change in NOMAS scores during the intervention.

Procedure

Four training sessions were delivered to nursing and medical staff to provide a background to the intervention rationale. Parents in the treatment group were expected to provide ten minutes of oral stimulation by gently stroking the bottom lip with a finger or pacifier, then moving intraorally to stimulate the tongue in a gentle front to back movement until the finger/pacifier was prompting a non-nutritive suck pattern. This was carried out during the first ten minutes of a tube feed from the time infants demonstrated readiness to attempt oral feeding with nasogastric tube supplements until they received all of their feeds orally.

The NOMAS²⁸ was used to assess oral-motor performance during non-nutritive sucking before and after intervention. It scores infants on the number of normal, disorganised or dysfunctional patterns seen. Disorganised patterns are characterised by arrhythmic jaw movements, difficulties coordinating a suck-swallow-breathe pattern and an inability to slow down the sucking pace. Dysfunctional characteristics include an excessively wide jaw excursion or minimal excursion, asymmetry of the jaw and limited tongue movement – either a flaccid or retracted tongue. The assessment was conducted by the researcher and a speech

		Days in hospital	Days to full oral feeding
Treated infants	Median	23.00	15.00
	Range	9 - 61	9 - 21
Untreated infants	Median	28.00	18.00
	Range	11 - 92	11 - 25

TABLE 2 Effect of non-nutritive sucking on length of stay in hospital and time to full oral feeding.

Group	NOMAS 'before'	NOMAS 'after'	NOMAS 'change' Mean (SD)
Treated infants	Median = 1 Range (0,4)	Median = 9 Range (6,10)	7.1 (1.9)
Untreated infants	Median = 2 Range (0,7)	Median = 7 Range (4,10)	4.6 (2.1)
			Mean difference = 2.5 U = 9.5 p = 0.034

TABLE 3 Changes in NOMAS scores pre- and post intervention.

and language therapist trained in the use of NOMAS, who was unaware of the group allocation of the babies.

Data was collected at a scheduled tube feed prior to implementation of the first oral feed and when the infant was on full oral feeds. Non-nutritive sucking patterns were observed for a 10-minute period and evaluated in terms of the NOMAS categories.

Infants in the control group still received the usual developmental care approach from the unit, with a speech and language therapist providing verbal support and discussion of oral feeding. Developmental care seeks to benefit infants by adapting the nursery environment, adapting the care of the infant, through an infant-led approach, and through close collaboration with the family^{35,36}. Care is individual and adjusted to fit an infant's emerging skills and needs and the needs of the family.

When infants in the experimental group started to tube feed, parents kept the pacifier/finger in the infant's oral cavity for ten minutes using the method described earlier. All parents who elected to have a pacifier used the Smoothie TM pacifier. This procedure was carried out three times a day. The researcher met with parents and nursing staff daily to evaluate progress.

Data on the length of each infant's stay in hospital and the number of days taken to transfer to full oral feeding were obtained from hospital records.

Results

TABLE 2 gives the median and range for each group. The pairs of children within the groups were compared using the

Mann-Whitney t test. These showed that the treated group took fewer days to achieve oral feeding – a difference of 3 days [U=11 (n=14) p=0.082 FIGURE 1], and spent fewer days in hospital – a difference of 5 days [U=16 (n=14) p=0.277 FIGURE 2], although these differences were not significant.

The change in NOMAS scores from before introducing oral feeds to when the infant was able to take full oral feeds without tube support in the two groups was compared. TABLE 3 shows the means and range of scores and results of the Mann-Whitney test.

As can be seen, the difference between the groups was statistically significant with the intervention group having a significantly greater change in NOMAS scores.

Discussion

This study is a pilot investigation to consider some of the key challenges when conducting such an intervention with a vulnerable group. The results are highly encouraging. Each of the outcome measures showed positive trends in favour of the treated group, and this was significant with the NOMAS scores. The infants given non-nutritive sucking spent fewer days in hospital, took fewer days to reach full oral feeding and made more rapid progress on the NOMAS assessment.

The use of the NOMAS to evaluate skills has not been reported in other studies. The assessment and its use require relatively subjective judgements. Nevertheless, the results from it were consistent with the data on days in hospital and days to

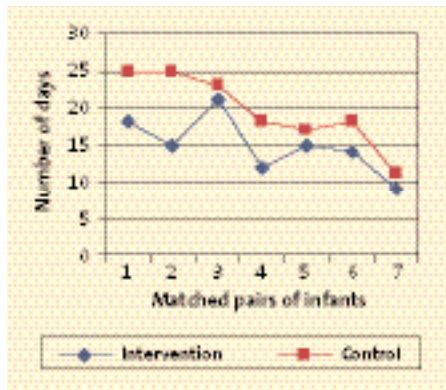


FIGURE 1 Graph illustrating the individual results for the number of days taken to achieve full oral feeds.

