Kangaroo Mother Care and the Bonding Hypothesis

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ABSTRACT. *Background.* **Based on the general bonding hypothesis, it is suggested that kangaroo mother care (KMC) creates a climate in the family whereby parents become prone to sensitive caregiving. The general hypothesis is that skin-to-skin contact in the KMC group will build up a positive perception in the mothers and a state of readiness to detect and respond to infant's cues.**

Method. **The randomized controlled trial was conducted on a set of 488 infants weighing <2001 g, with 246 in the KMC group and 242 in the traditional care (TC) group. The design allows precise observation of the timing and duration of mother–infant contact, and takes into account the infant's health status at birth and the socioeconomic status of the parents.**

Bonding Assessment. **Two series of outcomes are assessed as manifestations of a mother's attachment behavior. The first is the mother's feelings and perceptions of her premature birth experience, including her sense of competence, feelings of worry and stress, and perception of social support. The second outcome is derived from observations of the mother and child's responsivity to each other during breastfeeding at 41 weeks of gestational age.**

Interventions. **KMC has three components. The first is the kangaroo position. Once the premature infant has adapted to extrauterine life and is able to breastfeed, he is positioned on the mother's chest, in a upright position, with direct skin-to-skin contact. The second component is kangaroo nutrition. Although breastfeeding is the prime source of nutrition, infants also may receive preterm formula whenever necessary and vitamin supplements. The third component is the clinical control; infants are monitored on a regular basis, daily until they are gaining at least 20 g per day. Afterward, weekly clinic visits are scheduled until term, which constitutes the ambulatory minimal neonatal care.**

In the TC group, infants are kept in incubators until they are able to self-regulate their temperature and are thriving (ie, have an appropriate weight gain). Infants are discharged according to current hospital practice, usually not before their weight is ~1700 g. Afterward, as with the KMC group, weekly clinic visits are scheduled until term.

Results. **We observed a change in the mothers' perception of her child, attributable to the skin-to-skin contact in the kangaroo-carrying position. This effect is related to a subjective "bonding effect" that may be understood readily by the empowering nature of the KMC intervention. Moreover, in stressful situations when the infant has to remain in the hospital longer, mothers practicing KMC feel more competent than do mothers in the TC group. This is what we call a resilience effect. In these stressful situations we also found a negative effect on the feelings of received support of mothers practicing KMC. We interpret this as an isolation effect. To thwart this deleterious effect, we would suggest adding social support as an integral component of KMC.**

The observations of the mothers' sensitive behavior did not show a definite bonding effect, but rather a resilience effect. This is attributable to the KMC intervention; mothers practicing KMC were more responsive to an at-risk infant whose development has been threatened by a longer hospital stay. Otherwise, we observed that the mothers (in both the KMC group and the TC group) had behavioral patterns that were adapted to the child's at-risk health status and to the precarious condition of some premature infants requiring intensive care. We conclude that the infant's health status may be a more prominent factor in explaining a mother's more sensitive behavior, which overshadows the kangaroo-carrying effect.

Conclusion. **These results suggest that KMC should be promoted actively and that mothers should be encouraged to use it as soon as possible during the intensive care period up to the 40 weeks of gestational age. Thus, KMC should be viewed as a means of humanizing the process of giving birth in a context of prematurity. This finding confirms the conclusions of the 1996 Trieste workshop suggesting that KMC should be promoted both in hospitals and after early discharge.** *Pediatrics* **1998;102(2). URL: http://www.pediatrics.org/cgi/content/full/102/2/e17;** ***kangaroo mother care (KMC); bonding; preterm infants; neonatal health care; psychological impact.***

ABBREVIATIONS. KMC, kangaroo mother care; LBW, low birth weight; NICU, neonatal intensive care unit.

Kangaroo mother care (KMC) was first suggested in 1978 by Dr Edgar Rey in Bogotá, Colombia. It was developed initially as a way of compensating for the overcrowding and scarcity of resources in hospitals caring for low birth weight (LBW) infants.[1,2] The term KMC is derived from practice similarities to marsupial caregiving, ie, the premature infant is kept warm in the maternal pouch and close to the breasts for unlimited feeding. Dr Hector Martinez and Dr Luis Navarette continued

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Received for publication Jun 24, 1997; accepted Mar 30, 1998.

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and built on Rey's seminal work. In addition, since the end of the 1980s, a new KMC model has been developed by a team from the Colombian Department of Social Security and the World Laboratory (a Swiss nongovernmental organization).[3] Some developing countries[4,5] with funding from UNICEF, and developed countries including the United States,[6] England,[7] France,[8] Sweden,[9] Canada,[10] and the Netherlands[11] have introduced skin-to-skin contact in nurseries for premature infants. It is generally hypothesized that this type of care promotes physiological stability and enhances the parent–child relationship.

