

Kangaroo mother care and its physiological effects in low birth weight and preterm neonates

Gunjita Jain¹, Preeti Malpani², Manju Biswas³

From ¹P.G. Student, ²Associate Professor, ³Assistant Professor, Department of Pediatrics, M.G.M. Medical College, Indore, Madhya Pradesh, India

Correspondence to: Gunjita Jain, Department of Pediatrics, M.G.M. Medical College, Indore, Madhya Pradesh, India.

E-mail: gunjita07@gmail.com

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ABSTRACT

Objectives: The present study was undertaken to study and compare anthropometry and physiological parameters in preterm and low birth weight infants during conventional care and Kangaroo Mother Care (KMC). **Methods:** This prospective case-control study was conducted in the department of pediatrics of a tertiary care hospital in central India from June 2016 to September 2017. Study on KMC was conducted on 200 newborns weighing <2.0 kg meeting study criteria with similar baseline characteristics. With minimum duration of 6 hrs/day where as controls given incubator and cot care. Parameters were studied until discharge criteria were met. The primary outcome variable was “weight gain and anthropometry” and secondary measures included breastfeeding and duration of hospitalization and physiological parameters. **Results:** KMC group showed a significant decrease in the duration of hospital stay (11.69±5.14 vs. 18.5±1.8 days) (p=0.0001) and better rate of breastfeeding (66% vs. 21%) as compared to control group. KMC group also shows higher weight gain (19.7±6.3 g/day) in comparison to control (11.4±3.3 g/day), (p=0.001). There was a mean increase of 0.7 cm/week in head circumference in KMC group and 0.4 cm/week in the control group (p=0.000). The mean increase in length was 0.89 cm/week in KMC group and 0.45 cm/week in control group (p=0.0001). The mean heart rate and respiratory rate were similar in both the groups (p=0.498 and p=0.555, respectively). The mean temperature difference was significant and shows that KMC group has a higher temperature of 0.4°F (p=0.001). In other physiological parameters, no episodes of apnea and hypoglycemia were present in KMC group as compared to 4 episode of hypoglycemia and 3 episodes of apnea in the control group. **Conclusion:** Newborns receiving KMC showed better growth parameters as compared to the routine care along with a better breastfeeding rate. Better thermal control and decreased episodes of hypoglycaemia & apnea in KMC group.

Key words: Breastfeeding, Kangaroo Mother Care, Low birth weight, Preterm

In Indian scenario, where 1/3rd of babies are low birth weight (LBW) (<2500 g) and preterm deliveries being very common in our setup, their care is a heavy burden on the limited resources. Birth weight is a significant determinant of newborn survival. India contributes to one-fifth of global live births and more than a quarter of neonatal deaths. Nearly, 0.75 million neonates died in India in 2013, the highest for any country in the world [1]. The current NMR is 28 per 1000 live births [2]. The past few years have shown changes in neonatal care. One such change is the implementation of Kangaroo Mother Care (KMC).

In 1978, due to increased morbidity and mortality rates in the neonatal intensive care unit (NICU) in Bogotá, Colombia, Dr. Edgar Rey, introduced “KMC.” This helped LBW babies to keep them warm and to give exclusive breastfeeding (EBF) as needed [3]. This provided caregivers early discharge despite prematurity, improved survival rates, lowering the risks of nosocomial infection, & severe illness. It also increased EBF and improves maternal satisfaction and confidence [4]. KMC effectively and positively promotes premature infants

physiological stability, behavioral organization, and enhanced psychosocial outcome compared to conventional care as proved in various studies [5].

For physical and psychological growth, the environment may be the single most important factor in neonatal development [6]. In NICU, frequent procedures, handling, and exposure to light and noise may cause physiological stress and ultimately decrease cognitive development [7,8]. At times, sudden elevation of blood pressure is a risk factor for the development of intraventricular hemorrhage [9]. The baby is unable to sleep and rest and may remain irritable. This may lead to depletion of energy reserves with poor weight gain due to a constant state of arousal [10]. Bright light may adversely affect the development of central nervous system and may lead to the development of squint and reduced socialization. Duration of rapid eye movement sleep is increased, which may be associated with physiological liability manifested by bradycardia and apnea [11]. NICU’s may adversely affect the circadian biological rhythm leading to the reduced release of growth hormone and poor weight gain [12].

