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Impact of Kangaroo Mother Care (KMC) Initiated Immediately after Birth Versus After Stabilization on Clinical Outcomes in Very Low and extremely Birth Weight (<1500 g) Newborns

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Abstract

Background: Kangaroo Mother Care (KMC) enhances survival and growth in very low birth weight (VLBW) infants. However, the optimal timing remains uncertain.

Aims and Objectives: Compare length of stay (LOS), incidence of NEC, BPD, antibiotic duration, overall survival and weight gain between early KMC (initiated within the first week) and standard KMC (after stabilization).

Methods: A retrospective cohort study at a tertiary NICU was conducted over two six-month periods. Medical records of VLBW (<1500 g) neonates meeting inclusion criteria were reviewed. Standard care was unchanged. The primary outcome was survival; secondary outcomes included sepsis, antibiotic use, length of stay, and wait gain.

Results: Of total 322 neonates,201 standard KMC (Group A) and 121 received early KMC (Group B) LOS were comparable (27.8±18.7 Vs 27.2±17.1 days), Compared to group A, group B has lower incidence of NEC (40.8% Vs 10.7%, p<0.0001), sepsis (37.3%Vs26.4%, p=0.04) and BPD (18.9%Vs10.7%, p=0.05). total antibiotic days of therapy per 1,000 patient-days (393.3 vs 117.7 days), oxygen support (20.3 Vs 10.6 days, p<0.0001), Mortality was marginally lower with early KMC (2.5% Vs 1.7%). Daily weight gain was higher with early KMC (12.59 Vs17.19 g/kg/day, p=0.09) but not significant.

Conclusion: In this study, early KMC significantly reduced NEC, sepsis, BPD, antibiotic use, oxygen support, and marginally lowered mortality, with comparable NICU stay and a non-significant trend toward higher weight gain.

Keywords: Kangaroo Mother Care, Very Low Birth Weight, Neonatal Sepsis, Survival, NICU.

Introduction

Preterm neonates, especially those weighing less than 1500 grams VLBW and ELBW) are at high risk of morbidity and mortality. These are due to challenges such as Hypothermia feeding difficulties, and increased susceptibility to infections. Kangaroo Mother Care (KMC)—which involves early, continuous skin-to-skin contact between the mother (or caregiver) and the infant—has been shown to improve neonatal survival and reduce infection risks [1,2,3].

However, there is still debate regarding the optimal timing to initiate KMC. While some protocols advocate for KMC after clinical stabilization of the infant, growing evidence suggests that initiating KMC immediately after birth may confer additional benefits, including improved thermoregulation, faster weight gain, reduced length of hospital stay, and better bonding. The hypothesis of the study is that Early KMC as defined as initiation of KMC within the first 7 days of life in preterm neonates would reduce the mortality, and morbidities such as sepsis, duration of antibiotics and improve the weight gain in VLBW and ELBW babies.

This is a retrospective cohort study. The aim of the study is to see the effect of early KMC on neonatal mortality and secondarily we wanted to study its effect on neonatal sepsis, antibiotic use, length of stay.

Aims and Objectives

1. Primary Objective

To compare the survival rate of VLBW newborns (<1500 g) admitted to NICU when KMC is initiated within the first week of life (early KMC) versus when KMC is initiated after clinical stabilization (Standard KMC).

2. Secondary Objectives

- To compare the incidence of neonatal sepsis between early KMC and delayed KMC groups.
- To assess the duration of antibiotic therapy required in both groups.
- To compare the length of NICU, stay.
- To evaluate and compare weight gain in both groups.

Materials and Methods

Study Setting: This study was conducted in the Neonatal Intensive Care Unit (NICU) of BJMC and Sassoon General Hospital, Pune. The NICU followed standard protocols for the management of LBW infants, including temperature regulation, infection control, feeding, and monitoring.

Study Design

- **Study Type**: Retrospective, Cohort observational study.
- **Study Period**
  - **Standard KMC Group A**: 1st January 2024 to 30th June 2024.
  - **Early KMC Group B**: 1st July 2024 to 31st December 2024.

