

Neurodevelopmental and Growth Outcomes Among Low-Birth-Weight Infants Receiving Early Kangaroo Mother Care: A Cross-Sectional Study

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Submission Date : 29 Jan 2026
Accepted Date : 03 March 2026
Published Date : 30 March 2026
DOI: <https://doi.org/10.3329/jrPMC.v11i1.90056>

Abstract

Background:

Infants with low-birth-weight face heightened risks of mortality, growth retardation, and neurodevelopmental deficits, especially in resource-limited environments. Kangaroo Mother Care (KMC) enhances survival and growth. However, data concerning its long-term neurodevelopmental effects in Bangladesh is still insufficient.

Objective:

To evaluate neurodevelopmental and growth outcomes in low-birth-weight children receiving early Kangaroo Mother Care and to identify predictors of developmental delay.

Methods:

This cross-sectional analytical study was conducted at Bangladesh Shishu Hospital & Institute, Dhaka from June 2023 to November 2023, involving 65 low-birth-weight children aged 12 to 36 months who received early Kangaroo Mother Care there. The ASQ-3 was used to look at neurodevelopment, and WHO standards were used to look at anthropometric measurements. Chi-square tests, independent t-tests, Pearson correlation, and multivariable logistic regression were used to identify predictors of developmental delay.

Results:

In general, 67.9% of children demonstrated age-appropriate growth across all areas, with early initiation of Kangaroo Mother Care within 24 hours (AOR=0.38, p=0.026) and daily practice exceeding eight hours (AOR=0.41, p=0.045) serving as protective factors. A longer duration of KMC was positively associated with elevated ASQ-3 scores (r=0.18–0.29, p<0.05). Children with delays had much lower anthropometric measurements.

Conclusion:

Early and continuous Kangaroo Mother Care enhances neurodevelopment and growth in low-birth-weight children, underscoring its significance in conjunction with nurturing home environments in resource-constrained contexts.

Keywords: Low Birth Weight, KMC, Neurodevelopment, ASQ-3, Growth Outcomes, Developmental Delay.

Citation: Chowdhury MH, Islam T. Neurodevelopmental and Growth Outcomes Among Low-Birth-Weight Infants Receiving Early Kangaroo Mother Care: A Cross-Sectional Study. *J Rang Med Col.* 2026 Mar;11(1):183-188. doi: <https://doi.org/10.3329/jrPMC.v11i1.90056>

Introduction:

Low-birth-weight (LBW) infants, defined as those weighing less than 2,500 g at birth, remain a major global public health concern. Compared with normal-birth-weight infants, they face substantially higher risks of neonatal mortality, severe infections, impaired physical growth, and adverse neurodevelopmental outcomes.¹ Globally, an

estimated 20 million infants are born with LBW each year, and more than 80% of these births occur in low- and middle-income countries (LMICs), where access to advanced neonatal intensive care services is often limited and the burden of prematurity is disproportionately high.² Kangaroo Mother Care (KMC) was first introduced in the late 1970s in Bogotá, Colombia, by Rey

Sanabria and colleagues as an innovative response to high neonatal mortality and shortages of incubators.³ KMC consists of early, continuous skin-to-skin contact between the infant and caregiver, promotion of exclusive breastfeeding, and structured support for early discharge with appropriate follow-up.⁴ Over the past decades, numerous systematic reviews and meta-analyses have demonstrated that KMC significantly reduces neonatal mortality, severe infections, and hypothermia, while improving weight gain, head circumference growth, and linear growth among preterm and LBW infants.⁵ Emerging evidence also suggests potential neurodevelopmental benefits, including improved cognitive and neurobehavioral outcomes; however, heterogeneity in study design, assessment tools, and duration of follow-up limits definitive conclusions.⁶

