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Influence of holding practice on preterm infant development

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Abstract

Purpose—The purpose of this randomized, controlled trial was to determine if nurse supported kangaroo holding of healthy preterm infants in the first eight weeks of the infant's life facilitates early behavioral organization and development.

Methods—We randomized 87 infants born between 32 to 35 weeks gestation and their mothers to one of three holding groups: kangaroo (skin-to-skin between mother's breasts), blanket (held in mother's arms), or control (no holding restrictions). Nurse supported groups (kangaroo and blanket) received 8 weekly visits from a registered nurse who encouraged holding and provided education about infant development. The control group received brief social visits. Mothers recorded time held in a daily diary. The Assessment of Preterm Infant Behavior was administered when infants were 40 to 44 weeks postconceptional age.

Results—Total holding time averaged four to five hours per day and did not differ among groups. Mothers held kangaroo style an average of 59 minutes per day in the kangaroo group, and 5 and 9 minutes per day in the blanket and control groups respectively ($p < .001$). Infants in the kangaroo and blanket groups had more optimal scores than the control group in Robust Crying ($p = .015$) indicating that they could arouse to vigorous crying and calm. Scores, except for Attention and State Regulation, were at least as high as those of full term infants.

Clinical Implications—When kangaroo holding is compared to blanket holding, both methods may provide equal early behavioral organization and developmental benefit to the infant.

Keywords

Randomized trial; kangaroo holding; skin-to-skin; prematurity; mother-infant

Infants born preterm are at risk for a variety of developmental and cognitive disabilities such as motor, cognitive, memory, attentional, and behavioral difficulties (Chyi et al., 2008). While Romeo et al. (2010) reported similar developmental scores at 12 months corrected age between late preterm infants, born at 33 to 36 weeks gestation, and infants born at term,

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others have reported increased risk for delay or disability at kindergarten (Morse, Zheng, Tang, & Roth, 2009) and difficulties in math and reading through fifth grade (Chyi et al., 2008). Impairments in self-regulation are believed to be associated with behavioral disturbances and attention problems in infants born preterm. Rothbart, Posner and Kieras (2006) explain self-regulation as the ability to coordinate and organize motor activity, levels of arousal, and attention. It is well documented that self-regulatory ability is necessary for successful school performance, planning, decision making and social interactions (Watson 2010). Immaturity in brain development places preterm infants at risk for regulatory problems (Sun, Mohay, & O'Callaghan, 2009). Prolific brain development such as creation of brain cells, interconnections between neurons, and cell pruning occurs during the third trimester of pregnancy and early infancy. Rapid brain development occurs in areas of the cerebral cortex controlling higher order functioning and in the prefrontal cortex that is associated with self-regulation (Watson, 2010).

Quality of caregiving has been shown to facilitate development of early self-regulation. Maternal responses that are adaptive and sensitive to infant arousal assist the infant to learn regulatory strategies that promote calm, alert states that facilitate learning (Kalinauskiene et al., 2009). Preterm infants, however, display difficulty interacting socially with their mothers (Forcada-Guex, Pierrhumbert, Borghini, Moessinger, Muller-Nix, 2006). Immaturity of the nervous system makes it difficult for infants born prematurely to send clear cues, or to maintain extended interaction. Caregivers find it more difficult to recognize their preterm infant cues because of the infant's behavior, or because of their own issues of depression, anxiety, fatigue or guilt (Shaw et al., 2009). Thus, there is less synchronous behavior and cooperation in maternal-preterm dyads than in dyads in which the infants were born at term (Forcada-Guez, et al., 2006).

Holding is an intervention performed naturally by mothers and found to enhance regulation in infants. Korja et al (2007) reported a positive association between better quality mother-infant interaction and positive mood at 6 months, and duration of holding in preterm infants. Benefits of kangaroo holding for healthy preterm infants have been more extensively investigated than typical blanket holding. Preterm infants at 40 weeks postconceptional age who received 8 weeks of kangaroo holding, displayed more quiet sleep, respiratory regularity, and more mature EEG patterns than preterm infants at corrected term age who received undefined standard care, and term infants who were only 1 to 3 days postbirth (Scher et al., 2009). Ohgi et al., (2002) reported higher scores in orientation and state regulation at 40 weeks postconceptional age, and higher mental and motor developmental scores at 12 months corrected age in preterm infants who received kangaroo holding than those who received standard care. However, the kangaroo cohort was born 2 to 4 years after the control group. Findings also were confounded by several environmental enhancements and increased attention to mothers in the kangaroo group.

