Instruments for assessing readiness to commence suck feeds in preterm infants: effects on time to establish full oral feeding and duration of hospitalisation (Review)

Crowe L, Chang A, Wallace K

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Instruments for assessing readiness to commence suck feeds in preterm infants: effects on time to establish full oral feeding and duration of hospitalisation (Review)

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Instruments for assessing readiness to commence suck feeds in preterm infants: effects on time to establish full oral feeding and duration of hospitalisation

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ABSTRACT

Background

One of the most challenging milestones for preterm infants is the acquisition of safe and efficient feeding skills. The majority of healthy full term infants are born with skills to coordinate their suck, swallow and respiration. However, this is not the case for preterm infants who develop these skills gradually as they transition from tube feeding to suck feeds. For preterm infants the ability to engage in oral feeding behaviour is dependent on many factors. The complexity of factors influencing feeding readiness has led some researchers to investigate the use of an individualised assessment of an infant’s abilities. A limited number of instruments that aim to indicate an individual infant’s readiness to commence either breast or bottle feeding have been developed.

Objectives

To determine the effects of using a feeding readiness instrument when compared to no instrument or another instrument on the outcomes of time to establish full oral feeding and duration of hospitalisation.

Search methods

We used the standard methods of the Cochrane Neonatal Review Group, including a search of the Cochrane Central Register of Controlled Trials (The Cochrane Library 2010, Issue 2), MEDLINE via EBSCO (1966 to July 2010), EMBASE (1980 to July 2010), CINAHL via EBSCO (1982 to July 2010), Web of Science via EBSCO (1980 to July 2010) and Health Source (1980 to July 2010). Other sources such as cited references from retrieved articles and databases of clinical trials were also searched. We did not apply any language restriction. We updated this search in March 2012.

Selection criteria

Randomised and quasi-randomised trials comparing a formal instrument to assess a preterm infant’s readiness to commence suck feeds with either no instrument (usual practice) or another feeding readiness instrument.
Data collection and analysis

The standard methods of the Cochrane Neonatal Review Group were used. Two authors independently screened potential studies for inclusion. No studies were found that met our inclusion criteria.

Main results

No studies met the inclusion criteria.

Authors’ conclusions

There is currently no evidence to inform clinical practice, with no studies meeting the inclusion criteria for this review. Research is needed in this area to establish an evidence base for the clinical utility of implementing the use of an instrument to assess feeding readiness in the preterm infant population.

Plain Language Summary

Instruments for assessing readiness to commence suck feeds in preterm infants

Unlike babies born at term, who are able to breast or bottle feed soon after birth, preterm infants need time to learn to feed. This may take days or weeks after they are born. Preterm babies commence breast or bottle feeding at a time when the baby is deemed to be ready, as determined by healthcare professionals looking after the baby. The optimal timing of the introduction of suck feeds is unclear in both the literature and in practice. An individualised assessment specifically designed to assess an individual infant’s readiness to commence breast or bottle feeding has been suggested as the best way to promote consistency in identifying when it is safe for an infant to commence suck feeding. A limited number of assessment tools to determine readiness have been developed. However, no randomised controlled studies were found that evaluated the benefit or risk of their use.

Background

Description of the condition

One of the most challenging milestones for preterm infants is the acquisition of safe and efficient feeding skills (Hill 2002). The majority of healthy full term infants are born with skills to coordinate suck, swallow and respiration that allow safe oral feeding (Lau 2003). However, this is not the case for preterm infants who develop these skills gradually as they transition from tube feeding to suck feeds (Thoyre 2003; Dodrill 2008). This transition to full oral feeding is an important competency for the baby to attain prior to discharge home (Pickler 2003). Delays in discharge are often secondary to feeding difficulties, leading to increased financial costs (Simpson 2002). Strategies to avoid delays must be the focus of care without compromising the safety of the infant (McGrath 2004).

