

**EFFECT OF INTERMITTENT KANGAROO MOTHER CARE ON WEIGHT GAIN OF
LOW BIRTH WEIGHT NEONATES WITH DELAYED WEIGHT GAIN****Dr. Jai Prakash***

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ABSTRACT

Objective: To evaluate intermittent Kangaroo Mother Care (KMC) with additional opportunities to breastfeed on weight gain of low birth weight (LBW) neonates with delayed weight gain. **Methods:** 40 LBW neonates were followed to see whether KMC with additional opportunities to breastfeed improved weight gain. **Results:** In the KMC group, the mean age of regaining birth weight was significantly less (15.68 vs. 24.56 days) and the average daily weight gain was significantly higher (22.09 vs. 10.39 g, $p < .001$) than controls. **Conclusion:** KMC with additional opportunities to breastfeed was found to be an effective intervention for LBWs with delayed weight gain and should be considered to be an effective strategy.

KEYWORDS: Kangaroo mother care, neonatal weight gain, delayed neonatal weight gain.

Each year, about 20 million low birth weight (LBW) infants are born worldwide. The care of such infants is a burden for health and social systems everywhere (World Health Organization [WHO], 2003). Although it is expected that newborns will lose some weight, a loss of 7% is maximum and weight should plateau by 72 hr (Lawrence & Lawrence, 2011).

Although term neonates initially lose about 3%–5% of their birth weight over the first 3–5 days and regain birth weight by about 10 days, preterm infants may be allowed to lose 5%–15% of their birth weight over the first 5–6 days because of immature skin and kidneys. Preterm infants take longer to regain their birth weight (Doherty & Simmons, 2008; Ellard & Anderson, 2008).

Kangaroo Mother Care (KMC) was developed in Colombia in the 1970s (Nyqvist et al., 2010a). However, it remains unavailable in most low-income countries (Lawn, Mwansa-Kambafwile, Horta, Barros, & Cousens, 2010). The hallmark of KMC is the kangaroo position: the infant is cared for skin-to-skin (ventral surface of the mother to ventral surface of the baby) vertically between the mother's breasts and under her clothes, 24 hr per day, with the father/substitute(s) participating as relief KMC providers. The other components in KMC are exclusive breastfeeding (ideally) and early discharge continuing KMC at home with close follow-up (Nyqvist et al. 2010a).

Lawnet al. (2010) concluded that KMC in the first week of life showed a significant reduction in neonatal mortality (relative risk 0.49, 95% confidence interval =

0.29–0.82) compared with standard care among preterm babies in hospital, and was highly effective in reducing severe morbidity, particularly from infection. Thukral, Chawla, Agarwal, Deotari, & Paul (2008) concluded that all stable LBW babies are candidates for KMC. This is a desirable practice for the reasons described earlier and should be continued until the baby's postmenstrual age reaches term. Even unstable infants can be provided KMC irrespective of their clinical condition (WHO, 2003).

METHODS

The aim of this study was to examine the effectiveness of intermittent KMC with increased opportunities to breastfeed on weight gain in LBW neonates who did not start to gain weight after Day 7. Weight gain problems represent about 25% of cases in our neonatal intensive care unit (NICU).

The study followed the principles of research ethics adopted by the 18th World Medical Assembly, Helsinki, Finland, June 1964 and amendments including approval by the University Hospital's Institutional Review Board (IRB).

The study followed a nonrandomized controlled, quasi-experimental design. It was conducted at the NICU of Government Theni Medical College and Hospital, Theni, with limited resource in Theni.

As part of the efforts to promote breastfeeding, humanize care, and introduce "baby-friendly" attitudes and practices in our NICU, a private room has been allocated

for mothers for breastfeeding and KMC. After complete stabilization, parents of 40 LBW infants (birth weight <2,500 g) who met the inclusion criteria were informed about the study and were asked if they would like to participate—all consented. A convenience sample of 22 neonates whose mothers had permitting family and household commitments and were able to come to the NICU and provide KMC, including breastfeeding twice daily for at least an hour as described by Nyqvist et al. (2010a), were assigned to the KMC group. The remaining 18 infants received routine care.