In Bangladesh, neonatal mortality remains a pressing challenge, accounting for more than two-thirds of under-five child deaths.⁷ The estimated prevalence of LBW ranges from 20% to 22%, placing a large proportion of newborns at risk of growth faltering, motor delay, and cognitive impairment.⁸ These risks are further compounded by socioeconomic constraints, limited healthcare infrastructure, and inadequate early developmental screening and intervention services.⁹ Since the early 2000s, KMC has been incorporated into facility-based newborn care programs in tertiary and district hospitals across Bangladesh.¹⁰ Evidence from neonatal units in Dhaka and Chittagong indicates that infants receiving continuous KMC experience faster weight gain at discharge and higher rates of exclusive breastfeeding at six weeks compared with standard care.¹¹

Regional evidence from India and Pakistan similarly highlights survival benefits and shorter hospital stays associated with KMC, although findings regarding long-term neurodevelopment remain inconsistent.¹² Studies from Southeast Asia emphasize improvements in growth and breastfeeding, yet comprehensive long-term developmental data remain scarce.¹³ Therefore, further context-specific research is essential to clarify the sustained neurodevelopmental impact of KMC in Bangladesh and similar settings.

Methods:

This hospital-based cross-sectional analytical

study was conducted at Bangladesh Shishu Hospital & Institute, Dhaka from June to November 2023, involving 165 low-birth-weight children aged 12–36 months who received early Kangaroo Mother Care (KMC)¹⁴ within 24 hours of birth. Children with congenital anomalies, genetic syndromes, severe neurological disorders, or incomplete records were excluded from the study. Neurodevelopmental outcomes were assessed using the Ages and Stages Questionnaire, Third Edition (ASQ-3),¹⁵ which evaluated communication, gross motor, fine motor, problem-solving, and personal-social domains. Anthropometric measurements, including weight, height/length, mid-upper arm circumference, and head circumference, were taken according to WHO growth standards.¹⁶ Data were analyzed using SPSS software version 26. Adjusted odds ratios with 95% confidence intervals were calculated, and statistical significance was set at $p < 0.05$. Ethical approval was obtained from Dhaka Shishu (Children) Hospital, and informed consent was secured from the caregivers prior to participation.

Results:

Table-I showed the socio-demographic and birth characteristics of 165 babies who were born with a low birth weight. The majority were 18 to 23 months old (33.9%) and male (52.7%). The weights of the babies at birth ranged from 1000 to 2499 grams, with 43.6% falling between 1500 and 1999 grams. Prematurity was common (74.5%), and 41.8% needed to go to the NICU, which shows that they were very vulnerable clinically.

Table-II showed the main features of Kangaroo Mother Care (KMC) for 165 babies. Most babies (59.4%) got KMC within 24 hours. Of those, 44.8% got it 4–8 hours a day and 39.4% got it more than 8 hours a day. A large number (67.9%) continued KMC at home, which shows that they followed the rules after they left the hospital.

Table-III showed anthropometric measurements of 165 kids between the ages of 12 and 36 months. The average weight was 9.8 ± 1.4 kg, the average height was 79.6 ± 5.3 cm, the average mid-upper arm circumference (MUAC) was 14.1 ± 1.1 cm, and the average head circumference was 46.3 ± 1.9 cm. The ranges show that the growth of the group was different.

Table-I: Socio-demographic and birth characteristics (N=165)

Demographic and birth characteristics	no. (%)
Age (months)	
12–17	52(31.5)
18–23	56(33.9)
24–29	35(21.2)
30–36	22(13.3)
Sex	
Male	87(52.7)
Female	78(47.3)
Birth Weight	
1000–1499 g	38(23.0)
1500–1999 g	72(43.6)
2000–2499 g	55(33.4)
Gestational Age	
<37 weeks	123(74.5)
≥37 weeks	42(25.4)
NICU Admission	
Yes	69(41.8)
No	96(58.2)

Table-II: Kangaroo mother care (kmc) characteristics (N=165)