Introducing suck feeds as soon as the neurologic development and physical condition of the infant permits has been reported to have several advantages including shorter transition time to all suck feeds, greater maternal satisfaction and shorter hospital stay (Pridham 1993; Simpson 2002). However, feeding infants who are unable to safely commence feeding may lead to problems with respiration, growth and nutritional status, with infants being at higher risk of 1) aspiration pneumonia, 2) readmission to the neonatal intensive care unit (NICU), 3) fatigue, 4) increased energy expenditure, 5) hypoxia, 6) bradycardia and 7) deglutition apnoea (Hill 2002; Breton 2008). Therefore, careful timing is vital to ensure that the commencement of feeding is beneficial rather than detrimental to the health of the infant (McGrath 2004). Factors influencing the preterm infant’s ability to feed efficiently include neurobehavioural maturation, physiologic stability, control of tone, behavioural state organisation and coordinated sucking, swallowing and breathing (McGrath 2004). Successful coordination of feeding is also dependent on the adequate development of the structures of the upper airway including the lips, palate, jaw, tongue, pharynx, larynx and oesophagus (Hill 2002). Differences have been shown in the ability of infants to engage in feeding behaviour at a particular gestational age through studies of preterm infant sucking (Nyqvist 1996; Lemons 2001). Although gestational age is a guide to expected maturity, disparities are evident in the rates that infants mature (Nyqvist 1999; Simpson 2001).
2002). Furthermore, a preterm infant's feeding ability may not always be consistent at each feed while infants are transitioning from gavage feeds (McGrath 2004). Differences in the sucking patterns between breast and bottle feeding have also been found and may impact significantly on the infant's ability to commence suck feeds (Thoyre 2003).

Studies examining current practices in neonatal nurseries have found that over 50% of nurseries have no specific policy or guideline on when to commence suck feeds with nurses predominantly using behavioural cues, gestation age and weight to determine readiness (Kinneer 1994; Siddell 1994).

**Description of the intervention**

A preliminary search revealed three instruments designed to aid neonatal care providers in determining preterm infants’ readiness to commence feeding. The Preterm Infant Nipple Feeding Readiness Scale (PINFRS) was a 10-item scale that scored variables such as gestational age, post-conceptual age, colour and activity, state regulation, hunger cues and tone (McGrath 2003). However, this instrument has been renamed as the Feeding Readiness and Progression in Preterms Scale (FRAPPS) (McGrath 2008). The second instrument found, the Early Feeding Skill (EFS) assessment tool, not only aims to assess feeding readiness but also feeding skill and feeding recovery (Thoyre 2005). The feeding readiness section of the EFS consists of five items that assess an infant’s readiness to commence oral feeds by observing it's tone, energy level, state of arousal and oxygen saturation (Thoyre 2005). Lastly, Fuginaga 2007 developed and tested an 18-item preterm infant oral feeding readiness instrument consisting of items in relation to corrected gestational age, behavioural state, global posture and tone, gag reflex, tongue movement and cupping, jaw movements and maintenance of an alert state. Each item was scored from 0 to 2 with a possible maximum score of 36. All instruments were designed so that the infant being assessed for feeding readiness could pass or fail* These assessments aim to determine whether to attempt breast or bottle feeding and may easily be repeated prior to each feed while feeding is being established.

**How the intervention might work**

The use of a formal screening instrument that encompasses an individual infant’s behaviour and development has been suggested as a way to improve the accuracy of determining when the infant is ready to commence feeding (McGrath 2003). It is thought that many premature babies may be ready to breast or bottle feed however, as this readiness is often not identified, they continue to be fed via a tube for longer than necessary. Alternatively, some babies who are slower at developing these skills may be introduced to breast or bottle feeding too soon. It is hypothesised that by identifying their readiness, neonatal care providers could ensure that infants have more successful feeding attempts and reduce the time taken to achieve all suck feeds and the possibility of adverse events. The use of a formalised instrument could also standardise measurement of feeding readiness and facilitate the documentation of feeding attempts.

**Why it is important to do this review**

The possible benefits of a screening instrument to assess feeding readiness must be weighed against the additional staff time required and other costs and possible detrimental effects such as introducing oral feeds when infants are not ready or withholding oral feeding. This review addresses the balance of benefits and risks of screening instruments for commencement of suck feeds in preterm infants in order to assist in establishing an evidence base for clinical decision-making.

**OBJECTIVES**

**The primary objectives**

1. To assess the effects of using a formal feeding readiness assessment instrument when compared to no formal instrument in preterm infants deemed ready to commence feeds based on general clinical grounds using the outcomes of time to establish full oral feedings and duration of hospitalisation.

2. To assess the effects of different formal feeding readiness assessment instruments in preterm infants deemed ready to commence feeds based on general clinical grounds using the outcomes of time to establish full oral feedings and duration of hospitalisation.

The secondary objective of this review is to explore possible differential effects of applying a formal feeding readiness assessment instrument according to the following subgroups.

1. Gestational age (GA) at birth:
   - extremely preterm (< 28 weeks),
   - moderately preterm (28 to 31 weeks),
   - mildly preterm (32 to 37 weeks).