In a matched sample of infants born > 25 weeks gestation, kangaroo holding was performed in one hospital and the control group received “standard care” in another hospital. When infants were compared at 37 weeks, the kangaroo group showed more mature orientation, state regulation and more organized sleep-wake stability. Their mothers were more positive in affect and provided more nurturing touch and adaptation to infant cues. When compared at 3 months, infants in the kangaroo group displayed less negative emotion and more efficient arousal modulation. At the 6 month comparison, infants receiving kangaroo holding had higher mental and motor scores, better attentional ability and sustained play (Feldman & Eidelman. 2003; Feldman, Eidelman, Sirota, & Weller, 2002; Feldman, Weller, Sirota, & Eidelman, 2002).

We assessed infants who participated in this current randomized controlled trial at 6 months of age. The sample in the six-month follow-up was reduced from n = 87 to n = 65 due to attrition. Infants receiving 8 weeks of kangaroo holding displayed more co-regulated interaction with their mothers during play than dyads receiving blanket holding in their mother's arms (Neu & Robinson, 2010). Controlling for method of holding by including the blanket condition is a more rigorous comparison than the kangaroo vs. usual care comparison in other studies.

Many activities that are compromised in preterm infants are related to self-regulation. Thus, interventions such as holding that enhance infant self-regulation seem especially relevant. Previous research of kangaroo holding indicates that it facilitates self-regulation and infant development (Feldman & Eidelman. 2003; Feldman, Weller et al., 2002; Neu & Robinson, 2010; Ohgi et al., 2002; Scher et al., 2009). Our primary aim in this study was to determine if nurse supported kangaroo holding of healthy preterm infants in the first eight weeks of the infant's life facilitates behavioral organization and development. We hypothesized that when compared to preterm infants who experienced nurse supported blanket holding, or to preterm infants in a no support control group, preterm infants who experienced kangaroo holding will display enhanced behavioral regulation and development when infants reach term.

Study Design and Methods

We conducted a randomized, 8-week controlled trial. The kangaroo and blanket groups received parallel care. Power analysis indicated that 26 subjects per 3 groups would yield 80% power for univariate test of group differences using a moderate to high effect size of f =.35 and alpha of .05 (Cohen, 1988). We recruited eligible infants at five neonatal intensive care units (NICU's) from a metropolitan area in a midsized city in the western United States. The project director, who was not involved in data collection, coordinated randomization at each hospital using a computerized random number generator. Opaque sealed envelopes concealed allocation.

Participants were mothers of first-born infants who spoke English or Spanish, had no recorded illicit drug use, and no diagnosed serious chronic illness. Infants must have been born between 32 and 35 weeks gestational age (determination of the infant's gestational age was made by the attending physician), required less than ½ liter oxygen per nasal cannula, and had no umbilical lines, anticipated major surgery, physical anomalies, or intraventricular hemorrhage. We enrolled dyads in which infants were less than one month of age, but 58% were less than two weeks of age. We obtained approval to conduct the study from the University Institutional Review Board of the principal investigator and review boards of each study site. Mothers signed informed consent after the study was explained to them, before randomization to study groups.

Instruments

Assessment of Preterm Infant Behavior—The Assessment of Preterm Infant Behavior (APIB; Als, Lester, Tronick, & Brazelton, 1982) is a neurobehavioral assessment primarily designed for infants born preterm, from birth to 1 month after the expected due date. Adequate test-retest reliability, construct validity, concurrent validity and effects of intervention have been reported (Als et al., 2004; Noble & Boyd, 2011). The APIB, adapted from the Neonatal Behavioral Assessment Scale (NBAS; Brazelton & Nugent, 1995), examines newborn motor, autonomic, state and social development and adds assessment of the interaction and modulation of the infant's behavioral subsystems during increasing challenges. Ideally, the infant is asleep when the assessment begins and the examiner presents light and sound (rattle, bell) stimuli. Tactile stimulation is presented with the testing

of reflexes. Visual and auditory stimuli are presented by the examiner's face, voice, ball, and rattle. The exam may take up to 60 minutes.

