

Original Research Article

Effect of kangaroo mother care on neurodevelopmental outcome of low birth weight babies: a one-year randomized control trial

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ABSTRACT

Background: Low birth weight (LBW) is one of the risk factor for neurodevelopmental delay. The present study was undertaken to assess the role of the Kangaroo Mother Care (KMC) in the neurodevelopmental outcome of low birth weight babies.

Methods: The present study was undertaken at Department of Paediatrics, Jawarharlal Medical college, Belgaum during the period from January 2009 to October 2010. The study includes 80 stable LBW babies were randomized into 40 in the KMC group and 40 in convention method of care group. 36 babies in the KMC group and 33 babies in the CMC group completed the study. The Neurodevelopmental outcome was assessed by the Amiel Tison test at three, six, nine and twelfth months of age. This was compared with BSID test, at one year.

Results: The neurosensory examination and passive muscle tone (PMT) were found to be abnormal. Majority of the babies in both groups has a normal neurosensory and PMT development at one year. Statistically significant to muscle tone deficit was observed in the CMC babies at six months and nine months ($p = 0.005$ and $p = 0.013$). With respect to BSID, 16 and 29 KMC babies had a normal Psychomotor Development Index (PDI) and Motor Development Index (MDI) scores when compared to 8 and 18 CMC babies ($p = 0.003$ and $p = 0.057$ respectively). Number of babies with significant delay was observed to be higher in the CMC group being 11 versus 1 for PDI scores and 4 versus 1 for MDI scores.

Conclusions: The present study shows that KMC has a beneficial effect on the neurodevelopmental outcome of low birth weight babies and BSID II is a better test to detect the psychomotor and mental developmental delay when compared to the Amiel Tison test.

Keywords: Amiel-Tison test, Bayley's scale of infant development II, Conventional method care, Kangaroo mother care, Low birth weight

INTRODUCTION

Low birth weight (LBW) is a major public health problem worldwide. Low birth weight preterm babies are associated with high neonatal/infant mortality and morbidity.¹ Low birth weight babies are associated with neurodevelopmental problems with severity varying from serious problems such as cerebral palsy (7-10% very low

birth weight; 7-17% extremely low birth weight {ELBW}), mental retardation (40% of extremely low birth weight survivors) to less severe problem such as neurodevelopmental impairment (50%), visual impairment (ELBW infants 1-4%) or hearing impairment (9-14% in ELBW).² Different developmental scales are being used for neurodevelopmental assessment of infants and young children viz Bayley scales of infant

development (BSID), the neonatal behavioural assessment scales, Griffith mental development and Amiel - Tison (AT) test.

To improve neurodevelopmental outcome various interventional programs are implemented. Interventions such as sensory enrichment and individualized developmental care, have been shown to have a positive impact on attentive, cognitive and psychomotor development, more specific, tactile contact has been shown to affect premature infants motor maturity and visual habituation.^{3,4}

Skin-to-skin contact in the form of KMC may similarly contribute to the premature infant's cognitive development, as KMC integrates rhythmic, sensory, and tactile components into the mother infant contact.⁵

Various interventions such as rooming-in, bedding-in, NICU care and kangaroo mothers care are practiced for the care of low birth weight babies. Among the interventions available, Kangaroo mother care (KMC) is a cost-effective intervention proven to improve survival.⁶

However very limited data is available on the effect of KMC on neurodevelopmental outcome of LBW babies. Hence the present study was undertaken to assess the promotion of KMC in the neurodevelopmental outcome with suitable developmental test.

METHODS

The present study was conducted in the Department of Paediatrics, Jawaharlal Nehru Medical College, Belgaum during the period January 2009 to October 2010 on a total of 80 low birth weight babies who were followed up for one year.

The babies were divided into two groups of 40 each, in the KMC group and the CMC group respectively based on computer generated randomization list with random block length of 10" X 6".

Inclusion criteria

- Birth weight < 2200 gm in admitted in NICU
- Singleton gestation
- Babies who were stable and taking oral feeds.

Exclusion criteria

- Seriously ill babies who required ventilator support, Inotropic support > 15 days mother who are unable to stay with their babies because of medical problem
- Babies with congenital anomalies such as hydrocephalus, microcephaly, meningocele, spina bifida which could affect the neurodevelopmental outcome.
- Babies with congenital anomalies like cleft lip, cleft palate which could interfere with breast feeding.

The study was approved, and ethical clearance was obtained from Human Ethics Committee and informed consent was obtained from mothers.