2. Chosen method of feeding:
   - breast or bottle feeding.

**METHODS**

**Criteria for considering studies for this review**

**Types of studies**
Randomised, quasi-randomised controlled trials (including cluster trials) in which an instrument is compared with either no assessment instrument or an alternate instrument. Cross-over trials were excluded.

**Types of participants**

Studies which enrolled preterm infants (< 37 weeks gestation) after being deemed ready to commence either breast or bottle feeds based on general clinical grounds. Exclusion criteria included congenital malformations, syndromes or severe neurological problems.

**Types of interventions**

1. The experimental group involved infants who had been deemed ready on general clinical grounds and who were then assessed for readiness to commence oral feeding through the use of an instrument prior to the initiation of the first breast or bottle feed. The instrument had to include assessment of one or more of the following:
   a) motor development and abilities including posture, movement, tone, reflexes;
   b) behaviour state and cues including state of arousal and presence of feeding behaviour cues;
   c) physiological parameters;
   d) integrity of oral structures.
2. The control group involved infants who were not assessed by any formal instrument as feeding was commenced once readiness was determined on general clinical grounds.
3. A comparison group involved infants who had been deemed ready on general clinical grounds and who were then assessed for readiness to feed by an alternate feeding assessment instrument. General clinical grounds was defined as a clinical impression, which may have included gestational age, medical stability or infant cues, but excluded the use of a formal assessment instrument. Instruments must have undergone psychometric evaluation including tests for criterion-related or construct validity. In groups where an instrument was used, infants had to pass prior to commencement of feeding. Physiological parameters included heart rate, respiration rate and oxygen saturation levels. Other physiological parameters used by individual trials were acceptable provided they were defined in the trial protocol.

**Types of outcome measures**

**Primary outcomes**

1. Time from randomisation to full oral feeding (days).
2. Duration of hospitalisation (days from randomisation until the end of the trial).

**Secondary outcomes**

1. Time from randomisation to introduction of first feed (days).
2. Age (post-conception age and days from birth) at establishment of full oral feeding.
3. Daily weight gain (g/day or g/kg/day) from time of randomisation until the end of the trial.
4. Breast feeding (partial or full) on hospital discharge (number of infants).
5. Time from randomisation to regaining birth weight (days).
7. Number of apnoea or bradycardia episodes that required intervention from the caregiver (stimulation, oronasal suction, increase in delivery of oxygen, assisted ventilation).

**Search methods for identification of studies**

The standard search methods of the Cochrane Neonatal Review Group were used.

**Electronic searches**

This included electronic searches of the Cochrane Central Register of Controlled Trials (*The Cochrane Library*, Issue 2, 2010), MEDLINE via EBSCO (1966 to July 2010), EMBASE (1980 to July 2010), CINAHL via EBSCO (1982 to July 2010), Web of Science via EBSCO (1980 to July 2010) and Health Source (1980 to July 2010). The search strategy for each database is described in the appendices below. We did not apply any language restriction. We updated this search in March 2012.

**Searching other resources**

The meta-register of clinical trials (www.controlled-trials.com/mrct/search.html) and the US National Institutes of Health registry of clinical trials (http://clinicaltrials.gov/) websites were searched for completed or ongoing trials. The authors also searched cited references from the retrieved articles. We contacted a number of researchers who had either previously published an article on the topic of feeding readiness or were known to have completed preliminary psychometric testing of an instrument measuring feeding readiness in order to identify any other studies that might meet the inclusion criteria.

**Data collection and analysis**

The standard methods of the Cochrane Neonatal Review Group were used.
Selection of studies

Two authors (LC, KW or AC) independently screened the title and abstract of all studies identified by the above search strategy. Articles identified as potentially relevant based on the title and abstract were retrieved in a full text format and were then reassessed for selection. Those studies that did not fulfil the inclusion criteria were excluded. The authors resolved any disagreements by discussion.

Data extraction and management

If eligible studies were found, two authors would have independently extracted and entered the data into tables using Revman 5 software.

Assessment of risk of bias in included studies

If eligible studies were found, it was planned that these studies would be evaluated independently by two review authors (LC, KW and AC) for methodological quality in accord with the methods of the Cochrane Neonatal Review Group. Studies were to be assessed with regard to blinding of the randomisation, intervention and outcome as well as completion of follow-up. The results of this assessment would be added to the table ‘Characteristics of included studies’. It was also planned that consideration would be given to the following methodological issues.