Selection Criteria

Inclusion Criteria

1. Neonates with birth weight <1500 grams.
2. Neonates admitted to the NICU during one of the two specified study periods (1st January– 30th June 2024 for Standard KMC, 1st June– 31st December 2024 for early KMC).
3. Availability of complete medical records with outcome data (survival, sepsis, duration of antibiotics, length of stay, weight gain).

Exclusion Criteria

1. Neonates with life-threatening congenital anomalies not compatible with survival.
2. Neonates on mechanical ventilation.
3. Neonates who received less than 24 hours of NICU care due to discharge against medical advice or transfer out to another facility (where outcome data cannot be tracked).
4. Cases with incomplete documentation regarding KMC initiation time.

Study Procedure

1. Intervention/Exposure Definition

- **Group A (Standard KMC) (1st January – 30th June 2024):** KMC was initiated only after the neonate was considered clinically stable (e.g., stable vital signs, minimal respiratory support).
- **Group B (Early KMC) (1st July – 31st December 2024):** KMC was started as soon as possible after

birth (within the first few hours), once the infant was deemed stable enough for skin-to-skin contact, but without waiting for complete clinical stabilization.

2. Outcome Measures

1. **Survival Rate:** The proportion of infants who survived until hospital discharge.
2. **Sepsis Rate:** The incidence of culture-proven sepsis or clinically diagnosed sepsis requiring antibiotic treatment.
3. **Duration of Antibiotics:** total antibiotic days of therapy per 1,000 patient-days were calculated by summing all antibiotic days of therapy (DOT) in each group (e.g., total days each infant received at least one antibiotic) and then dividing by the total patient-days (the sum of days each infant was in the NICU) for that group. Finally, it was multiplied by 1,000.
4. **Length of Stay (LOS):** The number of days from NICU admission to discharge.
5. **Weight Gain:** Weight gain (g/kg/day) was determined by taking the difference between the initial and final weights (in grams), dividing by the total number of days in NICU, and average weight, and then normalizing the result per kilogram of the child's body weight.

3. Data Collection Methods

- **Data Source:** All relevant data, including demographics, birth weight, gestational age, duration of antibiotics, and length of NICU stay, were extracted from medical records and NICU logs.
- **Data Collection Tool:** A standardized data extraction sheet was used to ensure consistency in data collection.
- **Data Management:** All collected data were anonymized and stored in a password-protected electronic database, accessible only to authorized research team members.

Sample Size Estimation

Alpha (α): 0.05 (two-sided)

Power (1 – β): 80% (i.e., β = 0.20)

Mean Difference (δ): As per WHO 0.9 days (difference in average LOS between early vs. late KMC groups) was reported (4).

Assumed **Standard Deviation (σ)**: 2.0 days

$$n=2\times\frac{(Z\alpha/2+Z\beta)\times\sigma)^2}{(\delta)^2}$$

$n\approx77.44$

n= 78 (rounded off)

Adjusting to 25% inadequate data, Minimum 98 cases in each group was enrolled.

Statistical Analysis

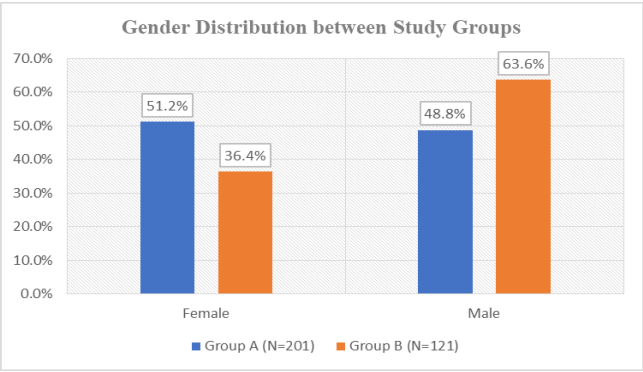
Raw data was collected from medical records and entered in Microsoft excel 2016. The statistical analysis was performed using IBM SPSS Version 25. Categorical variables were presented as numbers and percentages and proportions were compared using Chi-square test. Continuous variables were represented as mean and standard deviations and were compared using independent sample t test. Significance was considered at cut off value of 0.05.