The subsystems assessed by the APIB are: physiologic organization (PHYSM), motor organization (MOTOM), state organization (STATM), attention (ATTNM), self-regulation (REGUM), and the amount of facilitation required from the examiner to maintain behavioral organization (EXFAM). Scores range from 1 to 9. Lower scores indicate organized behavior and higher scores indicate disorganized behavior

Additional assessment is done with 28 behavioral, 18 reflex, and 9 supplementary NBAS items. Scores range from 1 to 9. Higher scores indicate better performance. Because direction of optimal performance is not consistent in scoring, the recommended transformations were made when entering the data so that 9 was the optimal score (Als et al., 1988).

The NBAS items are clustered to yield summary scores (Als et al., 1988). For this study we used **Orientation** (ability to focus on and follow visual and auditory stimuli); **Autonomic** (tremulousness, startles, threshold to color change, lability of color change); **Motor** (general tone, motor maturity, pull-to-sit, defensive maneuvers, activity level and hand to mouth; **State Regulation** (range and flexibility of states, irritability, robustness in handling the examination, control over input, improvement with facilitation); **Robust crying** (ability to achieve robust (vigorous) crying state, calm and be consoled from robust crying state); and **State Stability** (ability to arouse motorically, calm and be consoled from motoric arousal).

Other Variables

Demographic Questionnaires—At baseline, mothers completed a questionnaire describing the parent's age, ethnicity, education, occupation, and health. Hospital records were used to obtain information about pregnancy and birth. Hollingshead Four Factor Index was used to measure socioeconomic status (Cirino, et al., 2002).

Holding Diaries—All mothers were asked to record daily amount of kangaroo or blanket holding, amount of holding while feeding and sleeping, and who held the infant in a diary for 8 weeks. The registered nurse (RN) who conducted the home visits collected the diaries weekly. Participants were informed that they would receive $25.00 in cash for every week that they completed the holding diary.

State-Trait Anxiety Inventory—We used the State-Trait Anxiety Inventory (STAI; Speilberger, Gorsuch, Luchene, Vagg, & Jacobs, 1989) to assess maternal trait (relatively stable anxiety-proneness) and state (exists under certain circumstances) anxiety. Concurrent validity and test-retest reliability are adequate (Spielberger, 1983)

Center for Epidemiologic Studies-Depression Scale—We used the Center for Epidemiologic Studies-Depression Scale (CES-D; Radloff, 1977) to assess maternal depressive symptoms. Adequate reliability and validity is reported (Radloff, 1977).

Procedure

We randomly assigned dyads to either a nurse supported group where we asked mothers to hold their infants at least one hour a day for 8 weeks using a) kangaroo holding or b) blanket holding (infants dressed , wrapped in a blanket, and held in their mothers' arms); or c) a control condition (no restrictions on holding time or style). The principal investigator or another RN (fluent in Spanish) visited the nurse supported groups weekly for 30 to 60 minutes during the 8 weeks. Visits were conducted in the NICU until then infant was

discharged and then in the home (see Table 1). The nurse encouraged mothers to hold their infants in their assigned manner, and provided education about recognition and response to infant cues (Browne, MacLoed, & Sharp, 2000; Butterfield, 2000; Solchany, 2001). We did not prohibit mothers in the blanket group from kangaroo holding. An RN visited mothers in the control group for 10 to 20 minutes every week to collect holding diaries and financially reimburse mothers (as in the other two groups). We did not encourage holding in the control group, but did inform mothers about both types of holding.

An examiner scheduled two APIB assessments with an interval of approximately 48 hours between them at the end of week 8 to insure optimal performance. We used the best score for each infant in the analysis. The APIB was given approximately an hour before a feeding and during the infant's expected nap time. If the infant was awake, the examiner began the exam at the orientation section in which babies tracked visual and auditory stimuli. Fifty-six percent of the infants were awake when the examiner arrived at the first exam and 46% were awake at the second exam. We found no group differences in infants being asleep at either exam (χ^2 (2) = 1.07, n.s. for exam 1) and χ^2 (2) = 0.98, n.s. for exam 2). We included awake status as a covariate in all analyses because of potential effects of this variable on APIB scores.

