

# A Study of the Patterns of Pre-feeding Responses in Newborns in relation to Child Development

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## Abstract

**Introduction:** Neonatal pre-feeding responses (NFR) that appear in newborns before the first feed are play an important role in their development. The pattern and diversity of these PFR need to be further investigated.

**Aim:** To examine the patterns and factors associated with NFR in relation to delivery practices, breastfeeding practices and later development.

**Methods:** We examined NFR among 90 infants, 45 who were delivered by cesarean section delivery (CSD) and 45 underwent vaginal delivery (VD). Data related to antenatal care, age, parity, gravidity, health related complications in mother, exclusive breastfeeding (EBF) and breastfeeding frequency (BFF) and duration of continued breastfeeding in previous child (CBF). Type of C-section; elective versus emergency and duration of VD were taken into consideration. Other information included previous breastfeeding practices.

**Results:** We identified 13 NFR. The grasp response was the most common NFR (68.9%) in vaginal and attempting to turn head was commonest in CSD (64.4%). and sucking at breast were significantly associated with EBF and developmental scores (in VD only) ( $r=0.3$  at  $P<0.05$ ;  $r=0.4$  at  $P<0.05$  respectively). Pushing feet down was associated with EBF ( $r=0.3$ ,  $P<0.05$ ) and attempts to lift breast was inversely associated with BFF ( $r=-0.4$  at  $P<0.05$ ) in all cases. Attempt to turn head was significantly associated with BFF in VD ( $r=0.4$  at  $P=0.007$ ). Attempts to suckle at skin and suckling at breast was significantly associated with number of ANC visits ( $r=0.3$  at  $P=0.3$  and  $r=0.35$  at  $P=0.2$ ). Pushing with feet and crawling was inversely associated with grasping with hands. Continuous SSC was associated with significant increase in motor, vision, social smile and hearing at six weeks developmental milestones and weight gain  $P<0.05$ . There were

significant correlations in-between the mile stones for motor, vision, social and hearing skills attained at 6 weeks  $P < 0.001$  but not with language  $P > 0.05$ .

**Conclusions:** NFR are a set of responses that emerge with early SSC and are linked to EBF. They continue to evolve with continuous SSC promoting weight gain and developmental milestones. NFR should be regarded as a developmental milestone which is linked to responsive feeding and should be encouraged as it can promote responsive parenting.

**Key words:** Pre-feeding responses, breastfeeding, child development, daily skin-to-skin care.

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## Introduction

Breastfeeding provides the best start in life for children. The innumerable benefits<sup>(1)</sup> that are provided by breastfeeding to both the mother<sup>(2)</sup> and the child make it an inevitable choice for mothers for excelling in the care given to their child<sup>(3)</sup>. In addition breastfeeding is not only a means of providing the best nourishment for children, but it also strengthens the communication between the dyad and thereby improves their child care and parenting skills making it an enjoyable and learning experience for both parents and children<sup>(4)</sup>.

Child birth practices<sup>(5)</sup> play a significant role in enhancing mother-infant relationship and child development. The World Health Organization (WHO) recommends that all babies be placed in skin to skin contact immediately after birth for as long as one or two hours and to initiate breastfeeding during this time<sup>(6)</sup>.

Children need time to develop their skills. The sense of touch, hearing, smell and taste pave the way to reflexes which evolve into movements, skills and complex thought processes. Social interaction is the basis of any human development and deprivation of such social interaction has been shown to lead to maternal and child outcome especially in preterm babies<sup>(7,8)</sup>. Whereas encouraging social interactions as early as possible in life by early mother-infant contact and interactions can promote child well-being and development<sup>(8)</sup>.

Mother child interaction that begins early by touch through skin-to-skin contact (SSC), soothing touch and eye-to-eye allows the baby to integrate their sense of smell through the odor of mother's glands on the breast (Montgomery glands on the areola) with the other senses of touch, taste and hearing of mother heart beats intermingled with mother's breath and

voice. All these senses orchestrate into a woven passionate social interaction called bonding that empowers the mother to develop her motherly caring skills and the child to awaken and trigger the reflexes which will later become the movements and skills for optimum growth and development<sup>(9)</sup>. Early neonatal feeding reflexes (NFR) are involuntary behavioral patterns of newborn babies that appear in response to an appropriate stimulus of touch, smell, so a number of behavioral responses have been identified which differ from one newborn to another. These responses follow a chronological order of sequence of movements and behaviors called the NFR which climax into the first suckle<sup>(10)</sup>. The overall medical benefits of such practices on shortening the duration and thereby complications of the third and fourth stage of labor are well documented<sup>(11)</sup>.

