



## REVISIONES

### Feeding methods in promoting the oral motor skills of the Preterm Newborn: A Scoping Review

Técnicas de alimentación en la promoción de las habilidades oromotoras del recién nacido prematuro: a scoping review

Técnicas de alimentação na promoção das competências oro-motoras do recém-nascido pré-termo: a scoping review

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#### ABSTRACT:

**Background:** Oral feeding is a highly complex and coordinated sensorimotor activity for the preterm infants, requiring nurses to implement neuroprotective care. In nursing care, there is no consensus on the choice of the most appropriate oral feeding method for the development of oro-motor skills and the consequent feeding autonomy of the preterm infant.

**Objective:** identify and map, in the scientific literature, the oral feeding method that promotes the development of oro-motor skills in preterm in preterm infants.

**Method:** A scoping review was carried out with a research that allowed the mapping of articles published in databases (Medline, CINAHL, Cochrane Central Register of Controlled Trials and Scielo) and unpublished (Google scholar, master's and doctoral theses), between 2000 and 2018.

**Results:** This scoping review included 28 studies: 21 are primary studies, 6 secondary studies and a doctoral thesis. Three feeding methods emerged (bottle, cup and finger-feeding). The bottle appears as a promoter of more mature suction patterns; the cup is the most studied method but little consensual regarding the benefits for oro-motor development and finger-feeding appears as a facilitator of suction training and breastfeeding.

**Conclusion:** The publications focus mainly on aspects of hemodynamic stability, weight gain and feeding autonomy, with consequent early hospital discharge. It is therefore essential to understand how each method promotes the development of oro-motor skills, and it is also essential to contemplate the wishes and expectations of parents regarding food, such as exclusive breastfeeding.

**Keywords:** preterm infant; feeding method; oral feeding; oral-motor skills

## RESUMO:

**Introdução:** A alimentação oral é uma atividade sensoriomotora altamente complexa e exigente relativamente à coordenação oro-motora do recém-nascido pré-termo, requerendo dos enfermeiros a implementação de cuidados neuroprotetores. Nos cuidados de enfermagem ao recém-nascido pré-termo, não existe consenso na escolha da técnica de alimentação oral mais adequada ao desenvolvimento das competências oro-motoras, o que decerto vai influenciar a autonomia alimentar.

**Objetivo:** identificar e mapear na literatura científica, as técnicas de alimentação oral promotoras das competências oro-motoras do recém-nascido pré-termo.

**Método:** Foi realizada uma scoping review com uma pesquisa que permitiu o mapeamento de artigos publicados em bases de dados (Medline, CINAHL, Cochrane Central Register of Controlled Trials e Scielo) e não publicados (Google Académico, teses de mestrado e doutoramento), entre o ano 2000 e 2018.

**Resultados:** Selecionaram-se 28 estudos, 21 primários, 6 secundários e uma tese de doutoramento. Destes emergiram três técnicas de alimentação (biberão, copo e *finger-feeding*). O biberão surge como promotor de padrões de sucção mais maduros; o copo surge como o mais descortinado, mas pouco consensual relativamente aos benefícios para o desenvolvimento oro-motor e o *finger-feeding* surge como facilitadora do treino da sucção e complementar da amamentação.

**Conclusão:** As publicações analisadas focam-se sobretudo em aspetos de estabilidade hemodinâmica, de ganho ponderal e da autonomia alimentar, com conseqüente alta hospitalar precoce. É por isso essencial compreender de que forma cada técnica promove o desenvolvimento das competências oro-motoras, sendo também essencial contemplar os desejos e expectativas dos pais quanto à alimentação, como por exemplo a realização da amamentação exclusiva.

**Palavras-chave:** recém-nascido pré-termo; técnica de alimentação; alimentação oral; competências oro-motoras

## RESUMEN:

**Introducción:** La alimentación oral es una actividad sensoriomotora muy compleja y exigente en relación con la coordinación oromotora del recién nacido prematuro requiriendo de los enfermeros la implementación de cuidados neuroprotectores. En el cuidado de enfermería para recién nacidos prematuros, no hay consenso sobre la elección de la técnica de alimentación oral más adecuada para el desarrollo de habilidades oromotoras, lo que ciertamente influirá en la autonomía de alimentación.

**Objetivo:** Identificar y mapear la literatura científica, las técnicas de la alimentación oral promotores de las competencias oromotoras del recién nacido prematuro.

**Método:** Se realizó una scoping review que permitió el mapeo de artículos publicados en cuatro bases de datos: Medline; CINAHL; Cochrane Central Register of Controlled Trials y Scielo y no publicados (Google scholar, tesis de maestría y doctorado), entre 2000 y 2018.

**Resultados:** Se incluyeron 28 estudios, de los cuales 21 son primarios, seis son secundarios y una tesis de doctorado. De estos surgieron tres técnicas de alimentación (biberón, taza y *finger-feeding*). Biberón aparece como un promotor de patrones de succión más maduros; la taza aparece como el más abierto, pero poco consensuado con respecto a los beneficios para el desarrollo oromotor y *finger-feeding* aparece como un facilitador del entrenamiento de succión y complementario a la lactancia materna.

**Conclusión:** Las publicaciones analizadas se centran principalmente en aspectos de estabilidad hemodinámica, aumento de peso y autonomía alimentaria, con el consiguiente alta hospitalaria temprana. Por lo tanto, es esencial comprender cómo cada técnica promueve el desarrollo de habilidades oromotoras, y también es esencial contemplar los deseos y expectativas de los padres con respecto a la alimentación, como la lactancia materna exclusiva.

