

REGULAR ARTICLE

Newborn behaviour to locate the breast when skin-to-skin: a possible method for enabling early self-regulation

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ABSTRACT**Aim:** The aim of this study was to provide a more detailed analysis of the infant's behavioural sequence that begins immediately after birth and terminates with grasping the nipple, suckling and then falling asleep.**Method:** Twenty-eight full-term infants were videotaped immediately after birth. A video protocol was developed to examine infant behaviours identified from five random videotapes.**Results:** When birth crying had stopped, the babies showed a short period of relaxation and then successively became alert. They went through an 'awakening phase', an 'active phase' with movements of limbs, rooting activity and looking at the mother's face, a 'crawling phase' with soliciting sounds, a 'familiarization phase' with licking of the areola, and a 'suckling phase' and last a 'sleeping phase'. Five factors related to the time spent to locate the breast: more number of looks at the breast 10–20 min after birth ($p < 0.0001$); and exposure to meperidine ($p = 0.0006$) related to increased time. Early start of crawling ($p = 0.0040$); increased number of 'soliciting sounds' ($p = 0.0022$); and performing hand–breast–mouth movements ($p = 0.0105$) related to shorter time.**Conclusion:** Inborn breastfeeding reflexes were depressed at birth, possibly because of a depressed sensory system. It is hypothesized that when the infant is given the option to peacefully go through the nine behavioural phases birth cry, relaxation, awakening, activity, crawling, resting, familiarization, suckling and sleeping when skin-to-skin with its mother this results in early optimal self-regulation.**INTRODUCTION**

We now know that the healthy newborn infant has an inborn sequential behavioural pattern during the first hours following birth if placed skin-to-skin on the mother's chest. Gradually, the reflexes come to life: the infant successively acquires sucking and rooting reflexes, fists the hand, brings the hand to its mouth at about half an hour after birth, and within 1 h postpartum, finds the mother's breast and begins suckling (1,2). It has recently been shown that the newly born infant massages the mother's breasts in preparation for the first feed. The massage-like movements are followed by increased maternal oxytocin levels and are, among other things, suggested to be significant for mother–infant interaction (3).

Apart from eliciting the infant's sequential behaviour, skin-to-skin contact has been found to be the best natural way to keep the infant warm after birth (4). To be born by the vaginal route brings about a surge of catecholamine, which facilitates the newborn's adaptation to extra uterine

life (5). Aeration of the lungs, liquid absorption and cardiac performance are improved. When the more acute effects of this surge of catecholamine are over, negative consequences related to stress may follow, such as extensive crying and sustained peripheral vasoconstriction. Recent research has suggested that these consequences are counteracted by skin-to-skin contact (6).

Even though much is known about the infant's inborn behavioural sequence, we wanted to look more close into how the infant located the mother's breast and for example if it could be understood what senses the infant may use. With more understanding of the infant's biological program while skin-to-skin, the less we as health care providers may disturb the healthy infant and the parents during their first hours together.

The goal of this study was thus to provide a more detailed analysis of the infant's behavioural sequence that begins immediately after birth and terminates with grasping the nipple, suckling and falling asleep.

MATERIAL AND METHODS

Selection

To meet the selection criteria, participants had to be a healthy woman with a normal, single-child pregnancy; a spontaneous, normal labour; and a full-term, healthy infant (38–42 weeks of gestational age).

At 08:00 h, women in labour at a maternity hospital in Stockholm, Sweden who met the inclusion criteria were asked if they were willing to participate in the study. The first infant to be born on the observation day was videotaped. Twenty-eight mothers and infants were videotaped directly after delivery. The local Ethics Committee approved the study.

Videotaping

Immediately after birth, the infant was placed naked, skin-to-skin on the mother's chest, with its eyes level to the mother's nipples. The mother was asked to allow the infant to move naturally on her chest. Thus, she did not shift the infant's position, but stroked and talked to the infant without restriction. The video camera was directed at the upper part of the infant's body, including the face. The videotaping ended when the infants started suckling. For those who did not suckle, the videotaping was discontinued when the infants entered their first sleeping period.

Video examination

Five random videotapes were studied by the research group to identify and define infant behaviours. The researchers looked at the videotaped infants with 'open minds' and without any preset hypotheses. The observers agreed upon a standardized description of the behaviours and activities of the infant from birth to first suckle or first sleeping period (see Results section Tables 1 and 2).