However many challenges face the development of these NFR. The mode of delivery<sup>(12)</sup> and exposure to the stress of separation with cesarean section delivery (CSD) triggers the despair response of crying and raise cortisol levels<sup>(13)</sup> in the infant which can delay or interfere with the NFR and their future development as shown by experimental studies<sup>(14)</sup>. Hence it is important to get a better understanding of how individual NFR are influenced by the mode of delivery and to identify

ways and means of reducing the negative effect of poor birthing practices on later child development.

Hence the aim of this study is to examine the differences in appearance of NFR in vaginal and cesarean delivery and how this can influence child development in order to identify means for promoting an enabling relationship of both successful motherhood and optimum child development.

### Methods

This is a prospective observational case-controlled study that was conducted in Benha University hospital and Ain Shams University hospital during the period from June 2019 to March 2020, and included mothers who are expected to deliver full-term normal healthy babies by CSD or NVD.

Inclusion criteria were healthy mothers at the child bearing period aged 20-44 years old with full-term normal healthy babies. Exclusion criteria were maternal medical or obstetrical complications, intrapartum neonatal complications include asphyxia and trauma, admission to neonatal intensive unit for over 24 hours, preterm babies, born needing oxygen and ventilator after 6 hours of life, infants with congenital anomalies and sick or jaundiced infants.

The study group was randomly divided into the following groups: Group I (15 NVD and 15 CSD): FSSC at birth until the first breastfeeding is completed, but no follow-up for SSC thereafter, they included 15 NVD and 15 CSD. Group II (15 NVD and 15 CSD): FSSC at birth until the first breastfeeding is completed and follow-up SSC daily for 6 weeks for at least 2 hours/day. Group III (30): (Control group) not exposed to any SSC (only early initiation of breastfeeding within the first hour of birth). Mothers underwent a one to one interview to collect data related to their age, education, and health including past and present obstetric and breastfeeding practices. The infants were assessed for weight, length, head circumferences, neonatal reflexes and health. They were followed-up at 2, 4, 6 weeks of age. Development assessment was done for babies at 6 weeks of age using Denver developmental scale<sup>(15)</sup>. Gross motor was assessed by equal movements on both sides and ability to lift head upward in ventral suspension. Fine motor (eye to hand coordination) was assessed by ability to follow object to midline, follow objects past midline, Social development was assessed by demonstrating social smile spontaneously. Language was assessed by ability to respond to a bell, make wailing and cooing sounds. The assessment score given was as follows:

0: doesn't initiate; 1: initiates (<10%); 2: partially completes (10-100%); 3: completes (100%).

**Ethical considerations:** An informed written consent will be obtained from patients before participation; it included data about aim of the work, study design, site, time, subject, tool and confidentiality. An approval from Research Ethics Committee in Benha university hospital and Ain Shams university hospital was obtained.

**Statistical analysis:** The collected data were tabulated and analyzed using SPSS version 16 software (SPSS Inc, Chicago, ILL Company). Normally distributed variables were expressed as mean  $\pm$  standard deviation and analyzed by student "t" test and one way analysis of variance (ANOVA) for 2 and 3 independent groups respectively. ANOVA (F test) was used to compare the continuous variables expressed as mean standard deviation ( $\pm$  SD). "F" is the ratio between variations due to the studied variable to variation due to error. The more the value of "F" the more significant is the result. Correlative studies were done using Pearson's correlative studies. The cut off of significance used was  $P < 0.05$ <sup>(16)</sup>.

## Results

Table (1) demonstrates the prefeeding responses identified in all babies and

by mode of delivery. The most common reflexes elicited in babies delivered by VD were the grasp response (68.9%) followed by the tongue protrusion response. In babies delivered by C-section with spinal anesthesia the commonest response were attempts to turn head (64.4%) followed by grasp response, tongue protrusion and attempts to suckle the skin (62.2%). There were statistically significant differences between VD and C-Section for attempts to turn head ( $p=0.02$ ) and suckling at the breast ( $P=0.01$ ).