The infants were enrolled in the study at 8 days of postnatal age when intermittent KMC with inherent ad lib breastfeeding opportunity was begun for the intervention group. All babies were generally stable all throughout the study.

Inclusion criteria

1. Babies admitted in the NICU in the first day of life.
2. Preterm LBW babies: babies born less than 37 weeks' gestational age.
3. GA was assessed using the Ballard score (Ballard et al., 1991). (GA; WHO, 2003).
4. Babies' birth weights were appropriate for gestational age (AGA). AGA = birth weight between the 10th and 90th percentile (according to Lee, 2008). So all our subjects were LBW and also premature.
5. Weight loss of 10%–13% of birth weight during the first week.
6. Babies who are generally stable and met the criteria for discharge according to May and Zaccagnini (2008) except for not starting to gain weight until Day 7.

Criteria for discharge according to May and Zaccagnini (2008).

- Alert, healthy appearance.
- Ability to maintain temperature in an open crib. (We frequently tested our subjects during feeding, weighing, and delivery of care and all maintained their temperature outside the incubator.)
- Ability to take feeding by bottle or breast without respiratory compromise.
- No apnea or bradycardia for 5 days.
- Steady weight gain.

Exclusion criteria

- 1 Term babies (37–41 6/7 weeks' GA).
- 2 Post term babies (42 weeks or more GA).
- 3 Small for GA (whose birth weight was lower than the 10th percentile).
- 4 Large for GA (whose birth weight was higher than the 90th percentile). (The previous
1. definitions are according to Lee, 2008.)
- 5 Babies who start gaining weight before Day 8.
- 6 Babies who lost less than 10% or more than 13% of birth weight in the first week.

- 7 Babies who are not stable (did not meet the previous criteria) before enrollment or during the observation period.
- 8 Babies with congenital anomalies, hypoxic ischemic encephalopathy, central nervous system (CNS) impairment, neonatal sepsis, urinary tract infection, or one of twins or higher order multiples.

The aim of this study was to examine the effectiveness of intermittent KMC with increased opportunities to breastfeed on weight gain in LBW neonates who did not start to gain weight after Day 7.

All investigations necessary to confirm the diagnosis of the exclusion criteria were performed (e.g., echocardiography (echo), ultrasound, computed tomography (CT) of the brain, blood gases, and blood or urine cultures).

Standardized nutrition and care were provided for all 40 neonates. All of the studied newborns of both groups received the same nutrition (120 Kcal/kg/day equivalent to 160 mL/kg/day; Doherty & Simmons, 2008; Ellard & Anderson, 2008) throughout the observation period. Feeds were given every 2 hr (expressed breastmilk with direct breast feed when available).

The infants of the KMC group had opportunities to directly breastfeed ad lib in addition to the standard nutrition. All the 40 studied neonates received standard care and monitoring inside the incubators (Dräger airshields isolette C450 H-1C). For all 40 neonates, we followed serum electrolytes, blood gases, complete blood count, daily urine output, renal and liver functions, serum albumin, and other investigations for the assessment of the nutritional status.

For the 22 neonates of the KMC group, intermittent KMC was begun twice daily, 7 days per week. The baby was cared for in skin-to-skin contact vertically between the mother's breasts under her clothes for at least 1 hr at a time wearing only a diaper and a cap, and breastfeeding during this time was also encouraged as described by Nyqvist et al. (2010a).

Weight was measured for the babies without clothes by using a calibrated electronic scale (Laica Model BF 2051) 3 times per day by the same investigator. The mean was taken and recorded as the daily weight, and the mean rate of daily weight gain was calculated as the secondary outcome measure.

When the baby regained his birth weight, our primary outcome measure was recorded (postnatal age of regaining birth weight).

