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Profiling non-nutritive sucking skills in full-term and preterm neonates

Ananya Vijay[1,2], Radish Kumar Balasubramanium[1,2*], Rahul Krishnamurthy[3], Uzair Chilwan[1,2], Nutan Kamath[2,4] and Kamalakshi Bhat[2,4]

Abstract

Background Non-nutritive sucking (NNS) is a reflex in neonates where they suck on objects without receiving food. It aids in oral development and self-regulation. Preterm birth can affect NNS and feeding. Based on current guidelines, early evaluation is crucial for identifying any delay in normal development in this population. Hence, the current study aims to profile non-nutritive sucking skills in full-term (37 to < 42 weeks) and preterm (32 to < 37 weeks) neonates and to compare non-nutritive sucking skills between the groups.

Method A total of 180 neonates completed this study. "The test for oropharyngeal dysphagia in Indian neonates" (TOD-IN) was used to profile non-nutritive sucking. The number of sucks, swallows, bursts, duration of sucking, suck/le per swallow, and pause duration was also assessed.

Results There was a statistically significant difference between the groups for non-nutritive sucking at $p = < .001$ and Cohen's d had a large effect size ($d = 1.42$). Preterm neonates had a lesser number of sucks, bursts, swallows, and duration of sucking but had a higher pause duration compared to full-term neonates.

Conclusion Non-nutritive sucking skills develop with advancing postmenstrual age and a detailed profile is imperative for a proper assessment to identify progress and delays.

Keywords Non-nutritive sucking, Preterm neonates, Full term neonates

Background

Non-nutritive sucking (NNS) is a primitive reflex in neonates, elicited by providing a tactile input in and around the mouth resulting in the infant closing the mouth and developing intraoral pressure around the stimulus. Rhythmic suctions and compressions are produced on the stimulus [1]. It consists of sucking fingers, pacifiers, or other objects without any nutritional delivery and is considered a normal part of fetal and neonatal development. NNS has been identified as early as 15 weeks after conception during the intrauterine stage. The quality and rhythmicity of NNS are said to be improved as the sucking rhythm gets stable and well patterned after 34 weeks of gestational age [2]. This normal development of NNS helps self-regulate and create an experience of oral feeding without the added stress of fluids [3, 4].

Physiologically, NNS is characterized by a stereotypic burst-pause pattern, and swallowing associated with NNS is reported to occur at a rate of 2 sucks per second [5, 6]. Even though NNS is considered a precursor to oral feeding, its interpretation regarding an infant's oral feeding performance needs caution [7]. This is due to the fact that oral feeding skills also necessitate suck, swallow and breathe coordination to manage bolus intake [8]. However, the stability of physiologic functions and rhythmic

*Correspondence:
Radish Kumar Balasubramanium
radheesh.slp@manipal.edu
[1] Department of Audiology and Speech Language Pathology, Kasturba Medical College, Mangalore, India
[2] Manipal Academy of Higher Education, Manipal, Karnataka, India
[3] Department of Special Education and Communication Disorders, University of Nebraska-Lincoln, Lincoln, USA
[4] Department of Paediatrics, Kasturba Medical College, Mangalore, India

NNS are prerequisites for beginning the transition to oral feeding.

In preterm infants, the development of NNS behaviors is reflective of neurobehavioral maturation and organization [9, 10]. Preterm birth can affect NNS despite it being a reflexive behavior in the neonatal period. Factors such as medical conditions and other complications can affect the development of NNS and oral feeding in preterm neonates [11]. The neonates who are born prematurely miss out on this opportunity to practice and develop their sucking and swallowing skills in utero. They are neurologically immature and are not efficient in the coordination of rhythmic sequences of sucking, swallowing, and breathing. Moreover, muscle strength is required to suck, which might be lacking in them successfully. Furthermore, poor NNS skills are reported to be indicators of underlying central nervous system problems and, thus, can result in poor feeding performance.