Results and observations

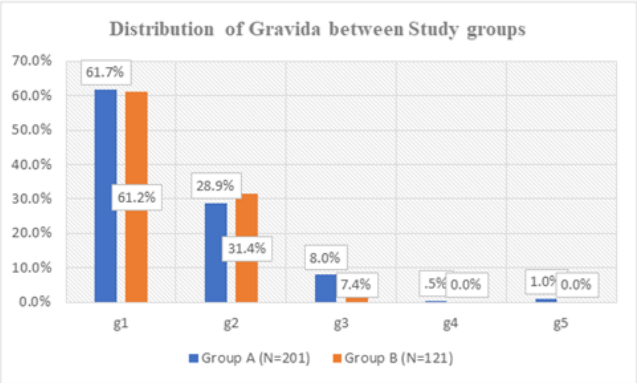
Table 1: Distribution of Demographic Characteristics of Group A and Group B

Demographic Characteristics			Group A (N=201)	Group B (N=121)	Total	P
Sex	Female	Number	103	44	147	0.009
		%	51.2%	36.4%	45.7%	
	Male	Number	98	77	175	
		%	48.8%	63.6%	54.3%	
Gravida	g1	Number	124	74	198	0.736
		%	61.7%	61.2%	61.5%	
	g2	Number	58	38	96	
		%	28.9%	31.4%	29.8%	
	g3	Number	16	9	25	
		%	8.0%	7.4%	7.8%	
	g4	Number	1	0	1	
		%	.5%	0.0%	.3%	
	g5	Number	2	0	2	
		%	1.0%	0.0%	.6%	

Graph 1:



Graph 2:

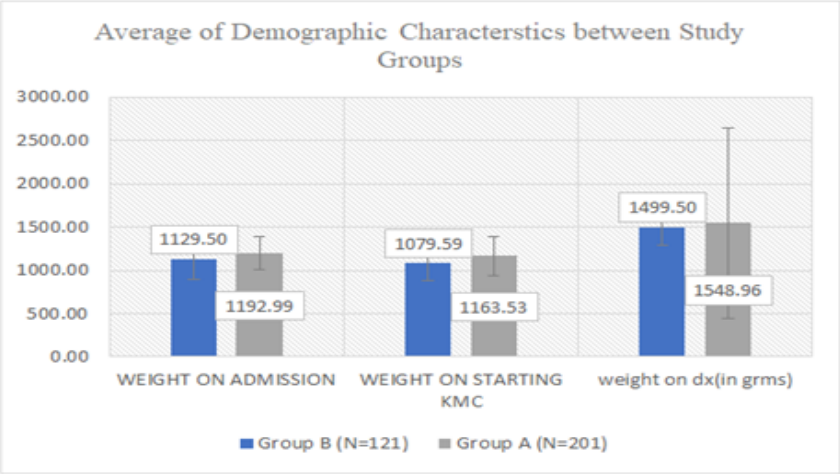


Group A (Early KMC) had more females (51.2%) than Group B (36.4%), while males were more prevalent in Group B (63.6%) than in Group A (48.8%), with a statistically significant difference (p = 0.009). Gravida distribution was similar in both groups, with primigravida (G1) being the majority (61.7% in Group A, 61.2% in Group B). Other gravida categories showed minimal variation, and the difference was not statistically significant (p = 0.736), indicating gravida status was evenly distributed.

