

## REVIEW ARTICLE

## Closeness and separation in neonatal intensive care

Renée Flacking (rfl@du.se)<sup>1,2</sup>, Liisa Lehtonen<sup>3</sup>, Gill Thomson<sup>4</sup>, Anna Axelin<sup>5,6</sup>, Sari Ahlqvist<sup>7</sup>, Victoria Hall Moran<sup>4</sup>, Uwe Ewald<sup>1</sup>, Fiona Dykes<sup>4</sup>, the SCENE group

1.Department of Women's and Children's Health, Uppsala University, Uppsala, Sweden  
2.School of Health and Social Studies, Dalarna University, Falun, Sweden  
3.Department of Pediatrics, Turku University Hospital, and Turku University, Turku, Finland  
4.Maternal and Infant Nutrition and Nurture Unit (MAINN), School of Health, University of Central Lancashire, Preston, Lancashire, UK  
5.Department of Family Health Care Nursing, University of California, San Francisco, CA, US  
6.Department of Nursing Science, University of Turku, Turku, Finland  
7.Department of Psychology, Turku University, Turku, Finland

### Keywords

Family, Infant behaviour, Intensive care, Neonatal, Parents, Preterm birth

### Correspondence

Renée Flacking, School of Health and Social Studies, Dalarna University, SE-791 88 Falun, Sweden.  
Tel: +46 23 778541 |  
Fax: +46 23 778084 |  
Email: rfl@du.se

### Received

8 May 2012; revised 27 June 2012;  
accepted 12 July 2012.

DOI:10.1111/j.1651-2227.2012.02787.x

Re-use of this article is permitted in accordance with the Terms and Conditions set out at [http://wileyonlinelibrary.com/onlineopen#OnlineOpen\\_Terms](http://wileyonlinelibrary.com/onlineopen#OnlineOpen_Terms)

### ABSTRACT

In this paper, we highlight the need for acknowledging the importance and impact of both physical and emotional closeness between the preterm infant and parent in the neonatal intensive care unit. Physical closeness refers to being spatially close and emotional closeness to parental feelings of being emotionally connected to the infant (experiencing feelings of love, warmth and affection). Through consideration of the literature in this area, we outline some of the reasons why physical closeness and emotional closeness are crucial to the physical, emotional and social well-being of both the infant and the parent. These include positive effects on infant brain development, parent psychological well-being and on the parent–infant relationship. The influence of the neonatal unit environment and culture on physical and emotional closeness is also discussed.

**Conclusions:** Culturally sensitive care practices, procedures and the physical environment need to be considered to facilitate parent–infant closeness, such as through early and prolonged skin-to-skin contact, family-centred care, increased visiting hours, family rooms and optimization of the space on the units. Further research is required to explore factors that facilitate both physical and emotional closeness to ensure that parent–infant closeness is a priority within neonatal care.

### INTRODUCTION

Physical closeness in a neonatal intensive care unit (NICU) ranges from skin-to-skin contact between parent and infant, to parents being in the unit but not in physical contact with their infant. Emotional closeness describes how parents can experience anything from feelings of strong and consistent love, care, affection and/or connection to emotional disconnection and alienation from their infant. Although 'physical closeness' may facilitate 'emotional closeness' and *vice versa*, there may be occasions when parents can be physically close but feel emotionally detached, or even physically remote but still feel emotionally connected. In this paper, we highlight the importance and potential impact of both physical and emotional closeness and the deleterious effects of separation between a preterm infant and the parent during neonatal care.

### BRAIN DEVELOPMENT AND LONG-TERM OUTCOME OF THE INFANT

The brain of a preterm infant is immature and vulnerable and, therefore, preterm infants are at a risk for abnormal

brain development and later developmental problems. However, they also have large brain plasticity and potential for injury compensation. A growing body of evidence in both humans and animals suggests that brain development and later development may be influenced by the quality of care given to preterm infants including physical and emotional closeness and parent empowerment. Mother–infant interaction in early postnatal life, or lack of it in case of

### Key notes

- The evidence suggests many benefits of early parent–preterm infant closeness during hospital care.
- In future, we need to explore facilitating and inhibiting factors to be able to implement strategies supporting closeness.
- Attention should be paid to both architectural structure and organizational culture in the neonatal units to support both the physical and emotional needs of parents and infants.