Most of the published studies on skin-to-skin contact have focused on the physiological benefits to the infant. Only a few have addressed the parent and child's psychological well-being (for a review, see Anderson[12] and Charpak et al[1]). The objective of this study is to investigate the impact of KMC on the mother's perception of giving birth as well as on the mother and child's responsiveness to each other. Based on the general bonding hypothesis, we suggest that KMC creates a family atmosphere in which parents become more exposed to sensitive caregiving.

The Bonding Hypothesis

After the publication of Klaus and colleagues' work,[13,14] the concept of bonding has withstood the test of time, and the perception that instantaneous bonding is a vital component of the "ideal" birth experience has dominated our perception of childbirth. The clinical benefits of humanizing the process of giving birth, resulting from the changes in intensive care nursery that Klaus et al supported, were widely recognized and accepted. On the other hand, although 25 years have passed since Klaus et al.'s article was published and despite a plethora of studies in the 1970s and 1980s on early mother–child bonding, controversial comments, critiques, and confusing conclusions abound. The importance of early contact between the mother and infant first was reviewed by Lamb and Hwang[15] in 1982 and critically analyzed by Diane Eyer[16] in 1992. Despite its apparent clinical importance, the bonding hypothesis still is not recognized universally.

Is there a postnatal bonding effect? Based on the literature and available empirical data, nothing is less obvious: the duration of both the bonding period and its effects are unknown. Furthermore, the nature of the attachment behavior is not clearly defined. On the other hand, in skin-to-skin contact, short-term effects (lasting for up to 1 month) are observed, and the mother's perception and behavior are different from those observed in the control groups. For all these reasons, replicate studies would be very useful to clarify some of the unanswered questions noted above.

KMC and the Bonding Hypothesis

Theoretically, KMC is based on the idea that a bonding effect is induced by early skin-to-skin contact between the child and its caregiver. After Bogotá's recent tradition and drawing on the well known importance of early social interactions with the caregiver, such as holding, touching, and eye contact, some neonatal intensive care units use KMC to add an emotional complementary dimension to routine care. This approach is an attempt to humanize care given during the period in the neonatal intensive care unit (NICU) and to improve both communication and attachment between caregiver and child. Moreover, KMC should be seen as a means to ensure the successful discharge of a fragile infant from the NICU by enhancing family caregiving during the post-NICU period.

Objectives and Hypothesis

In this study, mothers in a KMC group practicing 24-hour-a-day skin-to-skin contact were compared with mothers in a traditional care group (TC). Furthermore, infants in the TC group were kept in incubators at the minimal care unit until they met standard discharge criteria, after which they were sent home and received the same outpatient care as infants in the KMC group (see below). This randomized, controlled trial permits timing of mother–infant contact to be determined (1 to 65 days after birth) and takes into account the infant's health status and the marital and socioeconomic status of the parents. Because high-risk infant births can hinder the development of maternal attachment, such as in the mothering-disability syndrome that threatens the survival of neonates,[17,18] the KMC intervention in this context could produce major changes in the mothers' attachment behaviors and perceptions.

Two series of outcomes are taken as manifestations of a mother's attachment behavior. The first is the mother's feelings and perceptions of her premature birth experience, including her sense of competence, feelings of worry and stress, and perception of social support. The second outcome is derived from observations made of the mother and child's responsiveness to each other during breastfeeding, at the gestational age of 41 weeks. Our general hypothesis is that the skin-to-skin contact practiced in the KMC group will induce a positive perception and a state of readiness in the mother to detect and respond to infant cues. We suggest that KMC will be most effective 1) when the interval between birth and start of intervention is short; and 2) when the infant's health is fragile and intensive care during hospitalization is needed.

METHOD

Population and Sample

This study is part of a randomized, controlled trial conducted in Bogotá, Colombia,[3] involving 1084 infants that weighed <2001 grams and who were born between September 1993 and September 1994 at Clinica San Pedro Claver. Of these, 746 were eligible according to the following inclusion and exclusion criteria. An infant and mother were eligible if the mother or a relative was willing to follow instructions, and if the infant had overcome all major adaptation problems to extrauterine life, had a positive weight gain, and suckled and swallowed properly. Infant–mother dyads were excluded if the infant died; had been referred to another institution; had lethal or major malformations; had sequelae arising from perinatal problems (severe hypoxic–ischemic encephalopathy, pulmonary hypertension, etc); or had been aban-

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doned or given for adoption. Eligible mother–infant dyads were randomized according to a stratified block randomization procedure prepared in advance. Three strata were defined, based on weight at birth (<1200 g; 1200 to 1499 g; 1500 to 2000 g), and blocks of four infants (2 KMC and 2 TC control infants) were prepared using a random number table. Of the initial group of 746 infants, 153 (20.1%) were lost because of technical problems with the video sequences (same rates in both the KMC group and the TC group); 17 (2.3%) died between eligibility and 41 weeks of gestational age (the death rate was similar in both groups[3]); 61 (8.2%) abandoned the study; and 27 (3.6%) mothers practicing KMC did not follow instructions to carry the infant. Consequently, the study group was reduced to 488 mother–infant dyads, 246 in the KMC group and 242 in the TC group. We compared the final group of 488 dyads with the subgroup of 258 nonparticipating dyads. We found no differences in the families' sociodemographic backgrounds or in the characteristics of the pregnancy or labor. Moreover, the neonatal variables were all the same, except that infants in the nonparticipating group were slightly heavier at birth (by 56 g) (data not shown).