1. Sequence generation: was the allocation sequence adequately generated?
2. Allocation concealment: was the allocation adequately concealed?
3. Blinding of participants, personnel and outcome assessors: was knowledge of the allocated intervention adequately prevented during the study? At study entry? At the time of outcome assessment?
4. Incomplete outcome data: were incomplete outcome data adequately addressed?
5. Selective outcome reporting: Were reports of the study free of suggestion of selective outcome reporting?
6. Other sources of bias: was the study apparently free of other problems that could put it at a high risk of bias?

This data was to be reported in the ‘Risk of bias’ table.

For consistency, one review author (LC) was to act as the primary reviewer for all studies to be assessed and the secondary reviewer was to be one of the members of the review panel (AC or KW). It was planned that any differences between the review authors would be resolved either by discussion or by consensus after negotiation with the third review author (KW or AC).

Measures of treatment effect

Weighted mean difference (WMD) would have been calculated for continuous data and relative risk (RR) or risk difference (RD) for dichotomous data. For each treatment effect we planned to calculate a 95% confidence interval (CI).

Assessment of heterogeneity

If there were studies to synthesise in a meta-analysis, heterogeneity would have been assessed through the visual inspection of forest plots as well as by calculating the degree of heterogeneity statistically using the I² statistic. If statistical heterogeneity was found, the review authors would have searched for an explanation (interactional variations, intra-study variations, methodological error, publication bias and control effect) and would have either removed the heterogeneous study or not conducted the meta-analysis depending on the explanation for and the degree of heterogeneity. An I² statistic above 40% would have been considered moderate heterogeneity and a value over 75% considered as high.

Data synthesis

We planned to use the standard methods of the Neonatal Review Group to synthesise the data. If there were eligible studies to conduct a meta-analysis, weighted mean difference with a 95% confidence interval would be used for the continuous variables and relative risk and risk difference with 95% confidence interval for categorical variables. Number needed to treat (NNT) and number needed to harm (NNH) also would have been calculated if appropriate. To conduct the meta-analysis, it was planned to use a fixed-effect model. If any cluster trials were included in the review these studies would have been analysed separately from non-cluster trials using the inverse variance (IV) method, in consultation with the Cochrane Neonatal Review Group statistician. Data analysis was to be undertaken by using RevMan 5 software. If there were studies not suitable for meta-analysis then results of these studies would have been summarised either in narrative form or in tables. Instruments were to be analysed using separate comparisons according to the type of instrument.

Subgroup analysis and investigation of heterogeneity

Subgroup analysis was planned for the following subgroups, if data were available: gestational age at birth (extremely preterm < 28 weeks; moderately preterm 28 to 31 weeks; and mildly preterm 32 to 37 weeks) and chosen method of feeding (breast or bottle feeding). Post hoc subgroup analysis would be performed to detect the heterogeneous trials.

RESULTS

Description of studies
Instruments for assessing readiness to commence suck feeds in preterm infants: effects on time to establish full oral feeding and duration of hospitalisation (Review)

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See: Characteristics of excluded studies.

See: Characteristics of excluded studies.

Although the initial search found 955 publications, the number to be reviewed was reduced to 716 once duplicates were removed. Two review authors reviewed the titles and abstracts of all 716 publications. Only 44 articles were retrieved in the full text format for further consideration. However, no studies were found that met the inclusion criteria for this review.

With the 44 excluded articles, nine articles were found not to be research but a review of the literature. These nine articles were retrieved in the full text format to search the reference lists to ensure no studies were missed during the electronic searching of databases. Topics of the literature review articles included initiation of and transition to suck feeds (Lemons 1996; Ross 2002; Thoyre 2003; McGrath 2004; Frischknecht 2005; Fernández 2007; Lau 2007; Breton 2008) as well as the diagnostic tools used to determine feeding readiness (da Costa 2008).

A number of methods were found to assist staff in determining feeding readiness in the preterm infant population including a theoretical model (Pickler 2005), clinical guidelines (Premji 2000; Premji 2002; McCain 2003), protocols (McCain 2001; Premji 2004; Shaker 2007; Drenckpohl 2009), a clinical pathway (Kirk 2007) and scales or instruments (McGrath 2003; Thoyre 2005; Fuginaga 2007; Ludwig 2007).