separation, can mediate variations in offspring phenotype, including emotional and cognitive development, with long-term health consequences. Environmental factors can influence gene expression through epigenetic mechanisms to provide the 'plasticity' necessary to respond to variations in environment (1). Term infants born to mothers with high levels of depression and anxiety during the third trimester have been shown to display increased DNA methylation in cord blood cells and increased salivary cortisol in response to stress at 3 months of age (2). Early life separation can alter capacity to regulate responses to stressful events as illustrated in animal studies (3,4). Furthermore, animal studies show that prolonged or repeated physical separation between parent and newborn alters brain development (5), impairs the ongoing bonding/attachment process and has long-lasting effects on, for example, emotional programming (6,7). In preterm infants, cortisol levels have been shown to be higher when cared by depressed mothers compared with nondepressed mothers (8), an effect not seen in term infants. In contrast, close physical contact between parent and preterm infant decreases infant's cortisol levels and pain responses (9) and family-centred care, providing more parent–infant closeness, synchronizes cortisol variation between the preterm infant and mother (10).

Skin-to-skin contact, developmental care and other interventions supporting parenting and parental involvement in infant care have been shown to have the potential to enhance neurological and neurobehavioural outcomes of preterm infants (11–13). Parental closeness can lead to improved child outcomes by many mechanisms. One mechanism might be improved sleep, which has been associated with skin-to-skin contact in preterm infants (13,14). Second, parent's participation in pain management may reduce pain in preterm infants and moderate the use of pain medication (15). Third, infant massage with moderate pressure may increase the concentrations of hormones such as brain growth-promoting factor, IGF-1 (16) and oxytocin, potentially having positive effects on the brain functioning and development. Fourth, the presence of a parent may give the preterm infant learning experiences that he/she might not get otherwise, such as interactive communication. Caskey et al. (17) showed that exposure to parent talk in the NICU was a significantly stronger predictor of preterm infant vocalizations than talk from other adults. These mechanisms might underlie the finding that physical contact enhances early neurobehavioural and psychomotor organization (18–20). In addition, interventions supporting parents in their skills to observe and interpret their infant's behaviour have been associated with improved cognition years later (21–22). Such interventions may restore and normalize the parent–infant relationship even after initial separation.

#### **THE EMOTIONAL AND SOCIAL WELL-BEING OF THE PARENT**

A preterm birth has been associated with poor psychological functioning in mothers and fathers, and in more negative parental interactive behaviours with their infants. Higher prevalence of depression in parents of preterm infants

compared with those of full-term infants may be explained by interrupted psychological processes during pregnancy, a stressful birth, concern for their infant's well-being and NICU experiences (23–24). However, it is plausible that separation from the infant is one mechanism that increases the risk of parental depression. Early physical separation from the infant within 24 h of birth is related to an increase in parents' NICU-related stress (25). Furthermore, prolonged physical separation between mothers and infants is also known to cause maternal stress, anxiety and depression (26). Isolation between parents and infants, often attributed to the complex technological support crucial for the infant's viability, can place immense strain on parents leading to parents feeling less confident and more alienated from their infants and incompetent in the parental role (24, 27). Whilst poor and restricted staff–parent interaction and communication can exacerbate parents' sense of isolation from their preterm infants, it has also been suggested that parents' negative emotions and experiences associated with prematurity or infant illness have led them to withdraw physically and emotionally, thereby handing over the care of their infants to staff (27–28). Emerging evidence suggests that care practices supporting physical and emotional closeness between the parent–preterm infant decrease the prevalence of maternal depression similar to levels reported in mothers of full-term infants (29–30). Furthermore, psychological well-being of the parents of preterm infants has a long-term impact in terms on later child behaviour (31).

#### **THE SECURE PARENT–INFANT DYAD**

Parental attachment to the infant, also called psychological bonding, begins and is strengthened throughout pregnancy (32). After birth, close physical contact with the newborn is crucial for this bond to develop into a secure attachment relationship between parents and their infants (33). Research has shown that newborn infants have the capacity to exhibit sensory awareness, express emotions and share feelings (34). These abilities enable infants to engage in very complex early social relationships with their parents, which form the basis for the evolving parent–infant relationship and attachment (7, 35).