The two groups were randomized before seeking consent to participate, and informed consent forms were not completed by parents of infants assigned to the TC group. This procedure, proposed by Meinert and Tonascia,[19] was chosen because early discharge is very appealing to parents, and it is very likely that many of the families would have asked to be assigned to the KMC group. This procedure was accepted by the ethics committee because those assigned to the control group received the usual care provided at the participant institution.

KMC and TC Interventions

KMC has three components.[1,3] The first is the kangaroo position. Once premature infants have adapted to extrauterine life and can breastfeed, they are discharged and positioned in an upright position on the mother's chest, with direct skin-to-skin contact. It should be pointed out that the kangaroo position has the same temperature-regulating properties of the incubator. The mother and infant may then be released from the hospital regardless of the infant's actual weight or gestational age. Infants are maintained continuously in this position, 24 hours a day, until they demonstrate, behaviorally, that they are ready to leave, usually at ~37 to 38 weeks' gestational age. Other caregivers (eg, the father, grandparents, etc) may alternate with the mother as a kangaroo position provider. This first component is the related most directly to this study's psychological hypothesis.

The second component is kangaroo nutrition. Although breastfeeding is the prime source of nutrition, infants also may receive preterm formula and vitamin supplements when necessary. The third component is the clinical control: infants are monitored on a regular basis daily until a weight gain of at least 20 g per day is observed. Afterward, weekly visits are scheduled until term (40 weeks' gestational age), which constitutes the ambulatory minimal neonatal care.

In the TC group, infants are kept in incubators until they can regulate their temperature and are thriving (ie, have an appropriate weight gain). They are discharged in accordance to current hospital practice, that is, usually not before their weight is ~1700 g. This period is when infants no longer need intensive care, and stay in hospital is the only difference between them and infants in the KMC group. Otherwise, as with those in the KMC group, mothers are encouraged to visit and breastfeed their infant as early as possible during the inpatient period, and infants receive preterm formula and vitamin supplements when necessary. These infants received the same outpatient care and follow-up as infants in the KMC group. Therefore, the TC intervention includes an inpatient period (from eligibility to discharge) as well as an at-home period lasting until term.

Outcome Variables

The Mother's Perception of Premature Birth Questionnaire

Essentially, this questionnaire addresses three aspects of the mother's life linked to experiencing a premature birth. It has been designed based on interviews with the mothers and takes into account published empirical research on the experience of prematurity. From a theoretical aspect, the questionnaire includes three general domains: 1) the mother's social, family, and institutional environment—and in particular, her perception of the respective support received from these three environments; 2) the mother's feelings and worries about her LBW infant (anxiety, guilt); and 3) the mother's sense of competence and confidence in her ability to nurture her premature infant. These three domains are measured using a Likert scale (1 to 5), 24 hours after birth and when the infant has reached 41 weeks' gestational age. Although the questions varied somewhat in the 24-hour and 41-week questionnaires (in terms of the contextual difference), the factor analyses conducted on the sample of 488 families suggested the presence of the same three score model at each time point: mother's sense of competence, perception of social support, and feeling of stress and worry. These factor scores are used in this study.

The Nursing Child Assessment Feeding Scale

This scale measures the emotional bond between mother and child, and consists of 76 binary items organized according to six conceptual subscales. Four of them describe the mother's behavior toward her infant: sensitivity to the infant, response to infant's distress, and behaviors related to socioemotional, and cognitive stimulation of the infant. The remaining two subscales describe the infant's response to the mother (clarity of cues, responsiveness). The validity and reliability of the scale are well established,[20] and interrater agreement is ≥0.85 in this study.

Control Variables

Many control variables have been introduced to optimize data interpretation. They include gestational age at birth, gender, weight, height and head circumference at birth; intrauterine growth diagnosis according to the Lubchenco classification; parity; Apgar score at 1 and 5 minutes; diagnoses at eligibility time; age, weight, height, and head circumference at eligibility; family sociodemographic descriptors; and pregnancy and delivery variables.

Procedures

All infants were evaluated at birth, at time of eligibility, and at term by a team of pediatricians, nurses, social workers, and psychologists. All mothers (1084) participated in a structured interview after 24 hours in the hospital and after their respective infants reached a gestational age of 41 weeks, for the dyads remaining in the study. A 15-minute interaction–feeding sequence was videotaped in a small room near the clinic when the parent and child attended the follow-up clinic at gestational age 41 weeks. These sequences were scored according to the Nursing Child Assessment Feeding Scale. Performing the entire study under completely blind conditions was not possible because during the LBW follow-up clinic, the psychologists involved with the patients also were both observers during the videotaping as well as final evaluators. However, the large number of subjects, the 1-year interval before videotaping, and the coding procedure ensure that the study was performed under quasiblind conditions.