Early evaluation of NNS is vital since delays in the development of sucking and feeding skills are sensitive indicators of central nervous system (CNS) dysfunction, poor oral feeding performance, and many important clinical markers [12]. Emerging evidence has shown interdependence between sucking skills, feeding, and successive neurodevelopment [13]. There are various subjective and objective assessments to measure NNS, and one such is "The test for oropharyngeal dysphagia in Indian neonates" (TOD-IN) [14]. It is a clinically valid and reliable tool for the identification of feeding and swallowing difficulties in neonates in the Indian population. The test is divided into four primary sections, of which the NNS section evaluates the non-nutritive sucking abilities and distress cues.

While the importance of NNS in early development is acknowledged, quantitative behavioral data on NNS beyond the first weeks of life are limited [15]; furthermore, comparative data is lacking. This necessitates a need to profile NNS skills among full-term and preterm neonates. Such quantitative behavioral data would aid in the early identification and monitoring of developmental trajectories. Therefore, the aim of this study was to profile non-nutritive sucking skills in full-term (37 to < 42 weeks) and preterm (32 to < 37 weeks) neonates and to compare non-nutritive sucking skills between the groups.

Method

Participants

A cross-sectional study design was used where 90 preterm neonates (28 to < 37 weeks) and 90 full-term neonates (37 to < 42 weeks) were recruited from April 2021 to March 2022. The exclusion criteria considered were the presence/history of neurologic, gastrointestinal, craniofacial, and cardiovascular disorders. The neonates and their parents were recruited using convenience sampling from a government maternity hospital where routine feeding and swallowing assessment takes place for the neonates. Prior to conducting the study, informed consent from the parent or caregiver was taken. The study was approved by the institutional ethics committee at Kasturba Medical College, Mangalore (IEC KMC MLR 03-2021/92).

Procedure

The NNS section from the Test of oropharyngeal dysphagia in Indian neonates (TOD-IN; was used to profile the NNS behaviors in the current study [14]. Each infant was gently aroused to an awake, alert state with minimal to moderate motor activity. Neonates' behavioral state was noted, and they were assessed only during the quite alert and active alert behavioral states. Appropriate NICU protocol was followed prior to further assessing the neonate. The index finger was introduced into the infant's mouth to stimulate suck/ suckle behavior for a span of 30 s. Various parameters related to NNS from TOD-IN (described below) were recorded and collected for analysis. This procedure was carried out two times, and the best suck was taken. During the assessment, if the clinician noticed any changes in behavior the assessment was immediately terminated.

Outcome measures

The clinician assessed the following domains from TOD-IN during the NNS stimulation: acceptance of the finger introduced in the infant's mouth, Assessment of lips, Assessment of tongue, Suck–Swallow Coordination, and Distress cues during NNS.

- *Number of sucks:* Total number of sucks that occur within one suck burst cycle.
- *Number of swallows:* Total number of swallows that occur within a span of 30 s of NNS stimulation.
- *Number of bursts*: total number of suck burst cycles that occur within 30 s of NNS stimulation.
- *NNS duration*: duration of the non-nutritive suck burst in seconds.
- *Suck/le per swallow*: ratio of the number of sucks to the number of swallows.
- *Pause duration:* rest period between two suck burst cycles.

Statistical analysis

SPSS version 26.0 software was used to perform statistical analysis. Descriptive statistics, independent *t* test, and Cohen's *d* were obtained for all the TOD-IN parameters to analyze the statistical significance and the effect size.

Descriptive statistics was carried out to measure the mean and standard deviation of the other outcome measures along with an independent *t* test.

Results

A total of 180 neonates were recruited for the study and were divided into two groups: Group I and II comprised 90 full-term and 90 preterm neonates respectively. The results of the study are discussed under the following domains.

The 15 questions listed under the 4 domains of the NNS section in TOD-IN were assessed and documented as yes (score 1) or no (score 0) for the two groups. Frequency analysis was performed for all the 15 questions across both the groups. The results are shown in Fig. 1.

Based on the findings from Fig. 1, it was observed that full-term neonates did not have difficulty in most of the parameters in comparison to preterm neonates.

