



Original Research Article

Effects of Kangaroo Mother Care on Physiological Stress Parameters of Premature Babies in NICU

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Abstract. Background: Kangaroo Mother Care (KMC) is a proven, low-cost, and effective method of neonatal care involving skin-to-skin contact that helps stabilize vital signs and improves overall outcomes in preterm and low-birth-weight infants. It plays a crucial role in reducing morbidity and mortality in resource-limited settings.

Objectives: To evaluate the effect of Kangaroo Mother Care on physiological parameters (respiratory rate, heart rate, oxygen saturation, and temperature) in preterm neonates. **Study Design & Setting:** A quasi-experimental study conducted at Department of Pediatrics Combined Military Hospital (CMH), Multan from 21 April 2025 to 20 July 2025. **Methodology:** A total of 121 preterm neonates were enrolled using non-probability consecutive sampling. Baseline demographic and clinical characteristics were recorded, including gestational age, gender, and birth weight. Physiological parameters were measured before and after KMC sessions. Data were stratified by gestational age, birth weight, and gender. Statistical analysis was performed using paired t-test with p-value <0.05 considered significant. **Results:** Of the 121 neonates, 50 (41.3%) were males and 71 (58.7%) were females. The mean gestational age was 35.03 ± 1.42 weeks, and mean birth weight was 2192.7 ± 217.8 g. Following KMC, respiratory rate decreased from 46.57 ± 3.30 to 44.51 ± 3.26 breaths/min, heart rate from 142.65 ± 6.31 to 139.58 ± 6.69 bpm, oxygen saturation increased from $95.83 \pm 1.48\%$ to $96.91 \pm 1.55\%$, and temperature improved from $36.72 \pm 0.23^\circ\text{C}$ to $36.83 \pm 0.24^\circ\text{C}$ (all $p < 0.05$). Significant improvements were observed across subgroups of gestational age, birth weight, and gender. **Conclusion:** Kangaroo Mother Care significantly improves physiological stability in preterm neonates and should be widely implemented as a standard neonatal care practice, especially in resource-constrained settings.

Keywords: Birth weight, Gestational age, Kangaroo Mother Care, Neonates, Oxygen saturation, Preterm infants, Temperature, Vital signs.

INTRODUCTION

The transition from intrauterine to extrauterine life is considered one of the most critical stages in the human lifespan.¹ To ensure this shift occurs smoothly, supportive strategies are required that

enhance autonomic stability, promote neurobehavioral development, and assist the newborn in adapting to the external environment.² However, this transition often becomes challenging in infants who are premature, have low birth weight, or suffer

from medical complications such as hypoglycemia and sepsis.³ In response to these challenges, Kangaroo Mother Care (KMC) was first introduced in 1979 as an innovative method of neonatal care. By providing skin-to-skin contact, KMC fulfills the infant's essential needs for warmth, breastfeeding, weight gain, stimulation, protection, and emotional bonding, while simultaneously serving as a beneficial alternative to conventional neonatal care for both mother and child.⁴

Several studies have demonstrated that Kangaroo Mother Care (KMC) significantly contributes to the survival and overall well-being of low birth weight (LBW) infants, especially in resource-limited settings.⁵ Beyond survival benefits, KMC also fosters stronger mother–infant attachment and makes neonatal care more family-centered.⁶ Skin-to-skin contact has been shown to positively influence multiple physiological parameters, such as respiratory stability, oxygen saturation, and thermoregulation. Moreover, it reduces the incidence of bradycardia and apnea, enhances breast milk production, accelerates weight gain, and shortens the duration of hospitalization.⁷

Preterm birth and low birth weight remain significant public health challenges worldwide, accounting for a large proportion of neonatal morbidity and mortality. Traditional incubator-based neonatal intensive care, while effective, is often costly, technology-dependent, and inaccessible in resource-limited settings.⁸ Kangaroo Mother Care, by contrast, is a simple, natural, and evidence-based intervention that provides continuous skin-to-skin contact, enabling stabilization of physiological parameters and fostering emotional connection. Its global recognition by the World Health Organization underscores its importance as an essential component of neonatal care strategies aimed at improving survival and long-term outcomes of vulnerable newborns.⁹

In light of such evidence, the present study has been designed to assess the impact of KMC on the physiological status of low-birth-weight neonates. As a simple, low-cost, and non-invasive intervention, KMC has the potential to reduce reliance on expensive neonatal intensive care services, thereby alleviating the financial burden on families and healthcare systems. By ensuring greater stability of vital parameters, KMC may also lower the risk of complications in LBW infants, particularly in resource-limited regions. Furthermore, findings from this study will provide valuable data to guide policymakers in advocating for wider implementation of KMC within neonatal care protocols, with the overall objective to determine its effect on the physiological status of low-birth-weight neonates.

