Original Article

Kangaroo Mother Care as an Alternate Mode of Transport to Prevent Hypothermia in Low Birth Weight Babies — An Observational Study

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Abstract

Background : Neonatal Hypothermia is a significant concern Globally, particularly affecting Low Birth Weight (LBW) and premature infants. Despite the recognition of the importance of thermoregulation in newborn care, rates of Neonatal Hypothermia remain high, especially in resource-limited settings. Kangaroo Mother Care (KMC) has emerged as a recommended method for preventing and treating Neonatal Hypothermia.

Aims and Objectives : This study aims to evaluate the effectiveness of KMC positioning during Neonatal transport in preventing Hypothermia and improving thermoregulation in Low Birth Weight infants.

Materials and Method : An observational study was conducted at a Teaching Medical College in Bangalore for over one year. Ethical approval was obtained, and informed consent was obtained from parents. Newborns with birthweights below 2.5kg were included, with exclusion criteria for specific medical conditions. About 120 neonates were randomly assigned to either KMC or conventional transport groups. Vital signs were recorded after transportation in both the groups and statistical analysis was performed using SPSS software.

Results : An equal distribution of participants was achieved between the KMC and non-KMC groups with similar gestational ages and sex distributions observed in both groups. Comparing vital signs between groups, the KMC group showed significantly higher temperatures (98.438±0.41°F *versus* 97.977±0.53°F, p<0.001), Lower Heart Rates (140.97±7.798 bpm *versus* 135.38±7.718 bpm, p<0.001), Lower Respiratory rates (38.42±2.403 breaths/min *versus* 42.15±5.79 breaths/min, p<0.001) and higher Oxygen Saturation levels (97.97±0.92% *versus* 96.02±1.157%, p<0.001) compared to the non-KMC group.

Conclusion : KMC positioning during neonatal transport effectively prevents Hypothermia and improves thermoregulation in Low Birth Weight Infants. The study underscores the importance of KMC in promoting physiological stability, reducing the risk of complications during transport and fostering parent-infant bonding.

Key words : Hypothermia, Kangaroo-Mother Care Method, Low Birth Weight Infants, Neonatal Intensive Care Unit, Neonatal Respiratory Distress Syndrome.

Neonatal Hypothermia is a prevalent issue Globally. It is preventable and significantly contributes to morbidity and mortality. It primarily affects infants with Low Birth Weight (LBW) and those born prematurely[1,2]. Hypothermia in newborns adversely affects various body systems, such as the heart, lungs, immune system and metabolism. It also hinders regular growth and development by diverting calories from bodily growth to producing heat.

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Editor's Comment :

- Kangaroo Mother Care (KMC) during neonatal transport significantly improves vital sign parameters and reduces Respiratory Distress Syndrome (RDS) incidence compared to conventional methods, emphasizing its effectiveness and protective role.
- Despite similar distributions in gestational age and sex, KMC significantly decreases the prevalence of early preterm births, highlighting its benefits in reducing neonatal complications. Moreover, KMC enhances parental bonding and satisfaction, providing emotional support and security during transport.
- Integrating KMC into transport protocols is a cost-effective and family-centered approach, crucial for improving outcomes and promoting healthy development in preterm neonates, especially in resource-limited settings.

Preventing Hypothermia is fundamental for optimizing newborn survival and overall outcome[3]. Newborns Worldwide, regardless of income levels, experience

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hypothermia with reported in-hospital rates ranging from 32% to 85%[4]. Neonatal Hypothermia rates are still high, especially in locations with few resources, even though thermoregulation is an important element of infant care[5]. In resource-limited settings, Kangaroo Mother Care (KMC) is the recommended method for preventing and treating Neonatal Hypothermia[6-8]. KMC involves skin-to-skin contact between the mother and newborn. This approach is becoming more prevalent in Neonatal Intensive Care Units (NICUs), particularly to mitigate the adverse effects of stress on newborns[9]. A significant prevalence of mild Hypothermia was seen in Low-birth-weight newborns getting conventional care during transport, in contrast to those who received KMC, who exhibited heightened thermoregulation[10]. KMC also decreases occurrences of bradycardia and Oxygen desaturation events in preterm infants. This helps in maintaining physiological stability and may offer potential advantages for neuro-developmental outcomes[11]. Clinically acceptable values for mean cardiorespiratory and temperature outcomes were continuously maintained throughout KMC. Severe episodes of bradycardia, periodic breathing, or apnea did not occur during KMC workouts. Further, when contrasted with infants getting conventional NICU care, those experiencing KMC showed an improvement in regular breathing[12].