RESULTS

The data presented in Tables 1 and 2 show that the KMC group and the TC group were identical at the conceptional age of 41 weeks based on sociodemographic criteria and factors related to pregnancy and labor. A significant difference both in the gestational age and in the infant's weight at birth and at eligibility was observed that had completely disappeared at the time of observations (41 weeks; Table 2). Because weight at eligibility is the most representative group difference before start of intervention, it will be used as covariate in the analyses.

Two-way analysis of variance stratifying by birth weight showed that the savings in hospital stays were clearly related to weight at birth: an interaction effect ($F_{(3480)} = 4.06$, $P < .01$) shows that the maximum saving in the KMC group was observed in infants weighing <1501 g (4.5 to 6.7 days), whereas in infants weighing >1500 g, the length of hospital

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TABLE 1. A Comparison Between the KMC Group and the TC Control Group Based on Sociodemographic, Labor, and Delivery Characteristics

Variables	KMC	Controls	$F_{(p)}$	Variables	KMC	Controls	$F_{(p)}$
Social insurance, *n* (%)				PROM*, *n* (%)	81 (34)	85 (36)	.65
Usuaria	167 (68)	150 (62)	.22	Duration <48 hours	224 (93)	223 (93)	
Beneficiaria	79 (32)	91 (38)		>48 hours	17 (7)	15 (6)	.86
Age of the mother (mean ± SD)	27.4 ± 6.0	27.3 ± 5.8	.79	Cesarean section *n* (%)	170 (69)	163 (67)	.75
Marital status *n* (%)				Duration of labor			
Stable couple	205 (83)	209 (86)		<12 hours	225 (93)	222 (95)	.46
Unstable couple	8 (3)	9 (4)	.48	>12 hours	18 (7)	13 (6)	
Single	33 (13)	24 (10)		Primiparae, *n* (%)	99 (40)	88 (37)	.46
Mother's education level, *n* (%)				Multiple deliveries, *n* (%)	46 (19)	8 (16)	.47
Primary or less	50 (20)	50 (21)					
Secondary	141 (57)	134 (56)	.92	Number of prenatal visits (mean ± SD)	7.2 ± 3.7	7.5 ± 4.7	.51
>Secondary	55 (22)	57 (24)					
Mother's employment, *n* (%)				Postpartum hospital stay, day (mean ± SD)	2.6 ± 1.1	2.5 ± 1.1	.16
Office work	32 (13)	33 (14)					
Physical labor	84 (34)	69 (29)	.43				
Housewife	81 (33)	95 (39)		Mother's height, cm (mean ± SD)	158.3 ± 7.1	157.7 ± 6.8	.30
Others	49 (20)	45 (19)					
Per capita monthly				Mother's weight, kg (mean ± SD)	54.5 ± 7.1	53.9 ± 8.2	.40
(1994 Col pesos)	91 000	82 000					
Mean (min–max)	(14–400 000)	(17–300 000)	.06				

* Premature rupture of membranes.

TABLE 2. A Comparison Between the KMC Group and the TC Control Group Based on Factors Related to Newborn Infants

Variables	KMC	Controls	$F_{(p)}$	Variables	KMC	Controls	$F_{(p)}$
Weight at birth, g (mean ± SD)	1660 ± 268	1736 ± 259	.002	Distribution of weight at birth, g *n* (%)			
Length at birth, cm (mean ± SD)	41.4 ± 2.9	41.9 ± 2.8	.06	<1201	20 (8)	16 (7)	
				1201–1500	45 (18)	39 (16)	.62
				1501–2000	181 (74)	187 (77)	
Head perimeter at birth (mean ± SD)	30.3 ± 1.8	30.6 ± 1.7	.10	Lubchenco classification, *n* (%)			
Gestational age at birth (mean ± SD)	33.1 ± 2.3	33.7 ± 2.6	.02	PT–AGA*	175 (71)	165 (68)	
				PT–SGA	52 (21)	48 (20)	.29
Male/female, *n*	131/115	105/137	.03	T–SGA	19 (8)	29 (12)	
Weight at eligibility, g (mean ± SD)	1633 ± 225	1707 ± 235	.000	Asphyxia according to Apgar at 1 min, *n* (%)			
Age at eligibility (days) (mean ± SD)	10.0 ± 10.5	8.6 ± 10.0	.11	No asphyxia (8–10)	141 (64)	137 (66)	
				Mild (6–7)	68 (31)	57 (27)	.55
Head perimeter, 41 weeks (mean ± SD)	34.7 ± 1.6	34.7 ± 1.6	.97	Moderate (4–5)	8 (4)	7 (3)	
				Severe (0–3)	4 (2)	8 (4)	
Weight (g) at 41 weeks (mean ± SD)	2851 ± 527	2855 ± 513	.93	Feeding, *n* (%)			
				Breastfeeding only	105 (43)	111 (46)	
Height at 41 weeks, cm (mean ± SD)	46.8 ± 2.3	47.0 ± 2.3	.42	Breast and formula	135 (55)	111 (46)	.01
				Formula	6 (2.4)	20 (8.3)	

* PT–AGA indicates preterm, appropriate for gestational age; PT–SGA, preterm, small for gestational age; T–SGA, term, small for gestational age.

stay was virtually identical in both groups (Table 3). As expected, there was no group effect in the NICU length of stay ($F_{(1480)} = 1.79$, NS), which, however, increased with a decrease in birth weight ($F_{(3480)} = 22.6$, $P < .001$).