The examination area was quiet with warm temperature and dim lighting. The examiner videotaped the exam with mothers present. Two examiners conducted the exams and both had current inter-rater reliability with a skilled trainer. Examiner 1 was blind to group assignment and scored all of the assessments. Assessments performed by Examiner 2 were scored from the videotapes. Assessments lasted 30-45 minutes. Some mothers were unable to schedule two exams. Inconsolable irritability was the reason that the other infants could not complete both exams. We found no group differences in the number of infants who could not complete the APIB because of irritability, χ^2 (2) = 0.39, n.s.

Data Analysis—The subsystem scores were highly correlated (r = .94 to .99), with the exception of ATTNM (r = .55 to .67). Therefore we analyzed only two APIB subsystem variables, autonomic organization (PHYSM) and attentional organization (ATTNM). We compared demographic and background variables across groups using chi-square analyses for categorically measured variables and one-way ANOVA models for continuously measured variables. We planned to use variables that differed across groups as covariates in model testing. Using a series of one-way ANOVA models, we examined effects of infant gender and examiner (Examiner 1 versus Examiner 2) on each outcome; if significant effects emerged, we included gender and/or examiner as factors in final model testing. We used examiner as a covariate because in some clusters, scores were more optimal for Examiner 1 than for Examiner 2. We estimated final ANCOVA models to examine condition effects on each of the eight APIB scores, including gender and/or examiner effects, and controlling for awake status during APIB measurement, and any variables that differed between conditions.

Results

Sample Characteristics

Mothers of 217 infants were approached for enrollment. Of these potential participants, 130 (60%) declined, resulting in 87 dyads who agreed to participate before randomization. The potential for being randomized to a holding group, and not wanting to complete daily diaries were primary reasons for declining. Dyads were randomized to kangaroo holding (n = 31), blanket holding (n = 29), and control group (n = 27). Eight dyads withdrew during the 8-week trial: 2 in the kangaroo group, and 3 each in the blanket and control groups. Mothers withdrew because they said they were too busy to complete the diaries or disliked the group assignment.

Forty-nine percent (n = 39) of the sample were male, and 49% (n = 39) of the sample were white, nonhispanic. Mean gestational age at birth was 33.3 weeks (SD = 0.97). Mean birth weight was 1948.18 g (SD = 388.76). Infants received a mean of 2.98 (SD = 2.86) days of phototherapy and a mean of 8.94 (SD = 17.23) days of supplemental oxygen. APGAR scores averaged 6.96 (SD = 1.82) and 8.94 (SD =1.07) at one and five minutes. Mothers' mean age was 26.08 years (SD = 6.64), and 78.2% were married or living with a partner. Only 7.6% of mothers breastfed exclusively throughout the 8 weeks while 46.8% combined breast and bottle feeding. Mothers who breastfed did so an average of 35 (SD = 31.06) days. Detailed description of this sample is provided in the first three columns in the sample characteristics tables in Neu & Robinson (2010). We found no baseline demographic differences among groups, so no additional variables were included as covariates in model testing.

Total holding time in the NICU and after discharge did not differ among groups. Maternal holding time within each group, however, did differ significantly between the NICU and home for those dyads who began the intervention in the NICU (See Tables 1 & 2). Holding patterns, as per design, differed among groups. Although mothers in the kangaroo groups also held blanket style, they used the kangaroo method an average of 59 minutes per day after discharge. Eight mothers held longer than 60 minutes, up to 1.8 hours per day. Beginning in the NICU, 14 mothers (48.6%) practiced kangaroo holding 40 to 55 days and 12 mothers (41.4%) practiced kangaroo holding for 25 to 39 days. Only 3 mothers (10.3%) practiced kangaroo holding 10 to 14 days. In the blanket group, nineteen mothers (73.1%) never tried kangaroo holding. Kangaroo holding was practiced by three mothers (11.5%) from 1 to 9 days, three mothers from 10 to 19 days, and one mother for 27 days. In the control group, 10 mothers (41.7%) never tried kangaroo holding. Eleven mothers (45.8%) tried kangaroo holding for 1 to 9 days and three mothers held kangaroo style for 19, 27, and 33 days.

