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Instruments and indicators for the assessment of oral skills in preterm newborns to begin oral feeding: A scoping review

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ABSTRACT

Introduction: The present scoping review was conducted with the objective of identifying and mapping in the scientific literature instruments or indicators that evaluate oral competencies for the beginning of oral feeding in preterm newborns hospitalized in neonatal units.
Method: ology: The present scoping review followed PRISMA-ScR guidelines. The PCC question structure was used to determine the eligibility of the included studies.
Results: 13 studies were included, with 3 articles addressing indicators for food readiness and 10 referring to assessment instruments. Two assessment instruments were identified to evaluate oral feeding readiness in preterm infants: the Preterm Oral Feeding Readiness Scale (POFRAS) and the Oral Feeding Readiness Assessment in Premature Infants. The main indicators were non-nutritive sucking, behavioral conditions, swallowing and hemodynamic stability.
Conclusion: It is essential to invest in further research aimed at the development of an instrument based on scientific evidence and for clinical use to assess skills related to oral feeding readiness in preterm newborns.

1. Introduction

Oral feeding in preterm newborns (NBs) is a complex and dynamic process, which includes the interaction of the oral motor, neurological, cardiorespiratory, and gastrointestinal systems (Camur and Cetinkaya, 2021). This makes feeding a challenge for both preterm infants and their caregivers, demanding from nurses and parents as much safety and efficiency as possible (Osman, 2018). It is essential to identify the appropriate time to start feeding (Brantes and Curado, 2023). This identification aims to provide NBs with positive feeding experiences; promote mother-infant interaction; and promote economic benefits for families and hospital institutions, reducing the time of enteric feeding and contributing to faster acquisition of food autonomy and, consequently, shorter hospital stays in neonatology units (Bolzan et al., 2016; Osman, 2018).

Scientific evidence has increasingly shown that the initiation of oral feeding should be based on developmental cues such as food readiness behaviors, which allow identification of the safe time to start oral feeding (Tubbs-Cooley et al., 2015; Pickler et al., 2015). However, in neonatology units (NUs), oral feeding practices are often inconsistent and contradictory among the various professionals (Dalgleish et al., 2016), making it so that feeding readiness behaviors are not always correctly identified. This may contribute to NBs being fed by gastric tubes longer than necessary or to oral feeding being introduced early in NBs with immature oral skills (Crowe et al., 2016). This trial-and-error approach leads to feeding being a highly stressful experience for NBs, since they are led to perform an activity for which they are not yet prepared physiologically or behaviorally, which can delay the acquisition of food autonomy and hospital discharge (Osman, 2018).

To minimize these situations, individual assessment of NBs throughout the development of their oral motor skills is essential, namely the timing of oral feeding readiness (Brantes and Curado, 20203). The evaluation of oral feeding readiness is a complex process, which involves the evaluation of oral structures (face, tongue, lips, jaw,