The scores of all domains in NNS from TODIN test were added and total scores for both groups were compared. Independent *t* test was performed to analyze the differences between the means of both the groups. Results revealed that there was a statistically significant difference between the groups for non-nutritive sucking ($t_{106.31} = 9.526$, $p = < .001$). Cohen's *d* was later employed to estimate the effect size which was large for non-nutritive sucking ($d = 1.42$) indicating high practical significance.

Descriptive statistical analysis was employed to obtain the mean and standard deviation for all the quantitative measures of NNS. The results are shown in Table 1.

It is observed that the mean scores for the number of sucks, the number of swallows, the number of bursts, NNS duration, and suck/le per swallow are lesser in

Table 1 Mean and standard deviation for all NNS parameters

Dependent variables	Group I ($n = 90$)		Group II ($n = 90$)	
	Mean	SD	Mean	SD
Number of sucks–measure 1	8.22	2.01	5.00	2.54
Number of sucks–measure 2	10.20	2.03	6.29	2.97
Number of swallows	2.13	0.50	1.60	0.65
Number of bursts	3.67	0.54	2.28	1.10
NNS duration	5.10	1.38	4.25	1.21
Suck/le per swallow	4.98	1.27	4.17	2.15
Pause duration	2.53	0.85	4.38	1.68

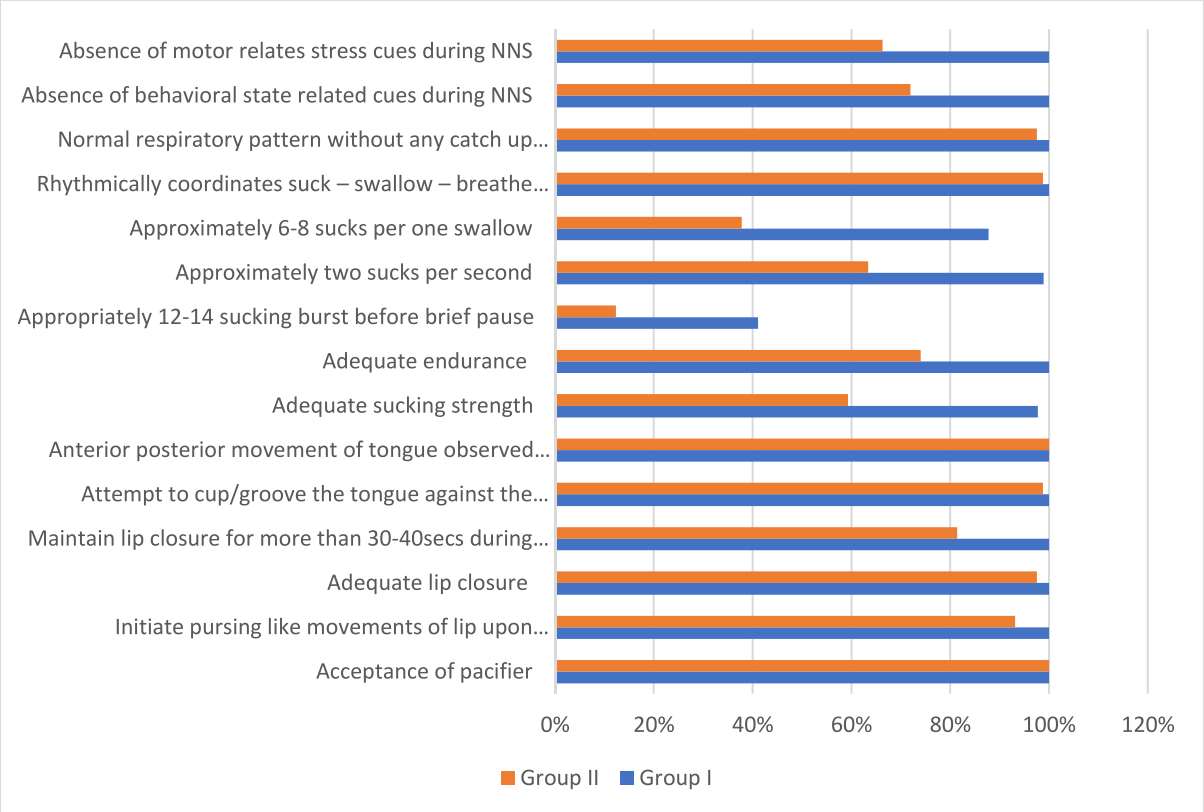

Fig. 1 Frequency analysis of all the qualitative parameters

preterm neonates. However, the mean pause duration is higher in the preterm group. Independent *t* test was performed to analyze the differences between the means of both the groups. The results are shown in Table 2.

