

Effects of Infant Massage on Cognitive, Motor, and Social-Emotional Functioning in High-Risk Infants

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The cognitive, motor, and social-emotional outcomes of infant massage were examined in nine studies of high-risk infants. These studies included 311 children, 159 of whom received infant massage. Infant massage is characterized by a systematic protocol that consists of both tactile stimulation with moderate pressure and kinesthetic stimulation that takes the form of rocking or passive extension and flexion of limbs. Despite investigators' claims regarding the benefits of this form of massage on the cognitive, motor, and social-emotional development in high-risk infants, serious methodological flaws indicated that a number of rival explanations are equally plausible for explaining positive findings. Currently, there is insufficient evidence to support the use of this practice for improving cognitive, motor, and social-emotional outcomes in high-risk infants.

Purpose

The purpose of this practice-based research synthesis is to investigate the effectiveness of infant massage for improving cognitive, motor, and social-emotional outcomes in infants at high risk for developmental delays. The infant massage practice that constituted the focus of this synthesis consists of a manipulation of the infant's body that combines tactile (touch) and kinesthetic (movement) stimulation performed in a purposeful and sequential application.

The conduct of the research synthesis is guided by a framework that focuses on the degree to which variations in the infant-massage intervention was associated with variations in cognitive, motor, and social-emotional outcomes (Dunst, Trivette, & Cutspec, 2002). In general terms, a practice-based research synthesis differs from more traditional meta-analyses by systematically examining and unpacking the characteristics of practices that are related to differences in outcomes or consequences. Specifically, this type of analysis focuses more on an understanding of *how* the same or similar characteristics exert the same or similar observable effects and not solely on statistical or observation-based relationships between or among these variables.

Background

High-risk infants are at increased risk for developmental delays as a consequence of events that occur prior to, during, or after birth, such as: exposure to toxins, labor

and delivery problems, low birthweight/prematurity, or family psychosocial factors. A myriad of early intervention programs have been initiated in an effort to curtail the likelihood of poor developmental outcomes among these children. The majority of these programs consist of sensory-enrichment interventions, which are based on the underlying assumption that high-risk infants suffer from sensory deprivation that then impedes normal physiological, mental, and emotional development (Feldman & Eidelman, 1998). It is hypothesized that appropriate forms of sensory enrichment may enhance the infant's capability to respond behaviorally to his/her environment. It is also assumed that an improved ability to interact with the environment may increase infant responsiveness. This, in turn, may positively influence the infant's interactions with caregivers, and thus, improve the developmental outcomes for these children (Leib, Benfield, & Guidubaldi, 1980; Sameroff & Emde, 1978).

Sensory-stimulation interventions administered to high-risk infants have taken a variety of forms. One form of

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stimulation that has been studied extensively in the research literature is a combination of tactile and kinesthetic stimulation. The popularity of this form of stimulation emanates from the widely recognized importance of tactile stimulation in early neurological development (Montague, 1986), as well as its importance in cultivating the parent-infant relationship. In addition, researchers have argued that tactile and kinesthetic sensory modalities are the most appropriate to engage in stimulation interventions, because they are among the most highly developed sensory systems at the time of birth (Ross, 1984).

To date, two systematic reviews of the effects of tactile stimulation on at-risk infants have been conducted. Ottenbacher, Muller, Brandt, Heintzleman, Hojem, and Sharpe (1987) employed meta-analysis to examine the effectiveness of tactile stimulation in 19 studies that included a range of outcome measures (e.g., physiological, motor, reflex, social, visual, and auditory). The authors reported that study participants in the treatment groups performed better than 72% of children in control groups. The results of this meta-analysis, however, are difficult to interpret, because the authors included studies that used a combination of tactile stimulation and other types of sensory input (i.e., multimodal treatments). In addition, the types of tactile stimulation were quite varied, ranging from massage, to non-nutritive sucking and oscillating waterbeds. In addition, Ottenbacher and colleagues reported that study results were strongly influenced by the quality of study designs, such that poorly designed studies were more likely to produce outcomes that favored the intervention group.