Transcription

A data sheet for transcription was developed where the phases and behaviours identified were listed in the vertical

Table 1 Definition of phases/behaviours identified

Phases	Behaviours
Birth cry	Intense crying just after birth
Relaxation phase	Infant resting/recovering. No activity of mouth, head, arms, legs or body
Awakening phase	Infant begins to show signs of activity. Small thrusts of head: up, down, from side-to-side. Small movements of limbs and shoulders
Active phase	Infant moves limbs and head, is more determined in movements. Rooting activity, 'pushing' with limbs without shifting body
Crawling phase	'Pushing' which results in shifting body
Resting phase	Infant rests, with some activity, such as mouth activity, sucks on hand
Familiarization	Infant has reached areola/nipple with mouth positioned to brush and lick areola/nipple
Suckling phase	Infant has taken nipple in mouth and commences suckling
Sleeping phase	The baby has closed its eyes

Table 2 Definitions of behaviours not restricted to a specific phase

Behaviours	Definition
Eyes	Closed or opened Looks mainly at mother's breast Looks mainly in the direction of the mother's face
Soliciting sounds	An affirmative, short, ringing so sound
Hand-to-mouth	Hand in/or touching the mouth
Hand-breast-mouth	Infant moves hand across mother's breast and brushes the nipple/areola and brings hand to mouth
Rooting	Twisting movement where face is brought across or lifted above mother's chest and turned to side or hand
Rocking/pushing	Rocking activity without shifting position

plane and the time, minute by minute, in the horizontal plane. A single demarcated behaviour was marked by a dot, and a behaviour that lasted for some time was noted with a line corresponding to the time the behaviour was seen. No behaviours were assessed according to graded scales. With this type of observation sheet, it was easy to obtain an overview of an infant's behaviour. This type of videotape transcription has been described by Erickson (7).

Tests for inter-observer reliability

Before the systematic coding took place, three random tapes were tested for inter-observer reliability. For congruence, 10-min observations of each video were compared. Between observer 1 and 2, the coding was congruent in 95% of the observed behaviours; between observer 1 and 3, 75% were congruent; and for observer 2 and 3, the corresponding figure was 80%.

Coding procedure

The videos were simultaneously studied minute by minute by all three observers. A 'conference score' was noted. The tape was stopped while the notes were made. If something was unclear within the minute studied, the tape was rewound and the sequence restudied until the observers agreed. The observers did not have access to any background data concerning the mother or baby.

Statistics

Values are given as medians and ranges unless otherwise specified. The Wilcoxon signed-rank test, the Mann-Whitney *U*-test, chi-square test and multiple regression analysis were used.

RESULTS

Information regarding maternal age, weeks of pregnancy and infant birth weight can be seen in Table 3.

Infant phases of activity during the first hour of life are described in Table 1. After the baby was dried, had stopped birth crying after a median time of 2 (2–4) min, and was left in peace on the mother's chest, a short period of 'relaxation' was apparent. In the relaxation phase, the baby did not

Table 3 Background data (medians and range or frequencies)

Parity	
Primiparae	12
Multiparae	16
Age (years)	29.5 (21–37)
Weeks of pregnancy	40 (38–42)
Analgesia	
Epidural anaesthesia	4
Pudendal block	14
Meperidine	10
Other	11
Birth weight, grams	3475 (2500–4650)

move any parts of the body, not even the mouth. Soon thereafter, the infant entered an awakening phase and started to make small thrusts with its head and small movements with its shoulders and arms. The awakening phase was followed by an active phase, when the infant showed more distinct activity. Most of the behaviours described in Table 2 (e.g. looking at the breast, looking at the mother's face, rooting movements, hand-to-mouth activity, soliciting sounds) occurred during the active phase. Between different activities, resting phases were identified. During the crawling phase, the infant approached the areola, and during the familiarization phase, the baby became acquainted with the areola by licking and touching the nipple before eventually entering the suckling phase, in which the baby started suckling the breast without help. Recorded median time points after birth at which a phase or behaviour first appeared are shown in Table 4.

Eighteen of the 28 infants reached the areola (primary outcome variable in this study) by themselves and started touching and licking, and 15 of them began suckling spontaneously.

