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Infant Behavior & Development 28 (2005) 74–81
Infant Behavior & Development

Short communication

Massage therapy facilitates mother–infant interaction in premature infants

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Received 30 March 2004; received in revised form 9 July 2004; accepted 26 July 2004

Abstract

Preterm infants ($n = 51$) received massage therapy in the NICU by their mothers or a female researcher, or no massage (controls). At 3 months, mothers of massaged infants were less intrusive, interactions were more reciprocal, and treated infants were more socially involved compared to controls.

Keywords: Massage therapy; Preterm infants; Mother–infant interaction

Abbreviations: NICU, Neonatal Intensive Care Unit; CIB, Coding Interactive Behavior

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0163-6383/$ – see front matter © 2004 Published by Elsevier Inc.
doi:10.1016/j.infbeh.2004.07.004

Table 1
Infant possible intervening variables (mean ± S.D.)

	Staff group ($n = 18$)	Mothers group ($n = 18$)	Control group ($n = 19$)	p
Gestational age[a]	32.056 ± 1.73	30.72 ± 1.96	31.16 ± 2.11	0.12
Birth weight[a]	1539 ± 330	1314 ± 337.3	1312 ± 376.8	0.09
Weight at onset of intervention	1439 ± 304.0	1365 ± 265.9	1338 ± 306.5	0.56
CRIB	0.80 ± 0.94	1.00 ± 1.08	1.89 ± 2.19	0.092

[a] Used to match the random clusters a priori and analyzed postfactum.

Premature birth and the subsequent separation between mother and infant have been shown to have a negative effect on the development of mother–infant relationships (Haut, Peddicord, & O'Brien, 1994). Premature birth deprives the infant not only of the protective and nurturing environment of the mother's womb but also of the benefits of maternal proximity and contact. Numerous studies in animals and humans have documented negative effects of early social deprivation on social responsiveness and psychobiological functioning (Dawson, Ashman, & Carver, 2000). It has been suggested that early separation may compromise the child's later ability to respond to social cues (Klaus & Kennel, 1976; Tessier et al., 1998). In addition, due to the premature infant's immature neurological development, such infants often display a limited repertoire of social behavior and their communicative signals are often unclear (Malatesta, Culver, Tesman, & Shepard, 1989). Failure to understand the infant's interactive behavior may lead to intrusive and over stimulating mothering (e.g. Crnic, Ragozin, Greenberg, Robinson, & Basham; Greene, Fox, & Lewis, 1983).

The negative effects of maternal separation on social, cognitive, and physiological functioning have been shown to decrease following handling in animal models (e.g. Meaney et al., 1991). In human preterm and full-term infants, mother–infant skin-to-skin contact improves the infant's neurobehavioral development and social responsivity and the mother's sensitivity and reciprocity with her infant (Feldman, Eidelman, Sirota, & Weller, 2002; Feldman, Weller, Sirota, & Eidelman, 2002; Ferber & Makhoul, 2004; Field, 1995). Massage therapy, a "handling-like" procedure (Field et al., 1986), was found to promote the preterm infant's growth and sleep–wake cyclicity maturation and to improve mother–infant interaction in depressed mothers and their infants (Ferber, Kuint, et al., 2002; Ferber, Laudon, Kuint, Weller, & Zisapel, 2002; Onozawa, Glover, Adams, Modi, & Kumar, 2001). Thus, the current study aimed to investigate the effect of postnatal infant massage administered by either staff members or mothers compared to controls on mother–infant interactions.