Correlative studies between score for pre-feeding responses in both VD and C-S delivered babies and variables under study by mode of delivery including ANC, mother level of education, CBF in the previous child, depression scores, gravidity and maternal age. No significant correlations were present in relation to the score given to the appearance of

these responses ( $P>0.05$ ) as shown in table (2).

Correlations between developmental milestones and EBF, breastfeeding frequency and continued breastfeeding in previous child in cesarean delivery are shown in table (3). There were significant negative correlations between developmental milestones and breastfeeding frequency in cesarean delivery ( $r=0.4$ ,  $P<0.01$ ).

Correlations of pre-feeding responses with developmental milestones, exclusive breastfeeding, breastfeeding frequency and number of antenatal care visits in vaginal delivery are shown in table 4. There were significant correlations between head turning responses and breastfeeding frequency ( $r=0.4$  at  $P=0.007$ ). Suckling reflex was significantly correlated with antenatal care (ANC) visits ( $0.4$ ,  $P<0.01$ ) and child development ( $r=0.35$ ,  $P<0.01$ ) (Table 4).

**Table (1) Prefeeding responses identified in all babies and by mode of delivery**

Prefeeding responses	Cesarean delivery (by spinal anesthesia)		Vaginal delivery		Total	
	No.	%	No.	%	No.	%
<b>Pushes feet down</b>	28	62.2	24	53.3	52	57.8
<b>Crawling</b>	21	46.7	25	55.6	46	51.1
<b>Grasping responses</b>	28	62.2	31	68.9	59	65.5
<b>Hands to mouth</b>	27	60	20	44.4	47	52.2
<b>Sucks fingers</b>	25	55.6	21	46.7	46	51.1
<b>Protrudes the tongue</b>	28	62.2	26	57.8	54	60
<b>Lip smacking</b>	27	60	21	46.7	48	53.3
<b>Attempts to lift the head</b>	19	42.2	23	51.1	42	46.7

Preeeding responses	Cesarean delivery (by spinal anesthesia)		Vaginal delivery		Total	
Attempts to turn the head	29	64.4	18	40	47	52.2
Attempts to suckle the skin	28	62.2	20	44.4	48	53.3
Grasps nipple	0	0	0	0	0	0
Suckling breast	25	55.6	13	28.9	38	42.2
Baby off the breast	11	24.4	10	22.2	21	23.3

Table (2) Correlative studies between score for pre-feeding responses and variables under study by mode of delivery (ANC, mother level of education, CBF in the previous child, depression scores, gravidity and maternal age)

C-Section deliveries	Preeeding responses in C-S delivery	Sig. (2-tailed)	Pre-feeding responses in vaginal delivery	Sig. (2-tailed)
ANC visits	r-0.081	.596	r-0.15	0.3
EBF	r0.130	0.393	r0.191	0.2
Mother education	r0.050	.745	r0.066	0.7
CBF	r-0.029	.852	r0.201	0.2
Depression scores	r-0.020	.894	r0.040	0.8
BF frequency	r0.003	.983	r-0.278	0.1
Gravidity	r0.077	.617	r0.054	0.7
Maternal age	r0.029	.848	r0.129	0.4

Pearson Correlation \*. Correlation is significant at the 0.05 level (2-tailed). \*\*. Correlation is significant at the 0.01 level (2-tailed).

Table (3) Correlations between developmental milestones and exclusive breastfeeding, breastfeeding frequency and continued breastfeeding in previous child in cesarean delivery

	Exclusive Breastfeeding	Continued Breastfeeding	Breastfeeding Frequency
Push feet down	r0.3*	r0.17	0.19
Crawling	r0.17	r0.05	r0.16
Grasping with hands	r-0.25	r-0.07	r-0.13
Hands to mouth	r0.13	r0.01	r0.01
Sucks fingers	r0.02	r0.3	r0.1
Protrude the tongue	r-0.1	r-0.117	r0.05
Lip smacking	r-0.08	r0.01	r0.1
Attempt to lift the head	r-0.07	r-0.07	r-0.4*