Although there were two randomised trials (McCain 2001; McCain 2002) that evaluated the clinical utility of the implementation of a feeding protocol found in the search, these studies did not compare assessment of feeding readiness with no assessment but rather compared no non-nutritive sucking with the use of 10 minutes of non-nutritive sucking prior to assessing behavioural state as an indicator of feeding readiness. There were also two studies (Kirk 2007; Drenckpohl 2009) that used historical controls to evaluate their implementation into practice. Other articles related to methods to determine feeding initiation or transition were either a description of the method (Premji 2002; Premji 2004; McCain 2003; Pickler 2005; Thoyre 2005; Ludwig 2007; Shaker 2007) or psychometric testing of an instrument (McGrath 2003; Fuginaga 2007; Fuginaga 2007a; Neiva 2008; Rossarolla 2009).

Psychometric testing of the instruments did not involve an experimental design but rather other non-experimental designs such as observational studies and expert panels.

A further three observational studies were found that described the psychometric testing of instruments that either did not measure or indirectly measured the construct of feeding readiness. The Dynamic-Early Feeding Scale (D-EFS) is an observational coding scheme to continuously code videotaped oral feeding (Thoyre 2009). This instrument should not be confused with another instrument developed by the authors, the Early Feeding Skills (EFS) (Thoyre 2005), which is described in the background of this review and contains a checklist of five questions to determine feeding readiness. The other two observational studies used an existing instrument, the Neonatal Oral Motor Assessment Scale (NOMAS) that measures infants’ nutritive sucking behaviours. These studies investigated the NOMAS psychometric characteristics within a healthy preterm population (Howe 2007) and as an indicator of feeding readiness (Church 2006).

Other studies were found that contributed to the knowledge of feeding readiness and progression but did not involve assessment of feeding readiness. Staff surveys were used to document how staff decide to commence breast or bottle feeding (Kinnear 1994; Siddell 1994) as well as manage the transition period from tube feeding to all breast or bottle feeds (Dodrill 2008a). Current management of feeding initiation and progression has also been investigated using chart audits (Flint 2007; Dodrill 2008).

Observational studies were utilised to explore factors that may relate to feeding readiness (Cagan 1995; McGrath 2002; Bühler 2004; McGrath 2005; Pickler 2005a; Bauer 2008) as well as interventions that may enhance preterm infants’ ability to engage in feeding behaviour (White-Traut 2002; White-Traut 2005). The effects of feeding experience, maturity and morbidity on feeding milestones (Pickler 2009) as well sucking patterns (Cunha 2009) were also studied.

Risk of bias in included studies

No studies met the inclusion criteria.

Effects of interventions

No studies met the inclusion criteria.

DISCUSSION

The absence of randomised or quasi-randomised studies evaluating the use of a formalised instrument to assess a preterm infant’s readiness has resulted in this systematic review being unable to determine the effects of using such an instrument on the time to establish full oral feeding or duration of hospitalisation.

The excluded studies of this review show that there is an interest among researchers in how to best approach the dilemma of when to commence breast or bottle feeds. This review focused on validated instruments but there were a number of other methods found (for example care pathways, protocols, clinical guidelines) that could potentially aide clinicians in managing suck feeding initiation and progression. There were a few studies that demonstrated that the application of a feeding protocol may improve outcomes including the time taken to all suck feeds (McCain 2001; Kirk 2007; Drenckpohl 2009) and length of hospital stay (McCain 2001). The benefit of using a formalised instrument over other methods such as clinical judgement or a criterion such as gestational age is that an instrument ensures that a systematic and consistent method of assessing feeding readiness is utilised.
There were a number of instruments that specifically assessed feeding readiness, however the clinical utility of these instruments was not investigated in an experimental study. The studies were observational with their focus on establishing the validity and reliability of the tool (McGrath 2003; Fujinaga 2007; Fujinaga 2007a; Neiva 2008; Rossarolla 2009). The lack of any experimental studies to establish the clinical utility of the instruments may simply be that they are too newly developed to have undergone such testing. The absence of randomised or quasi-randomised trials may also be a reflection of the practical difficulties in ensuring that the comparison group is not exposed to the intervention, particularly in the situation where the use of an instrument is compared to normal clinical practice with direct caregivers collecting data.

**AUTHORS’ CONCLUSIONS**

**Implications for practice**

There is no evidence to inform clinical practice with no studies meeting the inclusion criteria for this review.