Fifty-one mothers and infants who were recruited from three medical centers in central Israel, accounting for 20% of preterm deliveries throughout the country participated in this study. The Institutional Review Boards for Human Experimentation in all three medical centers participating in the study approved the protocol and all parents provided written informed consent. The subjects were assigned as dyads to three groups using the random cluster design: one treatment group in which the mothers performed the massage therapy (mothers), another in which the trained female figure who administered the massage was unrelated to the infant (staff), and no-massage controls (control group [CG]). Gender distribution and maternal parity did not significantly differ between groups. The clusters were matched for variables considered a priori as possibly intervening with the outcome measures (Table 1). Birth weight and gestational age were matched for treatment or control only, considering these two variables most relevant to the treatment utilized, not the identity of the performing person (Ferber, Kuint, et al.,

2002). To prevent parental bias, clusters were treated using the "wash out" procedure (Ferber, Kuint, et al., 2002), namely without any subjects being assigned to different groups at the same time in the same nursery room. This meant not recruiting additional mothers until the current cluster left the room, which prevented the possibility of having women of two different groups in the same room at the same time. Data on the weight gain of these infants have been published (Ferber, Kuint, et al., 2002).

Exclusion criteria were: (1) genetic anomalies, congenital heart malformations, gastrointestinal disturbances and central nervous system dysfunction; (2) age <5 days; (3) considered medically unstable and not weaned from ventilatory assistance; (4) receiving medication other than theophylline; (5) parenteral nutrition only. The Clinical Risk Index for Babies (CRIB International Neonatal Network, 1993), an objective measure of infant medical risk for infants born prematurely, was assessed on the basis of the entire hospitalization period and was used to ensure group similarity at baseline.

Massage therapy was adapted, with some modifications, from the Field et al. (1986) protocol. The technique, rhythm and shape of movements, as well as number of movements per second of the massage therapy, and global approach to the different regions of the baby's body were adapted from Field (1992). The kinesthetic portion of Field's procedure was omitted because we aimed to study the effect of touch exclusively, and the massage session was extended from the original 5 min at the beginning and 5 min at the end to 15 min. The treatment was administered three times daily, at the beginning of each of three successive hours, over the period of 10 days. Massage therapy was scheduled each day between feedings, and began 20 min after the end of feeding. The massages were scheduled during the daytime only (08:00–19:00 h). The infant was left alone twice during the 45-min breaks between the three 15-min sessions. Massage therapy comprised of stroking all over the baby who lay in an incubator on an open diaper. Each 15-min session was composed of two segments: one while the infant was lying prone, and the other while supine. Between the first and the second segments the infant was turned over. Each segment of the session lasted 7 min, 30 s, and comprised of two parts: during the initiation part (10 s), two hands were laid on the baby's head without any movement; during the main treatment (7 min, 20 s), the infant was stroked slowly by hand movements from the head towards the legs, and back again towards the head. Smooth slow stroking movements were used with minimum of direction change in the stroking hands. Treatment was administered in a closed incubator through its portholes. Medium pressure was applied for the duration but did not alter skin color and did not reach the bones. Chest and stomach regions were not massaged. The massage was provided on a 10-day, daily treatment schedule. In order to facilitate compliance with the study procedures, one no-treatment day was included for all groups during the second half of the intervention period.

Neither additional medical interventions nor touching by the parents were permitted during the 3 h of the daily sessions and breaks, and during the matched times within the control group. The massage was considered part of the daily treatment schedule of the participating infants.

To ensure uniform administration of the procedure, medium pressure was demonstrated and practiced before study onset by physically pressing the mothers' and the research assistants' (therapists) hands first lightly and then more firmly. In this manner the moderate pressure was both experienced and evident visibly by muscle contraction of the trainer's hand. Training was performed initially for the therapists. Mothers were trained individually following consent. Reliability of treatment procedure was maintained by having one trainer (the first author) for all therapists and mothers and by periodical observations of massage administrations during the trainer's site visits. Three regular telephone calls were made to all mothers on days 1 or 2, 5 or 6, and 9 or 10. Mothers also performed massage therapy twice, once on days 1 through 3 and once on days 7 through 9, in the presence of a professional site-visitor who monitored their

compliance with the procedure. Mothers who were excluded from the study for reasons of noncompliance were treated as "study subjects" for "wash out" considerations. The total refusal rate to participate after being informed of the group assignment was 14%. The total attrition rate for all reasons after 3 days of participation in the study was 10.5%. At 3 months of age, 51 infants participated (7% attrition rate out of the total number of participants at conclusion of intervention). Causes for dropout were parents' personal reasons, change in infant's medical condition, or difficulties in conforming to the experimental procedure as observed by the research team. This information was monitored through the aforementioned telephone calls and site visits. Mothers in the mothers group massaged their infants according to the study protocol during 10 days and then ceased giving massages.