Statistical Methods

Data were analyzed using SPSS win statistical package version 15 (SPSS Inc., Chicago, IL). Numerical data were expressed as mean, standard deviation, and range.

Qualitative data were expressed as frequency and percentage. Chi-square test (Fisher's exact test) was used to examine the relation between qualitative variables. For quantitative data, comparison between two groups was done using Mann-Whitney test for univariate analysis. Factors possibly affecting the numerical outcome measures were tested in a general linear model univariate analysis for detection of the independent factors. A p value $<.05$ was considered significant. The power of the study was calculated according to the number of patients in each group and the resultant rate of weight gain at an alpha level of 0.05, and it resulted in a power of 100%.

RESULTS

There were 40 LBW infants (KMC group = 22, control group = 18) included in this study. There were no statistically significant differences between the two groups regarding the demographic characteristics, namely, mode of delivery ($p=.455$) and gender ($p=.482$; Table 1) or baseline values at enrollment, namely, GA at birth ($p=.270$), birth weight ($p=.218$), mean weight loss ($p=.834$), and weight at enrollment ($p=.258$; Table 2).

Table 1: Comparison Between KMC Group and Control Group Regarding Mode of Delivery and Gender.

Variable	Kangaroo Mother Care		Control		p value
	Frequency	(%)	Frequency	(%)	
Mode of delivery					
Vaginal delivery	17	(77.3)	12	(66.7)	.455
Cesarean surgery	5	(22.7)	6	(33.3)	
Gender					
Boys	11	(50.0)	11	(61.1)	.482
Girls	11	(50.0)	7	(38.9)	

Table 2: Comparison Between Kmc Group And Control Group Regarding Gestational Age, Birth Weight, Weight Loss, and Weight At Enrollment.

Points of Comparison	Kangaroo Mother Care, Mean, \pm SD(Range)	Control, Mean, \pm SD (Range)	p value
Gestational age (weeks)	31.1 \pm 2.5 (27–35)	32.0 \pm 2.1 (28–35)	.270
Birth weight (grams)	1,381.8 \pm 391.1 (850–2,100)	1,502.8 \pm 285.7 (900–1,900)	.218
Weight loss (%)	11.4 \pm 1.4	11.4 \pm 1.0	.834
Weight at enrollment (grams)	1,226.7 \pm 339.7 (765–2,100)	1,329.3 \pm 247.0 (810–1,672)	.258

The mean postnatal age at which the babies regained their birth weight (primary outcome measure) was significantly less in the KMC group, 15.7 \pm 0.7 days, compared to the control group, 24.6 \pm 3.8 days ($p < .001$). The mean daily weight gain (secondary outcome measure) was significantly higher in the KMC group, 22.1 \pm 2.5 g, compared to the control group, 10.4 \pm 2.5 g ($p < .001$; Table 3). No significant associations were noticed of the primary outcome measure (age of regained

birth weight) or the secondary outcome measure (average daily weight gain) with mode of delivery, gender, GA, or birth weight (Table 4). In a general linear model, univariate analysis for these factors in addition to the kangaroo care with ad lib breastfeeding, the intervention was the only independent factor affecting the outcome measures (Table 5). Neonates of the KMC group were found to have had a mean of additional breastfeeding opportunities of 17.4 \pm 1.3 times.

Table 3: Comparison Between KMC Group and Control Group Regarding the Outcome Measures.

Points of Comparison	Kangaroo Mother Care, Mean, \pm SD(Range)	Control, Mean, \pm SD(Range)	pvalue
Time of regaining birth weight (days postpartum)	15.7 \pm 0.7 (15–17)	24.6 \pm 3.8 (20–30)	<.001
Rate of weight gain (g/day)	22.1 \pm 2.5 (20–28)	10.4 \pm 2.5 (8–15)	<.001

Table 4: Relation of Mode of Delivery, Gender, Gestational Age, and Birth Weight With the Outcome Measures.