From Table 2, it is observed that all the NNS parameters are significantly different between preterm and full-term neonates.

Discussion

Overall, the data showed a significant difference in NNS between full-term and preterm neonates. Using a finger to elicit NNS agrees with previous studies where a gloved finger was introduced into the neonate's mouth [16, 17]. This method of subjective measurement of various NNS parameters, including number, duration, frequency of bursts, and pauses, is considered appropriate [9].

Acceptance of finger

All the neonates were able to accept the finger introduced in the mouth and there was no significant difference between the groups. These findings are in agreement with the study [18] where all the preterm infants were able to grasp the pacifier with their mouth.

Assessment of lips

None of the neonates had any substantial difficulty initiating pursing-like lip movements for sucking and had adequate lip closure. This is in agreement with the study where > 95% of the full-term infants had adequate lip seals [19]. However, some of the pre-term neonates had difficulty maintaining lip closure for more than 30 to 40 s compared to full-term neonates.

Assessment of tongue

Both full-term and preterm neonates did not struggle to cup/groove their tongues against the clinician's finger. The anterior-posterior movement of the tongue was observed in all the neonates during sucking. This can be because tongue cupping develops as early as 28 weeks gestation, and anterior-posterior tongue movements (suckling) develop between 18 to 28 weeks gestation [20]. The results also align with the study where > 95% of the full-term infants had adequate tongue motion and tongue cupping [19].

However, only half of the preterm neonate group had adequate sucking strength and endurance while the full-term neonates had no difficulty in this aspect. These findings agree with other studies where preterm infants had significantly lower mean maximum tongue pressure and lesser tongue force than full-term infants [12, 21]. It is also in agreement with another study where preterm infants had weaker suck vigor and exhibited less endurance [18, 22].

Table 2 Independent *t* test between groups

Dependent variables	Independent *t* test
Number of sucks–measure 1	$t(178) = 9.62, p < 0.001$
Number of sucks–measure 2	$t(158.49) = 10.42, p < 0.001$
Number of swallows	$t(165.092) = 6.18, p < 0.001$
Number of bursts	$t(133.276) = 11.270, p < 0.001$
NNS duration	$t(177) = 4.488, p < 0.001$
Suck/le per swallow	$t(146.163) = 2.633, p < 0.05$
Pause duration	$t(127.365) = -10.098, p < 0.001$

Suck-swallow coordination

The results revealed a significant difference between preterm and full-term neonates with respect to the number of sucking bursts. However, even in the full-term group, only half of them passed this criterion. This can be because the neonates had to be aroused from their deep and light sleep stages to an awake-alert stage to perform the assessment. Hence, there is a possibility of having better NNS in the full-term group when neonates are assessed in the pre-test active alert stage. This is essential since it is known that infants' state of arousal significantly affects the quality of NNS and their behavior is state-dependent [18, 23]. Another possible explanation is that infants of similar gestational age demonstrate wide variance in the maturational level of their skills [6, 24].

The results also revealed that all the full-term and half of the preterm neonates had approximately two sucks per second and 6–8 sucks per one swallow. This is in agreement with the finding that full-term neonates have 2 sucks per second [6]. In other studies, preterm infants had about 1.7 sucks/second [5] and 1.15 sucks per second during NNS [25].

Results also revealed that all the neonates rhythmically coordinated suck-swallow breath patterns and had a normal respiratory pattern without any catch-up breathing. This is in accordance with the finding that rhythmic NNS patterns are observed as early as 27 weeks of gestation [26] and that infants early on breathe at a rate of 40–60 breaths per minute or 1.5 to 1 breath per second [27].