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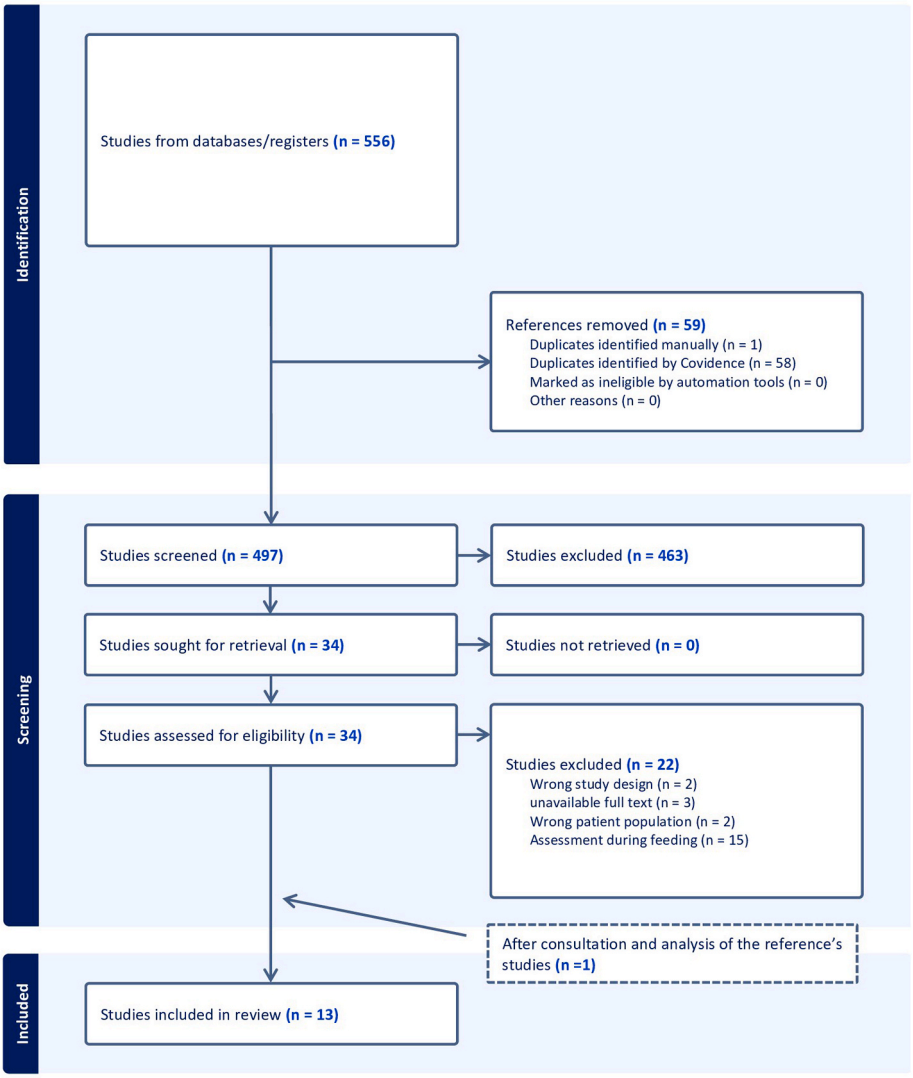

Fig. 1. Prisma Of the 13 studies included, 9 were primary and 4 were secondary studies, with 3 articles addressing indicators for food readiness and 10 referring to assessment instruments.

palate) and oral motor functions; body tone; behavioral stage; suction-swallowing-breathing coordination; aerobic capacity; and energy expended by the NB during feeding (Thoyre et al., 2013). The application of an assessment instrument for oral feeding readiness should encompass parameters related to the behavior and development of the NB, allowing determination with greater precision of the time to start oral feeding (Gennattasio et al., 2015).

The present scoping review was conducted with the objective of identifying and mapping in the scientific literature instruments or indicators that evaluate oral competencies for the readiness to begin of oral feeding in preterm NBs hospitalized in NUs.

2. Methodology

Prior to the beginning of this scoping review, we investigated whether other scoping reviews that addressed the studied topic existed in the JBI EBP and the Cochrane Library, and none were identified.

The present scoping review followed PRISMA-ScR guidelines (Tricco et al., 2018).

The research question was: *What instruments or indicators for the evaluation of oral skills exist that allow us to identify oral feeding readiness in preterm newborns admitted to neonatology units?*

2.1. Eligibility criteria

This scoping review considered all types of published scientific articles that included quantitative and qualitative studies, in addition to literature reviews that met the objective outlined for the review. The PCC (population, concept, and context) question structure was used to determine the eligibility of the included studies.

The articles were limited to those written in Portuguese and English that were published between January 2011 and December 2021.

2.2. Research strategy and study identification

The study was divided into three stages. In the first, indexing terms were identified in the Medline and CINAHL databases. Subsequently, the following electronic databases were searched: Medline, CINALH, Cochrane Central Register of Controlled Trials and Cochrane Systematic Review via the EBSCO platform, Wiley Online Library, Scielo, and Scopus. In the third stage, when the list of references of the previously selected articles was analyzed, we proceeded to search for possible additional studies that could be relevant to increase the sensitivity of the scoping review.

The following survey terms were used: (Newborn OR Infant, Premature OR Premature OR Preterm or Neonat*) AND (Intensive Care

Table 1
Characteristics of studies related to food readiness indicators.