Parental bonding with an infant strengthens gradually through interactions spanning pregnancy, birth, and the early stages of the infant's life. This bond is expected to develop organically through shared experiences, interactions and mutual acquaintance. A newborn's first and most natural habitat is in close proximity to its mother. The physiological stability of the newborn is enhanced, their crying is reduced, and the likelihood of breastfeeding is increased through early physical contact[13]. The establishment of a stable parent-infant attachment depends on the mother's close physical touch with her newborn. This bond plays a significant role in the cognitive, motor, and social development of the infant, both during hospitalization and beyond[14]. The effect of close proximity in the NICU extends beyond reducing hospital stay, as it also plays a significant role in alleviating parental stress and enhancing the parent-infant relationship[14]. The bond formed through closeness with their infant serves as a powerful source of strength for parents, guiding them through the inevitable periods of separation in the NICU and helping them transition to normal parenthood[15]. Given the aforementioned context, the following study was conducted to evaluate the effectiveness of KMC positioning during neonatal transport compared to the conventional swaddle method (neonate dressed with a Cap, Cotton Clothing, Diapers, Socks, Cap and Gloves and wrapped in a Blanket, then transported in a Crib) in preventing Hypothermia, measured using temperature in degrees Fahrenheit, and improving thermoregulation of low birthweight infants, assessed by measuring heart rate and respiratory rate.

Materials and Methods

Study Settings and Duration :

A cross-sectional analytical study was conducted at a teaching Medical College in Bangalore. The study was conducted over a one-year timeframe, specifically from October, 2022 to September, 2023.

Ethical Consideration :

Approval for conducting this study was obtained through the ethical clearance process of the Institutional Ethics Committee on Human Subjects (Approval No. MSRMC/EC/2016). Following the approval from the Institutional Ethics Committee, data was gathered from parents of neonates whose babies met the inclusion criteria and study protocol, having provided their informed consent through a signed document.

Study Population :

Newborns with birthweights of less than 2.5kg were admitted in the NICU of Teaching Medical College in Bangalore during the study period were included in this study.

Inclusion Criteria :

Mothers willing to take part and capable of practicing KMC comfortably were included. All the LBW neonates (from 1 kg to less than 2.5 kg) who were physiologically stable were enrolled in the study.

Exclusion Criteria :

Infants on ventilation, with septicemia, fever, or congenital cardiac and lung abnormalities were excluded from the study.

Sample Size Calculation :

According to Ludington-Hoe, *et al* study[12], considering the mean and Standard Deviation of Heart rate in KMC group as 152.17±10.84, mean and Standard

Deviation of Heart rate in the Control group as 147.22 ± 6.99 at 95% confidence interval with 80% power, the sample size is calculated as –

$N = (Z_{1-\alpha/2} + Z_{1-\beta})^2 * 2 * \sigma^2 / (m1 - m2)^2$

Z1-α/2 - two tailed probability for a 95% confidence interval = 1.96,

Z1-β - two tailed probability for 80% power = 0.84,

μ1 - mean of Heart rate in KMC group = 152.17,

μ2 - mean of Heart rate in the Control group = 147.22,
σ - average Standard Deviation of Heart rate in KMC group & Heart rate in the Control group = 8.92,

N = (1.96 + 0.84) ^2 * 2 * 8.915^2 / (152.17-147.22) ^2

N = 50.92, Thus, the minimum sample size required for each group is 51 and the total sample size is 102.

Sampling Method :

A total of 120 infants were included in this study. Subjects comprising the study population were categorized into two categories. To ensure fair randomization, sixty infants were assigned at random through sequentially sealed opaque envelopes to either Group 1 (KMC) or Group 2 (No KMC).

Intervention :

Group 1 neonates were provided with KMC while being transported. The neonate was clothed and diapered, then carefully transferred and positioned against the exposed Chest of the caregiver. The head was rotated to one side and held in a slightly extended position, while the arms and legs were flexed and abducted in a "frog" formation. Following appropriate positioning, the neonate was strapped in using the KMC garment that was being put on by the caregiver. The infant was clothed in a Blanket. Subsequently, the attendant was directed to apply manual support to the patient's back and neck.

During transportation, the neonates in group 2 were not administered to KMC. The neonate was dressed in cotton clothing, including a Cap, Baby Diapers, Stockings and Mittens. Additionally, a blanket was used to encase the infant as they were conveyed in the crib.

Data Collection Procedures :

Heart rate, respiratory rate, body temperature, and Oxygen Saturation of participants were recorded by the health worker before and after shifting the baby from the NICU to ward.