**Palabras clave:** recién nacido pretérmino; técnica de alimentación; alimentación oral; competencias oromotoras.

## INTRODUCTION

The growing scientific and technological development in the area of health, and neonatology in particular, has contributed unequivocally to lower infant mortality rates worldwide, with the survival rates of newborns (NBs) at 24 weeks of gestation being situated between 35-84% and at 29 weeks a rate of 92-98% <sup>(1)</sup>. Despite all of these developments, prematurity has increased in developed countries, many of the preterm

NBs have a high risk of morbidity, which is accentuated by long hospitalisations in the neonatology unit (NU) <sup>(2)</sup>. Major morbidities, such as grade III and grade IV intraventricular haemorrhage, are highlighted in 10.6% of newborns up to 32 weeks and 13.6% of these are still associated with other morbidities, such as bronchopulmonary dysplasia <sup>(3)</sup>.

In this especially vulnerable population, stability will be achieved through neuroprotective care, which is supported by interventions to support neurodevelopment, or which facilitate it after a neuronal injury, by building an environment that recognises multidimensionality and the complex needs of preterm NBs, as well as their family <sup>(4, 5)</sup>. It is, therefore, essential to carry out neuroprotective care, in order to minimise factors that contribute to an aggressive NU environment, such as constant activity, noise and light that influence preterm Nbs' brain development <sup>(2, 4, 5)</sup>.

One of the neuroprotective measures is nutrition optimisation. Oral feeding, which is a highly complex and demanding sensory motor activity in relation to the oral motor coordination of the preterm NB, requires the nurses to effectively implement neuroprotective care <sup>(4; 6)</sup>. In this sense, on an oral feeding level, this type of care aims to provide a successful and quality experience, in which the NB's maturity level is respected <sup>(4)</sup>. This should contribute to help the NB to reach their ideal state of wellness, that is, increase their existing strengths and reduce the influence of environmental conditions in the transition to oral feeding and, consequently, to feeding autonomy. Autonomy is one of the hospital discharge criteria for preterm NBs <sup>(2)</sup>, so it is crucial to implement strategies that improve oral feeding skills in preterm NBs <sup>(2)</sup>.

The development of oral motor skills for feeding in these NBs depends on several factors, namely the ability to organise and coordinate their oral functions in order to promote an efficient consumption of calories, progressing their growth and development. These skills also involve the NB's ability to maintain interest in food at a physiological and behavioural level; organise their oral motricity and breathing coordination, with suction and swallowing and maintaining their physiological stability <sup>(7)</sup>. This complex process involves the balanced development of brain maturation and its relationship with physiological and behavioural development <sup>(2)</sup>. The acquisition of oral motor skills is considered one of the development milestones of preterm Nbs <sup>(8)</sup>, as these are skills that allow a safe, functional and pleasurable feeding experience for both the NB and their parents <sup>(9)</sup>.

Physiologically, oral feeding involves a complex interaction between the brain and the central nervous system, as well as oral-motor reflexes and the multiple muscles of the mouth, pharynx, oesophagus and face. It also requires rhythmic coordination between sucking and swallowing, simultaneously with effective breathing.

Conceptually, oral feeding is defined as a consequence of multiple events that involve activities in search of food, ingestion and swallowing. Both in practice and in scientific literature, there is no consensus regarding the ideal time to start oral feeding. Recommendations have emerged that 32/34 weeks of gestational age (GA) or adjusted age (AA) are not criteria to begin feeding <sup>(10)</sup>, which should be delayed until 34 weeks<sup>(11)</sup>. The coordination maturation between sucking, swallowing and breathing usually occurs between 34-36 weeks <sup>(12)</sup>, therefore a tailored assessment by nurses is essential, allowing them to identify when it is safe to start feeding.

In nursing care, there is a lack of consensus on a daily basis regarding the most appropriate oral feeding technique for the development of the oral motor skills and the consequent feeding autonomy of the preterm NB. For the NB to be autonomous in oral feeding, they will have to ingest all the daily feeding intakes, with no instances of haemodynamic instability, even subtle ones, and show no signs of neurobehavioural stress. For this reason, it is essential that during feeding, the nurse performs a tailored and systematic assessment of the NB's oral motor skills through oral skills assessment scales, such as the Observation Scale for Early Skills in Oral Feeding <sup>(7)</sup>. Additionally, it is imperative to discover which feeding techniques positively influence the development of feeding skills and the preterm NB's consequent autonomy, so that the technique selection is standardised in care practices <sup>(13)</sup>.

This review will consider a feeding technique as the way in which oral feeding is given to preterm NBs to develop their feeding skills. The technique chosen to begin oral feeding, on the part of the nursing team, should fall on factors such as the mother's desire or not to breastfeed, the NB's GA and AA, their weight and feeding readiness behaviours demonstrated.

Oral feeding, as a nursing intervention, incurs the nurse's responsibility in decision making, regarding the feeding technique to be used in order to guarantee suitable nutrition, that is, that which is necessary for growth and development. This decision should be based on scientific evidence, made in partnership with the parents and that which will meet the NB's needs. Thus, the relevance of carrying out this review is related to the importance of identifying and mapping out in the scientific literature the oral feeding techniques that promote the preterm newborn's oral motor skills.

## METHOD

A scoping review was selected in order to carry out this review, as it contributes to a greater understanding of the subject under study. In this type of review, a systematic approach is followed to map out evidence on a topic and identify the main concepts, theories, sources and gaps in knowledge on the topic <sup>(14)</sup>. This type of review can be a preliminary exercise before conducting a systematic review of the literature, because it allows us to verify emerging evidence when it is not yet possible to ask and address more specific questions <sup>(15)</sup>.