More recently, Vickers, Ohlsson, Lacy and Horsley (2003) reviewed the literature on the effects of infant massage for promoting the growth and development of at-risk infants. The primary focus of their review was on physiological and clinical outcomes (e.g., weight gain and length of hospital stay). These authors also included studies that used multimodal interventions in which massage was a component. Studies that investigated rubbing and stroking were included, as well as studies where the intervention consisted of still, gentle touch. The authors reported no effects for still, gentle touch interventions. For massage interventions involving rubbing and/or stroking, moderate improvements in daily weight gain and length of hospital stay were found. The authors stated, however, that the credibility of the study findings was compromised by methodological flaws inherent in the studies reviewed.

This current research synthesis is the first to specifically examine the effects of infant massage on cognitive, motor, and social-emotional outcomes for infants at risk for developmental delays. It also differs from previous systematic reviews by virtue of its focus on infant-massage interventions that are comprised exclusively of tactile and kinesthetic components and that are implemented in a structured and systematic manner.

Description of the Practice

The infant-massage practice that is the focus of this research synthesis is comprised of both a tactile stimulation component (i.e., maneuvers that activate the exteroceptors in the skin, resulting in the sensation of touch) and a kinesthetic stimulation component (i.e., maneuvers that activate the proprioceptors in the joints, resulting in the sensation of kinesthesia, position sense, or joint movement) that are performed in a purposeful, sequential application. Tactile stimulation consists of systematic stroking and/or rubbing that is applied gently, but with a moderate degree of pressure (enough to stimulate pressure receptors and avoid creating a tickling sensation). Kinesthetic stimulation consists of either passive extension and flexion of limbs or rocking.

Although there were some variations in the protocol for the tactile/kinesthetic stimulation model of infant massage, the protocol developed by Field and her colleagues (1986) has been used most often in published research studies. This protocol specifies that the infant receive three 15-minute sessions during three consecutive hours on a daily basis for a total of 10 days. Each 15-minute session is comprised of three components: (1) a five-minute tactile phase in which the infant is placed in the prone position and stroked with the flat fingers of both hands (with or without some form of lubricant), then 12 five-second strokes are delivered in a prescribed sequence (see Table 1); (2) a second five-minute kinesthetic phase in which the infant is placed in the supine position and six passive flexion/extension movements are administered to the right arm, left arm, right leg, left leg, and both legs together, with each movement lasting 10 seconds; and (3) a five-minute tactile phase that is identical in composition to the first phase.

Search Strategy

Search Terms

Identification of relevant studies was accomplished by using the keywords infant massage, touch therapy, and tactile stimulation. An author search (Tiffany Field) was also conducted.

Sources

A computer-assisted bibliographic search was conducted using Psychological Abstracts (PsycINFO), Educational Resources Information Center (ERIC), Social Science Citation Index (SSCI), MEDLINE, Cochrane Database of Systematic Reviews (CDSR), Cochrane Central Register of Controlled Trials (CENTRAL), Database of Abstracts of Reviews of Effects (DARE), Cumulative Index to Nursing and Allied Health Literature (CINAHL), InfoTrac OneFile, Expanded Academic ASAP, and Academic Search Elite. An online search via the Google search engine was also conducted. The reference lists of all acquired sources were reviewed in order to locate additional sources that may

have been omitted from the bibliographic search findings. Finally, a bibliography of massage-therapy literature located on the University of Miami's Touch Research Institute website was also reviewed (<http://www.miami.edu/touch-research/>).

Selection Criteria

Studies were included in the research synthesis if they met the following criteria: (1) the focus of the study was to establish the effectiveness of infant massage as a form of sensory enrichment for infants at risk for later developmental delays; (2) the infant-massage intervention was described in sufficient detail to ascertain that it exhibited the characteristics outlined in the Description of the Practice section of this synthesis; (3) infants in the study sample were at high risk for developmental disabilities as a consequence of premature birth (< 37 weeks), low birth-weight (< 2500 g), a medical condition (e.g., HIV or cocaine exposure), and/or the presence of a high-risk mother (e.g., depression, poverty, etc.); and (4) the study included at least one infant measure of cognitive, motor, or social-emotional outcomes.