Gender and Examiner Main Effects—Gender main effects were observed for Robust Crying where higher (more optimal) scores were observed for girls (M = 8.67) than for boys (M = 7.55), and for PHYSM, where lower (more optimal) scores were observed for girls (M = 3.78) than for boys (M = 4.27). There were several examiner main effects, with higher (more optimal) scores for Examiner 1 for Motor (M = 4.72 versus M = 4.03), Orientation (M = 4.94 versus M = 4.30), and State Regulation (M = 4.89 versus M = 4.11) and lower (more optimal) scores for Examiner 1 for PHYSM (M = 3.58 versus M = 4.19).

Condition Effects—One-way ANCOVA models (with awake status as covariate) testing condition effects were estimated for Autonomic, State Stability, and ATTNM. Two-way ANCOVA models were estimated for Robust Crying, Motor, Orientation, and State Regulation to test condition effects along with sex (Robust Crying) or examiner (Motor, State Regulation, and Orientation) effects. A three-way ANCOVA model was tested for PHYSM to examine condition effects while counting for significant sex and examiner effects. Table 3 shows variable means and standard deviations for the three conditions and the condition main effect. The only significant condition effect was for Robust Crying. Infants in the kangaroo and blanket groups scored significantly higher (more optimal) than infants in the control condition but did not differ from each other. There were no significant interactions between gender or examiner with condition, but the condition by gender interaction approached significance for Robust Crying (F 2, 70) = 2,51, p = .089. The difference between conditions was more pronounced for boys than for girls due to boys in the control condition scoring lower than any other group.

Comparison of Scores with Infants Born at Term—After finding few differences among our holding groups, we compared all six subsystem scores of the preterm infants in

this study with those reported by Mouradian, Als, & Coster, (2000) who used the APIB for full term infants. Mouradian et al (2000) conducted the exam on 16 full term infants, born a mean of 40 weeks gestational age, 10 to 14 days after birth. Preterm infants in our study were compared to the term infants on the following variables: Physiologic Organization, Motor Organization, State Organization, Attention Organization, Self-Regulatory Organization, and Examiner Facilitation. No differences were found except that full term infants displayed lower (more optimal) scores in attention, 4.46 (SE = 0.50) than the preterm infants 5.43 (SE = 0.15), $p = .017$.

We also compared only the cluster scores (preterm vs. term) that we knew to contain the same items as the clusters that we used: State Stability, State Regulation, and Robust Crying. State Stability did not differ between groups, but preterm infants in this study had higher (more optimal) scores in Robust Crying, 8.12 (SE = 0.21) vs. 6.52 (SE = 0.49), $p = <.003$, and lower (less optimal) scores in State Regulation 4.32 (SE = 0.13) vs. 5.81 (SE = 0.30), p <.001 than term infants.

Discussion

We hypothesized that when compared to preterm infants who experienced nurse supported blanket holding, or to infants in a no support control group, preterm infants who experienced kangaroo holding would display responses indicating enhanced behavioral regulation and development. When we measured and provided identical support for mothers in the kangaroo and blanket group, and compared kangaroo holding to blanket holding, the results did not support this hypothesis. Infants had similar scores and effect sizes were quite small.

Previous research on kangaroo holding indicated that when compared to “standard care” or lying in bed, kangaroo holding resulted in superior physiological regulation such as sleep-wake stability, respiratory regularity, more mature EEG patterns (Feldman & Eidleman. 2003; Scher et al., 2009), and more optimal behavioral regulation (Feldman et al., 2002a; Feldman et al., 2002b). Even when compared carefully to blanket holding, dyads who practiced kangaroo holding displayed better maternal-infant interaction (Neu & Robinson, 2010).