Therefore, to reduce the stay of cardiopulmonary stable babies and decrease the harmful effect of NICU environment due to prolonged stay of preterm and LBW babies, KMC was initiated as low cost, feasible, and easily acceptable effective method. We planned this study to compare various anthropometry and physiological parameters in preterm and LBW infants during conventional care and KMC.

MATERIALS AND METHODS

This prospective case–control study was conducted in a teaching institution with a tertiary level NICU in Indore over a period of 15 months from June 2016 to September 2017. Prior approval was obtained from the Institutional Ethics Committee, and consent was taken from the parents or local guardians before recruitment. Cases included newborns weighing <2.0 kg who received KMC. An equal number of newborns from the same setting, with same baseline characteristics, received routine care (warmer or blanket) were taken as controls.

The study included all neonates with birth weight <1000 g and >2000 g with stable cardiopulmonary status, Apgar of >7 at 5 min and on feeds (breast, spoon or tube), and who received KMC at least 5 days. All sick and unstable newborns, premature infants with infections, respiratory distress, and congenital anomalies were excluded. Newborns admitted in NICU who are given to mother only for intermittent care and feeding and mothers not giving consent to participate in the study were also excluded.

After allocation, babies in the KMC group received kangaroo care (skin-to-skin contact) with the help of specially designed kangaroo bag and control received routine care, temperature maintenance was done by warmer and heaters. The minimum duration of skin-to-skin contact was 5 h in 2–4 sittings. There was no upper limit for the duration. The mothers were encouraged to give KMC for as many hours (~24 h) as deemed possible and comfortable.

KMC was continued until discharge criteria are fulfilled that were - Weight >1800 g or/and stable, gaining weight (at least 15–20 g/kg/day for at least 3 consecutive days), minimum duration of stay 5 days, baby's general health is good with no evidence of infection and baby is feeding well (exclusively or predominantly breast milk), and maintaining body temperature satisfactorily for at least 3 consecutive days in room temperature. We also ensured that the mother and family members were confident to take care of the baby in KMC and were ready to come for follow-up visits regularly. Babies fulfilling the above points and weight >1600 g were discharged.

All the necessary information was collected for all the babies including detailed birth history, vitals, and anthropometry including weight, length, and head circumference (with stretchable measuring tape). Weight was monitored daily with electronic weight machine (error \pm 5 g) daily. Physiological parameters such as heart rate, respiratory rate, axillary temperature, and episodes of hypoglycemia and apnea were recorded twice a day throughout the stay for both the groups.

Quantitative data with assured normality was mean and SD was used to describe quantitative data with assured normality and Student's t-test (unpaired) was used as a test of significance, and Where normality was not assured, median was used to describe the data, and Mann–Whitney U-test was used as a test of significance. Qualitative data were assessed by Pearson's Chi-square test is applied to test the relationship of categorized independent and dependent variables, and if the expected number in the cell was below 5 in a table, Fisher's exact test (exact two-sided) was used. $p < 0.05$ was deemed statistically significant.

RESULTS

A total of 200 newborns including 100 newborns each in cases (KMC group) and controls (routine care) were included in the study. The baseline characteristics were comparable as shown in Table 1.

Mean duration of KMC was 7.52 ± 3.42 h. KMC group showed significantly decreased in duration of stay (11.69 ± 5.14 vs. 18.5 ± 1.8 days) ($p < 0.005$). 91% of newborns were discharged within 0–20 days of stay. Prolonged duration of stay, of more than 30 days, was not required in KMC group, whereas in control group, 69% of newborns stayed over a period of 0–20 days followed by 17% stayed for 21–30 days and 14% also required a prolonged stay of more than 30 days.