Exclusion criteria. It was necessary to exclude certain studies that appeared to have met all of the inclusion criteria during the initial phase of the search process. Specifically, excluded studies were those that (1) presented data that was identical to those presented in a previously published journal article (e.g., Rice, 1979; Scafidi et al., 1986); (2) employed a tactile intervention that lacked a kinesthetic component (e.g., Cigales, Field, Lundy, Cuadra, & Hart, 1997; Onozawa, Glover, Adams, Modi, & Kumar, 2001); (3) employed tactile/kinesthetic stimulation as part of a multimodal intervention (e.g., Koniak-Griffin & Ludington-Hoe, 1988; Scholz & Samuels, 1992); (4) employed a touch-therapy technique that does *not* consist of stroking with moderate pressure, such as TAC TIC therapy, Kangaroo Care, and Gentle Human Touch (e.g., de Roiste & Bushnell, 1993; Feldman, Eidelman, Sirota, & Weller, 2002); and (5) only contained parent-level outcomes (e.g., Cullen, Field, Escalona, & Hartshorn, 2000).

Search Results

A total of nine studies met the selection criteria and were included in the research synthesis. Eight studies were published in peer-reviewed journals, and one study (Dieter, 1999) was an unpublished dissertation. One study in this synthesis constituted a follow-up investigation of an original study. Specifically, the Schanberg and Field (1987) study presents follow-up data on a subset of families who participated in the Field et al. (1986) study.

Participants

Table 2 summarizes the characteristics of the infant study participants. The nine studies included 311 in-

ants, of which, 159 received infant massage and 152 served as control- or comparison-group participants. The vast majority of study samples (78%) consisted of medically stable preterm infants, with a mean gestational age of 33 weeks and a mean gestational weight of 1,815 grams across the studies. From the information that was available regarding infant gender and ethnicity, it appears that study samples included roughly equal proportions of male and female infants and that the vast majority of these infants were either African-American or Hispanic (89% across all studies).

Only four of the studies (44%) specified the infant's age at the time the intervention was initiated. There was a large degree of variability across studies regarding the timing of intervention initiation, ranging from 2 to 90 days following the infants' birth.

Characteristics of Infant-Massage Intervention

Selected characteristics of the infant-massage intervention implemented in each study are presented in Table 3. The environments in which the infant massage was administered include hospital nurseries (78%), the family's home (11%), and the nursery school attended by the infant (11%). Seven studies identified the individual who administered the infant-massage intervention. Of these seven studies, 43% reported that infant massage was administered by a research staff member (e.g., investigator, research assistant). One study used the mother to administer the massage, while another study reported that the intervention was administered by a research staff member during the infant's first five days of life, and then by the mother for the remainder of the study. In two studies, either research staff or a hospital nurse administered the intervention.

All studies outlined a standardized infant-massage protocol, in which the type of stroking, number of strokes, order of body parts to be stroked, and duration of tactile/kinesthetic components were specified. In all but one study, the kinesthetic component of the infant-massage intervention consisted of passive flexion and extension of the infant's arms and legs. In the Rice (1977) study, infants were swaddled in a blanket and rocked. A 10-day treatment phase was used in 67% of the studies, while one study employed a 30-day treatment phase and another implemented a 42-day treatment phase. In the Mathai et al. (2001) study, infants were massaged from their third day of life until their term-corrected age. Duration of individual treatment sessions was 15 minutes across all studies, with most studies (78%) delivering three treatment sessions each day to the infants. One study delivered treatment sessions at the rate of four per day, while the remaining study administered only two sessions per week. Lubricants (e.g., powder, mineral oil) were used in about one-fourth of the infant-massage interventions protocols.