Perhaps group differences in development would be evident six to twelve months after the intervention as found in some studies (Feldman et al., 2002a; Feldman et al., 2002b). Another possibility is that scores of the infants in this study were enhanced due to the intervention. When scores of the preterm infants in this study were compared to those of infants born at term, scores were quite similar, indicating enhanced scores in all groups, especially subsystem organization. Scores indicated infant ability to self-regulate, physiologically or behaviorally. Ability to achieve and maintain a robust crying state is an indicator of high energy level and excellent health of the infants in this study (Als et al, 1982) that surpassed that of infants born at term (Mouradian, et al., 2000). Their high autonomic cluster score of 7.04 supports their physiologic health. Frail infants would not be able to attain vigorous crying or sustain the cry due to physiologic interference such as oxygen desaturation or respiratory irregularities. Arousal needed to achieve robust crying is substantial. The infant must draw on self-regulatory strategies (using environmental stimuli as distraction, bringing hand to mouth, or sucking on fist to calm). The infant also must be able to use the examiner's assistance of looking or smiling at the infant, talking, placing a hand on the infant abdomen, holding or rocking (Brazelton & Nugent, 1995).

Even though scores of infants in the control group were lower than in the nurse supported groups, they were in the high range, suggesting that the intervention was responsible for the enhancement, not style of holding. The intervention had several components that most likely

contributed to increased parent holding that is found to enhance development (Kalinauskiene et al., 2009). Attention during the visits, even social visits in the control group, and the daily diaries were frequent reminders about holding. All mothers knew that a goal of the study was to promote holding and this also may have increased their time of holding. Daily amount of holding in this study was more than the 3.3 hours reported in a study (Korja et al., 2007) in which duration of holding was associated with better regulation.

There were several limitations in this study. Differences between groups may have been found with a smaller effect size that would have necessitated a larger sample. We were unable to initiate holding immediately after birth. Very early kangaroo holding may have been advantageous. We also did not know how mothers held before intervention. However, because most did not know about kangaroo holding, it is unlikely that many mothers had tried it. Some mothers may have felt constrained on holding time, especially in the kangaroo group, but we constantly encouraged holding and stated that an hour of holding was the minimum.

The intervention did not enhance attention and state regulation scores of infants. These scores indicate the ability of infants to maintain a quiet alert state throughout visual, auditory, and tactile stimulation, seek out stimulation, and complete the exam with few rest periods to reduce irritable arousal or regain energy. Perhaps these skills would be apparent at a 6-month assessment as shown in previous studies (Feldman et al., 2002a; Korja et al., 2008).

Clinical Nursing Implications

Nurses and other caregivers should inform mothers about available holding options and evidence on benefits of holding so they can make the best individualized decision for themselves and their baby. Active promotion of holding, regardless of holding style, while infants are hospitalized and providing a home visit or phone call after discharge to encourage holding may be very beneficial to preterm infant development, and needs further study. Enhanced development from holding that improves energy levels and regulatory ability of preterm infants has the potential to subsequently support attentional abilities of these infants.

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Callouts

1. Holding is an intervention performed naturally by mothers and found to enhance regulation in infants.
2. Mothers in the kangaroo group practiced kangaroo holding an average of 59 minutes per day after discharge.
3. Only 28% of mothers had previous knowledge about kangaroo holding.
4. Infants in the nurse-supported holding groups displayed significantly more vigorous crying than infants in the control group.
5. With the exception of Attention and State Regulation, scores of preterm infants were at least as high as those of full term infants.

Clinical Nursing Implications

- Inform mothers about kangaroo and blanket holding methods.
  - Include available evidence on the benefits of holding.
- Encourage mothers to hold their infants.
- Provide attention to all mothers about holding.
- Consider home visiting or follow-up telephone contact after hospital discharge, or as part of routine infant care visits for all mothers of preterm infants to encourage holding.