The mothers of KMC group were advised and explained the importance of practicing the components of KMC namely skin to skin contact and exclusive breast feeding. Mothers were explained and monitored to practice exclusive breast feeding as far as possible. They were encouraged to give direct breast feeds or direct breast feeds and expressed breast milk in a sterilized palade depending on the ability of the baby to suckle.

Nurses were provided a KMC chart to mark whenever KMC was given. At discharge, mothers were counseled and advised to continue the KMC at home.

In the CMC group babies were placed in the warmers after dressing with a nappy and kept warm in NICU. Mothers were allowed to touch and breast feed babies. Once the babies were stable, they were shifted to mother and kept warm by adequate wrapping and by practicing bedding in. These babies were also given exclusive breast feeding as far as possible. At discharge mothers were counseled and advised to continue the CMC at home.

Babies were discharged once they met discharge criteria that is,

- Weight gain of 15 to 20 gm/kg/day for three consecutive days.
- Successful breast feeding or EBM feeding by palade.
- Maintenance of temperature with KMC or CMC.
- No evidence of illness.
- Mother confident of caring for her baby

All babies of both groups were supplemented with micronutrients namely calcium, zinc and iron. Both groups are monitored for neurodevelopmental outcome.

Neurodevelopmental outcome was assessed using Amiel Tison (AT) at 3rd, 6th, 9th and 12 months of corrected gestational age by a pediatrician who was blinded for the study.

Bayley's scale of infant development assessment was done at the end of 12 months of corrected gestational age by a qualified psychologist. The data obtained was tabulated on excel worksheet and comparison was done using chi-square test. The results were considered significant if p value was <0.05.

RESULTS

A total of 36 babies in the KMC group and 33 babies with the CMC group completed the study. Four babies (10%) in KMC group and seven babies (17.5%) in the CMC group could not complete the study as their mothers did not come for follow up.

Demographic data

In both the groups, maternal age was similar with majority of the mothers belonging to the age group of 20-24 years in both groups.

Table 1: Comparison of age of the mothers in KMC and CMC group.

Age in years	KMC group		CMC group	
	Number	Percentage	Number	Percentage
15-19	1	2.50	1	2.50
20-24	24	60.00	28	70.00
25-29	13	32.50	9	22.50
≥30	2	5.00	2	5.00
Total	40	100.00	40	100.00

$\chi^2 = 1.023$; DF = 2; $p = 0.599$

Majority of the babies in both groups had a birth weight of >1.49 Kg. Though 6 (15%) of KMC babies had a birth weight <1.5 Kg when compared to only 3 (7.5%) of CMC babies, this difference was not statistically significant ($p = 0.569$).

Table 2: Comparison of birth weight in KMC and CMC group.

Birth weight (Kg)	KMC group		CMC group	
	No.	Percentage	No.	Percentage
<1.49	6	15.00	3	7.50
1.5-1.79	10	25.00	11	27.50
1.8-2.20	24	60.00	26	65.00
Total	40	100.00	40	100.00

$\chi^2 = 1.128$; DF = 2; $p = 0.569$

By 11-15 Weeks all babies in both the groups had achieved a weight of 2.5 Kgs. However, the weight gain was faster in the babies of the KMC group as 60% had achieved a weight of 2.5 Kg by <5 weeks, 35% by 14 Weeks and 5% babies by 11 to 15 Weeks. The comparative percentages in the CMC group were 50%,

42.5% and 7.5%. However, these differences were not statistically significant ($p = 0.652$).

Table 3: Comparison of duration to achieve 2.5 Kg weight in KMC and CMC group.

Gestational age (In Kg)	KMC group		CMC group	
	No.	Percentage	No.	Percentage
Up to 5 weeks	24	60.00	20	50.00
6-10 weeks	14	35.00	17	42.50
11-15 weeks	2	5.00	3	7.50
Total	40	100.00	40	100.00