A recent meta-analysis (36) was undertaken to explore mother–infant interactions and relationships within the preterm and full-term populations. The results revealed that, during first 6-month post birth, mothers of preterm infants demonstrated less positive interaction behaviours with their infants than mothers of term infants. However, this review also identified how mothers of preterm infants were as likely to form secure attachments as full-term infants and their mothers at 1 year of infant's corrected age. Whilst this review focused on the whole preterm population, research targeting infants requiring intensive supervision and surveillance, and hence early and long periods of separation from their parents, identified different results. A qualitative study of attachment revealed that mothers of very low birth-weight infants who experienced prolonged separation displayed more negative attachment behaviours compared with mothers of healthy full-term or preterm infants (37). It

has also been suggested that the lack of physical contact between the mother and infant after birth is associated with later emotional problems in preterm infants (38). Studies undertaken with fathers and their preterm infants have also identified an association between early contact and feelings of emotional closeness (39) and more positive interactions at discharge (14). Goulet et al. (40) described how physical closeness and emotional closeness (through vocalizations, visual contact, touch and other sensorimotor interactions) are crucial to the establishment of the parent–infant relationship. Whilst close contact facilitates the development of positive parent–infant relationships, it can also enhance the parent’s confidence and capabilities in providing care for their newborn. Further studies have concluded that maternal sensitivity in mothers with preterm infants is less optimal when compared with full-term controls (41–42). Research has identified how mothers of preterm infants may be more controlling, actively engaged and/or intrusive with their infants, perhaps compensating for guilt/shame for not having been the caregiver they wanted to be during hospitalization or for preterm infants’ inactive interaction (28,41,43). These findings emphasize that close physical contact may be important and powerful for the formation of secure and healthy attachment relationships.

Feeding is one of the most prominent care-giving activities in a NICU, in which the transition from tube feeding to breastfeeding is complicated by the degree of prematurity, emotional exhaustion, mother–infant separation, institutional authority and by a view of breastfeeding as a productive process, thereby preventing mothers’ experiences of breastfeeding as reciprocal and ‘successful’ (28,44). Early physical closeness and breastfeeding have been described by many mothers as ‘steps towards normality’, nurturing the intimate mother–infant interplay (28,44). Skin-to-skin contact has been highlighted as an important intervention to promote breastfeeding, in which oxytocin release is suggested to be an important mediator for the effects of close physical contact on breastfeeding (45). Moreover, long periods of mother–infant skin-to-skin contact are regarded as an effective way to empower mothers to become familiar with their infants, strengthen their mothering at their own pace and increase feelings of parental competence (46).

#### THE NICU ARCHITECTURE FACILITATING CLOSENESS

Evidence-based architecture has provided research on the benefits of different options concerning the physical structure of a neonatal unit. There is a trend towards single family room design when building new units (47), which started at step-down units (e.g. at Rainbow Babies’ and Children’s Hospital, Cleveland, Ohio, opened in 1997), spread to intensive care units (e.g. at Blank Children’s Hospital, Des Moines, Iowa, opened in 2001) and has been increasingly replacing traditional open-bay design units worldwide. This architectural structure provides the family with an opportunity to be with their child in the neonatal intensive care unit day and night providing facilities for parents’ basic needs including the need for privacy. This design has been

suggested to be associated with a lower rate of hospital-acquired infections, similar to single patient rooms in adult intensive care (48), earlier full enteral nutrition, higher breastfeeding rates and a more soothing environment with, for example, lower ambient sound levels (49). As this design has been shown to reduce the length of stay in hospital significantly, for example, by 10 days in preterm infant below 30 weeks of gestation in a Swedish study (50), it shortens the time of separation for the infant from the home and family. Parents have reported that they felt that a single family room design in a NICU facilitated their presence with their infant (51), but the increase in parent–infant closeness gained by a single family room model during hospital care is not well documented in scientific literature.

There are ways, even in traditional open-bay units, to increase parent’s facilities to be close to the infant, for example, by providing comfortable chairs and/or beds for them. Parents’ presence can also be promoted by improving privacy by visual separation and ear phones when other families’ issues are discussed in the same room. There is a very large variation between the neonatal units as to the extent to which they offer such facilities. One survey reported that reclining chairs were offered for parents in 11–100% of units and beds in 0–100% of units in different European countries (52). Based on these data, it can be concluded that there is likely to be a great variety in the time parents spend with their infants in different units/countries.