According to Peters *et al.* <sup>(15)</sup> the structure of the scoping review must follow the following steps: defining and outlining the issues and objectives; defining the inclusion criteria according to the questions and definitions; outlining research strategies and study selection; researching and selecting studies; extracting results; summarising the evidence in relation to the objectives and consulting experts and specialists.

The questions outlined for this review are: What are the most common techniques to support oral feeding for preterm newborns? What are the techniques to support oral feeding of preterm newborns, and what is their influence on the development of their oral motor skills?

This review considered studies that include preterm NBs, with a GA greater than or equal to 32 weeks, of GA and/or AA up to 36 plus 6 of GA and/or AA that are undergoing intervention in oral feeding. The feeding techniques must be implemented on

haemodynamically stable newborns admitted to the NU. Studies whose participants were preterm NBs with central nervous system and orofacial malformations, intraventricular haemorrhages of a degree greater than II, chromosopathies and bronchopulmonary dysplasia were excluded.

The review considered studies that focus on the various techniques to support the preterm NB feeding and their influence on the development of oral feeding skills. Studies that relate oral feeding techniques to feeding autonomy in preterm NBs were also considered.

All types of scientific articles will be considered, including quantitative and qualitative studies, as well as systematic literature reviews. The articles were limited to Portuguese, Spanish and English. Chronologically, articles from 2000 to 2018 were considered.

### **Research Strategy**

The research strategy outlined for the preparation of this review aimed to scan published and unpublished articles, having been divided into three distinct stages. In the first stage, the research was limited to the Medline and CINAHL databases in order to analyse the words present in the titles and abstracts and the indexing terms used to describe the articles on the topic.

In the second stage, a search was carried out in each database with the descriptors in natural language and the indexing terms corresponding to each of them, having analysed the definitions of the indexing terms and their use to describe the articles, thus proceeding to their validation. Of the existing articles, initially only the titles and respective abstracts were taken into account and read, this was in order to exclude those that did not meet the previously defined inclusion criteria. After selecting the articles that were considered to be relevant, they were read in full.

In the third stage, using the list of references of previously selected articles, we proceeded to search for possible additional studies that could be relevant, in order to increase the sensitivity of the research.

The databases in which the research was carried out were Medline, CINAHL, Cochrane Central Register of Controlled Trials and Scielo. The search for unpublished studies was carried out through Google Scholar, master's and doctoral theses with access via the Nursing School of Lisbon's virtual library.

Two reviewers carried out the search for and selection of articles and then proceeded to select titles and then abstracts, taking the inclusion and exclusion criteria of the review into account. Subsequently, duplicate studies were removed.

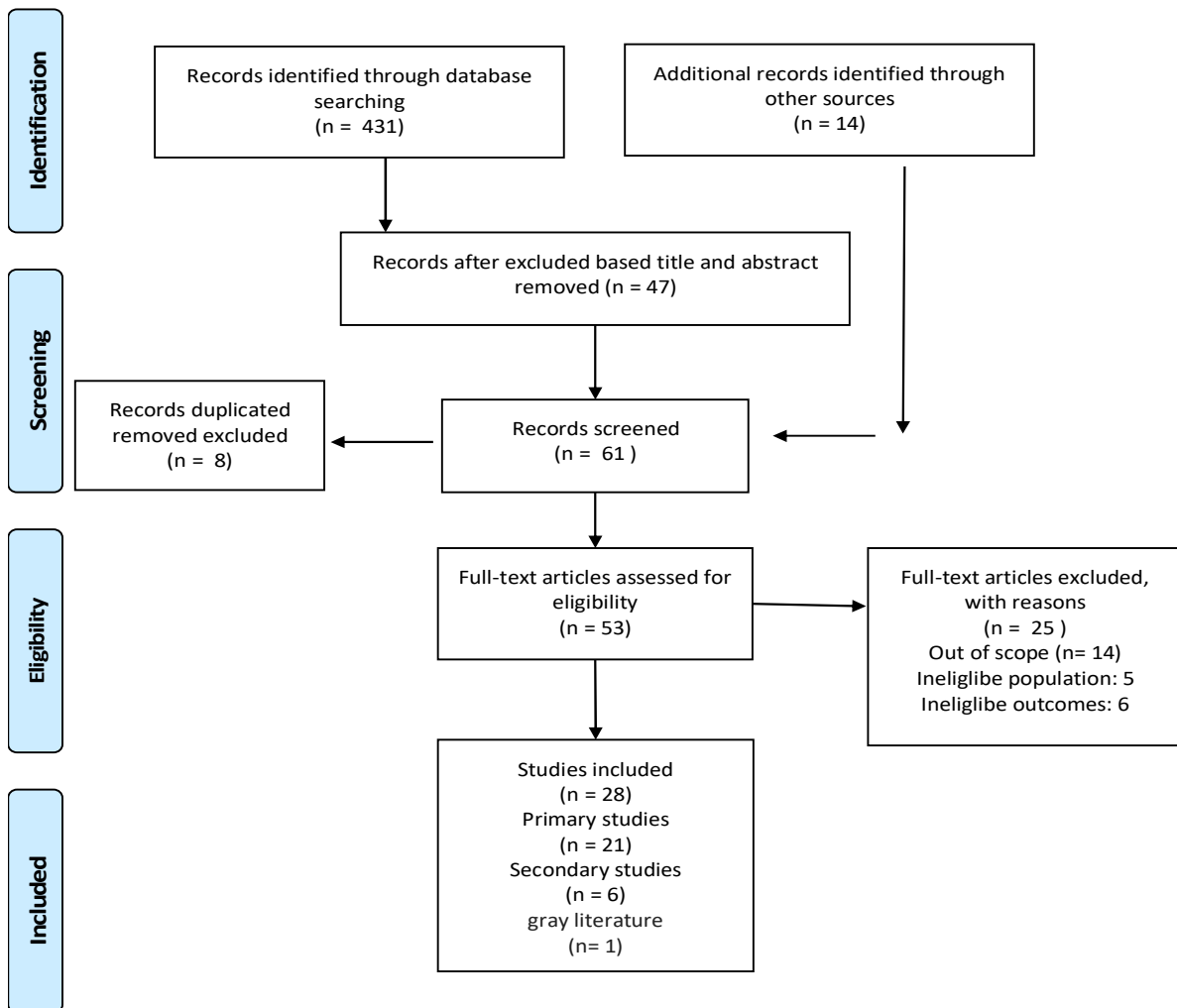
The complete research strategy is shown in table 1.