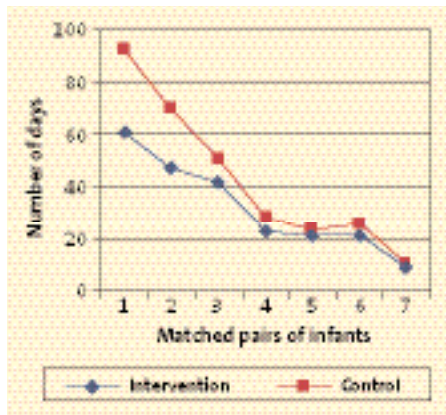


FIGURE 2 Graph illustrating the number of days spent in hospital.

achieve oral feeding, which resulted from independent decisions by medical and nursing staff. Considerable variation occurred between infants particularly on the number of days that they spent in hospital. However, on both time to achieve oral feeding and length of stay in hospital the treated infant in each matched pair obtained the lower score. It is recognised that the NOMAS has been developed and used on a population of bottle fed infants²⁹, and as such has not been validated on breast fed infants. Its use with this vulnerable group of infants requires further investigation.

These results suggest that relatively short periods of oral stimulation during non-nutritive sucking can benefit preterm infants by accelerating their progression to full oral feeding and possibly shortening their stay in hospital. As such the procedure has a wide range of potential economic implications. In the present case the additional demands were the provision of a short training course for medical and nursing staff. The speech and language therapist involved in the project visited the ward daily to review the programme. In an ongoing use of an oral stimulation

programme neither would be necessary on a regular basis. Clearly, the demands are much reduced if the parents administer the oral stimulation. This is the ideal arrangement as it may also enhance parent-child bonding and increase parents' confidence in caring for their babies^{37,38}. Use of the therapy programme increases the level of handling and interaction between infant and parent. This may also have less specific benefits in increasing the infants' well being, reducing their level of stress and reducing parents' level of anxiety. Measel and Anderson⁵ also highlight the point about handling and suggest that non-nutritive sucking may have facilitated greater restfulness or lower activity levels in infants that enabled them to conserve their energy stores and gain more weight than their peers.

The present investigation was small and only intended as a pilot study. Despite its small scale it obtained positive results and should encourage future extensions of the project to other contexts using greater statistical power. Such studies might also examine a wider range of infants as well as exploring important issues such as the perceived differences between breast and bottle feeding in relation to the premature population. Speech and language therapists often work with infants requiring prolonged respiratory support and with delayed introduction to oral feeding, who may develop long term aversions with feeding and particularly weaning². The present study only examined the short term effects of oral stimulation. These appear to be quite substantial. Nevertheless, future studies might also examine whether infants gain further benefits in the longer term and whether infants with specific feeding difficulties gain any benefits. Finally, the positive results from this study suggest that future research should include an economic analysis to establish whether the benefits reported here have any substantive service level benefits.

References

1. Bowlby J. Attachment: Volume 1. Attachment and Loss. London: The Hogarth Press. 1969.
2. Hawden J.M., Beauregard N., Slattery J., Kennedy G. Identification of neonates at high risk of developing feeding problems in infancy. *Dev Med Child Neurol* 2000; **42**: 235-39.
3. Bosma J.F. Development of feeding. *Clin Nutr* 1986; **5**: 210-18.
4. Gewolb I.H., Vice F.L., Schweitzer-Kenney E.L., Taciak V.L., Bosma J.F. Developmental patterns of

rhythmical suckle and swallow in preterm infants. *Dev Med Child Neurol* 2001; **43**: 22-27.