#### THE NICU CULTURE FACILITATING CLOSENESS

Parallel to structural changes, there is an ongoing change in the care culture in neonatal units to support parenting in the context of neonatal intensive care. Even though there has been a change in the attitude in neonatal care towards a more family-centred approach, there is still a medical and technical focus and there seems to be a gap between care policies/practices and evidence from family and infant research (53). Furthermore, parents’ visits to their infants on NICU are still limited in many European countries and many units do not allow parents present during medical ward rounds, nursing shift handovers and ‘quiet periods’ (52). Whilst very few studies have looked at parents’ visiting patterns, Franck & Spencer (54) showed most mothers visited the NICU daily with a mean length of 3 h. Only a third of the fathers visited on a daily basis and their visits were shorter. Infrequent maternal visits have been identified as a risk factor for later psychological development in preterm infants (55). However, some parents have fewer means to be with their preterm infant during the hospital stay. Older siblings, long travelling distance to hospital or short parental leave limit the parents’ opportunities to be present at NICU. In such cases, modern technology could be utilized to support parent–infant contact. Web camera connection for parents has been used as a method for ‘virtual visitation’ of a neonatal unit (56).

To facilitate physical contact between parents and their infants, neonatal unit staff need to welcome parents’ participation in the care but also guide parents when adapting

parental touch into daily care, as touch may induce stress in very ill infants (57). In a genuinely family-centred culture, institutional powers are limited and the role of the staff is altered from 'doing' and supervising to becoming a resource and a facilitator. Hence, when family-centred care is implemented in a professional-centred caring culture, this can highlight issues about control and power or unclear responsibilities (58), which pose a considerable challenge for the current care culture. Thus, an important aspect of organizational culture centres upon the ways in which staff are facilitated to build relationships with parents. As parent–infant bonding is a primary goal, successful transition requires education and feedback to the staff as particular demands on staff and care will follow (46). Different interventions to increase parental involvement and empowerment during the neonatal care have already been performed and reported on: parents have been involved in pain management by holding the preterm infant (15); parents have been supported in observing and interpreting their infants behaviour (29); parents have been encouraged to give extended skin-to-skin care (59). Supporting parents' abilities to interpret their infant and supporting their empowerment has significantly shortened the length of hospitalization (29), decreasing separation of the infants from family and home. Although many short- and long-term benefits have been shown after these types of interventions, there is a lack of research on how these interventions change care culture and affect parent–infant closeness during neonatal care.

Large and systematic differences related to cultural and contextual issues in neonatal units, such as parental involvement, implementation of family-centred care and staff practices, might influence differences shown in breastfeeding rates, maternal depression, and short- and long-term outcomes of the children (60). There is a need to evaluate differences in parent–infant closeness/separation between the units and structural, cultural and socio-economic factors affecting the differences. These factors could be evaluated using qualitative and quantitative techniques including ethnography.

## CONCLUSION

There is increasing evidence supporting the benefits of early parent–infant closeness during hospital care of preterm infants. Both physical and emotional parent–infant closeness should be facilitated in neonatal units taking into account the socio-economic, political and cultural variations in different countries. To better understand the issues, we need to explore what facilitates and inhibits closeness and consider implementing strategies that enable closeness. These strategies include optimizing the spatial configuration of the neonatal unit; providing chairs/beds/privacy within the given architectural design; developing a nurturing unit culture by removing all restrictions with regard to parents being on the unit and including them as empowered players in the care effort. The most important consideration is paying attention to developing an organizational culture that supports the formation of parent–infant relationships, that is, the physical and emotional needs of parents and infants.

## ACKNOWLEDGEMENTS

This review has been conducted by the Separation and Closeness Experiences in the Neonatal Environment (SCENE) Group. We would like to thank the following additional members of the SCENE group for their scientific contributions: Hedvig Strand and Erik Normann, Uppsala University, Sweden; Lars Wallin, Karolinska Institutet, Sweden; Jaakko Matomäki, University of Turku, Finland; and Zack Boukydis, Semmelweis University, Hungary.