A similar process was followed for the eligibility of the full text. (Figure 1) <sup>(14)</sup>.

**Table 1: Research Strategy**

CINAHL	Medline	SciELO	Cochrane Central Register of Controlled Trials
(Preterm OR Infant, Premature OR Neonat*) AND ((Oral feeding OR Infant Feeding OR Infant Feeding, Supplemental) OR (oral motor skills OR oral Skills OR oromotor skills OR Feeding Skills OR Eating Behavior)) AND (Feeding Methods)	(Preterm OR Infant, Premature OR Neonat*) AND ((Oral feeding OR Infant Feeding OR Infant Feeding, Supplemental) OR (oral motor skills OR oral Skills OR oromotor skills OR Feeding Skills OR Eating Behavior)) AND (Feeding Methods)	((Preterm) OR (Infant, Premature) OR (Neonat*)) AND ((Oral feeding) OR (Infant Feeding) OR (oral motor skills) OR (oral Skills) OR (oromotor skills) OR (Feeding Skills)) AND (Feeding Methods))	(Preterm OR Infant, Premature OR Neonat*) AND ((Oral feeding OR Infant Nutritional Physiological Phenomena OR Infant Feeding) OR (oral motor skills OR oral Skills OR oromotor skills OR Feeding Skills OR Feeding Behavior)) AND (Feeding Methods)

**Figure 1: Flowchart**



The results were extracted using a data table. The complete data extraction was previously validated between the two reviewers, and as this process is interactive, a



table was built as the extraction was carried out. The extraction table contains the key information for all selected articles.

## RESULTS

At the starting point, 431 articles which were potentially eligible for this review were identified. However, upon reading their titles and abstracts, 381 of them were excluded. Two abstracts were not available and there was a duplicate of one article, both present in the CINAHL database. In the complete reading process, 61 articles were selected, of which 8 were duplicates, 25 were excluded and 28 were included in the scoping review, and it was those articles that met the defined inclusion criteria. Of the studies included, 21 are primary studies, 6 are secondary studies and there is one doctoral thesis.

In reviews, it is recommended to consider articles from 10 years prior to the review, in order to increase their reliability. However, in carrying out this review, it was necessary to expand the research to the year 2000, with the purpose of including a greater number of articles, seeking a more solid theoretical support. We can allude that the strategy of temporal expansion was justified by the fact that, at the end of the research, we verified that approximately half of the articles were before the year 2009.

### Description of the Primary Studies

In the primary studies, the most frequent study designs were cross-sectional (n=6) and observational (n=6) followed by experimental (n=4).

Table 2 summarises the main information extracted from the studies, such as, for example, the year, the feeding technique, the characteristics of the oral motor skills studied (coordination of the oral-motor reflexes, oral muscles, haemodynamic stability and behavioural stages), the presence of signs of behavioural stress and the milk waste. The feeding techniques present in the studies are bottle feeding, cup feeding, finger-feeding and syringe feeding. Two studies evaluate the implementation of gavage and spoon feeding.

This review includes studies related to breastfeeding (n=6), which compare the muscle activity and haemodynamic stability in bottle and cup feeding, as well as the suction pattern.

**Table 2:** Description of the Primary Studies

Article	Authors	Year	Design	Sample Size	Feeding methods	Oral-motor skills	Signs of stress	Spillage
Comparison of the finger-feeding versus cup feeding methods in the transition from gastric to oral feeding in preterm infant	Moreira <i>et al.</i>	2017	Experimental	57 PT	Cup feeding Finger-feeding	<b>Oral reflexes coordination:</b> <i>Finger-finger</i> support sucking training and sucking- swallowing-breathing coordination. <b>Hemodynamic stability:</b> <i>finger-feeding</i> fewer complication episodes (Sat, respiratory effort).		Finger-feeding group showed lower milk loss.
Characterisation of sucking dynamics of breastfeeding preterm infants: a cross sectional study	Geddes <i>et al.</i>	2017	Cross sectional	38 PT	Breastfeeding (with nipple shield)	<b>Oral reflexes coordination:</b> vacuum is generated by lowering their tongue in a parallel fashion with the nipple. Nipple shields were associated with weaker intra-oral vacuums.		
Spilled volume, oxygen saturation, and heart rate during feeding of preterm newborns:	Araújo <i>et al.</i>	2016	Quasi-experimental	30 PT	Syringe Finger-feeding	<b>Hemodynamic stability:</b> Heart rate was different (the values were within normal limits). Sat values were also different.		Finger feeding proved to cause less spillage