Points of Comparison	Time of Regaining Birth Weight (Days Postpartum)	Rate of Weight Gain (Grams/Day)
Mode of delivery		
Vaginal delivery	19.7 \pm 5.3	17.0 \pm 6.5
Cesarean surgery	19.7 \pm 5.0	16.5 \pm 6.3
p value	.455	.437
Gender		

Male	20.0 ± 5.0	16.6 ± 6.6
Female	19.3 ± 5.5	17.1 ± 6.3
<i>p</i> value	.199	.079
Gestational age		
<32 weeks	18.4 ± 4.4	17.3 ± 7.4
≥32 weeks	20.5 ± 5.5	16.5 ± 5.8
<i>p</i> value	.279	.692
Birth weight		
<1,500 g	19.0 ± 5.3	17.4 ± 7.3
≥1,500 g	20.6 ± 5.0	16.1 ± 5.2
<i>p</i> value	.218	.581

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Table 5: General Linear Model Univariate Analysis for Factors Affecting the Outcome Measures.

Points of Comparison	Time of Regaining Birth Weight		Rate of Weight Gain	
	<i>F</i>	<i>p</i> value	<i>F</i>	<i>p</i> value
Kangaroo care	104.400	<.001	243.251	<.001
Mode of delivery	1.669	.205	1.283	.265
Gender	0.295	.591	1.623	.211
Gestational age	0.280	.600	5.340	.070
Birth weight	0.003	.955	3.390	.056
Weight loss	0.094	.762	3.772	.061
Weight at enrollment	0.753	.392	0.138	.713

DISCUSSION

Intermittent KMC was found to be a safe, effective, and feasible method of care of LBW infants admitted to the NICU. In the context of our interventions to promote breastfeeding and introduce baby-friendly practices in our NICU, we have been exploring the effect of these interventions on various aspects of neonatal health problems such as jaundice (Samra, El Taweel, & Cadwell, 2011), infant cognitive development (El Azim & Samra, 2011), infant vital parameters (Samra & Brimdyr, 2011), and weight gain (this study). Weight gain problems represent about 25% of cases in our NICU.

LBW newborns that did not start to gain weight by Day 7 were intermittently placed ventral surface to ventral surface on their mothers' chests in skin-to-skin contact and kept upright. This way, the mother became the niche and habitat for these immature beings, just as is done by kangaroos, according to Parmar et al. (2009). Understanding that parents expect their newborns to receive sophisticated care using advanced technology in our NICU, we could only try KMC on a convenience sample of neonates and only after they had been stabilized.

Intermittent KMC was found to be a safe, effective, and feasible method of care of LBW infants admitted to the NICU.

We designed the inclusion and exclusion criteria to limit to the utmost extent of the influence of confounding variables on our results. The only difference between both groups was the intervention. This was confirmed by the nonsignificant differences between both groups

regarding the pre-enrollment variables, namely, mode of delivery ($p = .455$), gender ($p = .482$), GA at birth ($p = .270$), birth weight ($p = .218$), mean weight loss ($p = .834$), and weight at enrollment ($p = .258$). We started the intervention at Day 8 when the infants should have started to regain weight, which we determined was the only factor delaying their discharge. In this study, we found that the mean postnatal age at which the babies had regained their birth weight was earlier in the KMC group (15.7 days) compared with that of the control group (24.6 days; $p < .001$). In addition, KMC babies had more than double the average weight gain per day (22.1 g) of that of the babies in the control group (10.4 g; $p < .001$).

These findings agree with those of Suman, Udani, & Nanavati (2008) whose research at a Level III NICU of a teaching institution in Western India reported an average weight gain per day in the KMC babies of 23.99 g versus 15.58 g in the conventional methods of care. However, they included cases of small for GA and they reported development of hypothermia, hypoglycemia, and sepsis in the conventional care group whose ages of enrollment were significantly younger than the KMC group, and both were younger than our cases. Several other investigators have reported weight gain in neonates using different inclusion criteria, starting KMC at different postpartum ages and implementing either intermittent or continuous KMC (Cattaneo et al., 1998; Charpak et al., 2005; de Leeuw, Colin, Dunnebie, & Mirmiran, 1991; Gathwala, Singh, & Singh, 2010; Ludington-Hoe, Morgan, & Abouelfetoh, 2008; Mörelis, Theodorsson, & Nelson, 2005; Ramanathan, Paul, Deorari, Taneja, & George, 2001; Tallandini & Scalcembra, 2006).