## CONFLICT OF INTEREST AND FUNDING

No author has a conflict of interest and research has been conducted without funding.

## References

1. Meaney MJ, Szyf M. Maternal care as a model for experience-dependent chromatin plasticity? *Trends Neurosci* 2005; 28: 456–63.
2. Champagne FA. Epigenetic influence of social experiences across the lifespan. *Dev Psychobiol* 2010; 52: 299–311.
3. Welberg LA, Seckl JR. Prenatal stress, glucocorticoids and the programming of the brain. *J Neuroendocrinol* 2001; 13: 113–28.
4. Feng X, Wang L, Yang S, Qin D, Wang J, Li C, et al. Maternal separation produces lasting changes in cortisol and behavior in rhesus monkeys. *Proc Natl Acad Sci U S A* 2011; 108: 14312–7.
5. Braun K. The prefrontal-limbic system: development, neuro-anatomy, function, and implications for socioemotional development. *Clin Perinatol* 2011; 38: 685–702.
6. Sullivan R, Perry R, Sloan A, Kleinhaus K, Burtchen N. Infant bonding and attachment to the caregiver: insights from basic and clinical science. *Clin Perinatol* 2011; 38: 643–55.
7. Hofer M. Psychobiological roots of early attachment. *Curr Dir Psychol Sci* 2006; 15: 84–8.
8. Bugental DB, Beaulieu D, Schwartz A. Hormonal sensitivity of preterm versus full-term infants to the effects of maternal depression. *Infant Behav Dev* 2008; 31: 51–61.
9. Morelius E, Nelson N, Gustafsson PA. Salivary cortisol response in mother–infant dyads at high psychosocial risk. *Child Care Health Dev* 2007; 33: 128–36.
10. Morelius E, Theodorsson E, Nelson N. Salivary cortisol and mood and pain profiles during skin-to-skin care for an unselected group of mothers and infants in neonatal intensive care. *Pediatrics* 2005; 116: 1105–13.
11. Als H, Duffy FH, McAnulty GB, Rivkin MJ, Vajapeyam S, Mulkern RV, et al. Early experience alters brain function and structure. *Pediatrics* 2004; 113: 846–57.
12. Milgrom J, Newnham C, Anderson PJ, Doyle LW, Gemmill AW, Lee K, et al. Early sensitivity training for parents of preterm infants: impact on the developing brain. *Pediatr Res* 2010; 67: 330–5.
13. Scher MS, Ludington-Hoe S, Kaffashi F, Johnson MW, Holditch-Davis D, Loparo KA. Neurophysiologic assessment of brain maturation after an 8-week trial of skin-to-skin contact on preterm infants. *Clin Neurophysiol* 2009; 120: 1812–8.
14. Feldman R, Weller A, Sirota L, Eidelman AI. Skin-to-Skin contact (Kangaroo care) promotes self-regulation in premature infants: sleep-wake cyclicity, arousal modulation, and sustained exploration. *Dev Psychol* 2002; 38: 194–207.
15. Pillai Riddell RR, Racine NM, Turcotte K, Uman LS, Horton RE, Din Osmun L, et al. Non-pharmacological management of infant and young child procedural pain. *Cochrane Database Syst Rev* 2011: CD006275.
16. Field T, Diego M, Hernandez-Reif M. Preterm infant massage therapy research: a review. *Infant Behav Dev* 2010; 33: 115–24.