At 3 months, mothers and infants were seen at home. Each mother–infant dyad was videotaped in a play situation during the day (10:00–19:00 h) following the mother's subjective observation and declaration that the infant was neither tired nor hungry, had eaten and slept well during the previous hours, and both were ready for play. The infant was placed in a mobile infant seat on the floor facing the mother. The mother was seated on a rug facing the infant in a position that allowed eye contact and face-to-face interaction. The distance between the infant and the mother was approximately 45 cm and the angle between their seating positions was 45° with both facing the camera. The mother was asked to play with the infant as she normally does, in accordance with previous studies (Feldman, Weller, Sirota, & Eidelman, 2003). Filming lasted 10 min, preceded by a 5-min period of warm-up and preparations. The camera was positioned on the research assistant's shoulder in one position for the entire filming period, i.e. neither the research assistant nor the camera moved. The camera focused upon the infant and the upper half of the mother's body, including her hands. The filming angle allowed observation of at least 75% of their faces.

Interactions were coded with the Coding Interactive Behavior Manual (CIB: Feldman, 1998). The CIB is a global rating system of parent–child interaction, with versions for newborn, infant and toddler. The CIB includes 42 codes: 21 for parents, 16 for infants, and 5 for dyads, rated on a 5-point scale ranging from 1 = low to 5 = high. Codes were averaged into four composites, in line with our previous research. The CIB has been validated in studies of healthy and at-risk dyads and has shown sensitivity to infant age and cultural setting, to parent gender and different interacting adults, to biological and emotional risk conditions, and to improvement following intervention (e.g. Feldman & Klein, 2003; Feldman, Masalha, & Nadam, 2001; Feldman et al., 2003; Mayes et al., 1997). Composites, codes, and internal consistency were as follows:

(1) Maternal Sensitivity based on 10 items: acknowledgement of the infant's interactive signals, elaboration of the child's vocalizations and movements, warm and positive affect, affectionate tone of voice, fluency of the interaction, consistency of style, resourcefulness in dealing with the infant's negative states, appropriate range of affect, and adaptation to the infant's state and signals ($\alpha = 0.92$). (2) Maternal Intrusiveness included three items; mother looking away from the infant, interrupting the infant's attention or activity, and mother-led interactions ($\alpha = 0.78$). (3) Child's Social Involvement included five items; child initiation of interactive bids, child's positive affect, child's vocalization, child's alertness, and infant-led interactions ($\alpha = 0.86$). (4) Dyadic Reciporocity based on 3 items: reciprocity, adaptation and regulation, and fluency ($\alpha = 0.89$).

Only the final 5 min of the videotaped observation, the "play situation", were coded. The previous minutes were referred to as "moments of habituation to the increased anxiety" due to the presence of the camera. Global 5-min interactions were coded off-line (i.e. overall session scores with no sub-divisions) on a coding grid. Coding was conducted in a university laboratory by two coders who were blind to infant

Table 2
Mother–infant dyadic interaction

	Staff group ($n = 15$)	Mothers group ($n = 19$)	Control group ($n = 17$)	F	p value
Child social involvement	4.29 ± 0.64	4.15 ± 0.53	3.52 ± 1.08	4.44	0.01
Dyadic reciprocity	2.46 ± 0.99	2.42 ± 0.87	1.66 ± 0.68	4.69	0.01
Maternal sensitivity	3.58 ± 0.74	3.66 ± 0.66	3.16 ± 1.05	1.78	0.18
Maternal intrusiveness	1.68 ± 0.63	1.97 ± 0.91	2.54 ± 1.01	4.05	0.02

group membership and trained to 85% reliability on all codes. Inter-rater reliability was computed on ten mother–infant interactions and reliability averaged 92%, $\kappa = 0.81$.

