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### Development of sucking patterns in preterm infants

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# 8 Summary

The studies reported on in this thesis addressed the development of sucking patterns in preterm newborns. Preterm infants often have problems learning to suckle at the breast or to drink from a bottle. It is unclear whether this is due to their preterm birth or whether it is the consequence of neurological damage. From the literature, as well as from daily practice, we know that there is much variation in the time and in the way children start sucking normally. Factors such as birth weight and gestational age may indeed be risk factors but they do not explain the differences in development. A small spot-check proved that most hospitals in the Netherlands start infants on oral feeding by 34 weeks' post-menstrual age (PMA). By and large the policy is aimed at getting the infant to rely on oral feeding entirely as soon as possible. The underlying rationale is to reduce the stay in hospital, and the idea that prolonged tube-feeding delays or even hampers the development of sucking.

Recent research found a relationship between frequent and serious reductions in oxygen saturation during feeding and behavioural eating problems at a later age. Likewise, not recovering within five minutes from the impact feeding has on the physiological parameters, bears a relationship to eating problems later on. There is no evidence that postponing oral feeding until the infant is ready for it from a physiological point of view has a negative effect on the development of sucking. It is important, therefore, to check carefully whether a preterm infant is ready to start feeding orally. When oral feeding actually commences, it is important to keep a close watch on whether the infant keeps in control of its physiological parameters and recovers rapidly after a feed. Knowledge about the development of sucking patterns in preterm infants and the ability to recognise the risk factors and indicators of abnormalities in this development will provide paediatricians and nurses insight in how they could best set up oral feeding schedules. We studied the development of sucking patterns in preterm infants from the time the infant started feeding orally until the age of ten weeks post-term. At weekly, or two-weekly intervals we observed sucking, swallowing and respiration with the aid of the Neonatal Oral-Motor Assessment Scale (NOMAS). The sessions were video-taped for future assessment.

In Chapter 1 we discuss the current knowledge concerning the impact of preterm birth on the development of sucking and swallowing. In addition, we address a number of unresolved issues that gave rise to the following research questions:

- 1 At what age do preterm infants develop a normal sucking pattern?
- 2 What is the developmental course of sucking patterns from the time oral feeding commenced to ten weeks' post-term?

- 3 Are there differences in the developmental courses of the sucking patterns between preterms with normal birth weights (AGA), preterms who have intrauterine growth retardation (SGA), and preterms with bronchopulmonary dysplasia (BPD)?
- 4 Which factors influence the development of sucking patterns?

The groups we studied consisted of:

- 1 Healthy, fullterm infants as controls.
- 2 Preterm infants with intrauterine growth retardation whose birth weights were below the tenth percentile.
- 3 Preterms with serious respiratory problems, i.e. bronchopulmonary dysplasia.

Chapter 2 consists of three parts. The first part describes a search of the literature for knowledge about the development of sucking and swallowing in preterm infants. Almost all the studies we found described some aspect of sucking and swallowing, like sucking pressure, length of the sucking bouts, or rhythm. Usually the researchers limited themselves to two measurements in time and to either breastfeeding or bottle-feeding. This made it difficult to obtain a complete picture of how infants learn to suckle at the breast or drink from a bottle.

The second part of this chapter describes the diagnostic instruments used in the studies to determine whether an infant is ready for oral feeding and the instruments that study sucking and swallowing itself. As part of the present study we investigated the reliability of these studies, the reliability and validity of the instruments and what exactly the instruments measured. We took into account the cost involved, whether the instruments were used for breastfeeding or for bottle-feeding and whether they were suitable for preterms. Finally, we investigated whether they were suitable for nutritive feeding only or whether they could also be used for non-nutritive feeding, and the instruments' degrees of invasiveness.

This investigation brought to light that no instrument available at the time was at once reliable, non-invasive, user-friendly, suitable for both breastfeeding and bottle-feeding, and for both fullterm and preterm infants. The third part of this chapter focuses on the relationship between an abnormal developmental course of sucking and outcome with regard to neurological functioning on the one hand, and the development of eating on the other hand. A growing number of publications reports on such a relationship, even though the groups studied were small and the children in most of the studies were only followed-up till the age of six, twelve, or eighteen months.

