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ORIGINAL ARTICLE

Outcome of premature and low birth weight infants who received kangaroo mother care in neonatal intensive care unit at a tertiary care hospital.

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ABSTRACT…. Objective: To evaluate the effects of Kangaroo Mother Care (KMC) on the outcome of growth amongst preterm low birth weight (LBW) infants. **Study Design:** Quasi-experimental study. **Setting:** Neonatal Intensive Care Unit (NICU), Shifa International Hospitals Limited, Islamabad, Pakistan. **Period:** April 2025 to September 2025. **Methods:** A total of 82 LBW and preterm newborns admitted to the NICU, were included. Group allocation was pragmatic and non-random. Weight, length, and head circumference measured at birth and then serially till the time of discharge, duration of hospitalization along with complications were recorded. Analyses used IBM-SPSS Statistics v26, by applying appropriate statistical tests taking p<0.05 as significant. **Results:** Amongst 82 participants, 45 (54.9%) received KMC, and 37 (45.1%) did not. Females accounted for 44 (53.7%) infants. Discharge weight was 2410.8±295.6 g with KMC, and 2178.9±318.1 g without KMC (p=0.001), and daily weight gain was 17.2±4.1 g/day with KMC, and 14.1±4.7 g/day with non-KMC (p=0.002). Length (p=0.029), length gain (p=0.034), head circumference (p=0.041), and head circumference gain (p=0.018) at discharge were significantly higher among infants undergoing KMCs. Hospital stay was 8.0 (6.0 to 11.5) days among KMC infants, and 12.0 (6.0 to 16.5) days among non-KMC infants (p=0.010). Complication occurred in 6 (13.3%) KMC infants, and 12 (32.4%) non-KMC infants, with risk ratio 0.4 (0.2 to 0.9; p=0.031). **Conclusion:** KMC significantly improves growth outcomes, reduces hospitalization, and lowers overall morbidity in stable preterm LBW infants, including those on non-invasive respiratory support. Structured KMC should be integrated into routine NICU practice.

Key words: Head Circumference, Infant, Kangaroo Mother Care, Low Birth Weight, Preterm.

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INTRODUCTION

Prematurity and low birth weight (LBW) are important causes of neonatal and infant mortality, and long-term neurodevelopmental disability.[1,2] An estimated 15-20% of infants are born with a LBW as a result of preterm birth or intrauterine growth retardation or both. Among 2.5 million neonates dying annually, around 80% are LBW, and 2/3rd are born prematurely.[3-5] LBW infants are at increased risk of cardio-respiratory instability, hypothermia, hypoglycemia, and infection owing to the immature function of their organ systems.[6] In the recent decades, antenatal corticosteroids, breastfeeding, hygiene, and improvement in overall access and healthcare including Kangaroo Mother Care (KMC) have improved survival of premature and LBW infants.[7,8]

KMC has been shown to have a significant stabilizing impact on cardio-respiratory parameters with fewer heart rate rises, fewer bradycardia episodes, and improved SpO_2 stability.[9-12] The Cochrane review on KMC demonstrated a 40% reduction in the risks of mortality for infants who received KMC compared to those who were given conventional care. This meta-analysis also showed that infants who were given KMC had fewer infections, higher rates of breastfeeding, and better weight gain than those who did not.[13]

The current study was planned aiming to determine the gain in weight, head circumference, and length, the duration of hospitalization, and the frequency of complications such as sepsis, necrotizing enterocolitis (NEC), and intraventricular hemorrhage (IVH) in LBW who receive KMC. The findings of this study would be a valuable addition to the existing local stats.

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If KMC is found effective, and by adopting the guidelines, families could shorten hospital stays, return home with in time, and live with the social support. Using KMC as an intervention in LBW infants would also help in reducing the cost as well as optimizing hospital beds for new admissions.

METHODS

This prospective, quasi-experimental study was performed at the neonatal intensive care unit (NICU), the pediatric department, Shifa International Hospitals Limited, Islamabad, Pakistan, from April 2025 to September 2025. Approval from the institutional review board was obtained prior to the commencement of the study (IRB#030-25, dated: 28th March, 2025). A sample size of 82 was calculated using the WHO sample size calculator, considering the anticipated premature infant weight gain with KMC as 23.3±8.7 g[14], setting the power of the study at 80%, and the margin of error at 5%. The inclusion criteria were neonates of any gender with a gestational age between 30+0 and 36+6 weeks and a birth weight between 1200 grams and < 2500 grams, and who were admitted to the NICU. Amongst those with the above mentioned gestational age and weight, those who were clinically stable (no apnea for 48 hours, no inotropic support, and not requiring invasive ventilation), and on noninvasive ventilation (CPAP, HFNC) were enrolled in this study. The exclusion criteria were infants having a major congenital or chromosomal abnormality, were hemodynamically unstable, those on a do-not-resuscitate (DNR) order or withdrawal of support care. The sample selection was done using the non-probability sampling technique. Written informed consent was obtained from parents or guardians.