$\chi^2 = 0.854$; DF = 2; $p = 0.652$

Amiel-Tison (AT) test for neurological development from 3rd month to one year

28 (70%) babies in the KMC group and 26 (65%) in the CMC group had a normal AT test in neurosensory examination. However, when babies with abnormal AT test were compared, the severity of abnormality was higher in the CMC group as 8 (20%) babies and 6 (15%) babies were assessed to have severe and moderate abnormal neurosensory examination. In comparison only 4 (10%) babies in the KMC group had severe deficits in neurosensory examination and 8 (20%) babies had moderate deficits. However, this difference was not statistically significant. Similarly, when the passive muscle tone was assessed, majority of the babies had a normal passive muscle tone at 3 months with 35 (87.5%) babies in the KMC group and 34 (85%) babies in the CMC group having a normal passive muscle tone. Again, the number of babies with severe abnormal AT for passive muscle tone was higher in CMC group 6 (15%) babies had severe deficits with passive muscle tone. In comparison, only 2 (5%) babies in KMC group had severe deficit with passive muscle tone. Though none (0%) of the babies in the CMC group and 3 (7.5%) of the babies from the KMC had moderate deficit in the passive muscle tone. This difference was not statistically significant.

Table 4: Third month AT (Amiel-Tison) test.

Parameters	Group	AT test					
		Normal		Moderate		Severe	
		No.	%	No.	%	No.	%
Neurosensory examination	KMC	28	70.0	8	20.0	4	10.0
	CMC	26	65.0	6	15.0	8	20.0
		$\chi^2 = 0.228$		$p = 0.633$			
Passive muscle tone	KMC	35	87.5	3	7.5	2	5.0
	CMC	34	85.0	0	0.0	6	15.0
		$\chi^2 = 0.105$		$p = 0.745$			

35 (87.5%) babies in the KMC group and 29 (72.5%) babies in the CMC group had a normal AT test in neurosensory examination. However, when babies with

abnormal AT test were compared, the severity of abnormality was higher in the CMC group as 6 (15%) babies and 5 (12.5%) babies were assessed to have severe

and moderate abnormal neurosensory examination. In comparison only one (2.5%) baby in the KMC group had severe deficits in neurosensory examination and 4 (10%) babies had moderate deficits. These differences were statistically significant ($p = 0.017$). Similarly, when the passive muscle tone was assessed, majority of the babies had a normal passive muscle tone at 6 months with 18 (45%) babies in the KMC group and 16 (40%) babies in the CMC group having a normal passive muscle tone. The number of babies with a severe abnormal AT for

passive muscle tone was higher in CMC group as all 13 (32.5%) had an abnormal had severe deficits with passive muscle tone.

The number of babies with moderate deficit was more as 19 (47.5%) babies in KMC group and 11 (27.5%) babies in CMC group muscle tone again indicating the severity of abnormal passive muscle tone was comparatively better in the KMC group than in the CMC group. This difference was statistically significant ($p=0.005$).

Table 5: Sixth month AT (Amiel-Tison) test.

Parameters	Group	AT test					
		Normal		Moderate		Severe	
		No.	%	No.	%	No.	%
Neurosensory examination	KMC	35	87.5	4	10.0	1	2.5
	CMC	29	72.5	5	12.5	6	15.0
		$\chi^2 = 5.644$		$p = 0.017$			
Passive muscle tone	KMC	18	45.0	19	47.5	3	7.5
	CMC	16	40.0	11	27.5	13	32.5
		$\chi^2 = 7.813$		$p = 0.005$			

Table 6: Ninth month AT (Amiel-Tison) test.

Parameters	Group	AT test					
		Normal		Moderate		Severe	
		No.	%	No.	%	No.	%
Neurosensory examination	KMC	35	89.7	3	7.6	1	2.6
	CMC	26	68.4	7	18.4	5	13.2
		$\chi^2 = 2.895$		$p = 0.089$			
Passive muscle tone	KMC	25	64.1	13	33.3	1	2.6
	CMC	18	47.3	11	28.9	9	23.6
		$\chi^2 = 6.175$		$p = 0.013$			

Table 7: Twelfth month AT (Amiel-Tison) test.

Parameters	Group	AT test					
		Normal		Moderate		Severe	
		No.	%	No.	%	No.	%
Neurosensory examination	KMC	35	97.23	1	2.77	0	0.00
	CMC	33	100	0	0.00	0	0.00
		$\chi^2 = 3.430$		$p = 0.12$			
Passive muscle tone	KMC	25	69.4	10	27.8	1	2.8
	CMC	18	54.5	10	30.3	5	15.2
		$\chi^2 = 3.320$		$p = 0.098$			

At nine months 35 (89.7%) babies in the KMC group and 26 (68.4%) in the CMC group had a normal AT test in neurosensory examination. However, when babies with abnormal AT test were compared, the severity of abnormality was higher in the CMC group as 5 (13.2%) babies and 7 (18.4%) babies were assessed to have severe and moderate abnormal neurosensory examination. In comparison only one (2.6%) baby and three (7.6%)