Although the length of intervention (expressed by the kangaroo position in the KMC group and by time between eligibility and 41 weeks' conceptional age in the TC group) was not related to dependent variables, it has not been used in additional analyses. Data analyses were then performed with two moderating conditions. The first was the interval between birth and eligibility, representing the period during which the mother was separated from the infant before beginning the intervention. It has been trichotomized: 1 to 2 days is the first category, including infants born in fairly good health and randomized shortly after birth. In this subgroup, infants left the hospital with their mothers and received either KMC or TC at home. A 3- to 14-day delay makes up the second category, and >14-day delay makes up the third category, representing a long separation before closer mother–infant contact.

The second moderating condition is the child's

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TABLE 3. Differences in Hospital Stay and Need of NICU Patterns from Birth to Term by Intervention Groups (KMC vs TC) and Birth Weight Categories

Weight	Stay in Hospital (days)		Stay in NICU (days)	
	TC (±SD)	KMC (±SD)	TC (±SD)	KMC (±SD)
<1201 g	40.0 ± 10.5	35.5 ± 17.0	7.2 ± 0.0	8.9 ± 14.1
1201 g–1500 g	26.9 ± 14.0	20.2 ± 8.8	2.6 ± 6.4	1.9 ± 4.1
1501 g–1800 g	10.0 ± 9.2	10.7 ± 7.8	.56 ± 2.0	1.8 ± 4.4
>1800 g	6.2 ± 7.6	6.7 ± 7.1	.34 ± 1.5	1.1 ± 4.9

health, measured by the duration of stay in the NICU. It is dichotomized as "yes" or "no." This second moderating variable is statistically independent of the delay between birth and eligibility (first moderating variable). Dependent variables are twofold: the first is the mother's perception of the experience of a premature birth, and the second is the mother and child's sensitivity to each other in a feeding situation. All statistical analyses were performed using the SPSS 7.5 for Windows.

KMC Benefits and the Timing of Intervention

The first set of analyses (multivariate analyses of variance) was computed using Groups as the independent condition and Delay Before Intervention as the moderating variable. These analyses were completed alternating with the mothers' perception and their sensitivity as dependent variables (Table 4). The hypothesis suggests an interaction effect for length of delay and Group. Based on the Mother's Perception of Premature Birth Questionnaire (perceptions scores) data for the 24-hour postnatal interview, no differences between the KMC group and the TC group were found—mothers in both groups reported the same general feelings about their recent experience. However, based on the 41-week (conceptional age) interview, there were some group differences ($F_{(3479)} = 5.33$, $P = .001$). Sense of competence was particularly higher for mothers in the KMC group ($F_{(1481)} = 10.36$, $P = .001$), and social support was perceived as lower for mothers in the KMC than for those in the TC group ($F_{(1481)} = 5.03$, $P = .03$). No delay effect was found. However, in the stress and worry subscale, the data show an interaction effect: the longer the separation, the more stressed were mothers in the TC group ($F_{(2481)} = 3.07$, $P = .05$). No covariate (infant's weight at eligibility) effect was observed. The data also suggest the following: 1) The mother's sense of competence was higher in the KMC group, regardless of timing of the intervention. However, post hoc analyses indicated that kangaroo-carrying practiced earlier (1 or 2 days) after birth modified the mothers' sense of competence to a greater degree. 2) Mothers in the TC group felt more supported than did their KMC counterparts, and post hoc comparisons confirmed that this is particularly true when the infant remained in hospital longer. Finally, 3) the TC mothers' feelings of stress increased with the time their infant spent in hospital, which was not the case for mothers in the KMC group.

Using observational data as dependent variables have shown that mother's sensitivity was higher in the KMC group ($F_{(1481)} = 3.71$, $P = .05$). Interaction effects on the duration of the infant's hospital stay before starting the KMC or TC intervention (Delay) also were found (Table 4). A Delay × Group effect was observed with respect to the mother's sensitivity ($F_{(2481)} = 4.23$, $P = .02$) and the mother's cognitive stimulations ($F_{(2481)} = 3.18$, $P = .04$), whereas mothers in the KMC group were more sensitive to the infant staying in hospital longer (>14 days) compared with mothers in the TC group. Finally, a slight but significant delay difference was observed, where the "3- to 14-day delay" subgroup of mothers responded more adequately to the child's distress than did those in the other subgroups ($F_{(2481)} = 3.04$, $P = .05$). These results show that the delay before starting the KMC or the TC intervention affects only marginally the expression of maternal sensitivity toward her infant.