Eyes of infants

The infants opened their eyes for the first time at a median age of 2.5 (0–16) min. A period of frequent opening and closing of the eyes followed. At 7.5 (0–124) min of age, the infants started to keep their eyes opened for periods longer than 5 min, and at 64 (10–153) min, they started to feel sleepy, (i.e. frequently closing their eyes for periods longer than 5 min). During the period in which infants had opened eyes, there were significantly more looks at the breast than at the mother's face during the first 10-min period after birth ($p = 0.04$) (Fig. 1A). Most looks at the mother's breast occurred during the second 10-min period after birth ($p = 0.055$) (Fig. 1B). Most looks at the mother's face occurred 10 min later ($p = 0.039$) (Fig. 2).

Infants' soliciting

During the total observation period (i.e. from birth to 10 min after the first suckle or up to 120 min, if the infant did not suckle), a median of five (0–90) soliciting sounds were registered. The number of soliciting sounds increased significantly from 15 min before the infants first brushed the areola with their mouths to the nearest 15 min after

Table 4 Median minutes (25th–75th quartile) after birth at which a phase or a spontaneous behaviour first appeared in 28 newborn infants. Medians and quartiles are calculated only on infants showing a behaviour

Variable	Infants showing the behaviour	Median (25th–75th quartile)	Infants not showing the behaviour
Birth cry	28	0 (0–0)	0
Relaxation phase	24 ^a	2 (2–4)	0
Awakening phase			
Head movements/small thrusts	28	2.5 (1–5)	0
Opening of the eyes	28	3.5 (1–7)	0
Mouth activity	28	3 (2–16)	0
Active phase	28	8 (4–12)	0
Eyes stay open for 5 min or more	26	9.5 (6–16)	2
Looks at breast	25	15 (0–53)	3
Looks at mother	24	15.5 (11.5–21.5)	4
Rooting	25	17 (12.8–23.5)	3
Hand-to-mouth movement	28	18 (9–31)	0
Soliciting	25	23 (17.5–32.5)	3
Resting phase	25	18 (13–26.5)	3
Crawling phase	21	36 (18–54)	7
Familiarization phase	18	43 (29–62)	10 ^b
Hand–breast–mouth movement	9	46 (32.8–70.5)	19
Suckling phase	15	62 (43.5–90.3)	13
Sleeping phase	28	70 (52.5–79)	0

^aFour videos could for technical reasons not be visually evaluated the first minutes. Delivery room routines as drying the baby and cutting the cord may have disturbed the length of this phase.

^bOf these ten infants, five had been exposed to meperidine (Pethidine hydrochloride, ACO Pharmacia) during labour.

($p = 0.05$). At 15 min before brushing the areola, there was a significant difference in the median number of soliciting sounds between boys and girls [i.e. 2.5 (0–6) vs. 0 (0–1) ($p = 0.02$), respectively]. At 15 min after the first brushing, the difference was not significant [i.e. 4 (0–10) vs. 1 (1–8) (ns)].

Movement of hand from areola/nipple to mouth

All of the nine infants who displayed hand–nipple–mouth movements (9/9) found the areola. In contrast, the areola was found by only nine of the 19 infants who did not show hand–nipple–mouth movements ($p = 0.01$).

Factors related to infants' success or failure in finding the areola

To determine which factors or specific skills might play a part in an infant's ability to locate the breast, a multiple regression analysis was performed. The dependent variable was the time taken to reach the areola. The regression analysis included the following independent variables: (i) number of looks at the mother's breast 10–20 min following birth, (ii) hand–breast–mouth movements (0/1), (iii) number of soliciting sounds 15 min before brushing the areola with