Once the subjects were enrolled, along with their demographic information, growth parameters, including weight (grams), length (cm), and head circumference (cm), were taken at the time of admission. Group allocation was non-random and decided pragmatically. Infants were assigned to the KMC when the mother or caregiver was available and agreed to provide the scheduled supervised skin to skin sessions, while infants were assigned to the non-KMC when KMC could not be implemented due to caregiver unavailability or logistical constraints, and they received standard NICU care. The mother-infant dyads were secluded with a screen separator at the bedside in the NICU for KMC. They were supervised by a trained nurse. Each neonate was given skin-to-skin contact between the mother's breasts in an upright position, dressed with a cap, socks, and diaper. Front-open gowns were made available for the mothers, providing them privacy and KMC facilitation room to change. Comfortable chairs were provided for the mothers practicing KMC. Mothers did KMC for one hour at a time, twice every day. Each baby was continuously monitored by a cardiopulmonary monitoring probe during the period of KMC. When not in the KMC position, the infant was placed back in the incubator well covered with a white wrapping sheet, cap, and socks. The growth outcome was measured as determination of weight gain and head and length growth in patients. Weight was obtained unclothed and without diaper by the registered nurse using an electronically calibrated weighing scale. It was then plotted on the Fenton growth chart; a total of three weight checks were performed in a week, until the time the patient was discharged from the NICU. The recumbent length and head circumference were measured by the registered nurse with a measuring tape using the standard method of measurement, and these parameters were then plotted on the Fenton growth chart. The infants were eligible for discharge once they reached a weight of >1.5 kg (gained an average weight of 15-20 grams per kilogram per day for three consecutive days), were stable in room air oxygen, and had reached full enteral (oral and tube) feeding. The duration of hospitalization and the frequency of complications such as sepsis, NEC, and IVH that occurred during the study period were also noted. All the necessary data were stored on a structured, predesigned proforma.

The statistical analysis was carried out using "IBM-SPSS Statistics" version 26.0. The qualitative variables were shown as frequency and percentage. After checking the normality of the quantitative data through the Shapiro-Wilk test, means and standard deviations (SD) for normally distributed data and medians and interquartile ranges (IQR) for the non-normal data were computed. The effect modifiers like gestational age, baseline weight, and comorbidities were controlled making a stratified table.Chi-square or fisher's exact test was applied

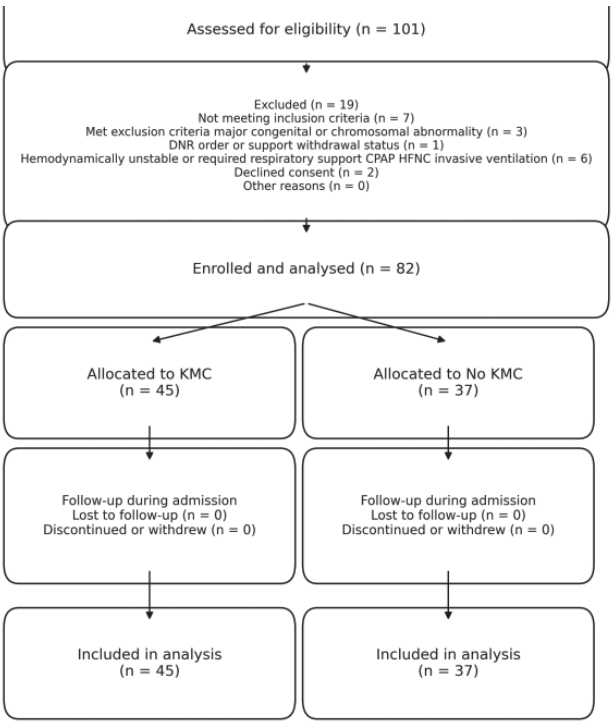
to compare categorical data between KMC and non-KMC infants, whereas, independent sample t-test or Mann-Whiteny U test were applied for comparing numeric data (as appropriate), taking p<0.05 as significant.

RESULTS

In a total of 82 LBW preterm neonates, 45 (54.9%) received KMC, and 37 (45.1%)) did not receive KMC (Figure-1).