TABLE 4. Mother's Perception and Mother and Child's Observed Sensitivity by Intervention Groups (KMC vs TC) and Delay From Starting Intervention

	Delay 1 (1–2 Days)		Delay 2 (3–14 Days)		Delay 3 (> 14 Days)		
	KMC (n = 100)	TC (n = 70)	KMC (n = 92)	TC (n = 85)	KMC (n = 50)	TC (n = 91)	
	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	
Mothers' perception	(a)	(b)	(c)	(d)	(e)	(f)	
Sense of competence	.26 ± .95	−.15 ± .82	.15 ± 1.0	−.10 ± 1.2	.09 ± 1.2	−.12 ± .85	ace > bdf*[1]
Stress and worry	.06 ± 1.0	−.25 ± .77	.12 ± .97	.03 ± .97	−.05 ± 1.1	.24 ± 1.3	f > d > b*[3] f > e*[3]
Social support	−.10 ± 1.0	−.04 ± .93	.03 ± .98	.09 ± .93	−.15 ± 1.2	.32 ± .77	ace < bdf*[1] f > e*[3]
Mothers' sensitivity							
Sensitivity	.73 ± .11	.71 ± .13	.72 ± .12	.73 ± .13	.75 ± .12	.69 ± .15	ace > bdf*[1] e > f*[3]
Response to distress	.87 ± .16	.90 ± .14	.92 ± .13	.91 ± .15	.88 ± .15	.87 ± .16	cd > ab = ef*[2]
Socioemotional growth fostering	.57 ± .16	.56 ± .16	.59 ± .15	.61 ± .15	.60 ± .15	.55 ± .15	
Cognitive fostering	.30 ± .20	.28 ± .17	.31 ± .19	.35 ± .21	.37 ± .20	.30 ± .19	e > f*[3]
Child's clarity of cues	.64 ± .15	.63 ± .15	.64 ± .14	.62 ± .18	.64 ± .13	.64 ± .14	
Child's responsivity	.29 ± .14	.31 ± .15	.31 ± .12	.29 ± .13	.33 ± .12	.28 ± .11	

(a), (b), (c), (d), (e), and (f) Represent group means.
* $P < .05$; ** $P < .01$; *** $P < .001$; $t < .10$.
[1] Group effect; [2] delay effect; [3] interaction effect.

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The type of intervention (KMC vs TC) is more likely to influence this maternal behavior, especially with longer infant hospital stay.

KMC Benefits and Infant's Stay in the NICU Before Intervention

The second set of analyses uses the NICU as a moderating variable. This is an indicator of infant's health status between birth and eligibility. This series of analyses aims to show the moderating effect of the infant's relative weakness on the mothers' perceptions and sensitivity toward her child. According to the first set of analyses, data revealed a strong Group effect, where mothers in the KMC group showed a greater sense of competence than mothers in the TC group ($F_{(1483)} = 11.02$, $P = .001$; Table 5). However post hoc analyses reveal that the mothers' sense of competence is modified to a greater degree when infants needed intensive care after birth. Marginally, a trend was seen in mothers whose infant needed intensive care to feel more socially supported ($F_{(1483)} = 2.61$, $P = .11$). No interaction or covariate effect was observed.

The mothers' sensitivity scores were not related directly to early skin-to-skin contact, but rather to the infant's health during the inpatient period. The mothers sensitivity was generally higher when the infant had spent some time in the NICU compared with the dyads who had not ($F_{(6478)} = 2,21$, $P = .04$). In particular, we found that in the former case, the mothers were more sensitive ($F_{(1483)} = 6.41$, $P = .01$) and stimulated the infant more cognitively ($F_{(1483)} = 7.84$, $P = .005$) and socioemotively ($F_{(1483)} = 8.14$, $P = .005$), and the infants gave clearer cues ($F_{(1483)} = 5.42$, $P = .02$) and were more responsive to their mother ($F_{(1483)} = 3.97$, $P = .05$). Consequently, we can say that mother and child's sensitivity to each other at 41 weeks' gestational age was higher if the infant needed intensive care at birth. Moreover, interaction effects occur whereby the infant's weakness affected the mothers in the TC group who stimulated more cognitively ($F_{(1483)} = 4.22$, $P = .04$) and socioemotively ($F_{(1483)} = 4.28$, $P = .04$) the infants that needed intensive care at birth compared with the mothers in the KMC group.

DISCUSSION

The psychological impact of KMC is obvious, but it also is more complex than we had initially thought. The mothers in the KMC group who carried their infant in the skin-to-skin position felt more competent than did their TC counterparts. The infant's health status, however, was also a major determinant of the mothers' attachment behavioral patterns.