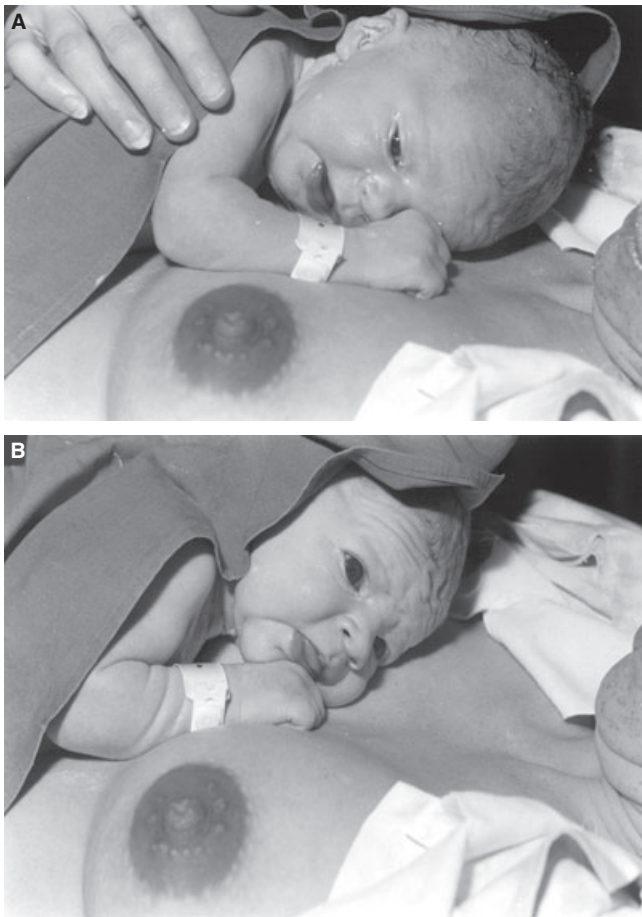


Figure 1 (A) The baby looks at the breast 15 min old. (B) The baby looks at the mother 21 min old. Photo: Thomas Annersten.

the mouth, (iv) exposure to meperidine and (v) use of pudendal block.

The independent variables related to the infant's reaching the areola are listed in order of significance: (i) an increased number of looks at the breast 10–20 min increased the time spent to reach the areola ($p < 0.0001$); (ii) exposure to meperidine increased the time spent locating the areola (0.0006); (iii) an increased number of soliciting sounds 15 min before touching the areola shortened the time spent reaching the areola ($p = 0.0022$) and (iv) presence of hand–breast–mouth movements decreased the time spent locating the areola ($p = 0.0105$). The time point for first crawling correlated positively to the time point when the areola was located ($p = 0.004$). Together, these variables explained 88% (adj. R^2) of the variation of the dependent variable (Table 5). The use of a pudendal block did not significantly influence the point in time when the baby reached the areola.

Time licking the areola before suckling

Fifteen of the infants started to suckle after they had reached the areola. They spent a mean time of 14 min (Range 1–45) licking and touching the areola and breast before suckling.

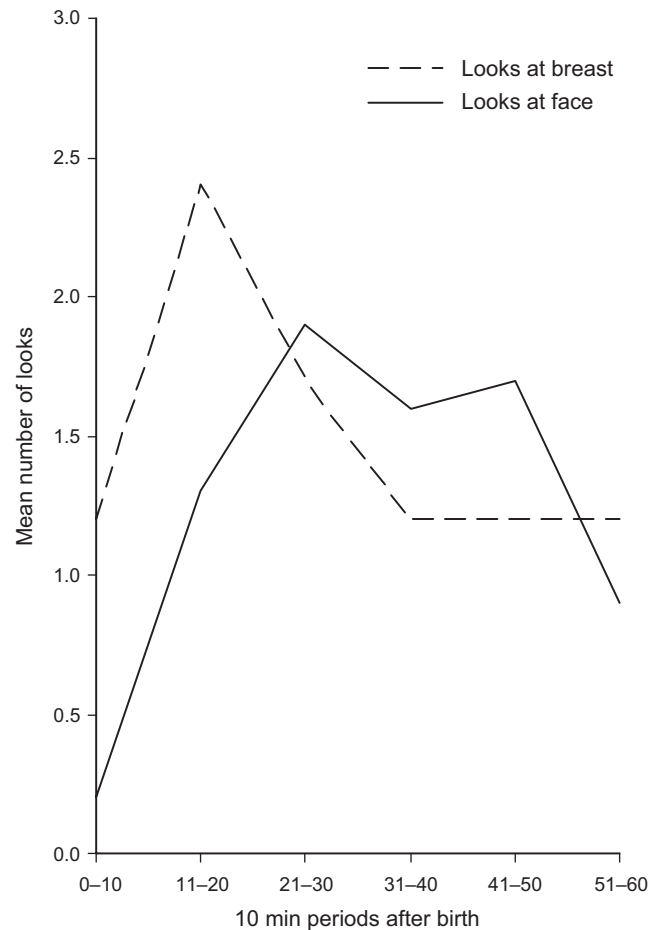


Figure 2 The infant's mean number of looks at either mother's breast or face is shown for 10-min periods during the first hour after birth.