**References to studies excluded from this review**

Bauer 2008 *(published data only)*


Breton 2008 *(published data only)*


Bühler 2004 *(published data only)*


Cagan 1995 *(published data only)*


Church 2006 *(published data only)*


**Implications for research**

Randomised or quasi-randomised trials are needed to evaluate the clinical utility of using an instrument to assess feeding readiness in the preterm infant population. Researchers need to also consider the use of a feeding readiness instrument in the preterm infant breastfeeding population as the majority of observational studies investigating feeding readiness and progression are predominately focused on bottle feeding.

**ACKNOWLEDGEMENTS**

We would like to thank Katie Welsh for assisting in formatting the protocol and Vicki Flenady for methodological advice and editorial input in regards to the development of the protocol. We would like to thank Kelly Dann for her assistance in formulating the search strategy as well as the expert panel who provided preliminary guidance on the topic selection: C Bagley, M Burris, P Dodrill, M Robken, C Lai, J Trotter and E Wilkes.
Instruments for assessing readiness to commence suck feeds in preterm infants: effects on time to establish full oral feeding and duration of hospitalisation (Review)

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Flint 2007 (published data only)

Frischknécht 2005 (published data only)

Fuginaga 2007 (published data only (unpublished sought but not used))

Fuginaga 2007a (published data only)

Howe 2007 (published data only)

Kinner 1994 (published data only)

Kirk 2007 (published data only)

Lau 2007 (published data only)

Lemons 1996 (published data only)

Ludwig 2007 (published data only (unpublished sought but not used))

McCain 2001 (published data only)

McCain 2002 (published data only)

McCain 2003 (published data only)

McGrath 2002 (published data only)

McGrath 2003 (published data only (unpublished sought but not used))

McGrath 2004 (published data only)

McGrath 2005 (published data only)

Neiva 2008 (published data only)

Pickler 2005 (published data only (unpublished sought but not used))

Pickler 2005a (published data only)

Pickler 2009 (published data only)

Premji 2000 (published data only)

Premji 2002 (published data only)
Instruments for assessing readiness to commence suck feeds in preterm infants: effects on time to establish full oral feeding and duration of hospitalisation (Review)

Additional references

Fuginaga 2007a

Hill 2002

Lau 2003

Lemons 2001

McGrath 2008
McGrath, JM. Testing preterm infant’s readiness to feed. Email 10th July 2008.

Nyqvist 1996

Nyqvist 1999

Pickler 2003

Pridham 1993

Simpson 2002

* Indicates the major publication for the study
### Characteristics of studies [ordered by study ID]