FIGURE-1

Study flow diagram



Females accounted for 44 (53.7%) infants, and 38 (46.3%) were males. The median gestational age was 34.0 (32.0 to 35.0) weeks overall, and birth weight 2090.3±494.2 g, with no evidence of between-group differences for gestational age (p=0.142), birth weight (p=0.356), baseline head circumference (p=0.554), or baseline length (p=0.722). Table-I is showing overall and between groups comparison of baseline characteristics of infants in KMC and non-KMC infants.

The mean discharge weight was 2410.8±295.6 g in the KMC infants, and 2178.9±318.1 g in the non-KMC infants (p=0.001), and the mean daily weight gain was 17.2±4.1 g/day in KMC infants, and 14.1±4.7 g/day in non-KMC infants (p=0.002). The mean change in weight from admission to discharge was significantly better among KMC infants (p=0.002). The median head circumference (p=0.041), and head circumference gain (p=0.018) at discharge were significantly better among KMC infants. Overall discharge length (p=0.029), and length gain (p=0.034) were significantly higher among KMC infants. Duration of hospitalisation was 8.0 (6.0 to 11.5) days amongst KMC infants, 12.0 (6.0 to 16.5) days in non-KMC infants (p=0.010). Time to successful weaning from supplemental oxygen was significantly shorter in infants undergoing KMC (p=0.002). Table-II is showing details about the comparison of final outcomes among KMC and non-KMC infants.

Frequency of sepsis (p=0.134), hypothermia (p=0.162), apnea requiring stimulation (p=0.278), NEC (p=0.303), and IVH (p=0.584) were statistically similar among KMC and non-KMC infants (table-3). Complications were recorded in 6 (13.3%) KMC infants, and 12 (32.4%) non-KMC infants with a risk ratio of 0.4 (95% CI: 0.2 to 0.9; p=0.031).

TABLE-I

Characteristics of study participants with respect to KMC

Characteristics		Total (N=82)	KMC (n=45)	No KMC (n=37)	P-Value
Gender	Male	38 (46.3%)	20 (44.4%)	18 (48.6%)	0.704
	Female	44 (53.7%)	25 (55.6%)	19 (51.4%)	
Gestational age (weeks)		34.0 (32.0-35.0)	34.0 (33.0-35.0)	33.5 (32.0-35.0)	0.142
Birth weight (grams)		2090.3±494.2	2139.1±415.7	2031.0±532.9	0.356
Head circumference (cm)		32.0 (30.0-34.0)	32.0 (30.3-33.8)	32.0 (29.0-34.0)	0.554
Length (cm)		44.0 (40.0-46.3)	44.0 (41.0-46.0)	41.0 (40.0-48.0)	0.722

TABLE-II

Comparison of outcomes among infants with and without KMC

Outcomes	Total (N=82)	KMC (n=45)	No KMC (n=37)	P-Value
Weight at discharge (grams)	2305.6±312.4	2410.8±295.6	2178.9±318.1	0.001
Weight gain (g/day)	15.8±4.6	17.2±4.1	14.1±4.7	0.002
Change in weight from admission to discharge (grams)	215.3±181.8	271.7±120.1	147.9±214.8	0.002
Head circumference at discharge (cm)	33.0 (31.5-34.5)	33.5 (32.0-35.0)	32.5 (31.0-34.0)	0.041
Head circumference gain at discharge (cm)	0.7 (0.5-1.0)	0.9 (0.6-1.2)	0.6 (0.4-0.9)	0.018
Length at discharge (cm)	45.0 (45.0-47.0)	46.0 (43.0-48.0)	44.0 (41.5-46.5)	0.029
Length gain at discharge (cm)	1.1 (0.6-1.6)	1.3 (0.8-1.8)	0.9 (0.5-1.4)	0.034
Time to successful weaning from supplemental oxygen (days)	5.0 (4.0-6.0)	4.0 (3.0-5.0)	6.0 (4.0-7.0)	0.002
Duration of hospitalization (days)	9.0 (6.0-12.5)	8.0 (6.0-11.5)	12.0 (6.0-16.5)	0.010

TABLE-III

Comparison of frequency of complications among infants with and without KMC

Complications	Total (N=82)	KMC (n=45)	No KMC (n=37)	Risk Ratio (95% CI)*	P-Value
Sepsis	11 (13.4%)	4 (8.9%)	7 (18.9%)	0.5 (0.2-1.4)	0.134
Hypothermia	9 (11.0%)	3 (6.7%)	6 (16.2%)	0.4 (0.1-1.5)	0.162
Apnea requiring stimulation	6 (7.3%)	2 (4.4%)	4 (10.8%)	0.4 (0.1-2.1)	0.278
Nectrotizing enterocolitis	4 (4.5%)	1 (2.2%)	3 (8.1%)	0.3 (0.1-2.5)	0.303
Intraventricular hemorrhage	3 (3.7%)	1 (2.2%)	2 (5.4%)	0.4 (0.1-4.2)	0.584
Any complications	18 (21.9%)	6 (13.3%)	12 (32.4%)	0.4 (0.2-0.9)	0.031