Statistical Analysis :

Data was entered into the Microsoft excel data sheet and was analyzed using SPSS 22 version software (IBM SPSS Statistics, Somers NY, USA). Categorical data were represented as frequencies and proportions. The Chi-square test, or Fischer's exact test, was used as a test of significance for qualitative data. Continuous data was represented as mean and Standard Deviation. The independent t test was used as a test of significance to identify the mean difference between two quantitative variables. P value of <0.05 was considered as statistically significant after assuming all the rules of statistical tests.

Results

The participants were allocated into two categories for our study: one group was administered KMC while shifting, and the other group was not provided with KMC during shifting. Each group comprised 60 subjects, allowing us to compare the outcomes of the two groups effectively. This design enabled us to assess the impact of KMC on various parameters during shifting and evaluate its potential benefits compared to standard care methods.

Table 1 describes the general characteristics in each group. Our study included 60 subjects in each group, with 91.7% of participants being less than 37 weeks gestational age. Sex distribution was similar between groups, with no significant difference. While 83.3%

Table 1 — *Comparison of Gestational Age, Sex, Comorbidities Diagnosis between two groups*

Variables	With KMC		Without KMC		P Value
	N	%	N	%	
Gestational age :					
<37weeks	55	91.7	55	91.7	1.000
>37weeks	5	8.3	5	8.3	
Sex of infants :					
Female	28	46.7	23	38.3	0.46
Male	32	53.3	37	61.7	
Diagnosis :					
Early preterm	1	1.7	14	23.3	0.001
Preterm	50	83.3	35	58.3	
Late preterm	9	15.0	11	18.3	
Respiratory Distress Syndrome :					
Yes	27	45.0	14	23.3	0.02
No	33	55.0	46	71.7	
Very Low Birth Weight :					
Yes	28	47.5	23	41.1	0.574
No	32	52.5	37	58.9	
Intra-uterine Growth Retardation :					
Yes	9	15.0	5	8.3	0.394
No	51	85.0	55	91.7	

of the KMC group were preterm, 58.3% were preterm in the non-KMC group, showing a significant difference in diagnosis. Regarding Respiratory Distress Syndrome (RDS), 45% of the KMC group subjects had RDS compared to 23.3% in the non-KMC group, showing a significant difference. However, no significant difference was found between the groups regarding Very Low Birth Weight (VLBW) or Intrauterine Growth Restriction (IUGR).

Table 2 provides a detailed comparison of vital signs between the two groups: one receiving KMC during neonatal transport and the other without KMC. The mean values and Standard Deviations for temperature, Heart rate, Respiratory rate and Oxygen saturation (SpO2) are presented for each group. In the KMC group, the mean temperature was recorded at 98.438°F, Heart rate at 140.97 beats per minute, respiratory rate at 38.42 breaths per minute, and SpO2 at 97.97%. Conversely, in the group without KMC, the mean temperature was slightly lower at 97.977°F, heart rate at 135.38 beats per minute, respiratory rate was higher at 42.15 breaths per minute, and SpO2 was lower at 96.02%. These differences were found to be statistically significant ($P<0.001$), showing that KMC is associated with more favorable vital sign parameters during neonatal transport. The data suggest KMC plays a crucial role in maintaining physiological stability and promoting optimal outcomes for transported neonates.

Discussion

In our research, we found that KMC effectively prevented Low Birth Weight neonates from getting too cold when they were moved from the NICU to the wards. We noticed that when compared to the traditional method of transport, using KMC helped keep the babies' Heart rate, breathing rate, and Oxygen levels stable. This method of transport, which was studied in Germany, was safe, effective, and cost little. Plus, it improved the bond between parents and their babies. Another study by Sontheimer, *et al*, involving 24 neonates, found that those transported in the KMC position (16 neonates) had similar stability in their vital signs during and even after transport, compared to those transported in an incubator (eight neonates)[16].