Multivariate analysis of variance (MANOVA) revealed that mother–infant interactions were more optimal in the treated groups compared to controls [Wilks' Lambda $F(4,46) = 2.37$, $p = 0.023$]. Univariate analysis showed differences in three interactive composites; mother–infant dyads in the two massage groups showed more dyadic reciprocity [$F(2,48) = 4.69$, $p = 0.013$] and the infants in these groups were more socially involved [$F(2,48) = 4.44$, $p = 0.017$], compared to controls. Maternal intrusiveness was higher in the controls compared to the two treatment groups [$F(2,48) = 4.05$, $p = 0.023$]. Duncan's test showed that both massaged groups were different from the controls and no differences were found between infants in the mother-massage and professional massage groups (Table 2 and Fig. 1).

Results of this study suggest that massage therapy applied in the neonatal period facilitates a more optimal mother–infant interaction at 3 months of age. These findings are consistent with previous research showing more maternal competence, positive affect, and adaptation to infant cues, following touch inter-

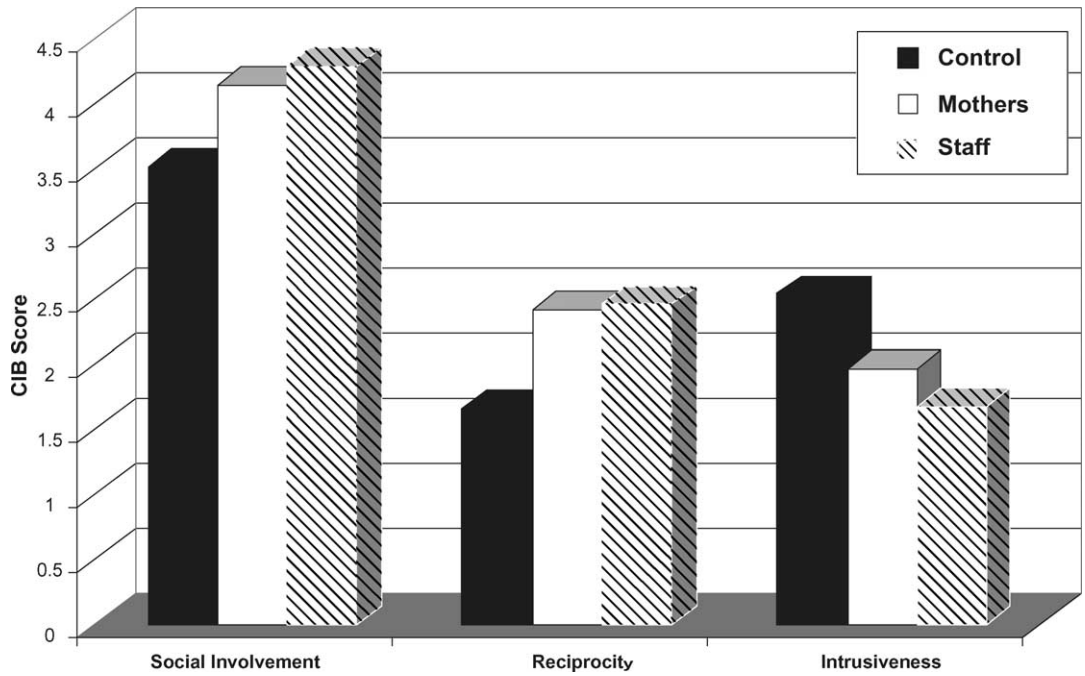

Fig. 1. Differences in mother–infant interaction between treated groups and controls.

ventions (Feldman, Eidelman, et al., 2002; Tessier et al., 1998), as well as increased infant alertness and decreased stress (Acolet et al., 1993; Feldman, Eidelman, et al., 2002; Ferber & Makhoul, 2004). Ecological and transactional models of infant social-emotional development suggest that the mother–infant relationship develops in a reciprocal, bi-directional manner over time (e.g. Sameroff & Fiese, 2000). Applying a transactional perspective, the findings suggest that massage therapy has long-term effects on infant social skills, the mother's behavior, and the degree of reciprocity between mother and child.