Research Designs

Table 4 summarizes design characteristics and outcome measures of the studies. All studies employed a between- and within-group design, in which participants were randomly assigned to an infant-massage or a control condition. Four studies used a stratified sampling procedure in which infants were blocked according to characteristics such as birth weight and gestational age, followed by random assignment of blocks to groups. In 78% of the studies, the control group received standard nursery care. One study used an alternative form of supplemental stimulation (rocking in a rocking chair) for the comparison-group intervention, and another study provided infant-care information to the mothers of control-group infants.

Six studies (67%) used a research design that consisted of pre-treatment assessment (O_1), treatment (X), and post-treatment assessment (O_2) components. The remaining three studies (33%) only assessed infants at post-treatment. Only one study (Schanberg & Field, 1987) reported follow-up data. The length of time between post-treatment and the two follow-up assessments in this study was 8 and 12 months.

Information regarding the fidelity of intervention implementation was lacking across all of the studies. Most of the studies simply stated that the intervention was implemented by individuals who underwent extensive training in the standardized protocol used in the study. With regard to outcomes, six studies (67%) reported using raters who were blind to the infants' group status to assess the study participants on the various study outcome measures. Four studies (44%) reported some form of reliability data for outcome measures, and two (22%) provided reliability data for all study outcome measures.

Outcomes

Although most of the studies included physiological/clinical outcomes (e.g., weight gain, sleep/wake data), these outcomes are omitted due to the research synthesis' focus on cognitive, motor, and social-emotional outcomes. Table 4 provides a summary of the specific infant-level outcome measures used in these studies. Six studies (67%) measured outcomes across the three categories, whereas two studies (22%) measured cognitive and motor, but not social-emotional outcomes. The remaining study (Field et al., 1996) measured social-emotional outcomes only.

Cognitive outcomes. Outcomes included the Bayley Scales of Infant Development Mental Development Index (Bayley, 1969), and the Brazelton Neonatal Behavioral Assessment Scale (BNBAS) Habituation component (Brazelton, 1973).

Motor outcomes. Motor outcomes were assessed via observational coding of activity level (e.g., gross body movements, multiple limb movements), as well as through the administration of standardized measures. Standardized

measures assessing the overall quality of motor performance included the Bayley Scales of Infant Development Physical Development Index (Bayley, 1969) and the motor behavior component of the BNBAS (Brazelton, 1973).

Social-emotional outcomes. The methods used to assess social-emotional outcomes included observational coding of particular behaviors, as well as the administration of standardized measures. The social-emotional outcomes assessed by these methods included frequency of crying and/or stress behaviors, excitability, depression, general affect (BNBAS Regulation of State component), social interaction (BNBAS Orientation component), and temperament [BNBAS Range of State and Autonomic Stability components; Colorado Child Temperament Inventory (Rowe & Plomin, 1977)].

Synthesis Findings

Table 5 summarizes the findings regarding the consequences of infant massage reported across all studies. The table indicates whether effects on cognitive, motor, and/or social-emotional outcomes were reported in each study.

Results

Cognitive change. Eight of the nine studies (89%) included some measure of cognitive development. Seven of these studies each presented original data, while Schanberg and Field (1987) presented longitudinal follow-up data from the Field et al. (1986) investigation. All studies relied on a single measure of cognitive change, including a general cognitive-development measure (25%) or a measure of infant habituation (75%). Group differences in cognitive outcomes favoring the infant-massage group were reported in 5 of the 8 studies (63%). It should be noted that group differences were much more robust in studies that utilized the Bayley MDI score as a cognitive outcome measure, relative to studies that employed the BNBAS Habituation score. In these latter studies, the infant-massage group out-performed the control group in half of the studies. Furthermore, the superior performance of the infant-massage group in two of these studies was the consequence of pre/post declines in control-group scores, rather than improvements in the infant-massage group. Schanberg and Field (1987) presented the only longitudinal findings regarding infant massage. They reported that the cognitive gains obtained at the time of post-treatment were maintained at 8 and 12 months.