Table 2: Average of Demographic Characteristics between Early and Standard KMC

Demographic Characteristics	Group A (N=201)		Group B (N=121)		Total		P
	Mean	SD	Mean	SD	Mean	SD	
WEIGHT ON ADMISSION	1192.99	191.01	1129.5	237.39	1169.13	211.53	0.009
WEIGHT ON STARTING KMC	1163.53	220.85	1079.59	203.37	1131.99	217.97	0.001
weight on dx(in grms)	1548.96	1102.2	1499.5	213.32	1530.37	880.06	0.626

Graph 3:



Neonates in Group A had higher admission weights (1192.99 ± 191.01 g) than Group B (1129.5 ± 237.39 g), a significant difference (p = 0.009). Similarly, weight at KMC initiation was higher in Group A (1163.53 ± 220.85 g) than Group B (1079.59 ± 203.37 g) (p = 0.001). However, discharge weights were similar (1548.96 ± 1102.2 g vs. 1499.5 ± 213.32 g), with no significant difference (p = 0.626).

Table 3: Distribution of KMC duration and Breast Milk exclusivity

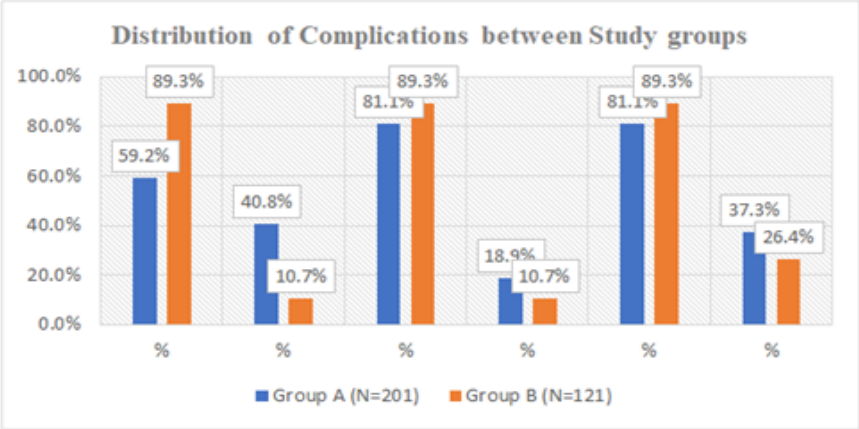
			Group A (N=201)	Group B (N=121)	Total	P
KMC >6HRS/DAY	NO	Number	69	47	116	0.414
		%	34.3%	38.8%	36.0%	
	YES	Number	132	74	206	
		%	65.7%	61.2%	64.0%	
Exclusive EBM On DX	No	Number	5	2	7	0.619
		%	2.5%	1.7%	2.2%	
	Yes	Number	196	119	315	
		%	97.5%	98.3%	97.8%	

The majority of neonates in both groups received >6 hours of KMC daily (65.7% in Group A, 61.2% in Group B), with no significant difference (p = 0.414). Similarly, exclusive EBM feeding at discharge was comparable (97.5% in Group A, 98.3% in Group B) (p = 0.619), indicating similar feeding practices across groups.

Table 4: Distribution of Complications between Early and standard KMC

Complications			Group A (N=201)	Group B (N=121)	Total	P
NEC	No	Number	119	108	227	<0.0001
		%	59.2%	89.3%	70.5%	
	Yes	Number	82	13	95	
		%	40.8%	10.7%	29.5%	
BPD	No	Number	163	108	271	0.052
		%	81.1%	89.3%	84.2%	
	Yes	Number	38	13	51	
		%	18.9%	10.7%	15.8%	
Sepsis	No	Number	163	108	271	0.04
		%	81.1%	89.3%	84.2%	
	Yes	Number	75	32	107	
		%	37.3%	26.4%	33.2%	

Graph 4:



