

Determining the Pattern of Weight Gain in Preterm and Term SGA Neonates Receiving Kangaroo Mother Care at Tertiary Care Hospital

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Abstract

Background: Low birth weight and small for gestational age (SGA) neonates are at increased risk of morbidity, mortality, and poor postnatal growth. Kangaroo Mother Care (KMC) is an evidence-based, cost-effective intervention known to improve neonatal outcomes, including weight gain. However, limited data exist comparing growth patterns between preterm and term SGA neonates receiving uniform KMC.

Objectives: To determine and compare the pattern of weight gain in preterm and term SGA neonates receiving Kangaroo Mother Care.

Methods: This prospective comparative cohort study was conducted in a tertiary care hospital in Bengaluru, India. A total of 100 SGA neonates were enrolled and divided into two groups: preterm SGA (n=50) and term SGA (n=50). All neonates received KMC for 6–8 hours daily and were followed for 14 days. Daily weight measurements were recorded using a calibrated digital scale. The primary outcome was average daily weight gain (g/day and g/kg/day). Data were analyzed using independent samples t-test, with $p < 0.05$ considered statistically significant.

Results: Term SGA neonates demonstrated significantly higher absolute weight gain compared to preterm SGA neonates, with greater average daily weight gain (19.94 ± 3.16 vs 15.24 ± 2.40 g/day; $p < 0.001$) and total weight gain over 14 days (279.16 ± 44.31 vs 213.36 ± 33.53 g; $p < 0.001$). However, weight gain expressed as g/kg/day was comparable between the groups (9.48 ± 1.71 vs 9.23 ± 2.05 ; $p = 0.500$).

Conclusion: While term SGA neonates achieved higher absolute weight gain, comparable weight gain in g/ kg/ day indicates similar growth efficiency in both groups. KMC promotes proportional growth irrespective of gestational maturity and remains an effective intervention for SGA neonates.

Keywords: Kangaroo Mother Care, Small for Gestational Age, Preterm, Term Neonates Weight Gain, Low Birth Weight.

Introduction

Low birth weight (LBW), defined as a birth weight of less than 2500 g, remains a major public health challenge and a leading cause of neonatal morbidity and mortality, particularly in low- and middle-income countries¹.

In India, a substantial proportion of neonates are affected, with increased susceptibility to early complications such as hypothermia, hypoglycemia, and sepsis, as well as long-term adverse outcomes including impaired growth and neurodevelopment². Small for gestational age (SGA) infants, especially when born preterm, represent a particularly vulnerable subgroup due to the combined effects of intrauterine growth restriction and physiological immaturity.

Kangaroo Mother Care (KMC), defined as early, continuous skin-to-skin contact along with exclusive breastfeeding, is an evidence-based and cost-effective

intervention for the care of LBW infants^{3, 4}. KMC has been shown to improve thermal regulation, promote breastfeeding, enhance maternal-infant bonding, and reduce neonatal morbidity and mortality⁵. The physiological benefits of KMC are mediated through improved autonomic stability and hormonal responses, including increased oxytocin secretion, which supports lactation and neonatal adaptation³.

Several studies have demonstrated the positive impact of KMC on weight gain. Margekar et al. reported improved weight gain and temperature maintenance among neonates receiving KMC compared to conventional care⁶. Similarly, Surandran and Nagendra found that longer duration of KMC was associated with better growth outcomes in preterm and LBW neonates⁷. Gagandeep et al. demonstrated a direct correlation between duration of KMC and weight gain⁸, while Jaywant et al.

highlighted significant improvements in weight gain among preterm infants receiving prolonged KMC⁹. Additional evidence by Phirke et al. supports the beneficial role of KMC in promoting neonatal weight gain¹⁰. Furthermore, large-scale studies have shown that KMC significantly reduces neonatal mortality among infants with birth weight less than 2000 g⁵.

Despite substantial evidence supporting KMC, there is limited literature comparing the pattern and efficiency of weight gain between preterm SGA and term SGA neonates receiving standardized KMC. Understanding whether gestational maturity influences growth response under uniform KMC exposure is essential for optimizing neonatal care strategies.

Hence, the present study was undertaken to determine and compare the pattern of weight gain in preterm and

term SGA neonates receiving Kangaroo Mother Care at a tertiary care hospital.