Distress cues during NNS

The result revealed that full-term neonates had no behavioral or motor-related distress cues during NNS. In the preterm group, a few neonates displayed distress cues during NNS, significantly different from the full-term neonates. Among those who displayed behavior state-related distress cues, excessive crying, facial grimaces, and staring were the ones commonly observed. Hyperextension of limbs, arching of the head, and increased stiffness were some of the motor state-related distress cues

noted in this group. This can be due to preterm infants engaging in sucking that surpasses their ability in maintaining stable physiology, thereby demonstrating behavioral stress signals [28].

Various parameters of NNS were analyzed and the results are discussed below in the following subsections.

Number of sucks

The number of sucks increased from a mean of 6.29 in the preterm group to 10.20 in the full-term group. This is consistent with other studies reporting that there are 4 to 10 sucks per burst [25] and NNS per burst increasing from 5 at 32 weeks to 6 ± 3 at 38 weeks post-menstrual age (PMA) [18]. It is also consistent with another study where preterm infants had an average of 4.80 sucks per burst [7], and full-term infants had an average of 9.60 NNS cycles per burst [29].

Number of swallows

The results of the present study revealed that the mean number of swallows in preterm and full-term neonates were 1.60 and 2.13, respectively. There is a significant difference between full-term and preterm neonates. This shows that as gestational age increases the number of swallows increases. In general, minimal swallowing is associated with NNS, and the infants do not require frequent and regular swallowing as no bolus is present except for the infant's saliva [9, 30].

Number of bursts

The mean number of bursts ranges from 2.28 in the preterm group to 3.67 in the full-term group in 30 s. This is in close agreement with other studies where the mean NNS bursts in preterm neonates was 3 [7, 18]. The results of the full-term group are also consistent in the study where 4.50 bursts were present in full-term neonates [29]. It was observed that the number of bursts increases with gestational age. Neiva and Leone also observed an increase in the number of sucks per minute as corrected gestational age increased in 95 preterm newborns [25].

NNS duration

The mean NNS duration in full-term neonates was 5.10 s. The finding is in close agreement with the study where full-term infants had an average of 4.74 s of NNS duration [29]. The preterm group had a mean NNS duration of 4.25, consistent with the findings of another study where preterm infants had a burst duration that was stable around 4.1 s [31]. The duration of NNS increased from the preterm group to the full-term group. This is supported by the evidence that NNS follows a developmental pathway featuring an increasing length of sucking bursts with maturation and an increase in gestational age [26, 28].

Suck/le per swallow

The results revealed a significant difference between full-term neonates and preterm neonates in this parameter. The number of suck/le per swallow increased with an increase in gestational age. To our knowledge, this is the preliminary study where suck/le per swallow is analyzed.

Pause duration

The results revealed a considerable difference existing between the two neonatal groups. It was observed that the pause duration is higher in the preterm group with a mean of 4.38 s and reduced in the full-term group with a mean of 2.53. The results are in close agreement with another study where 26 high-risk preterm infants with a mean gestational age (GA) of 34.5 had a pause duration greater than 6 s [32]. Other studies reported that poor feeders spent less time sucking and emitted fewer responses with longer intervals than good feeders in both nutritive and non-nutritive sucking [33, 34]. The results also reveal that with an increase in gestational age, the pause duration decreases. This is in agreement with the findings that the lower the gestational age, the more time the preterm newborns need to rest and recover from a period of continuous sucking, and as age advances the time necessary for pause reduces [25, 31, 34].

Thus, overall quantitative analysis revealed that preterm neonates had a lesser number of sucks, bursts, swallows, and NNS duration but had a higher pause duration when compared to full-term neonates. This is consistent with the finding that with increased maturation, the frequency of sucking within bursts and the number of bursts per minute increases [25]. Also, the sucking burst length increases [35], and there is a reduction in the duration of pause [25]. NNS skills advance from an immature pattern to a rhythmic pattern with an increase in gestational age [10, 35].