MATERIALS AND METHODS

The study was conducted in the Department of Pediatrics at Combined Military Hospital Multan from 21 April 2025 to 20 July 2025. It was designed as a pre- and post-intervention quasi-experimental study and carried out over a period of six months following approval of the synopsis. The sample size was calculated using STATA version 15, based on the formula for two paired means. The mean heart rate before Kangaroo Mother Care (KMC) was 142.03 ± 6.39 , while the mean heart rate at the end of KMC was 140.04 ± 5.95 . By keeping a significance level of 5%, a power of 80%, and a correlation of paired means of 0.20, the required sample size was determined to be 121 neonates. Participants were recruited through non-probability consecutive sampling.

The study was conducted after obtaining approval from the College of Physicians and Surgeons Pakistan (CPSP) and the institutional ethical review committee. A total of 121 low-birth-weight infants who fulfilled the inclusion criteria from the Neonatal Unit of the Pediatric Department were enrolled following informed consent from their parents. Baseline demographic characteristics, including gender, gestational age at birth as assessed by the last menstrual period (LMP) method, and birth weight measured on a digital weighing scale, were recorded. All enrolled infants were provided Kangaroo Mother Care (KMC) for one hour according to hospital protocol. Physiological parameters, including respiratory rate, heart rate, and oxygen saturation (SpO_2), were measured ten minutes before initiation of KMC and again at the completion of one hour. Respiratory rate was counted manually for a full one-minute duration, while heart rate and SpO_2 were assessed using a standard handheld pulse oximeter.

Infants were eligible for inclusion if they had a gestational age of ≤ 37 weeks as assessed by the last menstrual period (LMP) method, a birth weight of < 2500 grams, and were of either gender admitted to the neonatal unit of the pediatric medicine ward. Exclusion criteria included extremely low birth weight infants (< 1000 grams), those with respiratory illnesses such as respiratory distress syndrome, pneumonia, transient tachypnea, or meconium aspiration, as well as neonates with systemic infection including early-onset sepsis, based on history and medical records.

Physiological status included heart rate, oxygen saturation (SpO_2), and respiratory rate. Heart rate and SpO_2 were measured using a pulse oximeter applied on a warmed finger or toe for one minute, and these parameters were assessed before and immediately after Kangaroo Mother Care. KMC was carried out by mothers who wore a KMC blanket after taking a bath, and with the assistance of nursing staff, the neonate was positioned between the mother's breasts.

Each KMC session was conducted for one hour per day. Low-birth-weight infants, defined as those weighing less than 2500 grams on a digital weighing scale at birth, were included in this category.

Data were analyzed using SPSS version 23. The normality of numerical variables was assessed with the Shapiro–Wilk test. Continuous variables such as birth weight, gestational age, respiratory rate, heart rate, and oxygen saturation (SpO₂) were presented as mean $\pm$ standard deviation, while categorical

variables such as gender were expressed as frequencies and percentages. Comparisons of heart rate, respiratory rate, and SpO₂ before and after Kangaroo Mother Care were performed using the paired t-test, and a p-value of < 0.05 was considered statistically significant. Data were further stratified according to gestational age, gender, and birth weight to evaluate their effect on physiological parameters, and post-stratification paired t-tests were applied with the same level of significance.

RESULTS

The baseline demographic profile of the study population showed that out of 121 neonates, 50 (41.3%) were males and 71 (58.7%) were females. The mean gestational age was 35.03 ± 1.42 weeks, ranging from 31.3 to 38.2 weeks. Among them, 38 (31.4%) had a gestational age of ≤ 34 weeks, whereas 83 (68.6%) were > 34 weeks. The mean birth weight was 2192.70 ± 217.81 grams with a minimum of 1624 grams and a maximum of 2837 grams. Based on birth weight categories, 42 (34.7%) infants weighed ≤ 2000 grams while 79 (65.3%) were > 2000 grams, as given in Table 1.