Many studies have revealed that in areas where resources are limited, healthcare providers frequently don't have the equipment or training to treat Hypothermia effectively. This results in a lack of concern and insufficient focus on this widespread issue[17,18]. Different research endeavors and training initiatives have showed successful reductions in Hypothermia rates and enhancements in knowledge about the condition. This was achieved by offering education and providing suitable thermoregulatory equipment to supplement KMC[19]. In a systematic review and meta-analysis conducted by Narciso LM, *et al* in 2022, involving 12 studies, it was concluded that KMC is a safe and cost-effective intervention. The review found that KMC has been consistently effective in decreasing the occurrence of Hypothermia and shortening hospital stays for newborns[20]. The study mentioned also sheds light on the crucial aspect of keeping parents and infants together during neonatal transport. This practice is significant, as it allows parents to feel empowered in protecting their newborn and fosters a sense of security. KMC emerged as particularly beneficial as it facilitates increased closeness between parents and infants, offering advantages for both parties in terms of emotional bonding and care provision[21]. The study conducted by Sontheimer, *et al* revealed that parents expressed feelings of safety and happiness when they were present during their infant's transfer. This suggests that allowing parents to accompany their infant during transfer contributes positively to their emotional well-being and satisfaction with the care provided[16].

Transport attributes and mortality determinants among newborns referred to a Tertiary Care Center in North India were the subjects of an investigation by Singh J, *et al*. A decline in the hemodynamic status of neonates and heightened mortality rates were observed throughout the referral and transport processes it was determined. This highlights the critical challenges and risks involved in the transportation of neonates, particularly in resource-limited settings, underscoring the need for effective strategies to improve outcomes during this vulnerable period[22]. Several strategies can enhance outcomes during the transportation of neonates. These include ensuring sufficient stabilization, raising awareness

Table 2 — *Comparison of vitals between two groups*

Vitals	With KMC	Without KMC	P value
Temperature	98.438 ± 0.41	97.977 ± 0.53	0.001
Heart rate	140.97 ± 7.798	135.38 ± 7.718	0.001
Respiratory rate	38.42 ± 2.403	42.15 ± 5.79	0.001
SpO2	97.97 ± 0.92	96.02 ± 1.157	0.001

regarding proper transportation approaches and improving resuscitation abilities. KMC plays a crucial role in this process by preventing mortality and stabilizing neonates during transport. By promoting skin-to-skin contact, warmth, and parental involvement, KMC helps maintain physiological stability, reducing the risk of complications and mortality during transit. Therefore, integrating KMC into neonatal transport protocols can significantly contribute to improving outcomes and ensuring the safety of transported neonates[23]. When certain conditions are met, transporting an infant in the KMC position can be regarded as both a viable mode of transportation and a financially efficient strategy. When the infant meets the set criteria for KMC, such as stable vital signs and weight, using KMC for transport can offer several benefits. Not only does it promote physiological stability and parent-infant bonding during transit, but it can also be more cost-effective compared to traditional transport methods that may require expensive equipment or specialized vehicles. Therefore, when the conditions are suitable, opting for KMC as the mode of transport can be a practical and beneficial choice for both the infant and the healthcare system[24,25]. Indeed, KMC offers several advantages over conventional methods of transport for neonates. Its benefits include promoting physiological stability, reducing the risk of Hypothermia, facilitating parent-infant bonding, and potentially being more cost-effective. By utilizing KMC during transport, infants receive continuous warmth, support, and care from their parents, which can help maintain their well-being throughout the journey. Additionally, KMC encourages active parental involvement in the care of their newborn, fostering a sense of empowerment and emotional connection. Overall, the evidence suggests that KMC is a preferable and helpful mode of transport for neonates compared to conventional methods.

Limitations of the Study :

Although the study included 120 neonates, with 60 in each group, a larger sample size might have provided more robust statistical power and a better representation of the population, potentially enhancing the generalizability of the findings. Conducting the study in a single centre may limit the generalizability of the results to other healthcare settings with different practices, resources, and patient populations. The study employed an observational design, which might introduce bias and confounding variables that could affect the accuracy and reliability of the results compared to randomized controlled trials. While the study focused on vital sign parameters and Respiratory Distress Syndrome (RDS) incidence, other important outcomes such as long-term neurodevelopmental outcomes, duration of hospital stay, and parental satisfaction were not assessed, limiting the comprehensive evaluation of KMC during neonatal transport.

Conclusion

Neonatal Hypothermia presents a significant challenge, particularly in resource-limited medical settings. Maintaining euthermic is crucial for neonatal survival and normal growth and development. Therefore, it's essential to scale up effective interventions to combat Hypothermia, thereby optimizing neonatal outcomes. KMC has emerged as a protective measure against Hypothermia, offering a safe and low-cost intervention without evidence of harm. This approach not only prevents complications associated with preterm birth and low birth weight in full-term newborns, but also stabilizes the newborn's vital signs during transport, including [h]eart rate, Respiratory rate, and Oxygen Saturation. Given its many advantages, including promoting parental bonding and ensuring apparent safety, KMC should continue to promote development and fostering family-centered care for preterm neonates.

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