Table 1: Baseline characteristics of cases and controls

Parameters	Case	Control
Sex (M/F)	55/45	53/47
Gestational age (in weeks)		
Mean	31.6 ± 2.4	31.7 ± 2.5
28	15	16
30	30	25
32	20	27
34	27	20
36	8	12
Weight on admission (kg)		
Mean	1.38 ± 0.26	1.32 ± 0.18
1–1.25	25	29
1.25–1.5	61	57
1.5–2	14	14
Mean discharge weight	1.57 ± 0.16	1.514 ± 0.10
Classification based of Lubchenco's chart		
Small for date	68	70
Appropriate for date	32	30
Anthropometry		
Head circumference (cm)	31.1 ± 1.5	29.5 ± 1.9
Length (cm)	41.0 ± 2.6	40.2 ± 1.8
Normal delivery (%)	94	93
Mode of feeding (%)		
B/F	9	1
S/F	41	20
T/F	39	77

KMC group had a better rate of breastfeeding as compared to control group (66% vs. 21%). On admission, tube feeding, both in control group (77%) and KMC group (49%), was the major mode of feeding, which decreased to a negligible number in KMC group (2%) whereas remained significantly high in the control group until discharge (29%), i.e., higher rate of conversion of mode of feeding. Moreover, when compared with the duration of KMC with mode of feeding, newborns receiving >6 h of KMC had a maximum rate of breastfeeding (45%) and <6 hour had 19% with overall 66% of breastfeeding.

KMC group showed higher weight gain (19.72±6.32 g/day) in comparison to control (11.41±3.32 g/day) (p=0.001). Furthermore, the mean weight gain was more in KMC group than in the control group (~224.27 g vs. ~210.9 g) and comparatively higher range of weight gain (201–300 g) as compared to control (100–200 g) during a hospital stay. Overall, KMC group also showed higher mean weight at discharge than in controls (1.57±0.16 vs. 1.51±0.12 kg) (p=0.001) (Table 2).

Mean increase in the head circumference and length at the time of discharge was also significantly more in KMC group than the controls (p=0.0001 and 0.0001, respectively). The mean heart rate, respiratory rate, and saturation were similar in both the groups (p=0.498 and 0.555, respectively). The mean difference in temperature was significant, and KMC group had a higher temperature of 0.4°F (p=0.001). There were no episodes of apnea and hypoglycemia in the KMC group in comparison to 4 episodes of hypoglycemia and 3 episodes of apnea in the control group.

Table 2: Results of comparison of cases and control

Parameters	KMC	Control	p value
Mean duration of stay (days)	11.69±5.14	18.5±11.8	0.0001
Mean increase in head circumference	0.70 cm/week	0.40 cm/week	0.000
Mean increase in length	0.89 cm/week	0.45 cm/week	0.000
Weight parameters			
% Weight gain	97%	93%	-
Mean weight gain	224.27±10 g	210.92±12 g	0.005
Mean weight gain/day	19.73±6.31 g	11.41±3.31 g	0.001
Mean weight gain at discharge	1.57±0.16 g	1.51±0.10 g	0.001
Physiological parameters			
Mean respiratory rate	36.89±3.49	37.18±3.47	0.555
Mean heart rate	136.46±4.77	136.92±4.82	0.498
Mean temperature	98.6±0.24	98.13±0.13	0.001
Saturation (SapO ₂)	99±0.18	99±0.12	-
Apnea	0	3	-
Hypoglycemia	0	4	-
Breastfeeding % at discharge	66%	21%	-

KMC: Kangaroo Mother Care

DISCUSSION

The main goal of nutritional management of the LBW infants is the achievement of postnatal growth at intrauterine growth accretion rates. The ultimate endpoint of metabolism is somatic growth, measured by weight gain. In this prospective case–control study, we tried to assess the effects of KMC in the newborns weighing <2 kg. Baseline characteristics of newborns were matched for all the variables in both the groups. We demonstrated a significantly higher daily weight gain in infants who received the KMC with higher mean discharge weight (p=0.001).