Article	Authors	Year	Type of study	Feeding readiness indicators
Clinicians guide for cue-based transition to oral feeding in preterm infants: An easy-to-use clinical guide	Lube	2018	Narrative review	• Non-nutritive sucking • Presence of mouth and swallowing activity; • Hemodynamic stability, even with oxygen supply; • Presence of bowel movements and food tolerance; • Eye contact; • Hand-to-mouth movement • Sucking-swallowing-breathing coordination; • Thermoregulation capacity; • On alert.
State of the science – A contemporary review of feeding readiness in the preterm infant.	Briere et al.	2014	Narrative review	• Non-nutritive sucking • Presence of swallowing (with small milk bolus); • Feeding readiness behaviors.
Oral feeding readiness in preterm infants	Kish	2013	Analysis of feeding readiness concept in hospitalized preterm newborns	• Maturation of neurodevelopment; • Receptivity to non-nutritive sucking; • Rooting reflex; • Muscle tone; • Behavioral component.

Units, Neonatal OR Nursery OR NICU OR Neonatal Intensive Care Unit) AND (Clinical assessment tools OR Scale OR Instrument OR evaluation OR Assessment or Assessment tool OR Predict* OR Behavior Rating Scale) AND (Sucking behavior or Sucking Organization OR Sucking pattern OR oral motor skills OR oral feeding readiness OR Feeding Behavior OR Oral feeding skills OR Oral readiness OR Feeding readiness)

2.3. Data selection process

Two reviewers worked independently to select, extract, and encode the data. If a study was identified as relevant by one reviewer but not the other, both justified the reasoning underlying their evaluation. A third reviewer was not required.

- Study selection and management

The search results were entered into the Covidence instrument, which facilitated collaboration between the two reviewers in the study selection process. Initially, to select the studies, the researchers read the titles and abstracts and chose those considered relevant to be read in full. At this stage, duplicate studies were removed, while those that did not fully meet the eligibility criteria were excluded.

- Data extraction

For each of the studies, extraction and coding were carried out using a form specifically designed for this purpose (Appendix I), to better characterize them. The reviewers clarified any divergences, and there was no need for additional clarification from the original authors.

2.4. Summary of results

A systematic narrative synthesis was carried out based on the studies included in this scoping review, in which their characteristics and results were explained, in addition to the different characteristics of the instruments and indicators for evaluating the oral skills of preterm NBs for feeding readiness.

3. Results

A total of 497 eligible articles remained after the removal of 59 duplicate articles. After the selection of titles and abstracts, 34 articles remained. However, 3 studies were excluded because it was not possible to access their full text, which can be considered a limitation of this scoping review. Only 31 articles met the eligibility criteria for evaluation of the full text. After reading all the selected articles in full, 12 of the 31 were included (Fig. 1). After consultation and analysis of the references, one more study was added for a total of 13 studies included in this scoping review.

Tables 1 and 2Tables 1 and 2 summarize the main information extracted from the studies. Table 1 refers to food readiness indicators, and Table 2, to assessment instruments.

All studies referring to indicators of food readiness (Table 1) were secondary research studies. The indicators “non-nutritive sucking” and “behavioral conditions” were present in all the included studies (Lubbe, 2018; Briere et al., 2014; Kish, 2013), and the presence of “swallowing” appeared in two of the studies (Lubbe, 2018; Briere et al., 2014), as well as “hemodynamic stability” (Lubbe, 2018; Kish, 2013). The presence of bowel movements and food tolerance as an indicator for food readiness was identified in only one study (Lubbe, 2018).

One of the studies that was excluded because the full text was unavailable is a quantitative study that approaches the influence of non-nutritive sucking training and swallowing exercises on oro-motor skills, which could reinforce the importance of swallowing. Since this is an indicator that is not present in the instruments identified in this scoping.

Of the studies that referred to assessment instruments (Table 2), only one corresponded to secondary research. Other evaluation instruments were mentioned in this study, but their applicability criteria did not meet the population outlined for the present scoping review. All primary research studies were quantitative; three were methodological. According to the review objective, two assessment instruments were identified to evaluate oral feeding readiness in preterm infants: the Preterm Oral Feeding Readiness Scale (POFRAS) and the Oral Feeding Readiness Assessment in Premature Infants.

The POFRAS assessment instrument was the most present in the scientific literature, having already been translated and adapted to other languages (Camur and Cetinkaya, 2021; Chang et al., 2021) since its clinical validation in 2013 (Fujinaga et al., 2013). However, its statistical validation has not yet been performed (Chang et al., 2021). The other scale identified was the Oral Feeding Readiness Scale for Preterm Infants, an adaptation of the Feeding Readiness Scale with the aim of being applied to NBs with bronchopulmonary dysplasia (Davidson et al., 2013).