Motor change. Eight of the nine studies (89%) included a measure of motor development. With one exception (Schanberg & Field, 1987), all of these studies presented original data. Most studies (63%) relied on a single global motor-performance measure to assess motor development, while a few (37%) measured infant-activity level. In all of the studies in which activity level was measured, infants in the intervention group exhibited significantly

increased activity levels during and subsequent to the intervention, relative to the baseline assessment period. In addition, group differences in motor outcomes favoring the infant-massage group were reported in 4 of 8 studies. As with cognitive outcomes, Schanberg and Field reported that the motor gains obtained at the time of post-treatment were maintained at 8 and 12 months.

Social-emotional change. Seven of the nine studies (78%) included some measure of social-emotional development. All studies implemented multiple measures of social-emotional change, using several social-emotional components of the BNBAS (e.g., affect, social interaction, temperament). Five of seven studies (71%) reported group differences in social-emotional outcomes favoring the infant-massage group. The most commonly reported social-emotional consequences of infant massage included decreased stress behaviors (75%) and positive changes in temperament (57%). None of the studies, however, examined the longitudinal stability of changes in social-emotional development.

Rival Explanations

As noted in previous reviews of the infant-massage literature (Vickers et al., 2003), a number of threats to internal validity (Campbell & Stanley, 1963; Cook & Campbell, 1979) and rival explanations (Yin, 2000) could explain the study findings reported above. Perhaps the most compelling rival explanation regarding positive effects of infant massage is that mere extended contact with a caretaker (typically an extra 450 minutes over a 10-day period)—regardless of what transpired during that contact—is the key ingredient to improved developmental outcomes. Only 1 of the 9 studies (Field et al., 1996) controlled for this confound by providing an alternative intervention for the control group that equated the duration of caretaker contact across groups.

In addition to the failure to control for caretaker contact *within* the intervention periods of the studies, most studies also failed to control for caretaker contact *outside* the intervention periods. For instance, it was frequently impossible for nursing staff to remain blind to infants' treatment status. Knowledge of treatment status could likely result in differential treatment by nurses (either provision of compensatory treatment to control infants or more favorable treatment towards infants in the massage group) in an attempt to bolster the results of the investigation. Furthermore, in the "standard nursery care" protocol implemented in 78% of these studies, parents were allowed to handle and feed infants as often as they wished during the course of the investigation. In at least one study (Scafidi et al., 1990), treatment-group infants were fed/handled significantly more times per day by their parents. Therefore, increased parental interaction could have been responsible for group differences. In general, these studies failed

to describe any efforts to ensure that infants in different conditions were treated identically in all respects other than the experimental intervention.

Competing intervention factors also serve as internal validity threats. Although a few studies specifically stated that the person administering the massage remained silent during the intervention, there was no mention of controlling for verbalizations and facial expressions during infant-massage administrations in the majority of studies. In fact, Rice (1977) indicated that the massage administrator "... talked to the baby, caressed him/her, and looked frequently into his/her eyes" during the massage procedure (p. 72). Therefore, exposure to forms of stimulation (social, auditory) other than tactile/kinesthetic may account for positive findings.

Problems with instrumentation also exist, since the vast majority of studies used a single administration of the BNBAS as the sole study outcome measure. This is troublesome because research examining the psychometric properties of the BNBAS cluster scores (Asch, Gleser, & Steichen, 1986) strongly suggests that a single set of scores obtained by one examiner/rater from a single examination contains too much error variability to be reliable. It is generally recommended that the average score of two administrations (with two raters per administration) be used, in order to obtain even minimally acceptable generalizability. Failure to implement multiple measures of the outcomes of interest is a general shortcoming across the studies.

Three final threats to validity included: (1) investigator bias (i.e., the raters who coded observational measures and/or administered clinical assessment outcome measures such as the BNBAS and Bailey Scales were aware of the infants' group status), (2) a lack of treatment fidelity measures to gauge the extent to which infants within the treatment condition of a single study experienced similar doses and characteristics of the infant-massage intervention, and (3) a lack of longitudinal research designs to establish the degree to which treatment gains documented at the post-treatment assessment are sustained over time.