The Subjective Bonding Indices

The mothers' global perception of giving birth to a premature infant was different in the two groups. Mothers in the KMC group felt more competent, but also more isolated than did mothers in the TC control groups. First, the sense of competence was clearly much higher in the KMC group, and especially when the intervention started soon after birth (1 to 2 days). In this subgroup, the infants were basically healthy at birth and had had an early close contact with their mothers. Is there is a skin-to-skin effect? Because we had an a priori control on many variables, we suggest that the difference observed between these two groups may be attributable to close contact between the mother and child. It might be explained by empowerment of the mother's feelings, making her more responsible and confident in her capacity to care for her infant. In contradiction to Whitelaw and colleagues,[7] but according to Legault[10] and Affonso and coworkers,[21] we conclude that skin-to-skin contact at discharge is more effective in terms of the mothers' feelings than is traditional routine care in hospitals. Moreover, because the difference between the two groups decreases gradually as the delay between birth and start of TC or KMC intervention increased (Table 4), we can corroborate that early timing is more effective than late timing as a means to enhance the mothers' sense of competence toward her premature infant.

TABLE 5. Mother's Perception and Mother and Child's Observed Sensitivity by Intervention Groups (KMC vs TC) and Child's Need of NICU at Birth

	With NICU		Without NICU		
	KMC ($n = 47$)	TC ($n = 35$)	KMC ($n = 199$)	TC ($n = 207$)	
	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	
Mothers' perception	(a)	(b)	(c)	(d)	
Sense of competence	.24 ± 1.3	−.30 ± .87	.14 ± .98	−.10 ± .97	ac > bd**[1]
Stress and worry	.07 ± .91	.17 ± 1.3	.04 ± .94	−.08 ± .93	NS
Support	.20 ± 1.3	.25 ± .89	−.14 ± .99	.06 ± .91	ab > cd†[2]
Mothers' sensitivity					
Sensitivity	.77 ± .09	.75 ± .15	.73 ± .12	.71 ± .13	ab > cd**[2]
Response to child's distress	.90 ± .12	.85 ± .15	.89 ± .15	.91 ± .15	
Socioemotional growth fostering	.61 ± .14	.66 ± .16	.59 ± .16	.57 ± .15	ab > cd**[2] b > a*[3]
Cognitive growth fostering	.35 ± .19	.42 ± .24	.33 ± .20	.30 ± .18	ab > cd**[2] b > a*[3]
Child's clarity of cues	.66 ± .12	.67 ± .15	.64 ± .14	.62 ± .16	ab > cd*[2]
Child's responsivity to mother	.33 ± .12	.34 ± .15	.31 ± .13	.29 ± .14	ab > cd*[2]

(a), (b), (c), and (d) Represent group means.
* $P < .05$; ** $P < .01$; *** $P < .001$; † $< .10$.
[1] Group effect; [2] NICU effect; [3] interaction effect.

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The timing (delay) of contact between a mother and her child after birth has been an important theme in studies aimed at challenging the bonding hypothesis. In Klaus and colleagues' first study,[14] the mothers in the experimental group had 1 hour of skin-to-skin mother–infant contact (within the first 3 hours), followed by 5 hours' contact per day for 3 successive days. The authors concluded that the increased contact had enhanced the mothers' attachment behavioral patterns, but they could not determine whether it was the initial 1-hour contact or the 15 hours of additional contact that produced the effect. Because the idea of a very short parent–infant bonding period has been widely criticized, Klaus and Kennell in 1982[22] extended it to several hours or days after birth. However, we still lack the empirical data to determine the optimal length of time required—in these first few hours or days after birth—to produce an effect. From the data obtained in this study, we can empirically suggest that close mother–infant contact during the first 2 days after birth is optimal to produce a major change in a mother's sense of competence toward her infant.

Furthermore, based on our data, we also can extend the latter finding to infants that have a poor to bad health status after birth. We found that in infants who needed intensive care, the mothers had a heightened feeling of competence in the KMC group relative to those in the TC group. This finding was especially true for the subgroup that left the hospital earlier, ie, at between 3 and 14 days (data not shown). This discovery indicates a definite advantage of using skin-to-skin contact as early as possible, suggesting that kangaroo-carrying interventions should be encouraged during the NICU period. We are thus tempted to speculate that skin-to-skin contact is not only beneficial in the first days but also at any time during the perinatal period.

Second, the KMC intervention also produced negative feelings in the mothers. They felt more isolated than did mothers in the TC group. This was especially true for those whose infant spent a longer time in hospital. This may have occurred when the infant could not gain sufficient weight or suckle properly, had an infectious disease, or was sick in any way. These mothers may feel burdened with too many responsibilities in taking care of the infant and, consequently, feel overwhelmed and that they are not getting sufficient help from the hospital staff and family. This suggests that in such cases, we should add a social support to the KMC's usual components.

However, feelings of stress and worry in the mothers in the KMC group were maintained at a mean level in any Delay condition, which was not the case for the mothers in the TC group whose stress level was delay-dependent. The latter felt less preoccupied than did mothers in the KMC group when the infant left the hospital early, but they felt much more stressed when the infant stayed longer. Our hypothesis is that KMC gives the mother a feeling of control over her stress and worry about the infant's health, and that this sensation acts in a protective manner, making her more stress-resilient.