Risk ratio calculated for KMC infants

DISCUSSION

This study observed significantly higher weight, and faster head and length growth among infants receiving KMC. These observations align with earlier controlled trials among stabilized LBW infants where KMC was associated with greater daily weight gain and earlier readiness for discharge.[15] These associations are also consistent with pooled evidence that KMC improves growth outcomes through enhanced thermal regulation, reduced energy expenditure, improved sleep organisation, and facilitation of feeding behaviours and breastfeeding success, all of which support net anabolism in preterm and low birth weight neonates.[16] Possible explanation for these observations could be the delivery model of supervised skin to skin contact within the NICU using standardised positioning, infant clothing, and continuous cardiopulmonary monitoring, which likely improved adherence and reduced interruptions to care. In settings where KMC is delivered less consistently, growth effects tend to attenuate, whereas programs with longer daily skin to skin duration often report larger gains. Regional observational and quasi experimental reports from Pakistan have similarly described higher daily weight gain and shorter hospital stay among infants receiving kangaroo mother care in tertiary neonatal units, supporting generalisability across comparable care environments, staffing constraints, and family support structures.[17,18] Variability across studies is expected because KMC protocols differ by initiation timing, daily duration, eligibility stability criteria, and feeding policies, with each factor influencing growth trajectories.

In this study, differences in head circumference, and length at discharge favoured KMC. KMC has previously been found to improve linear growth, and head growth among stabilized LBW infants, though effect estimates vary by protocol and by the time point assessed. Improved physiologic stability and reduced stress responses during skin to skin contact can support neuroendocrine pathways

associated with growth and feeding efficiency.[11,19]

Length of hospitalization was significantly shorter among KMC infants, with a median of 8.0 (6.0 to 11.5) days, compared with 12.0 (6.0 to 16.5) days. This aligns with the established association between KMC and earlier discharge readiness, mediated by improved thermal stability, feeding tolerance, weight gain, and caregiver participation in care processes.[20,21] The clinical relevance of a 4 day difference is substantial within a tertiary care NICU given bed occupancy pressures and staffing demands. The reduction in length of stay also has economic implications, since NICU care is resource intensive and prolonged admission often results in indirect family costs related to travel, loss of wages, and care-giving responsibilities, which are particularly salient in low and middle income settings.[22]

Rates of individual complications such as sepsis, hypothermia, apnea requiring stimulation, necrotising enterocolitis, and intraventricular haemorrhage did not differ statistically between groups, while the composite outcome of any complication occurred in 13.3% of KMC infants and 32.4% of non-KMC infants with a risk ratio of 0.4 (0.2 to 0.9). This profile of results is clinically important when event counts are small, since individual outcomes often lack power to detect moderate differences, while a composite can capture overall morbidity burden. KMC has consistently been associated with reductions in hypothermia, and infection related outcomes, whereas effects on necrotising enterocolitis and intraventricular haemorrhage are less consistently demonstrated and often imprecise due to low baseline incidence and heterogeneity in diagnostic and screening practices.[19,23]

Several limitations should be considered when interpreting these findings. The study design was quasi-experimental and observational with non-probability sampling and non-random allocation, which introduces the possibility of selection bias and confounding. The study was conducted at a single tertiary centre, which may limit external validity across hospitals with different staffing ratios, infection control practices, and caregiver support resources. The KMC duration was limited to two hours daily, which may underestimate the maximal potential effect of extended skin to skin care.

CONCLUSION

The KMC in clinically stable LBW preterm neonates was associated with higher discharge weight, higher daily weight gain, greater gains in head circumference and length, and shorter hospitalisation, with a lower composite burden of in-hospital complications. These findings support routine integration of structured KMC in tertiary NICU care pathways and support further multicentre studies using rigorous allocation methods and longer follow up to define optimal dosing and longer term outcomes.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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AUTHORSHIP AND CONTRIBUTION DECLARATION	
1	**Ayesha Munir:** Study design, conception of idea.
2	**Areeba Nisar:** Interpreted data.
3	**Yasser Masood:** Data collection.
4	**Humaira Rafiq:** Data anlaysis.
5	**Shehla Choudhry:** Critical revisions.