4. Discussion

The aim of this scoping review was to identify the instruments or indicators used to assess oral skills for oral feeding readiness in preterm NBs hospitalized in NUs. However, the instruments frequently referred to in the studies evaluated NB feeding readiness from the first evaluation, and this was one of the main factors that led to their exclusion. For this reason, it is essential to clarify the definition of feeding readiness, which can be understood in two ways: as readiness to begin oral feeding

Table 2
Characteristics of the studies related to assessment instruments.

Article	Author	Year	Type of study	Sample size	Assessment tool
Improve the clinical effective decision of the oral feeding readiness in preterm infants: Revise and validate the TC-POFRAS	Hao et al.	2021	Exploratory factor analysis	81 clinically stable preterm NB's	Traditional Chinese-Preterm Oral Feeding Readiness Assessment Scale, the TC-POFRAS
Clinical validation of the preterm oral feeding readiness assessment scale in Taiwan	Chang et al.	2021	Quantitative study (scale translation)	81 preterm NBs	Preterm Oral Feeding Readiness Assessment Scale (TC- POFRAS)
The effects of swallowing exercise and non-nutritive sucking exercise on oral feeding readiness in preterm infants: A randomized controlled trial	Ostadi et al.	2021	Randomized controlled trial	45 preterm NBs in each of the III groups	Preterm Oral Feeding Readiness Assessment Scale (POFRAS)
The validity and reliability study of the Turkish version of the preterm oral feeding readiness assessment scale (T-POFFRAS)	Camur & Cetinkaya B	2021	Methodological study	90 preterm NBs	Turkish version of the Preterm Oral Feeding Readiness Assessment Scale (T-POFRAS)
Effectiveness of cue-based feeding versus scheduled feeding in preterm infants using comprehensive feeding assessment scales: A randomized clinical trial	Kamran et al.	2020	Randomized clinical trial	37 preterm NBs	Preterm Infant Oral Feeding Readiness Assessment Scale (PIOFRAS)
The effect of oral motor intervention on oral feeding readiness and feeding progression in preterm infants	Mahmood et al.	2019	Clinical trial	40 preterm NBs	POFRAS
Behavioral status and the performance of the preterm infant's readiness to start oral feeding (Estado comportamental e o desempenho da prontidão do prematuro para início da alimentação oral)	Fujinaga et al.	2018	Cross-sectional, observational and descriptive study	51 preterm NBs	Preterm Oral Feeding Readiness Assessment Scale (POFRAS)
Oral feeding readiness assessment in premature Infants	Gennattasio et al.	2015	Analysis of feeding readiness concept in newborns	Not applicable	Preterm Infant Oral Feeding Readiness Assessment Scale (PIOFRAS)
Clinical validation of the Preterm Infant Oral Feeding Readiness Assessment Scale	Fujinaga et al.	2013	Quantitative study (clinical validation of scale)	60 preterm NBs	Preterm Readiness to Begin Oral Feeding Assessment Instrument
Quality improvement study of effectiveness of cue-based feeding in infants with bronchopulmonary dysplasia in the neonatal intensive care unit	Davidson et al.	2013	Quasi-experimental	60 NBs in the control group and 55 in the experimental group	Adaptation of Oral Feeding Readiness Scale for Preterm Infants

and as readiness for a specific feeding event (Kish, 2013).

Clarifying these concepts is important not only in this review, but also in care practice. Often, when it is said that the NB preterm is ready to feed, it is referring to readiness for a specific feeding event, which was verified in the research carried out for this review throught the articles excluded. This may be one of the reasons which wasn't identify many instruments that assess feeding readiness compared to the existence of instruments that assess readniss for a specific feeding event.

Applying evaluation instruments allows determination with greater precision of when to begin oral feeding and promotes the use of a common language, favoring communication among health professionals (Gennattasio et al., 2015). In this scoping review, two instruments were identified: the Preterm Oral Feeding Readiness Scale (POFRAS) and the Oral Feeding Readiness Scale for Preterm Infants. The scarcity of assessments of feeding readiness may be related to the fact that there are no simple instruments that complement the decision of health professionals to start oral feeding in preterm infants (Kumari et al., 2019).