On comparison of physiological parameters before and after kangaroo mother care, it was observed that respiratory rate decreased from 46.57 ± 3.30 to 44.51 ± 3.26 per minute. Similarly, mean heart rate reduced from 142.65 ± 6.31 to 139.58 ± 6.69 per minute. Oxygen saturation showed an improvement from $95.83 \pm 1.48\%$ to $96.91 \pm 1.55\%$. Mean body temperature also increased slightly from $36.72 \pm 0.23^\circ\text{C}$ to $36.83 \pm 0.24^\circ\text{C}$, demonstrating an overall stabilizing effect of KMC on neonatal physiology, as presented in Table 2.

Stratification analysis revealed consistent improvements across different subgroups. In neonates with gestational age ≤ 34 weeks, mean heart rate decreased from 142.6 ± 4.4 to 140.6 ± 4.8 per minute ($p = 0.003$), while in those > 34 weeks it declined from 141.8 ± 5.8 to 138.7 ± 5.9 per minute. Similarly, among neonates with a birth weight ≤ 2000 g, heart rate dropped from 141.0 ± 6.2 to 137.8 ± 6.5 per minute ($p = 0.004$), whereas in infants > 2000 g it reduced from 143.1 ± 5.0 to 140.1 ± 5.0 per minute. Gender-based analysis showed that male neonates exhibited a decrease in heart rate from 142.8 ± 5.5 to 139.7 ± 5.8 per minute ($p = 0.001$), and female neonates from 142.1 ± 5.5 to 139.0 ± 5.6 per minute. These findings indicate that the positive effect of kangaroo mother care on physiological stability was consistent across gestational age, birth weight, and gender categories, as shown in Table 3.

Table 1. Baseline Demographic Characteristics of Study Population (n = 121)

Variable	Category	Values
Gender	Male	50 (41.3%)
	Female	71 (58.7%)
Mean Gestational Age	Mean $\pm$ SD	35.03 ± 1.42
	Range (min–max)	31.3 – 38.2
	≤ 34 weeks	38 (31.4%)
	> 34 weeks	83 (68.6%)
Mean Birth Weight (grams)	Mean $\pm$ SD	2192.70 ± 217.81
	Range (min–max)	1624 – 2837
	≤ 2000 g	42 (34.7%)
	> 2000 g	79 (65.3%)

Table 2. Comparison of Physiological Parameters Before and After Kangaroo Mother Care (n = 121)

Parameter	Before KMC	After KMC
Respiratory Rate	46.57 ± 3.30	44.51 ± 3.26
Heart Rate	142.65 ± 6.31	139.58 ± 6.69
SpO ₂ (%)	95.83 ± 1.48	96.91 ± 1.55
Temperature ($^\circ\text{C}$)	36.72 ± 0.23	36.83 ± 0.24

Table 3. Stratification of physiological parameters by gestational age, gender, and birth weight (n = 121)

Variable	Category	Before KMC	After KMC	p-value
Gestational Age	≤ 34 weeks (n=38)	142.6 ± 4.4	140.6 ± 4.8	0.003
	> 34 weeks (n=83)	141.8 ± 5.8	138.7 ± 5.9	
Birth Weight	≤ 2000 g (n=42)	141.0 ± 6.2	137.8 ± 6.5	0.004
	> 2000 g (n=79)	143.1 ± 5.0	140.1 ± 5.0	
Gender	Male (n=50)	142.8 ± 5.5	139.7 ± 5.8	0.001
	Female (n=71)	142.1 ± 5.5	139.0 ± 5.6	

DISCUSSION

Kangaroo Mother Care (KMC) is an evidence-based intervention involving skin-to-skin contact that promotes physiological stability in preterm and low-birth-weight infants. It has been shown to regulate body temperature, improve oxygen saturation, and enhance breastfeeding success.^{10,11} KMC is a cost-effective and feasible alternative to incubator care, particularly in resource-limited settings. Preterm neonates often face challenges of hypothermia, respiratory instability, and poor weight gain. Early implementation of KMC plays a vital role in reducing neonatal morbidity and mortality.¹² This study aimed to assess changes in physiological parameters before and after KMC in preterm neonates.