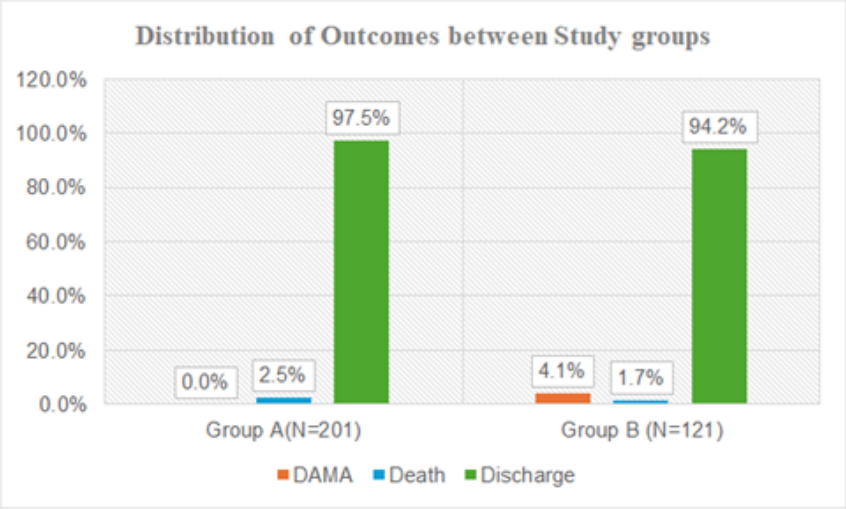
The incidence of NEC was significantly higher in Group A (40.8%) than in Group B (10.7%) ($p < 0.0001$), suggesting early KMC might pose a higher risk for fragile VLBW infants. BPD was slightly more common in Group A (18.9%) than Group B (10.7%), but the difference was not statistically significant ($p = 0.052$). Sepsis occurred more frequently in Group A (37.3%) than in Group B (26.4%) ($p = 0.04$), indicating a slightly higher risk with early KMC.

Table 5: Distribution of Outcome between early and standard KMC

Outcome		Group A (N=201)	Group B (N=121)	Total	P
DAMA	Number	0	5	5	0.013
	%	0.00%	4.10%	1.60%	
Death	Number	5	2	7	
	%	2.50%	1.70%	2.20%	

Discharge	Number	196	114	310	
	%	97.50%	94.20%	96.30%	

Graph 5:



The DAMA rate was higher in Group B (4.1%) than in Group A (0%). Mortality was slightly higher in Group A (2.5%) compared to Group B (1.7%). Discharge rates were high in both groups (97.5% in Group A vs. 94.2% in Group B). The overall outcome distribution showed a statistically significant difference (p = 0.013).

Table 6: Distribution of Clinical Outcomes

			Group A (N=201)	Group B (N=121)	Total	P
Oxygen Support	Upto 5 Days	Number	38	40	78	<0.0001
		%	18.9%	33.1%	24.2%	
	6 to 10 days	Number	32	36	68	
		%	15.9%	29.8%	21.1%	
	11 to 15 Days	Number	25	21	46	
		%	12.4%	17.4%	14.3%	
	16 to 20 Days	Number	20	8	28	
		%	10.0%	6.6%	8.7%	
	> 20 Days	Number	86	14	100	
		%	42.8%	11.6%	31.1%	
	No Support	Number	0	2	2	
		%	0.0%	1.7%	.6%	
Duration Of Hospital Stay	Upto 10 Days	Number	32	22	54	0.424
		%	15.9%	18.2%	16.8%	
	11 to 20 Days	Number	55	25	80	
		%	27.4%	20.7%	24.8%	

	21 to 30 Days	Number	47	32	79	
		%	23.4%	26.4%	24.5%	
	31 to 40 Days	Number	20	18	38	
		%	10.0%	14.9%	11.8%	
	> 40 Days	Number	47	24	71	
		%	23.4%	19.8%	22.0%	

Oxygen Support Requirement

A significantly higher proportion of neonates in Group A (42.8%) required oxygen support for more than 20 days compared to Group B (11.6%), while a small percentage in Group B (1.7%) did not require oxygen at all. The overall difference was statistically significant ($p < 0.0001$).