Materials and Methods

This prospective comparative cohort study was conducted for 6 months from July 2025 to January 2026, in the Department of Paediatrics at The Oxford Medical College, Hospital and Research Centre, Bengaluru, along with its affiliated outreach centre at Anekal, Karnataka, after obtaining approval from the Institutional Ethics Committee. Written informed consent was obtained from the parents or caregivers prior to enrolment.

A total of 100 neonates were included in the study and were divided into two groups: preterm small for gestational age (SGA) neonates ($n = 50$) and term SGA neonates ($n = 50$).

The sample size was calculated using the formula for comparison of two means, assuming a 95% confidence level, 80% power, a standard deviation of 5 g/kg/day, and a minimum clinically significant difference of 3 g/kg/day in weight gain between the groups. The minimum required sample size was 44 neonates per group, which, after accounting for a 10% attrition rate, was adjusted to 49 neonates per group; however, 50 neonates were ultimately included in each group.

Clinically stable preterm and term SGA neonates eligible for Kangaroo Mother Care (KMC) were included in the study. Neonates with major congenital anomalies, those requiring mechanical ventilation or intensive critical care, those with severe illness contraindicating KMC, and neonates whose mothers were unwilling or unable to provide KMC were excluded.

All enrolled neonates received Kangaroo Mother Care for 6–8 hours per day following standardized training of

mothers by trained healthcare personnel, and standard neonatal care protocols were uniformly followed. The neonates were followed up for a period of 14 days, during which body weight was measured daily at a fixed time using a calibrated digital weighing scale to minimize measurement variability.

The primary outcome measure was average daily weight gain, expressed in grams per day (g/day) and grams per kilogram per day (g/kg/day). Secondary outcomes included total weight gain over 14 days and the pattern of weight gain across early (Day 1–3), intermediate (Day 4–7), and late (Day 8–14) phases. Data were collected using a structured and pre-tested proforma that included demographic details, gestational age, birth weight, timing and duration of KMC, and serial daily weight measurements.

Data were entered into Microsoft Excel and analyzed using SPSS version 22.0 (IBM SPSS Statistics, Somers, NY, USA). Continuous variables were expressed as mean $\pm$ standard deviation, while categorical variables were presented as frequencies and percentages. The independent samples t-test was used to compare mean values between the two groups. The Chi-square test was used for categorical variables. A p-value of <0.05 was considered statistically significant. The study was conducted in accordance with ethical principles, and confidentiality of participant information was strictly maintained throughout the study.

Results

The baseline characteristics of the study population showed that maternal age was comparable between the preterm SGA and term SGA groups (26.5 ± 4.1 vs 26.5 ± 4.3 years; $p = 0.981$), indicating demographic homogeneity. As expected, gestational age was significantly lower in the preterm SGA group (33.9 ± 1.3

weeks) compared to the term SGA group (37.9 ± 0.8 weeks; $p < 0.001$). Birth weight was also significantly lower among preterm SGA neonates (1684.2 ± 226.7 g vs 2117.6 ± 172.8 g; $p < 0.001$). The APGAR score at 1 minute was significantly lower in preterm SGA infants (7.0 ± 0.5 vs 7.4 ± 0.6 ; $p = 0.003$), while the difference at 5 minutes was not statistically significant ($p = 0.095$), indicating satisfactory early adaptation in both groups. There were no significant differences in sex distribution (52% males in both groups) or mode of delivery (LSCS: 50% vs 40%; $p = 0.315$). Overall, except for gestational age and birth weight, both groups were comparable at baseline (Table 1).

Kangaroo Mother Care (KMC) practices were comparable between the two groups, with no significant difference in the day of initiation (1.32 ± 0.62 vs 1.18 ± 0.39 days; $p = 0.180$) or average daily duration (6.97 ± 0.16 vs 7.01 ± 0.16 hours; $p = 0.319$). All neonates in both groups demonstrated good compliance (100%), ensuring uniform exposure to the intervention. Despite similar KMC practices, preterm SGA neonates had a significantly longer duration of hospital stay compared to term SGA neonates (16.50 ± 2.17 vs 15.28 ± 1.18 days; $p < 0.001$), likely reflecting differences in physiological maturity. The incidence of complications was higher in preterm SGA neonates (22% vs 16%), although this difference was not statistically significant ($p = 0.520$). All neonates were discharged successfully, indicating favorable short-term outcomes with KMC in both groups (Table 2).