#### Characteristics of included studies

<table>
<thead>
<tr>
<th>Study</th>
<th>Reason for inclusion</th>
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<tbody>
<tr>
<td>Bauer 2008</td>
<td>Does not compare methods to determine feeding readiness. This was an observational study involving clinical observation and assessment of feeding readiness and performance of preterm infants during the transition period from gavage to bottle feeding.</td>
</tr>
<tr>
<td>Breton 2008</td>
<td>Literature review of introduction and transition to oral feedings</td>
</tr>
<tr>
<td>Bühler 2004</td>
<td>Does not compare methods of determining feeding readiness. An observational study examining factors that impact on commencement and transition to full oral feeding</td>
</tr>
<tr>
<td>Cagan 1995</td>
<td>Does not compare methods of determining feeding readiness. This study is an observational study examining behavioural state and feeding behaviours as indicators of feeding readiness</td>
</tr>
<tr>
<td>Church 2006</td>
<td>Does not compare methods of determining feeding readiness. This observational study examines the inter-rater reliability</td>
</tr>
<tr>
<td>Cunha 2009</td>
<td>Does not compare methods of determining feeding readiness. This study describes and compares the sucking patterns of very low weight preterm and full term infants</td>
</tr>
<tr>
<td>da Costa 2008</td>
<td>Literature review of diagnostic tools to determine feeding readiness and feeding performance</td>
</tr>
<tr>
<td>Dodrill 2008</td>
<td>Does not compare methods of determining feeding readiness. This study involves a retrospective chart audit examining early feeding milestones</td>
</tr>
<tr>
<td>Dodrill 2008a</td>
<td>Does not compare methods of determining feeding readiness. This study involves a survey of staff to investigate and document current transitional feeding practices</td>
</tr>
<tr>
<td>Drenckpohl 2009</td>
<td>Not a randomised or quasi-randomised study. This study uses a historical control to evaluate the implementation of a feeding protocol to initiate and advance feeds. Initiation is commenced at 30 weeks but no assessment is made</td>
</tr>
<tr>
<td>Fernández 2007</td>
<td>Not research but an article that discusses feeding readiness and the transition to suck feeds</td>
</tr>
<tr>
<td>Flint 2007</td>
<td>Does not compare methods of determining feeding readiness. This study involves an observational, retrospective cohort study design in which feeding milestones were examined</td>
</tr>
<tr>
<td>Frischknecht 2005</td>
<td>Not a study but an article that describes feeding readiness in preterm infants</td>
</tr>
<tr>
<td>Fuginaga 2007</td>
<td>Does not compare methods of determining feeding readiness. This is a descriptive, observational study</td>
</tr>
<tr>
<td>Author</td>
<td>Description</td>
</tr>
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<td>---------------</td>
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</tr>
<tr>
<td>Fujinaga 2007a</td>
<td>Does not compare methods of determining feeding readiness. This is an observational study to test for inter-rater reliability.</td>
</tr>
<tr>
<td>Howe 2007</td>
<td>Does not compare methods of determining feeding readiness. This is an observational study design to assess the validity and reliability of the Neonatal Oral Motor Assessment Scale.</td>
</tr>
<tr>
<td>Kinneer 1994</td>
<td>Does not compare methods of determining feeding readiness. This study involved a survey of neonatal nurseries to find out how clinicians determine feeding readiness.</td>
</tr>
<tr>
<td>Kirk 2007</td>
<td>Not a randomised or quasi-randomised study. This study compares a historical control with a study group. No psychometric testing reported.</td>
</tr>
<tr>
<td>Lau 2007</td>
<td>Not primary research but a discussion article on feeding initiation and progression.</td>
</tr>
<tr>
<td>Lemons 1996</td>
<td>Not research but an article discussing transition to breast or bottle feeds.</td>
</tr>
<tr>
<td>Ludwig 2007</td>
<td>Not research but an article that describes a feeding readiness scale developed by authors as part of their change in feeding documentation.</td>
</tr>
<tr>
<td>McCain 2001</td>
<td>This study does not evaluate the use of a feeding readiness indicator independently as the intervention incorporates a period of non-nutritive sucking. The effectiveness of assessing feeding readiness alone on the primary outcomes can not be established for this study.</td>
</tr>
<tr>
<td>McCain 2002</td>
<td>This study does not evaluate the use of a feeding readiness indicator independently as the intervention incorporates a period of non-nutritive sucking. The effectiveness of assessing feeding readiness alone on the primary outcomes can not be established for this study.</td>
</tr>
<tr>
<td>McCain 2003</td>
<td>Not a study but an article that describes an evidence-based guideline for the introduction oral feeding.</td>
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<tr>
<td>McGrath 2002</td>
<td>Does not compare methods of determining feeding readiness. This is an observational study that looks at the association between alertness and ability to engage in nutritive sucking.</td>
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<tr>
<td>McGrath 2003</td>
<td>Does not compare methods of determining feeding readiness. This study describes the content validity as well as an observational, pilot study of a feeding readiness scale.</td>
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<tr>
<td>McGrath 2004</td>
<td>Not research but an article discussing feeding readiness in preterm infants.</td>
</tr>
<tr>
<td>McGrath 2005</td>
<td>Does not compare methods of determining feeding readiness. This observational study explores factors associated with feeding readiness.</td>
</tr>
<tr>
<td>Neiva 2008</td>
<td>Does not compare methods of determining feeding readiness. This study established content validity of non-nutritive sucking scoring system as well as reporting the use of the tool within an observational study.</td>
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<tr>
<td>Pickler 2005</td>
<td>Not research. This article describes a theoretical model for feeding readiness in preterm infants.</td>
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<td>Pickler 2005a</td>
<td>Does not compare methods of determining feeding readiness and is part of a larger study. This study investigates the relationship between feeding readiness indicators and feeding performance.</td>
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<tr>
<td>Author</td>
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DATA AND ANALYSES
This review has no analyses.

APPENDICES

Appendix 1. CENTRAL search strategy
There were 92 results.
Each keyword was searched for in Title, Abstract or Keywords. There were 92 results for: (preterm or premature) and (feeding or breast or bottle) and (read* or commence or introduc* or start* or establish*).