We thus confirm the first part of our hypotheses related to the mothers' perceptions of a premature birth experience. There is a direct intervention effect favoring the KMC mothers' sense of competence and the TC mothers' perception of social support, but the moderating effects are more prominent. Mothers in the KMC group had a higher sense competence when the delay was shorter (bonding effect) and when the infants needed intensive care (resilience effect). Feelings of stress for mothers in the KMC group was lower than that for mothers in the TC group when the delay was longer (resilience effect). Finally, mothers in the KMC group felt less supported or more isolated when the delay was longer (isolation effect).

Maternal sensitivity was moderately induced by the KMC intervention in the sense that these mothers were more sensitive and stimulated their infant more cognitively in the context of a longer hospital stay. This may be interpreted as a resilience effect that also was expressed by the mothers' perceptions of their competence and low stress level in these high-risk situations. However, in the context of the infant needing intensive care, observed maternal sensitivity was not increased directly by skin-to-skin contacts. The infant's health appeared as a far more important factor, and mothers tended to provide more stimulation to infants who had a poor health status, which, in turn, led to a more responsive infant. Our initial interpretation of this finding was that poor health may increase the mother's attention, worry, and responsiveness to her infant and that a infant who had been overstimulated and stressed in an NICU—in some cases for a considerably long time (up to 50 days in this sample)—might have become oversensitive to any cues, including maternal cues. This interpretation, however, is not confirmed by our data, which showed that the subgroup that spent an average of 17 days in the NICU had a lower responsiveness to their mothers than did infants in the other group who spent an average of 4.4 days in the NICU (data not shown). Therefore, we hypothesize that this marked orientation toward the sick child might be the beginning of a continuing protective behavioral pattern observed frequently in the interaction between a mother and a sick child during the first years of life.[23,24] This might be interpreted as a natural trend observed in the mothers' behaviors aimed at protecting sick and feeble infants, and are as such, well adapted to the child's situation. However, it could be readily construed that mothers who continue to demonstrate oversensitivity to a child would later be overprotective. This conclusion, however, would require validation in a longitudinal study. At present, we can only conclude that the mothers in both groups, but more consistently in the KMC group, showed behavioral patterns that were adapted to a child's health status. They were more sensitive and more responsive to weak children. This effect overshadowed the KMC carrying effect.

In conclusion, observations of the mothers' sensitive behavior did not show a definite bonding effect, but rather a resilience effect. This is attributable to

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the KMC intervention: mothers in the KMC group were more sensitive toward an at-risk infant whose development has been threatened by a longer hospital stay. Otherwise, we observed that mothers in both the KMC group and the TC group had behavioral patterns that were adapted to the child's at-risk health status and to the precarious condition of some premature infants requiring intensive care. We conclude that the infant's health status may be a more prominent factor in explaining a mother's more sensitive behavior, which overshadowed the kangaroo carrying effect in our study.

From a subjective perspective, results are different. We observed a change in the mothers' perception of her child, which was attributable to the skin-to-skin contact in the kangaroo carrying position. This effect was related to a subjective bonding effect that may be understood readily by the empowering nature of the KMC intervention. Moreover, in particular situations when the infant needs intensive care at birth or has to remain in hospital longer, mothers who carried their infant in the kangaroo position felt more competent than did mothers in the TC control group. This is what we call a resilience effect. There also was an apparent negative effect on the KMC mothers' feelings: when the infant has to stay in hospital longer because of health problems or gestational immaturity, there appeared to be a gap between the mothers' stronger needs to be helped and the feeling of received support. We interpret this as an isolation effect. To minimize this deleterious effect, we would suggest adding social support as an integral component of KMC.

These results suggest that KMC should be promoted actively and that mothers should be encouraged to use it as soon as possible during the intensive care period, up to 40 weeks' gestational age. Thus, KMC should be viewed as a means of humanizing the process of giving birth in a context of prematurity. This finding confirms the conclusions of the 1996 Trieste workshop[25] suggesting that KMC should be promoted both in hospitals and after early discharge.

ACKNOWLEDGMENTS

This study was supported jointly by grants from COLCIENCIAS (Colombian government), the World Laboratory (nongovernmental organization, Lausanne, Switzerland, project MCD 13), the ISS (Instituto de Seguros Sociales), Colombia, and UNICEF.

We thank all members of the Kangaroo research team of the Clinica del Nino: A. Mondragón, MD; R. Gómez, MD; R. Martínez, RN; F.A. Gómez, RN; and Mrs M.V. Jiménez for facilitating the many steps of the process. Without their commitment and devotion, this study could not have been developed. We also thank Ms Pascale Mercier for codifying part of the mother–infant interactions, and Ms Line Nadeau for help with data processing and statistical analyses. We acknowledge general practitioners and neonatal intensive care unit and nurses at the San Pedro Claver Hospital for their support throughout the project. Finally, we thank the parents for their cooperation and participation.

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