In summary, none of the nine studies included in this synthesis adequately controlled for one or more threats to internal validity or rival hypotheses. Therefore, the positive findings from these studies cannot be conclusively attributed to infant massage.

Conclusion

Despite investigators' claims regarding the benefits of the infant-massage protocol examined in this research synthesis (tactile/kinesthetic stimulation), it cannot be recommended as an evidence-based practice for improving cognitive, motor, or social-emotional development in young high-risk infants at this time. This is due to the inconsistent findings across studies, as well as the myriad of un-

controlled threats to internal validity, the lack of treatment-fidelity procedures, and the lack of longitudinal data. These conclusions are consistent with reviewers' statements regarding the efficacy of massage for promoting growth and development in a recent Cochrane review (Vickers et al., 2003). Furthermore, these conclusions are made in the context of a previous meta-analytic review of tactile stimulation interventions, which demonstrated that poorly designed studies allow confounds and bias to influence the study results and produce outcomes that favor the intervention group (Ottensmeyer et al., 1987).

These conclusions should not be interpreted to mean that infant massage is an ineffective intervention for producing positive outcomes in the cognitive, motor, and social-emotional domains. Instead, the main contention is that investigators have failed to conduct studies in a manner that permits them to document the efficacy of their infant-massage interventions. Also, it is important to keep in mind that the conclusions presented in this research synthesis pertain only to infant-massage protocols that consist of systematic tactile stimulation with moderate pressure and kinesthetic stimulation (e.g., passive extension/flexion of limbs or rocking).

Implications for Research

Given that other forms of touch therapy (i.e., kangaroo care) have been shown to be effective for improving general growth and development (Field, 2001) the infant-massage protocol examined in this research synthesis may hold some promise as an effective intervention practice for promoting cognitive, motor, and social-emotional development in high-risk infants. Future studies should strive to eliminate rival hypotheses, which may account for the positive findings, in order to conclusively determine whether infant massage is an effective intervention and is deserving of its current status as a standard practice for intervening with high-risk infants in neonatal intensive-care units across the country.

There are a number of design features that future studies could employ in order to improve the scientific rigor of infant-massage research. Most important is the inclusion of an alternative intervention for the control group so that duration of caretaker contact is consistent across treatment and control groups. Research designs should also include: (1) a longitudinal assessment component (in order to determine whether immediate treatment gains are sustained over time), (2) multiple outcome measures, (3) blind raters for coding observational measures and administering developmental outcome measures, and (4) mechanisms for documenting treatment fidelity (i.e., the extent to which infant-massage protocols were implemented as intended). Finally, future investigations will need to eliminate competing intervention factors by controlling for exposure to social, auditory, and visual stimulation during

the administration of the infant-massage protocol. Studies that employ these design features will provide a basis for drawing more definitive conclusions regarding the effectiveness of infant massage for enhancing developmental outcomes in high-risk infants.

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Table 1
Tiffany Field's Infant Massage Protocol: Stroking Sequence^a

Step in Sequence	Description of Stroking
1	From top of head, down side of face to neck, back to head
2	From back of neck across shoulders, and back to neck
3	From the upper back down to the waist, and back up
4	From the thighs down to the ankles, and back to thighs
5	From the shoulders to the wrists, back to shoulders

^aAs described in Field, Schanberg, Scafidi, Bauer, Vega-Lahr, Garcia, Nystrom, & Kuhn (1986)