Variable	no. (%)
KMC Initiation	
Within 24 hrs	98(59.4)
24–72 hrs	45(27.3)
>72 hrs	22(13.3)
Daily KMC Duration	
<4 hrs	26(15.8)
4–8 hrs	74(44.8)
>8 hrs	65(39.4)
Continued at Home	
Yes	112(67.9)
No	53(32.1)

Table-III: Anthropometric measurements at assessment (12–36 months)

Parameter	Mean±SD	Minimum	Maximum
Weight (kg)	9.8±1.4	7.2	13.1
Height (cm)	79.6±5.3	69.4	92.8
MUAC (cm)	14.1±1.1	12.2	16.8
Head Circumference (cm)	46.3±1.9	42.5	50.1

Table-IV showed the neurodevelopmental results of 165 kids who were tested with the ASQ-3. Most of the kids were "on track" in all areas. The highest percentages were in Personal-Social (84.8%) and Fine Motor (83%). A smaller percentage fell into the Monitor Zone or Below Cutoff, which means they need help growing in those areas.

Table-V showed that early KMC initiation and >8 hours/day were protective against developmental delay, while preterm birth, recurrent illness, and low home stimulation significantly increased risk. Maternal education was not significantly associated in the adjusted model.

Table-IV: Neurodevelopmental outcomes using ASQ-3 (N=165)

Domain	On Track no. (%)	Monitor Zone no. (%)	Below Cutoff no. (%)
Communication	123(74.5)	26(15.8)	16(9.7)
Gross Motor	132(80.0)	21(12.7)	12(7.3)
Fine Motor	137(83.0)	18(10.9)	10(6.1)
Problem Solving	126(76.4)	24(14.5)	15(9.1)
Personal-Social	140(84.8)	17(10.3)	8(4.8)

Table-V: Multivariable logistic regression: predictors of developmental delay (N=165)

Outcome: Suspected developmental delay (Yes=30, No=135)

Variable	Adjusted OR	95% CI	p-value
KMC initiation within 24 hrs	0.38	0.16–0.89	0.026
KMC >8 hrs/day	0.41	0.17–0.98	0.045
Preterm birth	2.35	1.02–5.41	0.044
Recurrent illness	2.58	1.15–5.77	0.021
Low home stimulation	3.06	1.37–6.84	0.006
Maternal education (secondary+)	0.61	0.27–1.38	0.23

Figure-1 showed the developmental status of 165 low-birth-weight children aged 12 to 36 months, as measured by the ASQ-3. Most kids were "on track" in all areas, with the highest percentages in Personal-Social (84.8%) and Fine Motor (83%). A smaller number of kids were in the Monitor Zone or Below Cutoff, which means they needed extra help to develop.

Figure-II displayed adjusted odds ratios for predictors of developmental delay in children with low birth weight (n=165). KMC for 24 hours or less and more than 8 hours a day lowers the risk (ORs=0.38, 0.41). Preterm birth, recurrent illness, and low home stimulation elevate risk (ORs=2.35–3.06), whereas maternal education indicates a nonsignificant protective trend (OR=0.61).

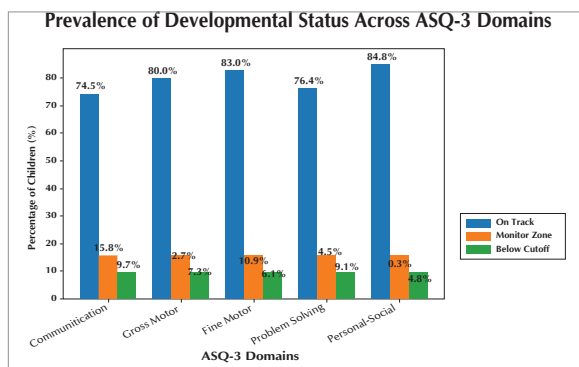


Figure-1: Domain-wise prevalence of developmental status assessed by ASQ-3 among low-birth-weight children aged 12–36 months (N=165)