In general, massage therapy resulted in long-term effects regardless of the identity of the massaging figure. Specifically, maternal intrusiveness, an interactive style that is typical of mothers of premature infants and is related in part to the infant's passivity, was higher in the control than in the treated groups although mothers did not differ in the level of sensitivity. These findings suggest that massage therapy supports preterm dyads by enhancing their relationship in the NICU even without the immediate participation of the mother in the intervention (Parker, Zahr, Cole, & Brecht, 1992). Thus, touch therapy may decrease typical disruptions to the development of the mother–infant relationship in premature dyads.

Regarding the overall pattern of the results, and in agreement with the animal literature, it is possible that human touch has special effects on the premature newborn, which contribute to neurobehavioral development regardless of the massaging person. This is in accordance with studies showing that touch decreases the physiological response of the newborns to maternal deprivation (e.g. Kuhn & Schanberg, 1998; Schanberg & Field, 1987). Similarly, Kisilevsky, Stack, and Muir (1991) have concluded that touch in early life serves the functions of eliciting attention, modulating affect and maintaining social interaction. Thus, human touch and not the familiar figure, is likely to predict higher social involvement in the treated infants.

It has been suggested that neonatal development contains "sensitive periods", in which certain inputs are required for optimal development of the central nervous system (Feldman, Eidelman, et al., 2002; Feldman, Weller, et al., 2002; Tucker, 1992). Touch and contact are important environmental inputs during the immediate post-birth period (Suchecki, Rosenfeld, & Levine, 1993). Touch is the earliest sense to develop embryologically (Montagu, 1971) and precedes other modes of sensory development such as vision and audition (Gotttlieb, 1991). It is possible that massage therapy utilized in the NICU, during an important "sensitive" period may reduce the negative effects of maternal separation and lead to improved infant self-regulation and social responsiveness regardless of the identity of the massaging figure. The more self-regulated infant may be able to communicate in a more coherent manner. This in turn may increase the reciprocity between mother and child. Animal studies have similarly shown that maternal behavior in rats is pup-induced (Villescas, Bell, Wright, & Kufner, 1977). Mother–infant synchrony has been associated with improved self-regulation and later language acquisition and is significantly reduced in preterm dyads (Feldman, Greenbaum, & Yirmiya, 1999; Lester, Hoffman, & Brazelton, 1985). Alternatively, perhaps the infants who received massage were alert for longer periods of time as reported earlier (Dieter, Field, Hernandez-Reif, Emory & Redzepi, 2003; Field et al., 1986). Alertness in the immediate postnatal period may reduce passivity typical of preterm infants' interaction and enhance earlier and more frequent interaction with adults. This could result in increased infant social involvement at 3 months. Thus, the massage intervention, which has been shown here to improve reciprocity, is of clinical importance.

The limitations of this study relate to the relatively small sample size. In addition, the generalization of the results is limited to middle-class, highly educated mothers and should be examined in other groups. The present findings, in addition to a body of previous research, demonstrate that massage therapy may be an important intervention for the high-risk premature infant.

Acknowledgements

The Social Science Dean's Scholarships and the Research Authority, Bar Ilan University supported this study. The Paula Rich Multidisciplinary Center (A.W.), and the Gonda Brain Research Center (R.F. and A.W.), Bar-Ilan University, are thanked for partial support of our research. We are most thankful to all infants and parents participating in this study. We are indebted to T.M. Field, Ph.D. for fruitful discussions, and gratefully acknowledge her contribution. We also thank N. Zisapel, Ph.D. for critical comments on a previous draft of this manuscript. Our appreciation also to all our research teams and medical crews at Wolfson and Chaim Sheba Medical Centers and Lis Maternity Hospital, Tel Aviv Sourasky Medical Center, for their good will and professionalism in assisting with the study procedures at all times. A fuller report of this study will be provided upon request.

References

Acolet, D., Modi, N., Giannakoulopoulos, X., Bond, C., Weg, W., Clow, A., et al. (1993). Changes in plasma cortisol and catecholamine concentrations in response to massage in pre-term infants. *Archives of Diseases in Childhood*, *68*, 29–31.