Table 2
Characteristics of Study Participants

Study	Sample Size ^a	Population ^b	Infant Characteristics				Age at Study Baseline (Days)
			Mean Gestational Age (Weeks)	Mean Gestational Weight (Grams)	% Male ^c	Ethnic Breakdown	
Dieter (1999)	30 (15/15)	MS preterm	29	1,341	67%	African American: 60% Caucasian: 30% Hispanic: 10%	NR
Field et al. (1986)	40 (20/20)	MS preterm	31	1,274	NR	African American: NR Caucasian: NR Hispanic: NR	NR
Field et al. (1996)	40 (20/20)	Infants of depressed mothers	39	3,483	NR	African American: 65% Caucasian: 0% Hispanic: 35%	30-90
Mathai et al. (2001)	48 (25/23)	MS preterm	34	1,593	NR	African American: NR Caucasian: NR Hispanic: NR	3
Rice (1977)	29 (15/14)	MS preterm	35	1,957	59%	African American: 76% Caucasian: 17% Hispanic: 7%	NR
Scafidi et al. (1990)	40 (20/20)	MS preterm	30	1,176	38%	African American: 68% Caucasian: 15% Hispanic: 17%	23
Scafidi & Field (1996)	28 (14/14)	HIV-exposed	39	3,023	NR	African American: 67% Caucasian: 0% Hispanic: 33%	2
Schanberg & Field (1987)	26 (15/11)	MS preterm	31	1,274	NR	African American: NR Caucasian: NR Hispanic: NR	NR
Wheeden et al. (1993)	30 (15/15)	MS preterm cocaine-exposed	30	1,212	NR	African American: NR Caucasian: NR Hispanic: NR	NR
Percent (%) & Means Across Studies	311 (159/152)	Preterm: 78% of studies Other: 22% of studies	33	1,815	55%	African American: 67% Caucasian: 12% Hispanic: 21%	9

^aTotal sample size, followed by a breakdown of infants in treatment (infant massage) group and children in control group

^bMS preterm = Medically stable preterm infant

^cNR = Not reported in study

Table 3
Characteristics of the Infant-Massage Interventions

Study	Person Administering Intervention ^a	Standardized Treatment Protocol	Kinesthetic Activity	Lubricant Used	Duration of Treatment Phase	Frequency of Treatment Sessions	Length of Treatment Sessions	Treatment Environment
Dieter (1999)	Research staff	Yes	Passive flexion & extension of limbs	No	10 days	3 per day	15 minutes	Hospital nursery
Field et al. (1986)	NR	Yes	Passive flexion & extension of limbs	No	10 days	3 per day	15 minutes	Hospital nursery
Field et al. (1996)	Research staff	Yes	Passive flexion & extension of limbs	Yes	42 days	2 per week	15 minutes	Nursery school
Mathai et al. (2001)	Research staff & mother	Yes	Passive flexion & extension of limbs	Yes	varied	3 per day	15 minutes	Hospital nursery
Rice (1977)	Mother	Yes	Rocking	No	30 days	4 per day	15 minutes	Infant's home
Scafidi et al. (1990)	Research staff or nurse	Yes	Passive flexion & extension of limbs	No	10 days	3 per day	15 minutes	Hospital nursery
Scafidi & Field (1996)	Research staff or nurse	Yes	Passive flexion & extension of limbs	No	10 days	3 per day	15 minutes	Hospital nursery
Schanberg & Field (1987)	NR	Yes	Passive flexion & extension of limbs	No	10 days	3 per day	15 minutes	Hospital nursery
Wheeden et al. (1993)	Research staff	Yes	Passive flexion & extension of limbs	No	10 days	3 per day	15 minutes	Hospital nursery
Percent (%) Across All Studies	Research staff: 43% Mother: 14% Multiple: 43%	100%	Passive F/E: 89%	22%	10 days: 67%	3 per day: 78%	100%	Hospital nursery: 78%