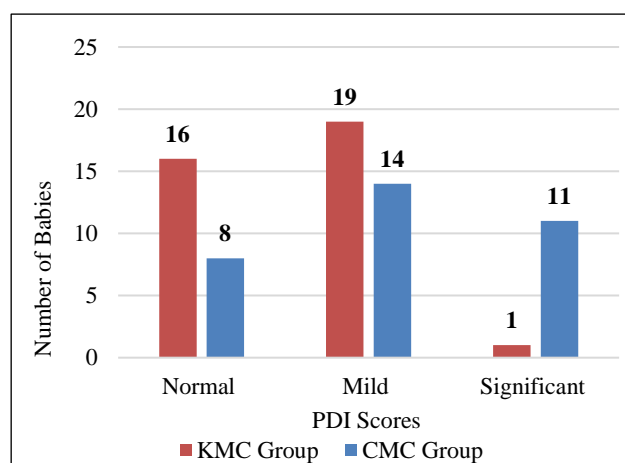
babies in the KMC group had severe deficits and moderate deficits in examination respectively. However, this difference was not statistically significant. Similarly, when the passive muscle tone was assessed, majority of the babies had a normal passive muscle tone at 9 months with 24 (64.1%) babies in the KMC group and 18 (47.3%) babies in the CMC group. Again, the number of babies with severe deficit in passive muscle tone was

higher in the CMC group with 9 (23.6%) babies who had severe deficits with passive muscle tone. In comparison with only one (2.6%) babies in KMC group had an abnormal passive muscle tone. This difference is statistically significant ($p=0.013$). However, 13 (33.3%) of the babies in the KMC group and 11 (28.9%) of the babies from the CMC had moderate deficit in the passive muscle tone.

35 (97.23%) babies in the KMC group and 33 (100%) in the CMC group had a normal AT test in neurosensory examination. However, when babies with abnormal AT test was compared, none of the babies from either group had severe deficits. In the KMC group only one baby had moderate deficit. However, this difference was not statistically significant. Similarly, when the passive muscle tone was assessed, majority of the babies had a normal passive muscle tone at 12 months with 25 (69.4%) babies in the KMC group and 18 (54.5%) babies in the CMC group having a normal passive muscle tone. Again, the number of babies with an abnormal AT for passive muscle tone was higher in CMC group as all 5 (15.2%) babies with an abnormal passive muscle tone had severe deficits, in comparison to only one (2.8%) baby in the KMC group. This difference was statistically significant ($p=0.068$). 10 babies from (27.8%) KMC group and 10 (30.3%) babies in the CMC group had moderate deficits.

BSID II test at one year

Interpretations of raw scores from the BSID II were assessed at the most reliable level that of psychomotor developmental index (PDI) and mental development index (MDI). Each of the distributions of the PDI and MDI scores had a mean of 100 and the standard deviation of 15.



*Drop outs = 4 in KMC and 7 in CMC

Figure 1: Comparison of PDI score in KMC and CMC at one year.

Figure 1 shows comparison of psychomotor index score in KMC and CMC group at 12 months of age. 16 (40%)

of the KMC babies and 8 (20%) of babies of the CMC babies had a normal development (1SD). In babies with psychomotor developmental delay the severity of delay was much more pronounced in the babies of the CMC group when compared to babies of the KMC group as the number of babies with significant psychomotor developmental delay (3SD) was much higher in the CMC group being 11 (27.5%) babies when compared to only one baby (2.5%) of the KMC group. 19 babies (47.5%) in the KMC group had mild PDI developmental delay when compared to 14 (35%) babies of CMC group. These differences were statistically significant ($p=0.003$).

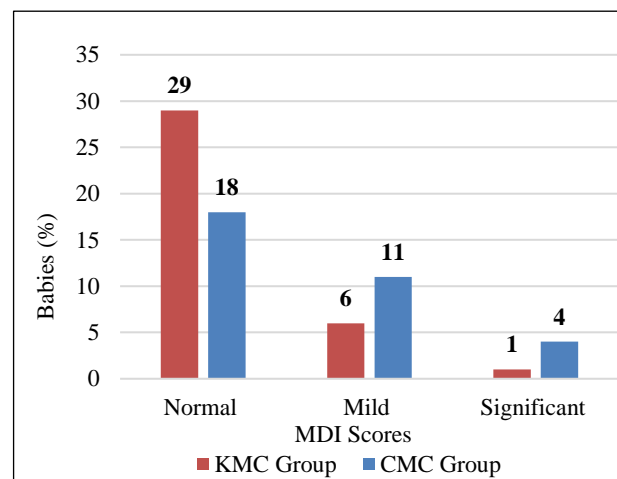


Figure 2: Comparison of MDI score in KMC and CMC at one year.