	Exclusive Breastfeeding	Continued Breastfeeding	Breastfeeding Frequency
Attempt to turn the head	r-0.05	r-0.06	r-0.1
Attempt to suckle the skin	r-0.104	r-0.05	r0.05
Suckling at breast	r0.30*	r-0.13	r-0.3
Off breast after feed	r0.245	r-0.15	r0.3

**Table (4) Correlations of pre-feeding responses with developmental milestones, exclusive breastfeeding, breastfeeding frequency and number of antenatal care visits in vaginal delivery**

	Exclusive Breastfeeding (45)	Breastfeeding Frequency (45)	Development	ANC visits (45)
Push feet down	r0.21	r-0.13	r0.02	r0.13
Crawling	r-0.24	0.051	r-0.02	r0.024
Grasping with hands	r-0.13	r-0.17	r0.2	r-0.07
Hands to mouth	r0.05	r0.28	r-0.04	r0.15
Sucks fingers	r-0.15	0.002	-0.2	r0.04
Protrude the tongue	r-0.02	r-0.13	0.03	r0.03
Lip smacking	r0.03	r-0.3	r-0.02	r0.03
Attempt to lift the head	r0.1	r-0.22	r-0.02	r0.03
Attempt to turn the head	r-0.15	r-0.4** P=0.007	r0.2	r0.03
Attempt to suckle the skin	r0.12	0.02	r0.2	r0.33* P=0.03
Suckling at breast	r-0.04	r-0.2	r0.4*	r0.35* P=0.02
Off breast after feed	0.032	r-0.07	r0.2	r0.26

\*. Correlation is significant at the 0.05 level (2-tailed). \*\*. Correlation is significant at the 0.01 level (2-tailed).

## Discussion

Pre-feeding responses were expressed by all babies irrespective of the prefeeding responses identified in all babies and by mode of delivery. This is in agreement with other studies that showed that despite challenges facing early SSC in CSD<sup>(17)</sup> yet, SSC with follow-up support can result in similar outcomes in the health and development of babies<sup>(18)</sup>. This has been demonstrated by studies that showed that social support and oxytocin interact to suppress cortisol and subjective responses to psychosocial stress<sup>(19, 20)</sup>. Hence the cortisol release suppressed by the oxytocin released by the immediate SSC, minimizing differences between CSD and VD.

However, our study showed that Responses such as grasp and tongue protrusion were more common in the VD babies. This could indicate that such babies are more ready to suckle at the breast. In babies of CSD with spinal anesthesia the commonest response were attempts to turn head which was significantly higher in these babies compared to VD babies<sup>(21)</sup>. This response is one of the earliest responses to appear and is an important protective defense in newborn babies that protects them against suffocation when placed prone. The explanation for this is that

vaginally delivered babies have already developed and expressed these reflexes when passing through the vagina as they twist and turn to be delivered, but in the CSD these babies were not exposed to this so it is important for them to train to express it as part of their developmental progress and early SSC assists this behavior to appear. This was substantiated by the significant negative correlations between head turning responses and breastfeeding frequency by increasing maternal responsiveness<sup>(22)</sup>. It seems breastfeeding facilitates this reflex to be replaced by voluntary movements rather than involuntary primitive responses and thereby readily promote and further the developmental milestones of head support and voluntarily lifting the head and chest, turning over, sitting and crawling in babies, thus enhancing child development<sup>(23)</sup>. It may also be important to help these babies develop these reflexes to protect them against sudden early death<sup>(24)</sup> possibly through prevention of hypothermia<sup>(25)</sup>.

The tongue protrusion reflex is yet another reflex that enables babies to develop the sense of taste and has been reported that the Montgomery glands on the areola have the same odor as the amniotic fluid of this mother<sup>(26, 27)</sup>,



this helps them to identify their source of food by encourage them, through the tongue protrusion to be prepared to feed at the breast. Other responses such as wide open mouth and mouthing and rooting responses spontaneously appear once the baby tastes the areola. The lowering of the jaw is encouraged by the fisting movements; when the baby places its knuckles (fist) inside the mouth in attempt to suckle at the areola. Also when the baby grasps the nipples and areola especially that the hands are mixed with amniotic fluid this encourages the baby to develop the suckling and swallowing response and breastfeed more ready at the breast <sup>(28)</sup>. It must be noted that these reflexes are assisted with other sensory stimuli, primarily the wide surface of skin-to-skin contact, the odor of the mother, the sounds and breath of the mother, her heart beats and probably also some eye to eye contact between them <sup>(29)</sup>. Babies are able at this age to distinguish the border between white and dark shades as the areola with rest of the breast and mother's smiling face, this is called contrast sensitivity function <sup>(30, 31)</sup>.