Table 5 Multiple regression analysis to establish the influence of behavioural variables and analgesic routines on the point-in-time when the infant locates the areola. Adjusted R^2 0.878

Variable	Coefficient	SE	t-value	p-value
Intercept	24.158	12.956	1.865	0.891
Looks at breast 10–20 min after birth	11.540	1.718	6.716	<0.0001
Meperidine	78.143	16.497	4.737	0.0006
Soliciting before familiarization phase	–18.573	4.689	–3.961	0.0022
Time point for first crawl	0.935	0.259	3.618	0.0040
Hand–breast–mouth movement	–35.398	11.493	–3.080	0.0105

DISCUSSION

The main findings in this study were that the newborn infant, after the birth cry, when immediately put skin-to-skin on the mother's chest, showed a short period of relaxation without any body movements. It successively increased body movements and exhibited a number of activities, such

as looking at the mother's areola/nipple and making specific soliciting sounds and hand-breast-mouth movements. These activities played a role in the infant's locating of the mother's breast.

Relaxation and awakening phases

The relaxation phase (no movements at all) lasted less than a minute as the infant was left undisturbed, and successively and slowly, the infant's reflex system was engaged. It seems as if the infant had a limited ability to regulate its body, as if the sensory system was depressed. It has been suggested that the surge of catecholamine and β -endorphin during birth brings about an increased pain threshold in the infant the first hour after vaginal birth (8–10). Bergqvist et al. have in a recent study found that infants have a high pain threshold after birth. They found that infants exposed to injections of vitamin K within >30 to \leq 90 min of delivery express less pain than those administered injections >90 to <260 min after birth (11).

An alternative explanation could be that the human foetus produces oxytocin (12), which may be a response to the stressful experience of being born (5). Oxytocin has been shown to increase the pain threshold in rats (13,14). The production of this substance in the human foetus may be enhanced during its stressful journey through the birth canal. The oxytocin released may increase the pain threshold or cause sedation, which is mirrored by the relaxation phase observed in the first minutes after birth. Because of these effects, the infant is not likely to spontaneously show a high rooting reflex immediately following birth.

Suctioning of the airways was not performed in these healthy full-term infants. It is a clinical observation that healthy crying newborn infants being suctioned are able to make defensive movements trying to get rid of the catheter, although not able to grab the catheter because the hands are flaccid, but using pushing movements. This is probably a survival mechanism to keep the airways free from foreign objects. It could be speculated from an evolutionary perspective that the short relaxation phase (after the lifesaving birth cry had stopped) may be a mechanism hindering detection by predators. But soon thereafter another surviving mechanism slowly comes into play; the search for food.

It should be taken into consideration that the procedure of drying the infant might have affected the length of birth cry as well as the time point the relaxation phase first could be seen.

Eyes

A number of animal species that are born with their eyes open are not as dependent on olfactory cues as are rat pups, whose eyes are closed at birth (15). We found that the infant seemed to look more often at the mother's nipple than at her face during the first 10–20 min after birth. In addition to olfactory cues, it is tempting to further speculate whether it is the shape and colour of the areola and the nipple, which has become darker during pregnancy that is drawing the attention of the infant.

It is interesting that half the infants who found the areola brushed their hand across the mother's areola/nipple and then brought their hand to their mouth. Of the infants who did not find the nipple, none made this kind of movement. Von Hofsten (16) found that at 5 days of age, infants have the ability to make a directed movement towards a moving ball at a distance of a couple of decimetres from their face. It is likely that the newborn babies in this study were able already during the first hour after birth to intentionally reach for the nipple. This movement of the hand from the breast to the mouth could thus be intentional and would be of importance for communicating taste–smell sensations that stimulate the infant to continue searching for the breast.

Olfaction

Olfaction seems to affect an infant's ability to locate the nipple, as was reflected by an increased number of soliciting sounds when the infants approached the areola with their mouth. This could be interpreted as the infant getting increasingly excited by the smell and taste from the areola and intuitively sending out signals to the mother to attract her attention and help.

Rat studies have indicated that washing of the mother's nipples just after birth essentially eliminates the first attachment of the newborn pups to a nipple (15). However, when extracts from the wash are then placed on the washed rat nipple, the pups' ability to attach to the nipple is restored, though not always completely. It has recently been observed in the same type of experiment that the newborn baby also crawls for the unwashed nipple (17). Even natural breast odours unsupported by other maternal stimuli appear to be sufficient to attract and guide the infant to the odour source (18). The newborn is most sensitive to remember odours soon after birth (19). This early sensitivity to odours may not only guide the infant to the breast but also serve the infant's recognition of the mother and thus facilitate the bonding process between them.