Analysis of weight gain patterns revealed that term SGA neonates consistently demonstrated higher absolute weight gain compared to preterm SGA neonates across all time points. Baseline weight and subsequent weights at Day 7 and Day 14 were significantly higher in the

term SGA group ($p < 0.001$ for all comparisons). Phase-wise analysis showed significantly greater weight gain in term SGA neonates during the early (Day 1–3), intermediate (Day 4–7), and late (Day 8–14) periods ($p < 0.001$ for all phases).

The total weight gain over 14 days (279.16 ± 44.31 g vs 213.36 ± 33.53 g; $p < 0.001$) and average daily weight gain (19.94 ± 3.16 vs 15.24 ± 2.40 g/day; $p < 0.001$) were significantly higher in term SGA neonates. However, when weight gain was normalized to body weight, no statistically significant difference was observed between the two groups in terms of weight gain expressed as g/kg/day (9.48 ± 1.71 vs 9.23 ± 2.05 ; $p = 0.500$) or percentage weight gain ($p = 0.495$).

These findings indicate that although term SGA neonates gained more weight in absolute terms, the relative growth velocity was comparable between preterm and term SGA neonates receiving KMC, suggesting similar efficiency of weight gain across both groups (Table 3).

The analysis of primary outcome variables demonstrated that term SGA neonates had significantly higher absolute weight gain, with an average daily gain higher by 4.70 g/day and total weight gain higher by 65.80 g over 14 days ($p < 0.001$ for both). However, there was no statistically significant difference in weight gain expressed relative to body weight (g/kg/day) between the groups ($p = 0.500$).

These findings indicate that while term SGA neonates achieve greater absolute weight increments, preterm SGA neonates exhibit comparable proportional growth under similar KMC exposure. Thus, Kangaroo Mother Care appears to promote equivalent growth velocity when adjusted for body weight, effectively fulfilling the

study objective of estimating and comparing weight gain between preterm and term SGA neonates (Table 4).

Table 1: Baseline maternal and neonatal characteristics

Variable	Preterm SGA (n=50)	Term SGA (n=50)	p-value
Maternal age, years	26.5 ± 4.1	26.5 ± 4.3	0.981
Gestational age, weeks	33.9 ± 1.3	37.9 ± 0.8	<0.001*
Birth weight, gms	1684.2 ± 226.7	2117.6 ± 172.8	<0.001*
APGAR score at 1 min	7.0 ± 0.5	7.4 ± 0.6	0.003*
APGAR score at 5 min	8.4 ± 0.7	8.6 ± 0.7	0.095
Male sex, n (%)	26 (52.0%)	26 (52.0%)	#1.000
LSCS delivery, n (%)	25 (50.0%)	20 (40.0%)	#0.315

Continuous variables expressed as mean ± standard deviation (SD) and compared using independent samples t-test.

Categorical variables expressed as frequency (percentage) and compared using Chi-square test.

Table 2: KMC exposure and clinical characteristics

Variable	Preterm SGA (n=50)	Term SGA (n=50)	p-value
KMC day of initiation	1.32 ± 0.62	1.18 ± 0.39	0.18
Average KMC duration, hours/day	6.97 ± 0.16	7.01 ± 0.16	0.319
Good KMC compliance, n (%)	50 (100.0%)	50 (100.0%)	—
Hospital stay, days	16.50 ± 2.17	15.28 ± 1.18	<0.001*
Any complication, n (%)	11 (22.0%)	8 (16.0%)	#0.52
Discharged, n (%)	50 (100.0%)	50 (100.0%)	—

Continuous variables expressed as mean ± SD and compared using independent samples t-test. # Categorical variables

expressed as frequency (percentage) and compared using Chi-square test

Table 3: Pattern of weight gain among Preterm and Term SGA neonates receiving KMC