Crnic, K. A., Ragozin, A. S., Greenberg, M. T., Robinson, N. M., & Basham, R. B. (1983). Social interaction and developmental competence of preterm and full-term infants during the first year of life. *Child Development*, *54*, 1199–1210.

Dawson, G., Ashman, S. B., & Carver, L. J. (2000). The role of early experience in shaping behavioral and brain development and its implications for social policy. *Developmental Psychopathology*, *12*, 695–712.

Dieter, J. N., Field, T., Hernandez-Reif, M., Emory, E. K., & Redzepi, M. (2003). Stable preterm infants gain more weight and sleep less after five days of massage therapy. *Journal of Pediatric Psychology*, *28*(6), 403–411.

Feldman, R. (1998). *Coding interactive behavior manual*. Unpublished manual, Bar-Ilan University, Israel.

Feldman, R., Eidelman, A. I., Sirota, L., & Weller, A. (2002). The effects of skin to skin contact (Kangaroo care) on parenting and infant development in premature infants. *Pediatrics*, *110*, 16–26.

Feldman, R., Greenbaum, C. W., & Yirmiya, N. (1999). Mother–infant affect synchrony as an antecedent of the emergence of self-control. *Developmental Psychology*, *35*, 223–231.

Feldman, R., & Klein, P. S. (2003). Toddlers' self-regulated compliance with mother, caregiver, and father: Implications for theories of socialization. *Developmental Psychology*, *39*, 680–692.

Feldman, R., Masalha, S., & Nadam, R. (2001). Cultural perspective on work and family: Dual-earner Jewish and Arab families at the transition to parenthood. *Journal of Family Psychology*, *15*, 492–509.

Feldman, R., Weller, A., Sirota, L., & Eidelman, A. I. (2002). Skin to skin contact (Kangaroo care) promotes self regulation in premature infants: Sleep–wake cyclicity, arousal modulation, and sustained exploration. *Developmental Psychology*, *38*, 194–207.

Feldman, R., Weller, A., Sirota, L., & Eidelman, A. I. (2003). Testing a family intervention hypothesis: The contribution of mother–infant skin-to-skin contact (Kangaroo Care) to family interaction and touch. *Journal of Family Psychology*, *17*, 94–107.

Ferber, S. G., Kuint, J., Weller, A., Feldman, R., Dollberg, S., Arbel, E., et al. (2002). Massage therapy by mothers and trained professionals enhances weight gain in preterm infants. *Early Human Development*, *67*, 37–45.

Ferber, S. G., Laudon, M., Kuint, J., Weller, A., & Zisapel, N. (2002). Massage therapy by mothers enhances the adjustment of circadian rhythms to the nocturnal period in full-term infants. *Journal of Developmental Behavioral Pediatrics*, *23*, 410–415.

Ferber, S. G., & Makhoul, R. I. (2004). The effect of skin-to skin contact (Kangaroo Care) shortly after birth on the neurobehavioral responses of the full-term newborn: A randomized controlled trial. *Pediatrics*, *113*, 858–865.

Field, T. (1992). Interventions in early infancy. *Infant Mental Health Journal*, *13*, 329–336.

Field, T. (1995). Infant massage therapy. In T. Field (Ed.), *Touch in early development* (pp. 105–114). NJ: Lawrence Erlbaum.

Field, T. (1998). Early interventions for infants of depressed mothers. *Pediatrics*, *102*, 305–310.

Field, T. M., Schanberg, S. M., Scafidi, F., Bauer, C. R., Vega-Lahr, N., Garcia, R., et al. (1986). Tactile/kinesthetic stimulation effects on preterm neonates. *Pediatrics*, *77*, 654–658.