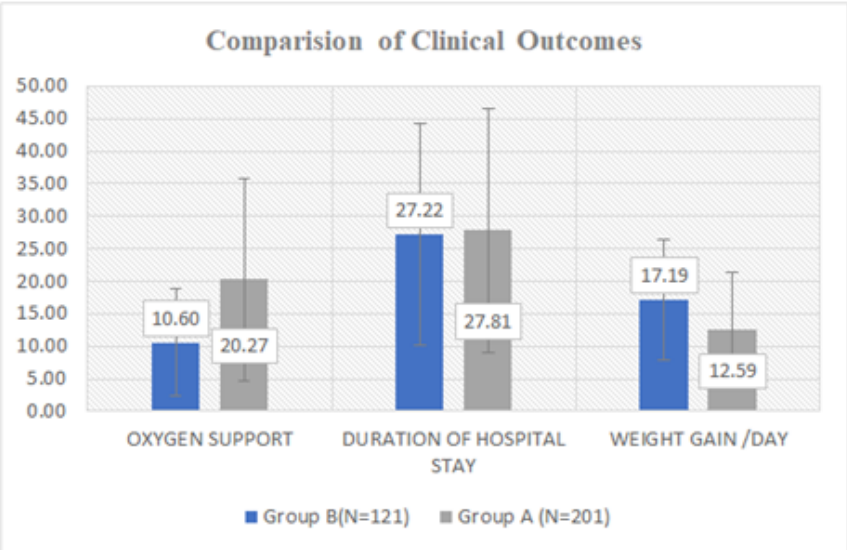
Duration of Hospital Stay

Hospital stay duration was comparable between groups, with similar proportions staying >40 days (23.4% in Group A vs. 19.8% in Group B) and 21-30 days (23.4% vs. 26.4%). The difference was not statistically significant ($p = 0.424$).

Table 7: Comparison of average clinical outcomes

	Group A (N=201)		Group B(N=121)		Total		P
	Mean	SD	Mean	SD	Mean	SD	
Oxygen Support	20.27	15.53	10.60	8.18	16.64	14.05	<0.0001
Duration Of Hospital Stay	27.81	18.70	27.22	17.05	27.59	18.07	0.778
Weight Gain /Day	12.59	8.82	17.19	9.28	14.32	3.55	0.09
Total antibiotic days of therapy per 1,000 patient-days	393.3		117.8				

Graph 6:



Oxygen Support Duration

Group A had a significantly longer mean oxygen support duration (20.27 ± 15.53 days) than Group B (10.60 ± 8.18 days) ($p < 0.0001$).

Hospital Stay Duration

The mean hospital stay was similar in both groups (27.81 ± 18.70 days in Group A vs. 27.22 ± 17.05 days in Group B), with no statistically significant difference ($p = 0.778$).

Weight Gain Per Day

Group B showed a higher mean daily weight gain (17.19 ± 9.28 g) than Group A (12.59 ± 8.82 g), but the difference was not statistically significant ($p = 0.09$).

Total antibiotic days of therapy per 1,000 patient-days was 393.3 days in group A whereas it was 117.7 days in group B

Table 8: Distribution of Birth Weight Categories between study groups

Weight Category		Group A (N=201)	Group B (N=121)	Total	P
ELBW (<1000 Grams)	Number	31	32	63	0.016
	%	15.4%	26.4%	19.6%	
VLBW (> 1000 to 1500 grams)	Number	170	89	259	
	%	84.6%	73.6%	80.4%	

Group B had a higher proportion of Extremely Low Birth Weight (ELBW) neonates (26.4%) compared to Group A (15.4%), while Group A had more Very Low Birth Weight (VLBW) neonates (84.6% vs. 73.6%). The difference was statistically significant ($p = 0.016$)

Discussion

Kangaroo mother care (KMC) has gained worldwide recognition as a critical intervention for enhancing survival and overall health in very low birth weight (VLBW) newborns, chiefly through skin-to-skin contact and early breastfeeding support. Although extensive research has demonstrated KMC's effectiveness in promoting warmth, reducing morbidity, and fostering parent–child bonding, the optimal timing for initiating KMC remains an area of active investigation. In the present study, early KMC was found to be superior to standard KMC in reducing the incidence of necrotizing enterocolitis, sepsis, and bronchopulmonary dysplasia, while also lowering oxygen support requirements, marginally reducing mortality, and showing a trend toward higher daily weight gain.