Once baby starts suckling at the breast, this brings a closure to the series of responses. The duration of breastfeeding has a positive effect on the mobility of the orofacial structures.

While prolonged duration of artificial feeding and sucking habits has deleterious effects on the oral motor control <sup>(32)</sup>.

At the end of suckling and as the maternal hormones transferred to the baby during labor decline and the center for sleep present in the reticular formation of the brain stem takes over and the baby goes to sleep. However this does not happen except after the other vital centers in the brain for thermal control, respiration and heart rate are stimulated and stabilized. Hence it appears that these reflexes play a role in the stimulation and stabilization of these centers after the exuberant experience of child birth <sup>(33)</sup>. With the appearance of these responses, and in parallel to them, maternal responses seem to emerge in a symphonic, orchestrated performance that enhance and reinforce one another. As the baby learns to explore, the mother learns to protect and nurture her child as she develops her motherly affectionate feelings towards her newborn termed as "bonding". A mother brain becomes programmed by "bonding" to her child in a manner that enables her to express spontaneous reactive and proactive innate responses for soothing, engaging and teaching her child to learn, which could be brought about by intracerebral changes and hormonal

changes<sup>(34)</sup>. Breastfeeding in response to baby cues (responsive feeding), builds her parenting responsiveness by increasing maternal sensitivity<sup>(35)</sup>.

In return this child becomes attached to the mother in what we call "attachment" and should be confused with dependency, but it should be seen as essential for the development of a sense of security and emotional stability that provides the milieu for safe learning, and become adaptable to stress, tolerate change and achieve optimum development. Early interactions are thought to fundamentally shape the development of the embodied self and mental models of physiological states, and the ensuing attachment schema is generalized to other socially challenging and emotionally charged situations or relationships encountered later in life<sup>(36)</sup>. Furthermore, certain types of suboptimal attachment experience have been linked to a predisposition for the development of various psychological disturbances<sup>(37)</sup>.

Delivery is a painful experience for newborns as they become separated from the womb they lived in for the past nine months. It seems that this pain becomes allied by psychoneuroimmunology and neuroendocrine programming early in infancy that becomes activated and enhanced by early SSC<sup>(38)</sup>. It has been

shown also those hormonal changes in the body of the mother that enable her to become the provider for her child both in terms of nutrition and nurture. There are also neuro-endocrine-immune changes which assist her body to regain the pre-pregnancy state, bringing back the immense changes that happened to her body with pregnancy back to close-down, increasing her ability to adapt to her body changes and increasing her self-efficacy<sup>(39)</sup>.

In conclusion a number of pre-feeding reflexes or responses become evident among babies when placed skin-to-skin with their mothers in the first hour after delivery. These responses were found to breastfeeding initiation and continuation and in the same time are linked with the progress of the child's developmental milestones. Although the mode of delivery may influence the appearance of these responses, SSC may be actually tuning up to baby needs by compensate for behaviors they may have been deprived of by not experiencing passage through the vagina. This enhances the child's preparedness to suckling at the breast<sup>(40)</sup>. Moreover, NFR may be closely linked with child's development later on when reinforced by DSSC, so they should be considered within the context of child development, cognition, safe

attachment and maternal responsiveness to her child's needs and parenting efficacy, by assisting her to reciprocate her child's needs and adapt to the stresses entailed by parenthood (41, 42). This should bring a better understanding of children with unmet developmental needs, special needs or delay in development or psychosocial or behavioral problems. We recommend that all newborn babies be encouraged to be placed skin-to-skin with their mothers at birth or as soon as they are ready to hold and

breastfeed their child and not to force the first breastfeed before allowing these natural reflexes to develop, as recommended by the UNICEF and World Health organization in the revised Ten steps to successful breastfeeding. With the significant rise in C-S deliveries we expect that these practices may play an important role in reducing the negative impact of this invasive mode of delivery on consequent child growth and developmental outcome.