17. Caskey M, Stephens B, Tucker R, Vohr B. Importance of parent talk on the development of preterm infant vocalizations. *Pediatrics* 2011; 128: 910–6.
18. Treyvaud K, Anderson VA, Howard K, Bear M, Hunt RW, Doyle LW, et al. Parenting behavior is associated with the early neurobehavioral development of very preterm children. *Pediatrics* 2009; 123: 555–61.
19. Feldman R, Eidelman A. Skin-to-skin contact (Kangaroo care) accelerates autonomic and neurobehavioural maturation in preterm infants. *Dev Med Child Neurol* 2003; 45: 274–81.
20. Montirosso R, Del Prete A, Bellù R, Tronick E, Borgatti R, the Neonatal Adequate Care for Quality of Life (NEO-ACQUA) Study Group. Level of NICU quality of developmental care and neurobehavioral performance in very preterm infants. *Pediatrics* 2012; 129: e1129–37.
21. Achenbach TM, Howell CT, Aoki MF, Rauh VA. Nine-year outcome of the Vermont intervention program for low birth weight infants. *Pediatrics* 1993; 91: 45–55.
22. Nordhov SM, Ronning JA, Dahl LB, Ulvund SE, Tunby J, Kaarensen PI. Early intervention improves cognitive outcomes for preterm infants: randomized controlled trial. *Pediatrics* 2010; 126: e1088–94.
23. Brandon DH, Tully KP, Silva SG, Malcolm WF, Murtha AP, Turner BS, et al. Emotional responses of mothers of late-preterm and term infants. *J Obstet Gynecol Neonatal Nurs* 2011; 40: 719–31.
24. Jackson K, Ternstedt BM, Schollin J. From alienation to familiarity: experiences of mothers and fathers of preterm infants. *J Adv Nurs* 2003; 43: 120–9.
25. Franck LS, Cox S, Allen A, Winter I. Measuring neonatal intensive care unit-related parental stress. *J Adv Nurs* 2005; 49: 608–15.
26. Miles MS, Holditch-Davis D, Schwartz T, Scher M. Depressive symptoms in mothers of prematurely born infants. *J Dev Behav Pediatr* 2007; 28: 36–44.
27. Arockiasamy V, Holsti L, Albersheim S. Fathers' experiences in the neonatal intensive care unit: a search for control. *Pediatrics* 2008; 121: e215–22.
28. Flacking R, Ewald U, Nyqvist KH, Starrin B. Trustful bonds: a key to "becoming a mother" and to reciprocal breastfeeding. Stories of mothers of very preterm infants at a neonatal unit. *Soc Sci Med* 2006; 62: 70–80.
29. Melnyk BM, Feinstein NF, Alpert-Gillis L, Fairbanks E, Crean HF, Sinkin RA, et al. Reducing premature infants' length of stay and improving parents' mental health outcomes with the Creating Opportunities for Parent Empowerment (COPE) neonatal intensive care unit program: a randomized, controlled trial. *Pediatrics* 2006; 118: e1414–27.
30. de Alencar AE, Arraes LC, de Albuquerque EC, Alves JG. Effect of kangaroo mother care on postpartum depression. *J Trop Pediatr* 2009; 55: 36–8.
31. Huhtala M, Korja R, Lehtonen L, Haataja L, Lapinleimu H, Rautava P. Parental psychological well-being and behavioral outcome of very low birth weight infants at 3 years. *Pediatrics* 2012; 129: e937–44.
32. Habib C, Lancaster S. Changes in identity and paternal-foetal attachment across a first pregnancy. *J Reprod Infant Psychol* 2010; 28: 128–42.
33. Mercer J. Understanding attachment: parenting, child care and emotional development. Westport, CT: Praeger, 2006.
34. Lagercrantz H, Changeux JP. The emergence of human consciousness: from fetal to neonatal life. *Pediatr Res* 2009; 65: 255–60.
35. Parsons CE, Young KS, Murray L, Stein A, Kringelbach ML. The functional neuroanatomy of the evolving parent-infant relationship. *Prog Neurobiol* 2010; 91: 220–41.
36. Korja R, Latva R, Lehtonen L. The effects of preterm birth on mother-infant interaction and attachment during the infant's first two years. *Acta Obstet Gynecol Scand* 2012; 91: 164–73.
37. Feldman R, Weller A, Leckman JF, Kuint J, Eidelman AI. The nature of the mother's tie to her infant: maternal bonding under conditions of proximity, separation, and potential loss. *J Child Psychol Psychiatry* 1999; 40: 929–39.
38. Latva R, Korja R, Salmelin R, Lehtonen L, Tamminen T. How is maternal recollection of the birth experience related to the behavioral and emotional outcome of preterm infants? *Early Hum Dev* 2008; 84: 587–94.