In the present study, Kangaroo Mother Care (KMC) led to a significant improvement in physiological parameters of preterm neonates, with respiratory rate decreasing from 46.57 ± 3.30 to 44.51 ± 3.26 breaths/min, heart rate reducing from 142.65 ± 6.31 to 139.58 ± 6.69 bpm, oxygen saturation increasing from $95.83 \pm 1.48\%$ to $96.91 \pm 1.55\%$, and temperature rising from $36.72 \pm 0.23^\circ\text{C}$ to $36.83 \pm 0.24^\circ\text{C}$ ($p < 0.05$ for all). These findings are consistent with a number of previously published studies, though some contrasts also exist. Our findings are in line with Zengin et al. (2023) who in a systematic review and meta-analysis of 634 participants concluded that KMC significantly improved temperature ($z = 3.21$; $p = 0.000$) and oxygen saturation ($z = 2.49$; $p = 0.000$), but no significant effect was noted on heart rate ($z = -0.60$; $p = 0.55$) and respiratory rate ($z = -1.45$; $p = 0.15$). Unlike their report, our study demonstrated significant improvement in all four parameters, suggesting that the positive effects of KMC may extend beyond oxygenation and thermal regulation when applied consistently.¹³

Similarly, Ranjan et al. (2019) also reported statistically significant improvement in arterial oxygen saturation, stabilization of systolic/diastolic blood pressure, heart rate, and respiratory rate with prolonged sessions of KMC, emphasizing a greater effect with increasing duration of care.¹⁴ Our study supports their findings, as we also noted significant reductions in both heart rate and respiratory rate along with improved SpO_2 . Thakur et al. (2020)

demonstrated statistically significant differences in physiological parameters across three days of KMC in 30 low-birth-weight infants, showing that repeated and sustained KMC sessions consistently stabilize vital signs.¹⁵ Our results corroborate this, further confirming the reproducibility of beneficial effects in larger sample sizes.

Arslan et al. (2024) reported significant improvement in body temperature ($p < 0.001$), rSO_2 ($p < 0.001$), heart rate ($p < 0.001$), SpO_2 ($p < 0.001$), and respiratory rate ($p < 0.001$) at 30th and 60th minutes of KMC application in 60 neonates.¹⁶ Their results align strongly with ours, highlighting immediate physiological stabilization even within short timeframes. Karimi et al. (2020) and Kamandani et al. (2024) primarily evaluated secondary outcomes such as neonatal weight gain, breastfeeding frequency, hospital stay, maternal attachment, and maternal sleep quality. They observed significantly higher breastfeeding frequency (13.32 vs. 5.04 feeds/day, $p < 0.001$) and shorter hospital stay (14.3 vs. 26.7 days, $p < 0.001$) with KMC¹⁷, along with significantly better maternal-infant attachment ($p < 0.011$) and maternal sleep quality ($p < 0.001$).¹⁸ Although these outcomes were not assessed in our study, they strengthen the holistic benefits of KMC beyond physiological stabilization.

Cristobal et al. (2022) found that mean respiratory rate of infants receiving KMC was significantly lower compared to incubator care (MD = -3.50 ; 95% CI, -5.17 to -1.83 ; $p < 0.00001$), while heart rate, oxygen saturation, and temperature improvements were not statistically significant.¹⁹ In contrast, our study demonstrated statistically significant improvement in all four parameters, suggesting that the magnitude of effect may vary by population and clinical protocols. Finally, Tanrıverdi et al. (2024) reported no significant change in neonatal body temperature before ($36.42 \pm 0.36^\circ\text{C}$), during ($36.35 \pm 0.01^\circ\text{C}$), and after KMC ($36.35 \pm 0.40^\circ\text{C}$; $p > 0.05$) in 56 newborns.²⁰ This contrasts with our findings where temperature significantly increased after KMC ($36.72 \pm 0.23^\circ\text{C}$ vs. $36.83 \pm 0.24^\circ\text{C}$, $p < 0.05$), possibly due to differences in sample size, gestational age, or ambient temperature control during KMC sessions. Overall, our findings demonstrate significant improvements

across all physiological parameters, aligning closely with most published literature(14–16, 19) while differing from studies that reported selective improvements.^{13,20} These results provide strong evidence that KMC is an effective intervention for stabilizing vital signs in preterm neonates.

The study provides valuable insight into the effectiveness of KMC in stabilizing vital parameters in preterm neonates. It was conducted with a reasonable sample size, ensuring reliable statistical outcomes. Multiple physiological parameters were measured, strengthening internal validity. However, it was a single-center study, limiting the generalizability of findings. Short duration of monitoring did not allow assessment of long-term outcomes. Additionally, lack of a control group reduced comparative strength.

CONCLUSION

Kangaroo Mother Care significantly improved physiological stability in preterm infants. It is a simple, low-cost, and effective intervention, particularly beneficial in resource-constrained settings. Wider adoption of KMC can contribute to improved neonatal outcomes.

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