5. Measel C.P., Anderson G.C. Non-nutritive sucking during tube feedings: Effect on clinical course in premature infants. *J Nursing* 1979; **8**(5): 265-72.
6. Dubignon J.M., Campbell E. Sucking in the newborn during a feed. *J Exp Child Psychol* 1969; **7**: 282-98.
7. Lau C., Sheena H., Shulman R.J., Schanler R.J. Oral feeding in low birth weight infants. *J Pediatrics* 1997; **130**: 561-69.
8. Daniels H., Devlieger H., Casar P., Eggermont E. Nutritive and non-nutritive sucking in preterm infants. *J Dev Physiol* 1986; **8**: 117-21.
9. Paludetto R., Robertson S., Haith M., Shivpuri C., Martin R. Transcutaneous oxygen tension (TcPO₂) during non-nutritive sucking". *Infant Behav Dev* 1984; **7**: Special Int Conf on Infant Studies Issue, 280.
10. Kron R.E., Stein M., Goddard K.E. A method of measuring sucking behaviour in newborn infants. *Psychosomatic Med* 1963; **25**: 181-91.
11. Sameroff A. The components of sucking in the human newborn. *J Exp Child Psychol* 1968; **6**: 607-23.
12. Goldman A.S., Chheda S., Garofalo R. Evolution of immunologic functions of the mammary gland and the postnatal development of immunity. *Paediatr Res* 1998; **43**: 155-62.
13. Hennart P.F., Brasseyr D.J., Delogne-Desnoeck J.B. et al. Lysozyme, lactoferrin, and secretory immunoglobulin A content in breast milk: Influence of duration of lactation, nutrition status, prolactin status and parity of mother. *Am J Clin Nutr* 1991; **53**: 32-39.
14. La Copetta B.J., Griell F., Horisberger M. et al. Epidermal growth factor in human and bovine milk. *Acta Paediatr Scand* 1992; **81**: 287-91.
15. Collins C.T., Ryan P., Crowther C.A. Effect of bottles, cups, and dummies on breast feeding in preterm infants: A randomised controlled trial. *Br Med J* 2004; **329**: 193-98.
16. Anderson G.C., Vidyasagar D. Development of sucking in premature infants from 1 to 7 days post birth. *Birth Defects: Original Article Series* 1979; **15**(7): 145-71.
17. Bernbaum J.C., Pereira G.R., Watkins J.B., Peckham G.J. Non-nutritive sucking during gavage feeding enhances growth and maturation in premature infants. *Paediatrics* 1983; **71**: 41-45.
18. Field T., Ignatoff E., Stringer S., Brennan J., Greenberg R., Widmayer S., Anderson, G.C. Non-nutritive sucking during tube feedings: Effects of non-nutritive sucking on behavioural state for pre-term infants before feeding. *Pediatrics* 1982; **70**: 381-84.
19. Fucile S., Gisel E., Lau C. Oral stimulation accelerates the transition from tube to oral feeding in preterm infants. *J Pediatrics* 2002; **141**: 230-36.
20. Fucile S., Gisel E., Lau C. Effect of an oral stimulation program on sucking skill maturation of preterm infants. *Dev Med Child Neurol* 2005; **47**: 158-62.
21. Pickler R.H., Frankel H.B., Walsh K.M., Thompson N.M. Effects of non-nutritive sucking on behavioural organisation and feeding performance in pre-term infants. *Nurs Res* 1996; **45**: 132-35.
22. Pinelli J., Symington A. Non-nutritive sucking for promoting physiologic stability and nutrition in preterm infants. *The Cochrane Database of Systematic Reviews*, Issue 4, Art. No. CD001071, Pub 2, DOI: 10.1002/14651858. CD001071.Pub 2. 2005.
23. Webster E. The use of pacifiers for non-nutritive sucking by babies in a neonatal unit: A qualitative

- investigation into nurses' perspectives. *JNN* 1999; **6**(2): 43-48.
24. **Wolf L.S., Glass R.P.** Feeding and swallowing disorders in infancy. Tuscon, Arizona: Therapy Skill Builders. 1992.
25. **Harris M.B.** Oral-motor management of the high-risk neonate. *Physical Occup Ther Pediatrics* 1986; **6**(3/4): 231-35.
26. **Lau C., Hurst N.** Oral feeding in Infants. *Curr Probl Pediatr* 1999; **29**: 105-24.
27. **Jacherla S.R., Shaker R.** Esophageal and upper esophageal sphincter motor function in babies. *Am J Med* 2001; **111**(Suppl 8A): 64S-68S.
28. **Palmer M.** Identification and management of the transitional suck pattern in premature infants. *JPNN* 1993; **7**(1): 66-75.
29. **Meier P.P.** Transitional suck patterns in premature infants. *J Perinat Nurs* 1994; **8**: vii-viii.
30. **Braun M.A., Palmer M.M.** A pilot study of oral-motor dysfunction in "at risk" infants. *Phys Occ Ther Pediatr* 1985; **5**: 13-25.
31. **Palmer M.M., Crawley K., Blanco I.A.** Neonatal oral-motor assessment scale: A reliability study. *Neo J Perinatol* 1993; **13**: 28-35.
32. **Seghal S.K., Prakesh O., Gupta A., Mohan M., Armand N.K.** Evaluation of beneficial effects of non-nutritive sucking in pre-term infants. *Indian Paediatrics* 1990; **27**: 263-66.
33. **Bazyk S.** Factors associated with the transition to oral feeding in infants fed by nasogastric tubes. *Am J Occ Ther* 1990; **44**(12): 1070-78.
34. **Evans-Morris S., Dunn-Klein M.** Pre-feeding skills. Tuscon, Arizona: Therapy Skills Builders. 1987.
35. **Hyde A.S., Jonkey B.W.** Developing competency in the neonatal intensive care unit: A hospital training programme. *Am J Occup Ther* 1994; **48**(6): 539-45.
36. **Sweeny J.K., Heriza C.B., Reilly M.A., Smith C., VanSaint A.F.** Practice guidelines for the physical therapist in the neonatal intensive care unit (NICU). *Pediatric Physical Therapy* 1999; **11**: 119-32.
37. **Warren I.** (Ed) Guidelines for infant development in the neonatal nursery. 2nd Edition. London: St.Mary's Hospital. 2000.
38. **Lau C., Schandler R.J.** Oral motor function in the neonate. *Clin Perinatol* 1996; **23**: 161-78.