Table 1

Intervention and Holding Mean Comparisons Among Groups

	Kangaroo (n = 29)	Blanket (n = 26)	Control (n = 24)
	Mean (SD)	**Mean (SD)**	**Mean (SD)**
Postnatal Days at First Intervention Hold	15.03 (6.67)	15.00 (4.88)	16.08 (5.71)
Length of Hospitalization	21.66 (10.86)	23.46 (8.25)	19.08 (6.41)
Daily Maternal Holding Hours @ Home[a]	2.56 (1.08)	2.45 (0.87)	2.46 (1.59)
Daily Total Hours Holding at Home[a] (Maternal and Others)	4.81 (2.12)	4.55 (1.31)	4.79 (1.59)
Visits in NICU (Number of Dyads)[b]	**n (%)**	**n (%)**	**n (%)**
None	6 (20.69)	3 (11.54)	6 (25.00)
1-2 Visits	18 (62.07)	19 (73.07)	17 (70.83)
3-4 Visits	4 (13.79)	3 (11.54)	1 (4.17)
5-6 Visits	1 (3.45)	1 (3.85)	0 (0.00)
Previous Knowledge of Kangaroo Holding	5 (17.24)	7 (26.92)	9 (37.50)

[a] Does not include holding during caregiver feeding or sleeping.

[b] Visits not conducted in the NICU were done in the home.

Table 2

Within Group Comparisons of Holding Times of Mothers who Held in the NICU and at Home

	n = 23		n = 23		n = 18	
	NICU	**Home**	**NICU**	**Home** **	**NICU**	**Home** *
Maternal Total Holding Hours for Infants held in the NICU and at Home[a]	1.12 (0.55)	2.58 (1.13)†	1.33 (1.12)	2.41 (0.89)**	1.41 (1.42)	2.32 (1.51)*
Maternal Hours Kangaroo Holding for Infants Held in the NICU and at Home[a]	0.62 (0.39)	0.95 (0.37)**	0.05 (0.22)	0.06 (0.19)	0.15 (0.38)	0.18 (0.38)
Total Hours Holding for Infants Held in the NICU and at Home[a]	1.64 (1.05)	4.88 (2.30)†	1.95 (1.52)	4.66 (1.32)†	2.48 (1.18)	4.69 (1.89)†

[a]This comparison was only for infants in which holding for the intervention was done in the NICU and at home. The paired samples t-test was used to compare within-groups not between groups.

*p <.03

**p <.01

†p <.0001

Table 3

Comparison of Groups Means (Standard Deviations) for Subsystem and Cluster Scores Examiner and sex effects were included as factors in the analyses, where relevant, and awake status at the start of the session was included as a covarate in all models.

APIB Subsystem scores Range = 1-9: Lower scores indicate better organization					
	Total Sample	**Kangaroo (n = 29)**	**Traditional (n = 26)**	**Control (n = 24)**	**Condition Main Effect**
ATTNM (Attention)	5.43 (1.34)	5.57 (1.13)	5.28 (1.44)	5.43 (1.51)	$F = 0.57$, $\eta^2 = .02$
PHYSM (Autonomic organization)	4.01 (1.13)	4.09 (1.11)	3.90 (1.15)	4.06 (1.18)	$F = 0.09$, $\eta^2 = .002$

NBAS Cluster Scores Range = 1-9: Higher scores indicate better performance					
	Total Sample	**Kangaroo**	**Traditional**	**Control**	**Condition Main Effect**
Motor	4.22 (0.93)	4.40 (.84)	4.10 (1.11)	4.11 (.82)	$F = 1.24$, $\eta^2 = .03$
Orientation	4.48 (0.91)	4.38 (.75)	4.57 (1.19)	4.93 (.74)	$F = 0.10$, $\eta^2 = .02$
Autonomic	7.04 (1.85)	7.27 (1.68)	7.16 (2.07)	6.64 (1.82)	$F = 0.77$, $\eta^2 = .02$
State Regulation	4.32 (1.17)	4.09 (1.14)	4.40 (1.27)	4.53 (1.11)	$F = 1.53$, $\eta^2 = .03$
Robust Crying	8.12 (1.86)	8.34 (1.66)	8.50 (1.09)	7.46 (2.53)	$F = 4.43^{*}$, $\eta^2 = .10$
State Stability	5.73 (3.05)	5.68 (3.27)	5.36 (1.0)	6.18 (4.10)	$F = 0.38$, $\eta^2 = .01$

η^2 refers to the eta-squared measure of effect size.

$^{*}p = .015$