comparison between two alternative feeding methods								
Evaluation of orofacial characteristics and breastfeeding in preterm newborns before hospital discharge	Castelli & Almeida	2015	Cross sectional	25 PT	Breastfeeding	<b>Oral reflexes coordination:</b> for the success of breastfeeding is important movement tongue during suction, movement of the of the mandible, coordination and the rate of deglutition and respiration. <b>Oral muscúles:</b> the absence of buccinator muscle. <b>Behavior State:</b> alert stage presented higher scores in the protocol of breastfeeding evaluation.		
Electromyography of muscles involved in feeding premature infants	Martins <i>et al.</i>	2015	Cross sectional	36 PT	Breastfeeding, cup feeding	<b>Oral muscúles:</b> No difference was observed between breastfeeding and cup-feeding in the analysis of the temporal and masseter muscles. Higher activity of suprahyoid musculature was observed during cup-feeding.		
Comparison of Sucking Pattern in Premature Infants With Different Feeding Methods	Rahman <i>et al.</i>	2015	Cross sectional	70 PT	Tube-feeding, spoon and breastfeeding	<b>Oral reflexes coordination:</b> The sucking behavior varies between tube-fed, spoon-fed, and breastfed preterm infant.		
Assessment of swallowing in preterm newborns fed by bottle and cup	López <i>et al.</i>	2014	Observational	19 PT	Bottle and cup feeding	<b>Oral reflexes coordination:</b> The majority of the bottle-fed PT (68%) presented strong and rhythmic suction and 63% showed good sucking/swallowing/breathing coordination. By cup (68%) could not perform the sipping movement and only 32% could suck.		
Surface Electromyography in Premature Infants: A Series of Case Reports and Their Methodological Aspects	Gomes <i>et al.</i>	2013	Observational	50 PT	Breast, bottle and cup feeding	<b>Oral muscúles:</b> Higher masseter muscle activity was observed in the infants that breastfed or used a cup; masseter muscle activity was reduced and buccinator muscle activity was increased in infants who were fed artificially using only a bottle.		
Indications and use of "finger feeding"	Fujinaga <i>et al.</i>	2012	Descriptive	PT and newborns in 3 hospitals	Finger-feeding	<b>Oral reflexes coordination:</b> Finger-feeding should be use in suction training when the mother is absent or as a complement with the present mother.		
A Controlled-flow Vacuum-free Bottle System Enhances Preterm Infants' Nutritive Sucking Skills	Fucile <i>et al.</i>	2009	Experimental	30 PT	Bottle (controlled-flow vacuum-free bottle system - CFVB vs. a standard bottle - SB)	<b>Oral reflexes coordination:</b> Stages of sucking, were consistently more mature in infants using the CFVB vs. SB in both period of evaluation. Suction frequency decreased in CFVB infants at 1-2 and 6-8 oral Feedings/day compared to SB and increased over time only in the SB. Expression frequency decreased in CFVB vs. SB at 1-2 oral feedings/day and increased over time only in the CFVB. Suction amplitude and sucking burst duration were similar in the two groups at both periods.		
Cup-feeding of premature newborn children	Silva <i>et al.</i>	2009	Experimental	20 PT	Cup feeding	<b>Behavior State:</b> There is no statistically significant difference between the behavior states (sleep and alert), both for the volume of the accepted and the wasted milk.	The PT who presented a stress signal (e.g. sneezing, coughing, reduced sucking movements, tongue tremor) had lower diet acceptability and those who did not presented accepted the total volume of milk offered. The 20 PT evaluated, only four showed no sign of stress.	
Evaluation of paladai cup feeding in breast-fed preterm infants compared with bottle feeding	Aloysius & Hickson	2007	Pilot study	15 PT	Paladai cup and bottle feeding		11 infants had stress cues during paladai feeding; desaturations (n=3), finger splaying (n=3), sneeze (n=2), gagging (n=1), cough (n=1), fell asleep (n=1) compared to three babies during bottle (dip in saturation, startle/ cough, inspiratory stridor/cough).	