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## دراسة الاستجابات العصبية اللاإرادية وعلاقتها بطريقة تغذية الطفل وأنماط النمو والتطور للرضع

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### نبذة مختصرة

مقدمة: استجابات حديثي الولادة قبل الرضاعة التي تظهر عند الأطفال حديثي الولادة قبل الوجبة الأولى تلعب دوراً مهماً في نموهم. يحتاج نمط وتنوع PFR إلى مزيد من التحقيق.

الهدف: دراسة الأنماط والعوامل المرتبطة باستجابات حديثي الولادة فيما يتعلق بممارسات الولادة وممارسات الرضاعة الطبيعية والتطور اللاحق.

**الطريقة:** قمنا بفحص استجابات حديثي الولادة بين ٩٠ رضيعاً، و ٤٥ ممن ولدوا بعملية قيصرية وخضع ٤٥ منهم للولادة الطبيعية. البيانات المتعلقة بالرعاية السابقة للولادة، والعمر، والتكاثر، والجاذبية، والمضاعفات المتعلقة بالصحة في الأم، والرضاعة الطبيعية الحصرية وتواتر الرضاعة الطبيعية ومدة الرضاعة الطبيعية المستمرة في الطفل السابق. نوع القسم C؛ تم أخذ الاختيارية مقابل الطوارئ ومدة الولادة الطبيعية في الاعتبار. وشملت المعلومات الأخرى ممارسات الرضاعة الطبيعية السابقة.

**النتائج:** تم ملاحظة ١٣ استجابة عصبية وكان منعكس الامسك باليد أكثر شيوعاً (٦٨,٩٪) في الولادة الطبيعية وكانت محاولة منعكس استدارة الرأس أكثر شيوعاً في العملية قيصرية (٦٤,٤٪) وكما كان هذا المنعكس ومنعكس المص على الثدي كانا مرتبطين بالرضاعة الطبيعية الحصرية والنمو (في الولادة الطبيعية فقط) ( $r=0.3$ ) بدلالة إحصائية مؤثرة ( $P < 0.05$ ؛  $r=0.4$ ) على التوالي. وارتبط منعكس الدفع بالقدم إلى أسفل بالرضاعة الطبيعية الحصرية ( $P < 0.05$ ،  $r=0.3$ ) وكانت محاولات منعكس رفع الرأس مرتبط عكسياً بتواتر الرضاعة الطبيعية ( $r-$ ) ( $P < 0.05$ )،  $0.4$  في جميع الحالات. وارتبطت محاولة منعكس استدارة الرأس مع تواتر الرضاعة الطبيعية في ولادة طبيعية بدلالة إحصائية مؤثرة ( $0.007$ ). وكانت

محاولات منعكس الرضاعة على مقبض اليد والرضاعة من الثدي كانت مرتبطة معنوياً بعدد زيارات رعاية الحمل (0.3r) و(0.35r). كما ارتبط منعكس الدفع بالأقدام والزحف عكسياً مع الإمساك باليدين. كما ارتبط المداومة على الرعاية اليومية بالجلد للجلد بزيادة مؤثرة إحصائياً بالتطور العصبي للحركة والرؤية والسمع والتطور الاجتماعي عند ستة أسابيع من العمر وأيضاً زيادة الوزن. ولكن ليس مع اللغة.

**الاستنتاجات:** استجابات حديثي الولادة عبارة عن مجموعة من الانعكسات العصبية الإرادية التي تظهر مع رعاية الرضيع مباشرة الجلد بالجلد وترتبط بالرضاعة الطبيعية الحصرية، وتعزز التطور العصبي وزيادة الوزن الطفل في الأسابيع الأولى.

و لذلك نوصي بتعليم الأم الاستجابة للانعكسات العصبية التي تظهر أثناء الرعاية بالجلد للجلد وتوجهها لحاجة طفلها للرضاعة فهي أيضاً تؤهل الأم فيما بعد للاستجابة لاحتياجات الطفل التربوية.