Our explanation for our significant findings is that the mother's skin-to-skin contact with her preterm infant provides multisensory stimulation including emotional, tactile, proprioceptive, vestibular, olfactory, auditory, visual, and thermal stimulation in a unique interactive style (Cong, Ludington-Hoe, McCain, & Fu, 2009) and also promotes beneficial physiological conditions in preterm infants such as increased quiet sleep state and more stable thermoregulation, heart rate, respiratory rate, and oxygen saturation (Chiu & Anderson, 2009). According to Tourneux et al. (2009), the newborn's energy expenditure is used in order of priority for (a) basic metabolism, (b) body temperature regulation, and (c) body growth. So when KMC decreases the expenditure needed for metabolism and thermoregulation, most of the energy is directed toward growth.

Also, the increased opportunities of direct breastfeeding (which amounted up to 17.4 ± 1.3 times), enjoyed by our KMC babies must have definitely added to the previously noted energy-saving effect, with the net result of their better weight gain. The positive impact of KMC on breastfeeding is stated in reports by WHO (2003), Nyqvist et al. (2010a), and others. Conversely, very few studies reported no difference in weight gain in KMC neonates compared to non-KMC neonates (Cerezo, de Leon, & Gonzales, 1992; Chwo, Anderson, Good, Dowling, Shiao, & Chu, 2002).

However, Conde-Agudelo, Belizán, & Diaz-Rossello (2011) in their most recent, extensive, and critical updated systematic review of 15 randomized controlled trials comparing KMC and conventional neonatal care, found compelling evidence that KMC is associated with increases in weight gain among other important benefits. They have come to that conclusion after having exhausted all critical appraisal tools and comparing different study parameters and inclusion and exclusion criteria with inclusion of subgroup analyses according to type of KMC (intermittent vs. continuous), infant age at initiation of KMC, setting in which the trial was conducted (low- or middle-income countries vs. high-income countries), and infant stabilization (before vs. after). Using the subgrouping described by Conde-Agudelo et al. (2011), our cases belong to the late-onset KMC, low- or middle-income country (but in a Level III university-based unit) and we used the intermittent type of KMC after stabilization of the infants.

Although we could not randomly assign our subjects to either of the two groups because of inconvenience, we took care that both groups were matching regarding patient characteristics, baseline values, and physical and environmental conditions before and at enrollment and all throughout the observation period. Neither of these variables appeared to have an influence on either of our outcome measures. In a general linear model univariate analysis for these factors in addition to the kangaroo care, the latter was the only independent factor affecting

the outcome measures. Also, to adjust for the relatively small sample size, the power of the study was calculated according to the number of patients in each group and the resultant rate of weight gain at an alpha level of 0.05, which resulted in a power of 100%.

In the light of research demonstrating the benefits of KMC, the WHO (2003) stated that.

Almost two decades of implementation and research have made it clear that KMC is more than an alternative to incubator care. It has been shown to be effective for thermal control, breastfeeding and bonding in all newborn infants irrespective of setting, weight, gestational age and clinical condition.(p. 2)

In conclusion, intermittent KMC with increased breastfeeding opportunities was found to be effective for improving weight gain in neonates who have delayed weight gain irrespective of birth weight, gender, mode of delivery, or GA. In light of our findings and others, KMC should be considered to be an effective strategy to increase weight gain in neonates with delayed weight gain.

More research is needed to explore the effects of KMC on other neonatal problems and to reconfirm our findings in other settings.

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