Effects of Single-Hole and Cross-Cut Nipple Units on Feeding Efficiency and Physiological Parameters in Premature Infants	Chan <i>et al.</i>	2007	Cross sectional	20 PT	Bottle (Single-Hole and Cross-Cut Nipple)	<b>Oral reflexes coordination:</b> PT sucked more efficiently with single-hole compared to those fed through cross-cut nipples. <b>Hemodynamic stability:</b> PT using cross-cut nipple units had a higher RR and SpO2 than those using single-hole nipples.	Compared to using cross-cut nipple units, PT using single-hole nipple units take more milk and tend to tolerate feedings better.	
A characterization of the use of the cup feeding technique at the neonatal intensive care unit of a public hospital	Gutierrez <i>et al.</i>	2006	Descriptive	28 PT	Cup feeding	<b>Oral muscles:</b> 82% of the PT were able to lapping or to drink the milk offered per cup. <b>Hemodynamic stability:</b> Signs of respiratory change during feeding per cup were not checked in none of the PT.		
Sipping/lapping is a safe alternative feeding method to suckling for preterm infants	Mizuno & Kani	2005	Observational	18 PT	Bottle and cup feeding	<b>Oral reflexes coordination:</b> Tongue movements while sipping/lapping differed from those while suckling a bottle or breast. <b>Hemodynamic stability:</b> Heart rate and SpO2 showed no statistically significant difference.		
Does the choice of bottle nipple affect the oral feeding performance of very-low-birthweight (VLBW) infants?	Scheel <i>et al.</i>	2005	Observational	10 PT	Bottle feeding	<b>Oral reflexes coordination:</b> Infants demonstrated a similar rate of milk transfer among all three nipples. However, the stage of sucking, suction amplitude, and duration of the generated suction were significantly different between nipples. Infants can modify their sucking skills in order to maintain a rate of milk transfer that is appropriate with the level of suck-swallow-breathe coordination achieved at a particular time.		
Implementing the Baby Friendly Hospital Initiative: The role of finger feeding	Oddy & Glenn	2003	Observational	17 PT	Finger-feeding	<b>Oral reflexes coordination:</b> Detect a developing or correct a faulty sucking technique.		
Cup or Bottle for Preterm Infants: Effects on Oxygen Saturation, Weight Gain, and Breastfeeding	Rocha <i>et al.</i>	2002	Experimental	78 PT	Breast, Bottle and cup feeding	<b>Hemodynamic stability:</b> No difference in the mean value of the lowest saturation levels or in the proportion of oxygen saturation below 90% was observed. When values of $\leq 85\%$ saturation were used as the cut off point, the bottle group had significantly more desaturation episodes than the cup group.		
Cup-Feeding for Preterm Infants: Mechanics and Safety	Dowling <i>et al.</i>	2002	Non-experimental	8 PT	Cup-feeding	<b>Oral reflexes coordination:</b> During sipping, this is accomplished by the creation of negative pressure in the oral cavity, whereas with lapping the bolus of milk is directed back into the oral cavity by the tongue. <b>Hemodynamic stability:</b> Breathing and oxygen saturation remain stable during bursts of laps and sips.		
A Comparison of the Safety of Cupfeedings and Bottlefeedings in Premature Infants Whose Mothers Intend to Breastfeed	Marinelli <i>et al.</i>	2001	Cross sectional	54 PT	Bottle and cup feeding	<b>Hemodynamic stability:</b> Heart and respiratory rate increased, and oxygen saturation decreased during both cup and bottle feedings compared to pre-feeding baselines. The amount of change from baseline to feeding period was similar for both feeding methods.		

## Oral Feeding Techniques

The most evident feeding techniques in the scientific evidence are bottle feeding (n=9), cup feeding (n=11) and finger-feeding (n=4). Five studies compare bottle feeding and cup feeding, in which the differences between the suction pattern and the haemodynamic stability of preterm NBs during feeding are verified. Finger-feeding, in two studies, is also compared with cup feeding and using a syringe, both of which intend to verify haemodynamic stability.

The coordination of oral motor reflexes and haemodynamic stability were the most present characteristics of the oral motor skills in the studies selected for this review. Muscle activity and behavioural stage appear in only four and two articles, respectively, and it should be noted that three of the studies are from the last five years.

In the doctoral thesis included in this review, oral activity during feeding is compared between the cup feeding and translactation techniques and breastfeeding. In this review, the translactation technique appears only in the thesis.

The presence of signs of behavioural stress and milk waste were other characteristics that were considered to be relevant to include in the description of the studies, although only present in three and two studies, respectively, as these may be related to the fact that oral motor skills have not yet been developed.

### Description of the Secondary Studies

The most frequent secondary studies were narrative reviews and feeding techniques, those most commonly addressed were bottle and cup feeding, and only two reviews addressed the finger-feeding technique. In three reviews, the need for greater consensus in the scientific evidence on the oral feeding technique to be implemented as an alternative to breastfeeding in preterm NBs was highlighted.

Table 3 succinctly summarises the main findings of the secondary studies.

**Table 3:** Description of the Secondary Studies

Article	Authors	Year	Aims	Design	Sample size	Feeding Methods	Key findings
<b>Oral-Motor Function and Feeding Intervention</b>	Garber	2013	This article presents the methods for initiation of oral feedings and transition from gavage to full breast or bottle-feedings are presented with supporting evidence.	Narrative review		Breast, bottle, cup, finger-feeding (haberman feeders and nutrilions system - Medela trademark), syringe	Methods to limited intake rate: <b>syringe</b> (usually 12 cc size) in a nipple to titrate small volumes of liquid into the nipple. <b>Finger-feeding</b> allows the infant can experience nutrition suckes with a controlled intake rate, the sensory input from a firm finger is different than that of a soft manufactured nipple and more similar to a mother's nipple. <b>Cup feeding</b> (does not typically providesuck-swallow-breathe coordination or strong suction needed for successful breastfeeding). <b>Differences Between Breast-Feeding and Bottle-Feeding:</b> After milk flow has been established, the duration of sucking cycles is shorter and the frequency of sucking is typically higher among breast-feeding infants compared with bottle-feeding infants. This may be due to slower flow of breast milk than formula or milk from a standard nipple and bottle. With high negative pressure during either NNS or NS, a mother's nipple is elongated and compressed slightly. This usually provides a more consistent flow rate for a breast-feeding. Manufactured nipples can collapse with negative pressure resulting in the infant unintentionally limiting or stopping the liquid flow rate. <b>Characteristics of Nipples and Bottles:</b> nipples with a straight shape and single hole are recommended for preterm infants needing bottle-feeding as a supplement to breast-feeding; hydrostatic pressure created by the volume of liquid present in a bottle; elimination of vacuum build-up within bottles.
<b>Alternative feeding methods for premature newborn infants</b>	López & Silva	2012	The use of glass/cup as an alternative method of feeding premature newborns and to identify if there is a consensus on its indication for this population.	Narrative review	31 studies (databases: Medline, Lilacs, SciELO)	Glass/cup feeding	Some studies showed that feeding premature infants using the glass/cup is safe and efficient, most of them did not apply an objective evaluation of the swallowing to identify the effect of the method. There is no consensus in the literature about feeding premature infants by glass/cup. Controlled studies should be conducted in order to evaluate risks and benefits of alternative feeding methods in preterm infants.
<b>The Complexity of Transitioning to Oral Feeds in Preterm Infants</b>	Zimmerman & Barlow	2009		Narrative review		Bottle feeding	The use of these differing nipple types is encoded by the infant's nervous system and provide what changes the infant must make in force dynamics to compensate for the differing mechanical properties and flow rates of individual nipples for the proper compression and expression of milk. The type of nipple used affects the pattern of intraoral stimulation, and this can be especially problematic for infants who are poor feeders.
<b>Evidence-based Interventions for Breast and Bottle Feeding in</b>	Sheppard & Fletcher	2007	The purpose of this article is to review the evidence-based approaches to the development and use of	Narrative review	Literature published in the past 10 years.	Breast and bottle feeding	Oral-Feeding Strategies: improving NS during the oral feeding include nipple selection, positioning, cheek and chin support, pacing, and feeding schedules. <b>Nipple characteristics:</b> can influence fluid flow. The shape or material of the nipple and size of the nipple hole—with size of hole playing the larger role. There is little evidence to support use of a specific type of nipple