Appendix 2. MEDLINE search strategy
There was 367 results.
S1 preterm or pre-term or premature or low birth weight or lowbirth weight or LBW
S2 newborn* or new born* or baby or babies or neonat* or infant*
S3 S1 and S2
S4 (MH "Infant, Premature")
S5 S3 or S4
S6 commenc* or start* or begin* or readiness or Introduc*
S7 breast fe* or breastfe* or bottle fe* or bottlefe* or nipple fe* or oral fe*
S8 (MH "Bottle Feeding") or (MH "Breast Feeding") or (MH "Feeding Methods")
S9 (MH "Feeding Behavior") or (MH "Sucking Behavior") or feeding behaviour or feeding behavior or sucking behaviour or sucking behavior
S10 S7 or S8 or S9
S11 S5 and S6 and S10

Appendix 3. EMBASE search strategy
72 results
(neonat* OR infant * or newborn OR baby OR babies) AND (preterm OR pre-term OR premature) AND (bottle fe* OR breast fe* OR nipple fe* OR oral fe*) AND (commenc* OR readiness OR begin* OR introduc*)

Appendix 4. CINAHL search strategy
There was 161 results.
S1 preterm or pre-term or premature or low birth weight or lowbirth weight or LBW
S2 newborn* or new born* or baby or babies or neonat* or infant*
S3 S1 and S2
S4 (MH "Infant, Premature")
S5 S3 or S4
S6 commenc* or start* or begin* or readiness or Introduc*
S7 breast fe* or breastfe* or bottle fe* or bottlefe* or nipple fe* or oral fe*
S8 (MH "Bottle Feeding") or (MH "Breast Feeding") or (MH "Infant Feeding")
S9 sucking behaviour or sucking behavior or (MH Sucking Behavior") or feeding behaviour or feeding behaviour
S10 S7 or S8 or S9
S11 S5 and S6 and S10
Appendix 5. Health Source search strategy

Results 66
S1 preterm or pre-term or premature
S2 newborn* or new born* or baby or babies or neonat* or infant*
S3 S1 and S2
S4 breast fe* or breastfe* or bottle fe* or bottlefe* or nipple fe* or oral fe*
S5 commenc* or start* or begin* or readiness or Introduc*
S6 S3 and S4 and S5

Appendix 6. Web of Science search strategy

150 results
Topic=(preterm or premature) AND Topic=(infant* or baby or babies or neonat* or newborn) AND Topic=(breastfe* or bottlefe* or nipplefe* or oral feeding) AND Topic=(commenc* or start* or readiness or introd* or establish*)Timespan=All Years. Databases=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH.

Appendix 7. Cochrane search strategy

There were 22 results.
Each keyword was searched for in Title, Abstract or Keywords. There were 22 results for: (preterm or premature) and (feeding or breast or bottle) and (read* or commence or introduc* or start* or establish*).

HISTORY

Protocol first published: Issue 1, 2006
Review first published: Issue 4, 2012

<table>
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<th>Date</th>
<th>Event</th>
<th>Description</th>
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<td>4 June 2008</td>
<td>Amended</td>
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CONTRIBUTIONS OF AUTHORS

Linda Crowe (LC) was the primary reviewer and author, with the help of Karen Wallace (KW) and Anne Chang who both acted as secondary reviewers and aided in the discussion and editorial process.
DECLARATIONS OF INTEREST

Linda Crowe is undertaking preliminary testing of an instrument for commencement of breast feeds for use with preterm infants.

SOURCES OF SUPPORT

Internal sources
- Qld Centre for Evidence Based Nursing and Midwifery Practice, Australia.
- Nursing Research Centre, Mater Health Services, South Brisbane, Queensland, Australia.
- Mater Research Support Centre, Mater Health Services, Australia.

External sources
- No sources of support supplied

DIFFERENCES BETWEEN PROTOCOL AND REVIEW

References were added to the background where appropriate, including the addition of a reference related to a tool developed by Fujingaga as well as a reference to the name change of the Preterm Infant Nipple Feeding Readiness tool.

The search strategy was also altered. The databases Oxford Database of Perinatal Trials and Pre-CINAHL were not searched. The original search terms in the protocol were also changed to fit with each database. See Appendices 1 to 7 (Appendix 1; Appendix 2; Appendix 3; Appendix 4; Appendix 5; Appendix 6; Appendix 7) for full details of the search strategy used for each database.

Changes to the wording of the text were made in the methods section of the review. A more comprehensive description of the assessment of risk of bias has been provided in the review. References to RevMan 4.2 software have been replaced by RevMan 5.

INDEX TERMS

Medical Subject Headings (MeSH)
- Bottle Feeding; *Breast Feeding; *Infant, Premature; *Sucking Behavior; Hospitalization; Infant, Newborn; Time Factors

MeSH check words
- Humans