In Chapter 3 we discuss the reliability of the NOMAS. The NOMAS, which uses visual observation for its assessments, was the only instrument

we found to be suitable for both breastfeeding and bottle-feeding, and it was the only instrument that could be used both before and after preterm age. The NOMAS is a much-used, non-invasive instrument consisting of 28 items: 14 for the observation of jaw movements and 14 for the observation of tongue movements. It distinguishes three sucking patterns: a normal (mature) sucking pattern, a disorganized, and a dysfunctional sucking pattern. In case of a disorganized sucking pattern the coordination between sucking, swallowing and respiration is disturbed while the tongue and jaw movements are normal. In case of a dysfunctional sucking pattern abnormal jaw and tongue movements make sucking impossible or inefficient. From our reliability study it appeared that the intra-rater reliability varied from 'fair' to 'almost perfect' (Cohen's  $\kappa$  ranged between 0.33 and 0.94). The inter-rater reliability varied from 'moderate' to 'substantial' (Cohen's  $\kappa$  ranged between 0.40 and 0.65). For a measuring instrument such as the NOMAS such levels of reliability were unacceptable. Since much useful information about the development of the infant's sucking ability can be gained from observing sucking and swallowing from a protocol, we recommended to amend the NOMAS in order to improve its reliability; partly also on the basis of new insights into the development of sucking and swallowing. This amendment should result in uniformity regarding the interpretation of differences between breastfeeding and bottle-feeding, the interpretation of the length of the sucking bouts, and of the number of sucking movements per swallow. If, in case of specific questions concerning tongue movements, we could use ultrasound in addition to the NOMAS observations, this instrument would become even more reliable and useful in future.

In Chapter 4 we examined the development of sucking patterns in 30 healthy, fullterm infants during either breastfeeding or bottle-feeding. The first video-recordings were made two or three days after birth. Subsequently, the infants were recorded every two weeks until ten weeks' post-term age. This resulted in 171 recordings; five to seven recordings per infant. The recordings were assessed by certified NOMAS experts. With a view to increasing the reliability of the NOMAS, each recording was assessed by two experts independently. If they could not reach consensus, the recording was assessed by a consensus group.

All the infants had a normal sucking pattern from the beginning. In 14% of the recordings (10 infants), however, we found one or more abnormal measurements during the course of the development of sucking. In these cases we found the slightest abnormality, i.e. arrhythmical sucking, that involved one or more burst of less than ten sucking-swallowing-respiration movements. A dysfunctional sucking pattern did not occur, nor problems of coordination between sucking, swallowing and respiration. Birth weight, gestational age, type of birth or sex had no influence on sucking patterns.

Arrhythmical sucking occurred slightly more often in infants that were bottle-fed.

Chapter 5 deals with the development of sucking of 15 preterm infants with intrauterine growth retardation in comparison with 34 preterm infants that had normal birth weights. The two groups differed significantly as regards birth weight and standard deviation score (SDS) for gestational age. These 15 infants performed worse on all aspects of the development of sucking than the group of preterms with normal birth weights: they developed a normal sucking patterns later and needed to be tube-fed for longer. Gestational age and birth weight bore a significant relationship to the age at which an infant sucks normally. Nevertheless, also the preterms infants with appropriate birth weights showed a different developmental course of sucking than the fullterm infants in the control group: only 38% (13 infants) showed a normal sucking pattern on their due dates. At the age of ten weeks post-term one infant still did not depend on oral feeding entirely and 25 of the 31 AGA preterms (81 %) had aquired a normal sucking pattern. With regards to their sucking patterns it was noticeable that the SGA preterms showed abnormal patterns including 'incoordination' and dysfunctional sucking more often. Prior to term age, they had more difficulty coordinating breathing with sucking and swallowing. Presumably, this was a reflection of their neurological functioning. By means of backward multivariate logistic regression we determined the factors that predicted abnormal development of sucking behaviour. Perinatal and neonatal characteristics that showed an association of  $p < .10$  with achieving a normal sucking pattern at term age were entered into the model: gestational age, SDS for birth weight, and the Nursery Neurobiologic Risk Score (NBRS). Only NBRS and SDS for birth weight remained in the model. At the age of ten weeks post-term, gestational age and SDS for birth weight remained in the model.

In Chapter 6 we describe the development of sucking of 16 preterms with BPD in comparison to 15 preterms without BPD, matched for gestational age. Preterms with BPD needed to be tube-fed for longer from birth. It should be noticed, however, that neither group was doing exceptionally well. The developmental course of sucking patterns in the two groups only differed significantly prior to term age; the BPD infants experienced more problems with starting to suck and they had more problems with coordinating respiration with sucking and swallowing due to their lung problems. The differences between the two groups disappeared after term age was reached. Apparently, after the due date, BPD had less influence than we were led to expect from the literature. In both groups the course of the development of sucking was determined more by the shorter gestational age than by BPD. In the General Discussion we state that the development of sucking patterns

in preterms differs from that of healthy, fullterm infants: three quarters of the preterms developed a normal sucking pattern later than fullterm infants did.. In particular, the developmental course of sucking is different in preterms with intrauterine growth retardation and preterms with a BPD. These two groups, as well as the group of very preterm infants (< 30 weeks' PMA) require extra attention when oral feeding schedules are set up. An infant's postnatal age should not be taken as the standard for starting oral feeding and for setting up oral feeding schedules, rather the individual infant's readiness for oral feeding should be taken into account. Close collaboration with a speech therapist is particularly important in case of a dysfunctional sucking pattern.