the Neonatal Intensive Care Unit			assessment tools for nipple feeding, and interventions that promote acquisition and maturation of sucking behaviors for breast and bottle-feeding				for enhancing oral-feeding performance in PT. Proper <b>positioning</b> : is thought to be critical for promoting safe and efficient sucking. <b>External pacing</b> : the feeder assists the infant in appropriately interspersing breaths during sucking bursts by interrupting the liquid flow. This demonstrated a significantly greater decrease in bradycardic incidences during feeding and more efficient sucking patterns at discharge than infants fed by traditional methods. frequently stopping and starting the nipple feeding may interfere with the infant's organization of sucking. <b>Firmer nipple</b> : permits a more controlled and manageable flow rate for the infant and providing external pacing by tipping and positioning the infant and bottle forward to empty the nipple, or removing the infant from the breast.
Nipple Confusion , Alternative Feeding Methods, and Breast-Feeding Supplementation: State of the Science	Dowling & Thanatharakul	2001	The purposes of this report are (1) to examine the evidence of the relationship between exposure of infants to artificial nipples and the development of nipple confusion, (2) to identify issues associated with the use of alternative feeding methods, and (3) to describe the current knowledge concerning the use of alternative feeding methods and long-term breastfeeding outcomes.	Report reviews		Cup and finger-feeding	Alternative feeding methods: cup feeding, finger feeding, spoon feeding and gavage feeding. This report recommends further research before alternatives to bottle feeding are routinely implemented.
The feeding of preterm newborns : alternative methods for the transition from tube-feeding to breastfeeding	Aquino & Osório	2008	This study investigates the methods normally used to effect the transition from tube-feeding to fullbreastfeeding in preterm infants.	Integrative review	4 articles were selected and only randomized studies considered	Bottle and cup feeding	The literature describes methods used to effect the transition from tube-feeding to full breastfeeding: bottle and cup-feeding. The studies demonstrate that the babies who used cup-feeding obtained better results in relation to physiological stability (cardiac frequency and oxygen saturation). Given the scarcity of studies in the literature and the methodological problems found, it is clear that more studies need to be carried out to compare the alternative methods used for the preterm feeding plan.

## DISCUSSION

The **cup** technique is the most evident in scientific evidence, however, there is little consensus in the studies analysed regarding the benefits for the development of oral motor skills (16; 17). What can be seen when some authors defend its use is that it is due to the fact that the behaviour of the masseter muscle (18, 19) and that of the temporal muscle is similar to during breastfeeding (10), and others note that the use of the tongue and muscles differ in cup feeding from those used in breastfeeding (20). One of the muscles that shows greater activity during cup feeding is the suprahyoid, which is not seen in breastfeeding, which may be related to the protruding movement of the tongue, through which the NB obtains the milk (19).

In cup feeding, when compared to breastfeeding, there is less execution and opening of the jaw, causing the negative intraoral pressure to be lower. This factor can lead to habituation and make breastfeeding difficult, such as that which occurs with nipple confusion. This fact leads us to question whether the use of different muscles during cup feeding, when compared to breastfeeding, may also contribute to the risk of nipple confusion.

Some authors also argue that this technique does not allow the NB to stimulate coordination between sucking-swallowing-breathing <sup>(12)</sup>, nor stimulate the sucking reflex, and instead only act on the swallowing level, which may cause frustration for preterm NBs <sup>(21)</sup>. If this frustration occurs repeatedly, feeding can become a negative stimulus with long-term consequences for feeding.

When cup feeding, the NB actively moves the milk bolus and the small volume of milk ingested and their greater control of the milk flow contribute to haemodynamic stability during outbreaks and in their intervals <sup>(22)</sup>. However, nurses do not always have this perception in their practice, which may be related to the fact that the cup technique is not implemented correctly, as many nurses say they are not comfortable performing the cup feeding technique and consider it to be less safe. Many report that there is more milk waste using this technique, coupled with the fact that NBs show more signs of stress during cup feeding, when compared to bottle feeding.