Gotttlieb, G. (1991). Experiential canalization of behavioral development theory. *Developmental Psychology*, *27*, 4–13.
Greene, J. G., Fox, N. A., & Lewis, M. (1983). The relationship between neonatal characteristics and three-month mother–infant interaction in high-risk infants. *Child Development*, *54*, 1286–1296.
Haut, C., Peddicord, K., & O'Brien, E. (1994). Supporting parental bonding in the NICU: A care plan for nurses. *Neonatal Network*, *13*, 19–25.
International Neonatal and Network. (1993). CRIB (Clinical Risk Index for Babies) score: A tool for assessing initial neonatal risk and relationships with nonmedical factors. *Developmental Behavioral Pediatrics*, *342*, 193–198.
Klaus, M. H., & Kennel, J. H. (1976). Caring for parents of a premature sick infant. In M. H. Klaus & J. H. Kennel (Eds.), *Maternal-infant bonding*. St. Louis: Mosby.
Kisilevski, B. S., Stack, D. M., & Muir, D. W. (1991). Fetal and infant response to tactile stimulation. In M. J. Salomon-Weiss & P. R. Zelazo (Eds.), *Newborn attention: Biological constraints and the influence of experience* (pp. 63–98). NJ: Albex.
Kuhn, C. M., & Schanberg, S. M. (1998). Responses to maternal separation: Mechanisms and mediators. *International Journal of Developmental Neuroscience*, *16*, 261–270.
Lester, B. M., Hoffman, J., & Brazelton, T. B. (1985). The rhythmic structure of mother–infant interaction in term and preterm infants. *Child Development*, *56*, 15–27.
Malatesta, C. Z., Culver, C., Tesman, J. R., & Shepard, B. (1989). The development of emotion expression during the first two years of life. *Monographs of the Society for Research in Child Development*, *54*(1/2), 1–104.
Mayes, L. C., Feldman, R., Granger, R. H., Heynes, O. M., & Borenstein, M. H. (1997). The effects of polydrug use with and without cocaine on mother–infant interaction at 3 months and 6 months. *Infant Behavior and Development*, *20*, 489–502.
Meaney, M. J., Mitchell, J. B., Aitken, D. H., Bhatnagar, S., Bodnoff, S. R., Iny, L. J., et al. (1991). The effects of neonatal handling on the development of the adrenocortical response to stress: Implications for neuropathology and cognitive deficits in later life. *Psychoneuroendocrinology*, *16*(1–3), 85–103.
Montagu, A. (1971). *Touching: The human significance of the skin*. New York: Columbia University Press.
Onozawa, K., Glover, V., Adams, D., Modi, N., & Kumar, R. C. (2001). Infant massage improves mother–infant interaction for mothers with postnatal depression. *Journal of Affective Disorders*, *63*, 201–207.
Parker, S. J., Zahr, L. K., Cole, J. G., & Brecht, M. (1992). Outcome after developmental intervention in the neonatal intensive care unit for mothers of preterm infants with low socioeconomic status. *Journal of Pediatrics*, *120*, 780–785.
Sameroff, A. J., & Fiese, B. H. (2000). Models of development and developmental risk. In C. H. Zeanah (Ed.), *Handbook of infant mental health*. NY: Guilford Press.
Schanberg, S. M., & Field, T. M. (1987). Sensory deprivation stress and supplemental stimulation in the rat pup and preterm human neonate. *Child Development*, *58*, 1431–1447.
Suchecki, D., Rosenfeld, P., & Levine, S. (1993). Maternal regulation of the hypothalamic-pituitary-adrenal axis in the infant rat: the roles of feeding and stroking. *Brain Research Developmental Brain Research*, *75*, 185–192.
Tessier, R., Cristo, M., Velez, S., Giron, M., de Calume, Z. F., Ruiz-Palaez, J. G., et al. (1998). Kangaroo mother care and the bonding hypothesis. *Pediatrics*, *102*, e17.
Tucker, D. M. (1992). Developing emotions and cortical networks. In M. R. Gunnar & C. A. Nelson (Eds.), *Developmental behavioral neuroscience (The Minnesota Symposia on Child Psychology, Vol. 24)*. Hillsdale, NJ: Erlbaum.
Villescas, R., Bell, R. W., Wright, L., & Kufner, M. (1977). Effect of handling on maternal behavior following return of pups to the nest. *Developmental Psychobiology*, *10*(4), 323–329.