These results were in accordance with studies done by Ali *et al.* [13] showing 10.4±4.8 versus 19.3±3.8 kg (p<0.001), Swarnkar *et al.* [14] showing 19.28±2.9 vs. 10.1±1.05 g, and Mahbulul *et al.* [15] showing better weight gain with KMC (18.35±7.8 vs. 13.55±4.89 g). In studies done without a control group, Charpak *et al.* [16] and Hann *et al.* [17] showed a good weight gain of 19 g/day and 27 g/day, respectively. Recently, Mishra *et al.* [18] and Phirke *et al.* [19] also showed a better daily weight gain in KMC as compared to those receiving conventional care (15.9±4.5 vs. 10.6±4.5 g) and 14.53 g/day, respectively. Kumbhojkar *et al.* [20] also showed much higher weight gain with KMC (KMC 25.28 g vs. CMC 14.216 g) as found in a study by Rao *et al.* [21].

In our study, duration of stay was comparatively less in KMC group than the control group (p=0.0001). Similar results were by Kumbhojkar *et al.* (12 days vs. 17 days) [20], Mishra *et al.* (6–8 days vs. 14–18 days) [18], and others [13,22,23]. Elias *et al.* showed that babies receiving KMC reached 2.7 kg earlier than the babies receiving conventional care (4.42±2.36 vs. 5.67±2.13 weeks, respectively) [24]. In our study, the mean increase in the head circumference was 0.7 cm/week in KMC group in comparison to 0.4 cm/week in control group (p=0.0001), and the mean length increased by 0.89 cm/week in KMC group in comparison to 0.45 cm/week in control group (p=0.0001). The ideal weekly increments in head circumference and length were only achieved in KMC group, and this was supported by many previous studies [14,18,20,21].

The increase in breastfeeding rate was significantly more in KMC group (from 9% to 66% in KMC vs. 1–21% in control). The similar results by Ali *et al.* [13], Charpak *et al.* [16], Kumbhojkar *et al.* [20], Rao *et al.* [21], Vohra *et al.* [25].

In our study, we could not find any significant difference in the physiological parameters such as heart rate and respiratory rate among newborns of both the groups. Similarly, Almeida *et al.* [26], Miltersteiner *et al.* [27], and Ali *et al.* [13] also did not find any significant change in the heart rate after applying KMC. On the contrary, Phirke *et al.* [19] observed that the heart rate dropped by 3–5 beats per minute during KMC. In contrast to results of our study, Almeida *et al.* [26] showed a significant difference (41.3 vs. 36.8, pre- and post-KMC). Similarly, Phirke *et al.* (45.9 vs. 40.1) and Kadam *et al.* (40.7 vs. 36.2, p<0.01) also showed a significant difference in respiratory rate with KMC [19,28]. The effect on respiratory rate is probably due to Kangaroo Mother position which keeps the baby upright inclined at 60°.

In our study, there was no difference in oxygen saturation between two groups which are in agreement with the previous studies [13,19,27,28]. However, Almedia *et al.* showed increased SpO₂ (93.8% vs. 97.3%) after performing KMC [26]. The mean temperature was also significantly higher in KMC group with an approximate difference of 0.4°F (p=0.0001). This is in accordance with results of studies done by Ali *et al.* [13], Phirke *et al.* [19], and Almedia *et al.* [26]. Episodes of apnea and hypoglycemia were less in KMC group as shown by other authors also [13,14,18,20,21]. Limitation of the study was the small sample size, and it was not done on a large scale. Furthermore, the low literacy rate in our area leads to difficulty in understanding the importance and to give proper KMC despite multiple demonstrations.

CONCLUSION

KMC demonstrates higher growth rates, higher weight gain, and early discharge in LBW babies. KMC prevents or reduces almost all associated morbidities of LBW infant. It also promotes EBF practice and increases mother's confidence in handling such babies and builds good mother-baby bonding.

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