Active phase – crawling phases and resting phases

In this study, we found that infants starting crawling movements early found the areola in a shorter time than those infants starting crawling later. It is likely that those babies who were less active spent more time trying to identify the areola by looking at the mother's breast. This inactive behaviour is likely to be related to the exposure to meperidine. It is well known that sedation and analgesia causes depressed pre-feeding behaviour (2,20).

It is interesting to note that the infants during the active phase took periods of resting. According to our experience, the infants should not be pushed to go on searching while they are resting but be left in peace and start searching on their own initiative. They seemed to work hard and to need rests.

At about 40–50 min after birth, the infant seemed to be more interested in searching the mother's face than her breast. Possibly, the mother's voice is drawing the infant's attention at that time. It is well known that the newborn

infant is capable of turning its head towards a human voice (21). We also know from the work of de Casper and Fifer (22) that the newborn infant already *in utero* learns to recognize the voice of the mother. In our experimental setting, the importance of looking into the mother's face became obvious, as the infant had to shift position to be able to see the face. When the infant turns its head early and looks at the face of the mother, the infant may associate the already known voice of the mother with her face. The mother's voice might thus be the 'attachment link' between intrauterine and extra uterine life. It should be remembered that during our study, the infant was placed between the mother's breasts with the eyes level to the areola. The position of the infant may be the factor deciding the order of the events 'looking at the breast' and 'looking at the mother's face'.

Familiarization

When the infants had reached the areola, they started licking and touching the areola with the lips. The 15 infants starting to suckle spent a mean time of 14 min to touch and shape the nipple before attachment. It could take up to 45 min after reaching the areola before they attached. It is wise to refrain from 'helping' the infant to attach because unfortunately the help can sometimes be too forcing and the infant may experience suffocation, fight the breast and establish aversive behaviours when later coming close to the breast (23).

Effect of skin-to-skin contact on infant self-regulation

When in contact with the mother's body, the baby becomes calm and relaxed (6), which may facilitate the baby's ability to make use of all its senses and reach the areola and find the breast. During this process, the baby coordinates its body movements with its senses of sight, hearing, smell and taste as shown in this study.

The effect of skin-to-skin contact on self-regulation in preterm infants has been evaluated in several studies. In these studies, the preterm infant has repetitively been put skin-to-skin with its mother during the neonatal period and found to improve self-regulation measured with different methods at different time points after birth (24–26). Bystrova et al. (27) found that full-term infants after 90 min of skin-to-skin contact soon after birth showed optimized self-regulation and dyadic mutuality 1 year later as measured by a standardized tool (Parent-Child Early Relational Assessment PCERA) (28).

The effects of skin-to-skin seen on self-regulation in studies on preterm infants may partly be an effect of that the infant has an optimal chance to successively re-organize/organize body movements with its senses and repeatedly become calm during skin-to-skin sessions. This process to improve self-regulation may take weeks or months in the preterm infant. We hypothesize that the full-term healthy infant when skin-to-skin with its mother immediately after birth optimizes its ability to reach self-regulation within the first period of wakefulness when going through the inborn biological program to find the mother's breast.

The finding of Lundqvist-Persson (29) that 3-day-old infants with low self-regulation levels are at risk for poorer social and cognitive development as well as regulatory disorders strengthens the importance of establishing early self-regulation even in the full-term infants.

Based upon our findings and conclusions, the baby should stay skin-to-skin with its mother the first hours after birth, and it is clear that delivery ward routines should be designed so as to not disturb the infant's self-regulation process, first suckling and maternal–infant attachment behaviours. As the infant seems to be depending on olfactory cues, the staff must avoid washing the mother's breasts and also postpone the baby's bathing and weighing. The administration of meperidine is an example of another disturbing factor and should not be given to the mother as a standard clinical routine. That meperidine delayed infant behaviour indicates that infants can be compromised by drugs during labour and may become vulnerable. Care must be taken to ensure that airways remain free.

All healthy infants should remain with their mothers from birth throughout the maternity stay to further facilitate breastfeeding and attachment.

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