In our present study, the proportion of males was higher in the early KMC group (63.6%) compared to the standard KMC group (48.8%), a trend also observed by Jayaraman et al. [5], who noted slightly more males in both early and standard KMC groups. Meanwhile, Brotherton et al.[6] and Logronio et al.[7] reported closer male-to-female ratios across their cohorts. Although these differences in gender distribution do not appear to significantly affect KMC outcomes.

In the present study, sepsis was documented in 37.3% of newborns receiving standard KMC (Group A) compared with 26.4% in the early KMC group (Group B) ($p=0.04$), suggesting that initiating KMC sooner may be linked to a lower risk of infection. In support of this, a systematic review and meta-analysis found that early KMC (initiated within 24 hours of birth) is associated with a probable decrease in clinical sepsis, with a relative risk of 0.85 (95% CI 0.76 to 0.96). [8.9].

In the present study, the duration of NICU stay was similar for both early KMC (27.22±17.05 days) and standard KMC (27.81±18.70 days). These findings align with Brotherton et al. [6], who also found minimal

difference between the two groups. However, Logronio et al.[7] and Swarnkar et al. [10] reported shorter NICU stays for infants receiving early KMC. Variations across studies may stem from differences in clinical practice, inclusion criteria, institutional protocols which affect hospitalization length in very low birth weight infants.

In the present study, birth weight was slightly lower in the early KMC group (1129.5±237.39 g) compared to the standard KMC group (1192.99±191.01 g), yet the early KMC infants exhibited a higher daily weight gain (17.19±9.28 g/day vs. 12.59±8.82 g/day). This trend aligns with findings from Swarnkar et al. (10), who also noted superior weight gain in the early KMC group, but contrasts with results from Brotherton et al. [6] and Logronio et al. [7], where standard or intermittent KMC showed marginally higher or comparable rates of weight gain. Differences in baseline birth weight, study protocols, and definitions of "early" KMC may account for these variations. Overall, early initiation of KMC appears to support favorable growth outcomes despite potentially lower initial weights.

In the present study, mortality was slightly lower in the early KMC group (1.7%) compared with the standard KMC group (2.5%). These findings are consistent with Brotherton et al. (6), who reported a reduction in 28-day mortality from 24% to 21% when KMC was started early, and Talikoti et al. [11], who observed a decline from 15.7% to 12% in neonatal deaths with early KMC initiation. n the present study, the overall mortality rates were notably lower than in previous research, which may reflect advancements in neonatal care, earlier detection and management of complications, and the relatively stable condition of the included very low birth weight infants.

Limitations and Future Prospects

This study did not consider important maternal health factors, such as systemic illnesses, which may have influenced neonatal outcomes. Additionally, it was not possible to consistently document whether the caregiver was the mother or another relative, limiting the ability to assess the role of different caregivers in providing kangaroo mother care. Future studies would benefit from incorporating broader maternal medical data, systematically tracking the identity of caregivers, and exploring how family dynamics and social support influence KMC outcomes. Studies with larger sample sizes and extended follow-up periods could help clarify the long-term benefits of early KMC, while also examining psychological impacts on mothers.

Conclusion

Initiating kangaroo mother care within the first week of life for very low birth weight infants was associated with a lower incidence of sepsis, reduced oxygen support requirements, marginally reduced mortality, and a trend toward higher daily weight gain compared to standard KMC, while the length of NICU stay remained similar in both groups. Total antibiotic days of therapy per 1,000 patient-days was significantly lower in early KMC. These findings highlight the potential benefits of early skin-to-skin contact and support its broader adoption in clinical settings to improve outcomes in this vulnerable neonatal population.

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