Conclusion

The results of the present study revealed a significant difference between the full-term and preterm neonates in most of the parameters assessing NNS. It also provided a complete profile of the non-nutritive sucking skills for both the groups. This data will benefit Speech-Language Pathologists, otorhinolaryngologists, pediatricians, and nurses in the assessment of preterm neonates and will also assist in monitoring the effects of various therapy techniques that help in facilitating NNS skills. The assessment of various NNS parameters was subjective in nature and future studies can incorporate objective measures to validate their findings. The influence of birth weight and the natal factors on various NNS parameters in preterm neonates are warranted in future studies.

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Authors' contributions
All authors were involved in the concepts and design of the study. AV was involved in data collection. AV, RKB, and RK were involved in the literature search and data analysis. AV, RKB, and UC edited and reviewed the manuscript. All authors read and approved the final manuscript.

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Availability of data and materials
The datasets used and/or analyzed in the current study are available from the corresponding author on request.

Declarations

Ethics approval and consent to participate
This study received ethical approval from the Institutional Ethics Committee (IEC) at Kasturba Medical College, Mangalore (IEC KMC MLR 03-2021/92). Informed written consent to participate in the study was provided by all participants.

Consent for publication
Written consent from the participants was obtained. No images or videos were related to an individual person in this study.

Competing interests
The authors declare that they have no competing interests.