39. Sullivan JR. Development of father-infant attachment in fathers of preterm infants. *Neonatal Netw* 1999; 18: 33–9.
40. Goulet C, Bell L, St-Cyr D, Paul D, Lang A. A concept analysis of parent-infant attachment. *J Adv Nurs* 1998; 28: 1071–81.
41. Forcada-Guex M, Pierrehumbert B, Borghini A, Moessinger A, Muller-Nix C. Early dyadic patterns of mother-infant interactions and outcomes of prematurity at 18 months. *Pediatrics* 2006; 118: e107–14.
42. Muller-Nix C, Forcada-Guex M, Pierrehumbert B, Jaunin L, Borghini A, Ansermet F. Prematurity, maternal stress and mother-child interactions. *Early Hum Dev* 2004; 79: 145–58.
43. Garel M, Dardennes M, Blondel B. Mothers' psychological distress 1 year after very preterm childbirth. Results of the EPIPAGE qualitative study. *Child Care Health Dev* 2007; 33: 137–43.
44. Sweet L. Breastfeeding a preterm infant and the objectification of breastmilk. *Breastfeed Rev* 2006; 14: 5–13.
45. Uvnas-Moberg K, Eriksson M. Breastfeeding: physiological, endocrine and behavioural adaptations caused by oxytocin and local neurogenic activity in the nipple and mammary gland. *Acta Paediatr* 1996; 85: 525–30.
46. Nyqvist KH, Anderson GC, Bergman N, Cattaneo A, Charpak N, Davanzo R, et al. State of the art and recommendations. Kangaroo mother care: application in a high-tech environment. *Acta Paediatr* 2010; 99: 812–9.
47. White RD. The newborn intensive care unit environment of care: how we got here, where we're headed, and why. *Semin Perinatol* 2011; 35: 2–7.
48. Teltsch DY, Hanley J, Loo V, Goldberg P, Gursahaney A, Buckeridge DL. Infection acquisition following intensive care unit room privatization. *Arch Intern Med* 2011; 171: 32–8.
49. Domanico R, Davis DK, Coleman F, Davis BO. Documenting the NICU design dilemma: comparative patient progress in open ward and single family room units. *J Perinatol* 2011; 31: 281–8.
50. Ortenstrand A, Westrup B, Brostrom EB, Sarman I, Akerström S, Brune T, et al. The Stockholm Neonatal Family Centered Care Study: effects on length of stay and infant morbidity. *Pediatrics* 2010; 125: e278–85.
51. Carter BS, Carter A, Bennett S. Families' views upon experiencing change in the neonatal intensive care unit environment: from the 'baby barn' to the private room. *J Perinatol* 2008; 28: 827–9.
52. Greisen G, Mirante N, Haumont D, Pierrat V, Pallás-Alonso CR, Warren I, et al. Parents, siblings and grandparents in the Neonatal Intensive Care Unit. A survey of policies in eight European countries. *Acta Paediatr* 2009; 98: 1744–50.
53. Davis L, Mohay H, Edwards H. Mothers' involvement in caring for their premature infants: an historical overview. *J Adv Nurs* 2003; 42: 578–86.
54. Franck LS, Spencer C. Parent visiting and participation in infant caregiving activities in a neonatal unit. *Birth* 2003; 30: 31–5.
55. Latva R, Lehtonen L, Salmelin RK, Tamminen T. Visits by the family to the neonatal intensive care unit. *Acta Paediatr* 2007; 96: 215–20.
56. Yeo C, Ho SK, Khong K, Lau Y. Virtual visitation in the neonatal intensive care: experience with the use of internet and telemedicine in a tertiary neonatal unit. *Perm J* 2011; 15: 32–6.
57. Peters KL. Infant handling in the NICU: does developmental care make a difference? An evaluative review of the literature *J Perinat Neonatal Nurs* 1999; 13: 83–109.

58. Domanico R, Davis DK, Coleman F, Davis BO Jr. Documenting the NICU design dilemma: parent and staff perceptions of open ward versus single family room units. *J Perinatol* 2010; 30: 343–51.
59. Franck LS, Bernal H, Gale G. Infant holding policies and practices in neonatal units. *Neonatal Netw* 2002; 21: 13–20.
60. Bonet M, Blondel B, Agostino R, Combier E, Maier RF, Cuttini M, et al. Variations in breastfeeding rates for very preterm infants between regions and neonatal units in Europe: results from the MOSAIC cohort. *Arch Dis Child Fetal Neonatal Ed* 2011; 96: 450–2.