Figure 2 shows the mental development index score comparison in KMC and CMC group at one year. The percentages of the babies with normal mental development were higher in KMC group 29 (72.5%) compared to 18 (45%) of babies in the CMC group. Overall 37.5% of babies in the CMC group were found to have a mental developmental delay in contrast to only 17.5% of the KMC group. The severity of the mental developmental delay was higher in the CMC group as 4 (10%) of the babies had significant delay (3SD) and 11 (27.5%) had mild mental developmental delay. The figures in the KMC group are 1 (2.5%) and 6 (15%) respectively. However, these differences were not statistically significant ($p=0.057$).

DISCUSSION

Low birth weight (LBW) is a major problem worldwide. Low birth weight is one of the risk factor for neurodevelopmental delay. Various interventions are used to prevent the delay such as early interventional therapy, touch therapy tactile stimulation, bedding and rooming. Kangaroo Mother Care (KMC) in which skin to skin contact is one of the essential components, is also known to stimulate visual, audial, taste and olfactory sensations. Skin to skin contact, an essential component of KMC is which is stated to contribute to the premature

infant's cognitive development, as KMC integrates rhythmic, sensory and tactile stimulation by promoting the mother infant contact.⁵

Hence, KMC being a multimodal sensory stimulant could promote or act as an interventional therapy for the better neurodevelopmental outcome of the low birth weight babies. However, this benefit of the KMC has not been adequately studied. Hence, the present study was undertaken to assess the role of the KMC in the neurodevelopmental outcome of low birth weight babies.

In the present study the sociodemographic character of the mothers, the anthropometric parameters of the babies in both the groups were comparable. Gestational age and mean birth weight were comparable. As 24 (60%) of KMC babies and 26 (65%) of conventional method care (CMC) babies had a birth weight of 1.8 to 2.2 kg.

The literature shows rates between 36 and 83%, depending on birth weight and gestational age. The impact on the development of a preterm baby is concerned with the presence of transient neurological disorders mainly observed in the muscle tone (hypo/hypertonia) within the first year of life.⁹⁻¹¹

The neurodevelopmental outcome of the babies in the both groups was assessed by the Amiel Tison (AT) test at 3, 6, 9 and 12 months of gestational age. This was compared with the BSID II test, at 12 months of age which is the gold standard for the neurodevelopmental outcome.

The only parameters found to be abnormal were the neurosensory examination and passive muscle tone.

Overall though the majority of the babies in both groups had a normal neurosensory and passive muscle tone development at 12 months of age. In babies in whom the deficit was detected it was observed that the severity of the deficit was much more significant in the CMC babies when compared to KMC babies. With respect to passive muscle tone this difference was statistically significant at 6 months and 9 months ($p = 0.005$ and $p = 0.013$).

With respect to BSID II, babies with normal PDI and MDI scores were observed in more number of babies in the KMC group 16 versus 8 ($p = 0.003$) and 29 versus 18 ($p = 0.057$). Significant delay was observed more in the CMC group being 11 versus 1 for PDI scores and 4 versus 1 for MDI scores.

Ludington et al study showed that the presence of parents facilitates skin to skin contact, which, in its turn, allows tactile proprioceptive stimulation and protects against an overload of aversive stimuli, being an acceptable method for the proper stimulation of the babies' neurobehavioral development.⁷

Sonia et al study showed that psychomotor development at 12 months. corrected age was similar in the two groups.⁸

The study done by Saldır M et al at Turkey showed that rate of psychomotor abnormality according to a low Bayley Psychomotor Development Index (PDI) score was 24.8%, and the rate of mental/cognitive abnormality on the basis of a low Bayley mental development index (MDI) score was 25.4% for preterm newborns at infancy.¹²

CONCLUSION

To conclude the present study shows that KMC has a beneficial effect on the neurodevelopmental outcome of low birth weight babies. This study also concludes that though AT test is simple and reliable in assessing abnormal neurosensory examination and passive muscle tone, however the BSID II is a better test to detect the psychomotor and mental developmental delay.

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Ethical approval: The study was approved by the Institutional Ethics Committee

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