Weight parameter	Preterm SGA (n=50)	Term SGA (n=50)	p-value
Weight on Day 0, g	1684.20 ± 226.73	2117.60 ± 172.81	<0.001*
Weight on Day 7, g	1791.88 ± 226.82	2258.04 ± 174.36	<0.001*
Weight on Day 14, g	1897.56 ± 228.94	2396.76 ± 177.16	<0.001*
Early gain (Day 1–3), g/day	15.19 ± 2.90	20.29 ± 3.62	<0.001*
Intermediate gain (Day 4–7), g/day	15.53 ± 2.89	19.89 ± 3.36	<0.001*
Late gain (Day 8–14), g/day	15.10 ± 2.49	19.82 ± 3.51	<0.001*
Total weight gain, g	213.36 ± 33.53	279.16 ± 44.31	<0.001*
Average weight gain, g/day	15.24 ± 2.40	19.94 ± 3.16	<0.001*
Weight gain, g/kg/day	9.23 ± 2.05	9.48 ± 1.71	0.5
Percentage weight gain	12.91 ± 2.87	13.28 ± 2.39	0.495

Independent samples t-test.

Table 4: Comparison of key weight gain outcomes between preterm and term small-for-gestational-age (SGA) neonates receiving Kangaroo Mother Care (KMC).

Outcome variable	Preterm SGA (n=50)	Term SGA (n=50)	Mean difference	p-value
Average daily weight gain, g/day	15.24 ± 2.40	19.94 ± 3.16	4.70 g/day higher in Term SGA	<0.001*
Total weight gain over 14 days, g	213.36 ± 33.53	279.16 ± 44.31	65.80 g higher in Term SGA	<0.001*
Weight gain, g/kg/day	9.23 ± 2.05	9.48 ± 1.71	0.25 g/kg/day higher in Term SGA	0.5

Independent samples t-test.

Discussion

The present study evaluated the pattern of weight gain among preterm and term SGA neonates receiving uniform Kangaroo Mother Care and demonstrated a clear distinction between absolute and relative growth outcomes. Term SGA neonates showed significantly higher absolute weight gain compared to preterm SGA neonates; however, relative growth velocity, assessed by weight gain in g/kg/day and percentage weight gain, was comparable between the two groups.

The higher absolute weight gain observed in term SGA neonates can be attributed to their greater physiological maturity, improved feeding efficiency, and metabolic stability. Similar findings have been reported in previous studies where more mature neonates exhibited higher daily weight increments^{7,9}. However, the absence of a significant difference in weight gain when normalized to body weight suggests that preterm SGA neonates are capable of achieving growth proportional to their size under optimal KMC support.

This observation highlights the effectiveness of KMC in promoting efficient growth irrespective of gestational age. Comparable relative weight gain has also been

reported by Ramesh and Sundari, who demonstrated improved growth velocity and reduced morbidity among LBW infants receiving KMC¹¹. The benefits of KMC are attributed to improved thermoregulation, enhanced breastfeeding, reduced energy expenditure, and better physiological stability^{3,6}.

In the present study, uniform KMC exposure with excellent compliance across both groups strengthens the validity of the findings. Previous studies have emphasized that longer duration of KMC is associated with improved weight gain, supporting a dose-dependent relationship^{7,8}. The standardized KMC duration in this study likely contributed to the comparable growth efficiency observed between preterm and term SGA neonates.

The longer duration of hospital stay among preterm SGA neonates reflects their inherent physiological immaturity rather than differences in response to KMC. Importantly, the comparable complication rates and universal discharge outcomes in both groups reinforce the safety and effectiveness of KMC across varying gestational ages.

Overall, while term SGA neonates demonstrated greater absolute weight gain, the similarity in weight gain per kilogram per day indicates that KMC facilitates equivalent proportional growth in both preterm and term SGA neonates. These findings support the role of KMC as an equitable and effective intervention for promoting growth in SGA infants, irrespective of gestational maturity.

Conclusion

Kangaroo Mother Care (KMC) is an effective and feasible intervention for promoting weight gain in both preterm and term SGA neonates. While term SGA infants demonstrated significantly higher absolute weight gain, the comparable weight gain in g/kg/day indicates similar growth efficiency in both groups. These findings suggest that KMC supports proportional growth irrespective of gestational maturity. Thus, KMC can be considered an equitable strategy for improving neonatal outcomes in SGA infants. Its implementation in routine neonatal care, especially in resource-limited settings, can contribute to improved growth and overall neonatal health.

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