Regarding **bottle feeding**, some researchers argue that its use can favour the development of oral motor skills, promoting a more mature suction pattern <sup>(23)</sup>, in which a greater range and duration of suction translates into a greater transfer of milk volume<sup>(18)</sup> and less milk waste <sup>(12)</sup>.

Regarding muscle activity, in a study that aimed to observe the muscular activity of the buccinator and the masseter muscles during bottle feeding, it found that the buccinator showed increased muscle activity and the masseter showed reduced activity <sup>(18)</sup>. However, the muscle activity of the masseter was further increased in breastfeeding, as previously mentioned, and the muscular activity of the buccinator is absent <sup>(24)</sup>. As bottle feeding is associated with the risk of nipple confusion, the authors of this review consider that indicators that analyse the tongue and jaw position during this technique would have been pertinent. As well as its impact on the development of the breathing and swallowing muscles.

We also emphasise the importance of the physical characteristics of bottles and teats, especially regarding the milk flow, and how they can influence the feeding performance of preterm NBs. The decision to bottle feed should take into account the existence of a vacuum and milk flow control system, in order to have better suction efficiency <sup>(23)</sup> and their swallowing and breathing coordination <sup>(26)</sup>. In a standard bottle, the implementation of some strategies, such as having a smaller volume of milk inside the bottle, keeping the milk up at the teat or feeding the NB in a reclined position, can help to reduce the milk flow and consequently facilitate coordination between their swallowing and breathing <sup>(12)</sup>. Therefore, the importance of nurses being knowledgeable regarding feeding techniques is clear, in order to adapt their interventions to control the milk flow when using the bottle. Even more so given that the bottles available in the NU are often standard bottles.

Regarding the choice of teats, the type of material, the hole, its shape and the size should be considered <sup>(25)</sup>. Several studies mention that straight or single-hole teats decrease the milk flow, thus facilitating swallowing-breathing coordination and consequently reducing milk waste through the labial commissure <sup>(12, 26)</sup>. Some breastfeeding experts even report that the lowest flow teats are those that most support breastfeeding and the NB's physiological stability. However, it is essential that nurses are wary of the signs of stress in NBs, as a very slow flow can cause fatigue and

frustration. There are references that wider teats involve the masseter muscle in a way that is similar to breastfeeding <sup>(25)</sup>.

The **finger-feeding** technique aims to train suction, complement feeding or to feed the NB, when the mother cannot be present <sup>(27)</sup>. In this technique, the sensory stimulation that is created due to the firmness of the finger is more similar to the nipple, facilitating the development of oral motor skills, which are more similar to those that the NB must present during breastfeeding <sup>(28)</sup>. Researchers have shown that this technique promotes suction that is similar to that which occurs during breastfeeding, with their mouth open wide, slow expression and deep sucking <sup>(28)</sup>. In most studies, this technique emerges as that which allows the stimulation of the sucking reflex <sup>(27-29)</sup>, developing their swallowing and breathing coordination. Two studies also report that less milk is wasted in the finger-feeding technique when compared to the cup or syringe technique <sup>(29, 30)</sup>.

Regarding haemodynamic stability, during finger-feeding, the NB presents less respiratory effort and fewer episodes of low saturation, in comparison to cup feeding <sup>(30)</sup>.

One of the aspects that nurses mention as being less advantageous in this technique is the greater expenditure of time in organising the material for its implementation <sup>(29)</sup>.

It is important to mention that in this review, no study was selected to compare breastfeeding and bottle feeding with finger-feeding.

## CONCLUSIONS

Although the research for this review has been temporarily expanded, it found, nevertheless, that there are few studies that effectively address how feeding techniques influence the development of oral motor skills.

The analysed publications focus mainly on aspects of haemodynamic stability, weight gain and feeding autonomy, with consequent early hospital discharge. It is therefore essential to understand how each technique promotes the development of oral motor skills, and it is also essential to consider the parents' wishes and expectations regarding feeding, such as exclusive breastfeeding.

Nurses should not only focus on the act of feeding the NB, they will have to also understand and know the various factors that are inherent to the NBs, such as adjusted age, weight, signs of feeding readiness among others that can interfere with the NB's feeding performance.

In this review, some studies were excluded due to their ineligible population, which could be important for understanding the influence of oral feeding techniques on the development of oral motor skills. Namely, how the characteristics of bottles can influence the milk flow. Therefore, it is plausible to question whether the research results would be different or not, had a population that included full-term NBs been established and the particularities of full-term NBs been taken into account later in the analysis of the studies.

The literature selected in accordance with the inclusion criteria was heterogeneous and relatively scarce. The cup feeding technique is the most evident technique in the

scientific literature and in the last few years more research has appeared on the finger-feeding technique. This may be due to the fact that it is increasingly recognised that oral feeding techniques influence the development of oral motor skills and as such, have consequences for breastfeeding and feeding autonomy. Other techniques have also emerged, such as the syringe and the translactation technique, which have emerged with the aim of replacing the use of the bottle in order to promote breastfeeding.

In view of the above, the need for future studies that address oral feeding techniques and their impact on the oral motor skills of preterm NBs is clear. For this reason, the research team considered that it would be appropriate to carry out a study, which is in the course of completion, which intends to learn about the nurses' perception of oral feeding, what motivates their choice of oral feeding techniques and the difficulties experienced in implementing them. A study will be undertaken in order to verify how each feeding technique, bottle feeding, cup feeding and finger-feeding, promote oral motor skills and which ones favour effective feeding autonomy, consistent weight gain and consequent decrease in the length of hospitalisation in the neonatal unit, supporting breastfeeding.

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