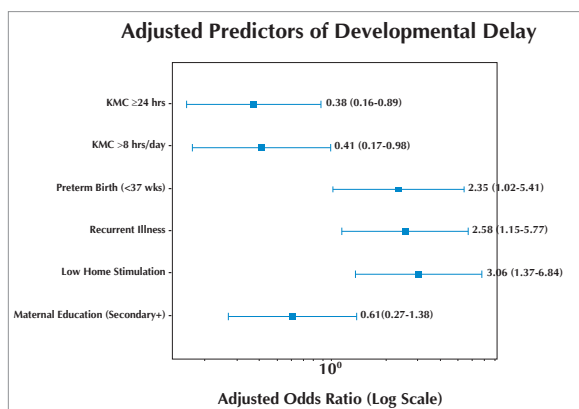


Figure-II: Adjusted odds ratios for predictors of suspected developmental delay among low-birth-weight children (Multivariable logistic regression model, N=165)

Discussion:

This study evaluated neurodevelopmental outcomes among 165 low-birth-weight (LBW) children aged 12–36 months who received early Kangaroo Mother Care (KMC). Overall, 18.2% of children showed suspected developmental delay, while 67.9% demonstrated age-appropriate performance across all ASQ-3 domains. These findings are broadly consistent with international evidence suggesting that early initiation and longer daily duration of KMC are associated with improved developmental outcomes. Vaidya et al (2018) reported lower rates of developmental delay among infants receiving early KMC compared to those who did not (15% vs. 28%).¹⁷ Similarly, Charpak et al (2017) observed significantly higher cognitive and motor scores among infants exposed to KMC for at least eight hours per day.⁴ In the present study, initiation of KMC within 24 hours (AOR=0.38, p=0.026) and continuation for more than eight hours daily (AOR=0.41, p=0.045) were independently protective, supporting a dose-response relationship between sustained KMC exposure and improved neurodevelopment.

Consistent with previous Bangladeshi research, preterm birth emerged as a significant risk factor for developmental delay. Khan et al (2018) reported increased odds of delay among preterm LBW children (OR=2.8),¹⁸ closely aligning with the current findings (AOR=2.35, p=0.044). Recurrent illness was also significantly associated with higher risk, underscoring the importance of infection prevention and continuous health monitoring in early childhood. In contrast to some national studies, maternal education did not demonstrate a statistically significant protective effect in this cohort, possibly reflecting sample characteristics or variations in socioeconomic context.

Home stimulation was identified as a strong independent predictor of neurodevelopment. Grantham-McGregor et al (2007) demonstrated that inadequate psychosocial stimulation adversely affects cognitive and socio-emotional development.¹⁹ Correspondingly, low home stimulation in this study significantly increased the likelihood of developmental delay (AOR=3.06, p=0.006), highlighting the interaction between biological vulnerability and environmental enrichment.

Anthropometric findings further reinforced the link between growth and development. Similar to observations by Bhutta et al (2014),²⁰ children with suspected delay exhibited significantly lower weight, height, mid-upper arm circumference, and head circumference, suggesting concurrent growth and neurodevelopmental vulnerability.

Limitations:

There are some limitations in this study; the cross-sectional design makes it hard to draw conclusions about the cause-and-effect relationship between KMC exposure and developmental outcomes. The fact that it was done in only one tertiary hospital makes it hard to generalize.

Conclusion:

This study shows that early initiation and prolonged Kangaroo Mother Care (KMC) are strongly linked to improved neurodevelopmental outcomes in low-birth-weight infants. Factors such as prematurity, frequent illness, and inadequate home stimulation increase the risk of developmental delay. The findings emphasize the importance of integrating KMC with supportive environments for optimal growth and brain development in resource-limited settings like Bangladesh. Health systems should make it easier for people to start and keep doing Kangaroo Mother Care in both hospitals and homes. Follow-up programs should include structured counseling for parents on how to stimulate their children at home and keep them from getting sick. Longitudinal multicenter studies are needed to look at long-term neurodevelopmental monitoring and what they mean for policy.

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