POFRAS was developed with the objective of supporting health professionals identifying the time to start breastfeeding in preterm newborns, promoting breastfeeding in NUs (Fujinaga et al., 2013). This instrument consists of 18 items distributed into 5 categories (gestational age, state of behavioral organization, oral posture, oral reflexes, and non-nutritive sucking) scored on a scale of 0–2 (Fujinaga et al., 2013, 2018). This is the only instrument found in our search that assesses oral motor skills before the start of oral feeding (Chang et al., 2021).

According to the authors of the instrument, gestational age is a predictor of preterm NB maturity (Fujinaga et al., 2013), which justifies its presence as one of the categories. However, the scientific literature also affirms that gestational age and corrected age should not be defining criteria for determining oral feeding readiness (Gennattasio et al., 2015), because what contributes to faster total oral feeding is the number of oral experiences (Lubbe, 2018). The scientific evidence, in addition to the above, states that starting oral feeding considering gestational age does not consider the NB readiness to feed (Chang et al., 2021).

The Oral Feeding Readiness Scale for Preterm Infants (which is an adapted scale of the Feeding Readiness Scale) can be applied to newborns with a corrected age of 33 weeks or more who are autonomically stable. This is a single-item scale with 5 response options that combine the signs of feeding readiness in preterm infants. In this scale, the item muscle tone was removed from the original scale, and the following items were maintained: behavioral state, rooting reflex behavior, and physiological instability (Davidson et al., 2013). The inclusion of items relating to physiological stability is important, as it will help health professionals to select interventions in a more individualized way, respecting and holistically supporting the development of the preterm newborn.

Feeding is one of the first parental experiences that can have an impact on the parent-baby dyad. However, due to the fragility that preterm NBs can present, the experience of starting oral feeding can cause parental stress and anxiety (Fry et al., 2018).

The use of feeding readiness assessment tools should be seen by health professionals as a facilitating and encouraging tool for parents to participate effectively in their children's feeding and provide them with realistic expectations of their performance.

Health condition, maturity of behavioral states, and neurodevelopment are essential to oral feeding readiness of preterm NBs, since these support the coordination of breathing, sucking, and swallowing, and physiological stability (Chang et al., 2021), which meets the indicators for feeding readiness identified in this scoping review. However, swallowing was not evaluated by any of the instruments mentioned above, even though it is important for successful oral feeding, because nutritive sucking requires coordination between sucking-swallowing and breathing (Ostadi et al., 2021). The ability of NBs to swallow their own secretions (Lubbe, 2018) or small amounts of milk (Briere et al., 2014) must be assessed. Physiological stability as an indicator refers to the ability of NBs to maintain adequate vital signs with good oxygenation (Kish, 2013) or to maintain these vital signs even

with supplemental oxygen intake (Lubbe, 2018). The behavioral component was an indicator present in all the selected articles (Lubbe, 2018; Briere et al., 2014; Kish, 2013). It refers to several factors, such as the ability of NBs to remain alert (Lubbe, 2018; Briere et al., 2014), how they transition between different behavioral states (Kish, 2013), and the presence of feeding readiness behaviors (Briere et al., 2014; Kish, 2013). Behavioral state is described in the scientific literature as an essential component to consider when initiating oral feeding. The alert state is described as the ideal state for its initiation (Fujinaga et al., 2018). When NBs transition smoothly and consistently between different behavioral states, it means they have a greater capacity to self-regulate in the face of different environmental stimuli (Griffith et al., 2017) and, consequently, to remain available for feeding for a longer time. The ability to remain alert, motor stability, and the presence of hunger signals, among others, are behaviors of feeding readiness, and reveal NB neurodevelopment maturity and the equilibrium among different subsystems.

5. Conclusion

The items identified in the assessment instruments included in this review met the indicators for oral feeding readiness, except for the evaluation of swallowing, even though this is referred to in the scientific literature as essential for successful oral feeding. For this reason, it is considered important include swallowing evaluation in future assessments instruments to assess oral feeding readiness. The presence of gestational age appeared in the assessment instruments; however, its consideration as a criterion for the initiation of oral feeding is not consistent in the scientific literature, which highlights the importance of individualized and maturational assessment of NBs.

It is essential to invest in further research aimed at the development of an instrument based on scientific evidence and for clinical use to assess skills related to oral feeding readiness in preterm infants. The instrument should contain the indicators presented in this review and be easy to apply, so that professionals are more likely to adhere to it.

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Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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APPENDIX I. Extration Form

Article	Author	Year	Type of study	Sample size	Assessment tool	Feeding readiness indicators

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