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References

1. Sohn M, Ahn Y, Lee S (2011) Assessment of primitive reflexes in high-risk newborns. J Clin Med Res 3(6):285
2. Zimmerman E, Carpenito T, Martens A (2020) Changes in infant non-nutritive sucking throughout a suck sample at 3-months of age. PLoS One 15(7 July)
3. Jenik AG, Vain NE, Gorestein AN, Jacobi NE (2009) Does the recommendation to use a pacifier influence the prevalence of breastfeeding? J Pediatr 155(3)
4. Warren JJ, Levy SM, Nowak AJ, Tang S (2000) Non-nutritive sucking behaviors in preschool children: a longitudinal study. Pediatr Dent 22(3):187–191
5. Barlow SM, Finan DS, Lee J, Chu S (2008) Synthetic orocutaneous stimulation entrains preterm infants with feeding difficulties to suck. J Perinatol 28(8):541–548. https://doi.org/10.1038/jp.2008.57
6. Wolff PH (1968) The serial organization of sucking in the young infant. Pediatrics. 42(6):943–956
7. Bingham PM, Ashikaga T, Abbasi S (2010) Prospective study of non-nutritive sucking and feeding skills in premature infants. Arch Dis Child Fetal Neonatal Ed 95(3):F194–F200. https://doi.org/10.1136/adc.2009.164186
8. McCain GC (2003) An evidence-based guideline for introducing oral feeding to healthy preterm infants. Neonatal Netw 22(5):45–50
9. Lau C, Kusnierczyk I (2001) Quantitative evaluation of infant's nonnutritive and nutritive sucking. Dysphagia 16(1):58–67. https://doi.org/10.1007/s004550000043
10. Pickler RH, Best A, Crosson D (2009) The effect of feeding experience on clinical outcomes in preterm infants. J Perinatol 29(2):124–129. https://doi.org/10.1038/jp.2008.140
11. Crapnell TL, Rogers CE, Neil JJ, Inder TE, Woodward LJ, Pineda RG (2013) Factors associated with feeding difficulties in the very preterm infant. Acta Paediatr 102(12):e539–e545. https://doi.org/10.1111/apa.12393
12. Medoff-Cooper B, Ray W (1995) Neonatal sucking behaviors. Image J Nurs Sch 27(3):195–200. https://doi.org/10.1111/j.1547-5069.1995.tb00858.x
13. Malas K, Trudeau N, Giroux MC, Gauthier L, Poulin S, McFarland DH (2017) Prior history of feeding–swallowing difficulties in children with language impairment. Am J Speech Lang Pathol 26(1):138–145
14. Krishnamurthy R, Balasubramanium RK, Kamath N, Bhat KG (2021) A Delphi survey based construction and validation of test for oropharyngeal dysphagia in Indian neonates. Int J Pediatr Otorhinolaryngol 140:110306. https://doi.org/10.1016/j.ijporl.2020.110306
15. Krishnamurthy R, Balasubramanium RK, Kamath N, Bhat KG (2020) Trends in neonatal dysphagia research: insights from a text mining approach. Canadian J Speech-Language Pathol Audiol 44(1)
16. Khodagholi Z, Zarifian T, Soleimani F, Khoshnood Shariati M, Bakhshi E (2018) The effect of non-nutritive sucking and maternal milk odor on the independent oral feeding in preterm infants. Iran J Child Neurol 12(4):55–64
17. Coulter McBride M, Coulter Danner S (1987) Sucking disorders in neurologically impaired infants: assessment facilitation of breastfeeding. Clin Perinatol 14(1):109–130
18. Pineda R, Dewey K, Jacobsen A, Smith J (2019) Non-nutritive sucking in the preterm infant. Am J Perinatol 36(3):268–276
19. Batista CLC, Rodrigues VP, Ribeiro VS, Nascimento MDSB (2019) Nutritive and non-nutritive sucking patterns associated with pacifier use and bottle-feeding in full-term infants. Early Hum Dev 132:18–23. https://doi.org/10.1016/j.earlhumdev.2019.03.007
20. Miller JL, Sonies BC, Macedonia C (2003) Emergence of oropharyngeal, laryngeal and swallowing activity in the developing fetal upper aerodigestive tract: an ultrasound evaluation. Early Hum Dev 71(1):61–87. https://doi.org/10.1016/s0378-3782(02)00110-x
21. Capilouto GJ, Cunningham T, Frederick E, Dupont-Versteegden E, Desai N, Butterfield TA (2014) Comparison of tongue muscle characteristics of preterm and full term infants during nutritive and nonnutritive sucking. Infant Behav Dev 37(3):435–445. https://doi.org/10.1016/j.infbeh.2014.05.010
22. Scherman A, Wiedrick J, Lang W, Rdesinski R, Lapidus J, McEvoy C, Abu-Shamsieh A, Buckley S, Rogers B, Buist N (2018) Quantification of nutritive sucking among preterm and full-term infants. Res Rep Neonatol 8:53–63. https://doi.org/10.2147/rrn.s165421
23. Prechtl HF (1974) The behavioural states of the newborn infant (a review). Brain Res 76(2):185–212. https://doi.org/10.1016/0006-8993(74)90454-5 PMID: 4602352
24. Lau C (2015) Development of suck and swallow mechanisms in infants. Ann Nutr Metab 20(66):7–14
25. Neiva FCB, Leone CR (2007) Development of sucking rhythm and the influence of stimulation in premature infants. Pro-Fono 19(3):241–248
26. Hafström M, Kjellmer I (2000) Non-nutritive sucking in the healthy preterm infant. Early Hum Dev 60(1):13–24
27. Koenig JS, Davies AM, Thach BT (1990) Coordination of breathing, sucking, and swallowing during bottle feedings in human infants. J Appl Physiol 69(5):1623–1629
28. Shaker CS (1990) Nipple feeding premature infants: a different perspective. Neonatal Netw 8(5):9–17 PMID: 2319997
29. Martens A, Hines M, Zimmerman E (2020) Changes in non-nutritive suck between 3 and 12 months. Early Hum Dev 1:149
30. Sameroff AJ (1968) The components of sucking in the human newborn. J Exp Child Psychol 6(4):607–623
31. Hack M, Estabrook MM, Robertson SS (1985) Development of sucking rhythm in preterm infants. Early Hum Dev 11(2):133–140
32. Case-Smith J, Cooper P, Scala V (1989) Feeding efficiency of premature neonates. Am J Occup Ther 43(4):245–250
33. Dubignon J, Cooper D (1980) Good and poor feeding behavior in the neonatal period. Infant Behav Dev 3(1):395–408
34. Medoff-Cooper B, Verklan T, Carlson S (1993) The development of sucking patterns and physiologic correlates in very-low-birth-weight infants. Nurs Res 42(2):100–105
35. McGrath JM, Medoff-Cooper B (2002) Alertness and feeding competence in extremely early born preterm infants. Newborn Infant Nurs Rev 2(3):174–186

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