^aNR = Not reported in study

Table 4
Study Design Characteristics and Outcome Measures

Study	Study Design Characteristics						Outcome Measures		
	Research Design ^a	Control-Group Intervention	Random Assignment to Groups	Use of Blind Raters	Tx Fidelity Data	Outcome-Reliability Data	Cognitive ^b	Motor ^c	Social-Emotional ^d
Dieter (1999)	O ₁ XO ₂ O ₁ O ₂	Standard nursery care	Yes	Yes	No	Partial	BNBAS-H	BNBAS-M Activity level	BNBAS-O BNBAS-Range BNBAS-Reg BNBAS-AS Stress behaviors
Field et al. (1986)	XO ₁ O ₁	Standard nursery care	Yes Stratified	Yes	No	No	BNBAS-H	BNBAS-M Activity level	BNBAS-O BNBAS-Range BNBAS-Reg BNBAS-AS
Field et al. (1996)	O ₁ XO ₂ O ₁ O ₂	Rocking chair	Yes	No	No	Yes	—	—	CCTI Crying
Mathai et al. (2001)	O ₁ XO ₂ O ₁ O ₂	Standard nursery care	Yes	No	No	No	BNBAS-H	BNBAS-M	BNBAS-O BNBAS-Range BNBAS-Reg BNBAS-AS
Rice (1977)	XO ₁ O ₁	Mother receives infant-care information	Yes	Yes	No	Yes	Bayley MDI	Bayley PDI	—
Scafidi et al. (1990)	O ₁ XO ₂ O ₁ O ₂	Standard nursery care	Yes Stratified	Yes	No	Partial	BNBAS-H	BNBAS-M Activity level	BNBAS-O BNBAS-Range BNBAS-Reg BNBAS-AS
Scafidi & Field (1996)	O ₁ XO ₂ O ₁ O ₂	Standard nursery care	Yes	Yes	No	No	BNBAS-H	BNBAS-M	BNBAS-O BNBAS-Range BNBAS-Reg BNBAS-AS Excitability Depression Stress behaviors
Schanberg & Field (1987)	XO ₁ O ₂ O ₃ O ₁ O ₂ O ₃	Standard nursery care	Yes Stratified	No	No	No	Bayley MDI	Bayley PDI	—
Wheeden et al. (1993)	O ₁ XO ₂ O ₁ O ₂	Standard nursery care	Yes Stratified	Yes	No	No	BNBAS-H	BNBAS-M	BNBAS-O BNBAS-Range BNBAS-Reg BNBAS-AS Stress behaviors
Percent (%)	Pre/post: 67%	SNC^e: 78%	100%	67%	0%	44%	89%	89%	78%
Across All Studies	Post only: 33%	Other: 22%							

^aSubscripted O = Different assessment phases of a study, X = Tactile/kinesthetic intervention phase of study

^bBNBAS-H: Brazelton Neonatal Behavioral Assessment Scale Habituation Score (Brazelton, 1973); Bayley MDI: Bayley Mental Development Index (Bayley, 1969)

^cBNBAS-M: Brazelton Neonatal Behavioral Assessment Scale Motor Score (Brazelton, 1973); Bayley PDI: Bayley Physical Development Index (Bayley, 1969)

^dBNBAS-O/Range/Reg/AS: Brazelton Neonatal Behavioral Assessment Scale Orientation, Range of State, Regulation of State, and Autonomic Stability Scores (Brazelton, 1973); CCTI: Colorado Child Temperament Inventory (Rowe & Plomin, 1977)

^eSNC = Standard nursery care

Table 5
Relation between Infant Massage and Cognitive, Motor, and Social-Emotional Outcomes

Study	Cognitive Outcomes		Motor Outcomes		Social-Emotional Outcomes			
	Habituation	Global Cognitive	Global Motor	Activity Level	Stress Behaviors	Temperament	Social Interaction	Affect
Dieter (1999)	No	—	No	Yes	No	No	No	No
Field et al. (1986)	Yes	—	Yes	Yes	—	Yes	Yes	No
Field et al. (1996)	—	—	—	—	Yes	Yes	—	—
Mathai et al. (2001)	No	—	No	—	—	Yes	Yes	Yes
Rice (1977)	—	Yes	No	—	—	—	—	—
Scafidi et al. (1990)	Yes^a	—	No	Yes	—	No	No	No
Scafidi & Field (1996)	Yes^a	—	Yes	—	Yes	Yes	No	No
Schanberg & Field (1987)	—	Yes	Yes	—	—	—	—	—
Wheeden et al. (1993)	No	—	Yes	—	Yes	No	No	No

^aGroup differences due to decrements over time in control-group scores

