International Journal of Contemporary Pediatrics
*Ranjan A et al. Int J Contemp Pediatr. 2019 Mar;6(2):791-795*
http://www.ijpediatrics.com
pISSN 2349-3283 | eISSN 2349-3291

DOI: http://dx.doi.org/10.18203/2349-3291.ijcp20190731

**Original Research Article**

# Effect of Kangaroo mother care on physiological parameters in low birth weight neonates

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**Received:** 03 January 2019
**Accepted:** 31 January 2019

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## ABSTRACT

**Background:** Low birth weight (LBW) babies require special care as they suffer from several handicaps, including maintenance of temperature, feeding, adequate weight gain and optimum neurobehavioral adaptation to the external environment. Kangaroo mother care (KMC) is an important modality that helps in the easy transition of the newborn infant to the outside world and overcomes the above problems. This study was planned to assess the effect of KMC on physiological parameters of low birth weight neonates, in a tertiary care hospital.
**Methods:** This was a single-centered prospective observational quasi-experimental study conducted over a period of 18 months on 70 eligible LBW neonates. The arterial oxygen saturation, blood pressure (systolic, diastolic and mean), heart rate and respiratory rate of the neonates were noted. The readings at 1 hour and 2 hours after KMC were compared with that of the reading at 10 minutes prior to initiating KMC to assess the changes in the mentioned physiological parameters.
**Results:** Analysis suggested statistically significant improvement in the arterial oxygen saturation and stabilization of the systolic, diastolic and mean blood pressure, heart rate and respiratory rate with institution of KMC. There was better improvement in the physiological parameters on increasing the duration of KMC from one hour to two hours and these changes were statistically significant.
**Conclusions:** LBW neonates receiving KMC showed significant improvement in oxygen saturation and blood pressure, heart rate and respiratory rate.

**Keywords:** Arterial oxygen saturation, Blood pressure, Heart rate, Kangaroo mother care, Low birth weight, Respiratory rate

## INTRODUCTION

Birth of a newborn represents one of the most dynamic and potentially critical events in the human life cycle. Therefore, methods that enhance stabilization of neurobehavioral and state regulation, autonomic maturation and facilitate the adaptation of the infant to the outside world should be introduced for smooth transition from fetal to neonatal life.[1] A stable transition becomes even tougher when the process gets complicated with factors such as low birth weight, prematurity and medical conditions like hypoglycemia and sepsis. Thus, came the genesis of Kangaroo mother care (KMC), a modality of newborn care developed by Edgar Rey Sanabria and Hector Martinez, at the Maternal and Child Institute of Bogotá, Colombia in 1979. KMC provides alternative to conventional neonatal care offering benefits to both the baby and mother, and is an effective way to ensure baby's needs for warmth, breastfeeding, weight gain, stimulation, safety and love.[2] Since then, various studies have suggested that KMC could significantly improve the health and survival of LBW neonates,

especially in those places where resources are scarce. It also contributes to the humanization of neonatal care and stronger mother-infant bonding. Skin-to-skin contact has additionally been found to improve a number of physiological parameters like thermal regulation, respiration, and oxygen saturation; reduce apnea and bradycardia, increase milk production, accelerate weight gain, and hastens hospital discharge.[3] Authors studied the effects of KMC on physiological parameters, namely arterial oxygen saturation, heart rate, respiratory rate, blood pressure (systolic, diastolic and mean BP) so as to enhance and improve the care of newborns with facilitating the implementation of KMC at a wider scale in present hospitals.

## METHODS

This study was a single-centred prospective observational quasi-experimental study on LBW neonates admitted in the Neonatal Intensive Care Unit (NICU) of a tertiary care hospital. Sample size was calculated on the basis of 'Two-sided equality Hypothesis' following which 70 eligible LBW neonates were enrolled in present study which was carried out over a period of 18 months. After an informed consent from the mother, KMC was instituted to the babies. The arterial oxygen saturation, blood pressure (systolic, diastolic and mean), heart rate and respiratory rate of the neonates were recorded by EMCO 4040 noninvasive blood pressure (NIBP) and pulse oximeter monitor (with accuracy of ±2mm Hg in BP, ±2bpm for pulse and ±2 digits at 70 to 100% of $SpO_2$) while the respiratory rate was counted manually over a period of one minute. The readings were noted at 10 minutes prior to initiating KMC and then taken at 1 hour and 2 hours from the initiation of KMC. The values at 10 minutes prior to initiating KMC served as the baseline reading of the neonates to assess the changes.

### *Statistical analysis*

Comparison between quantitative data measured at three-time intervals (before 10 minutes', at 1 hour and at 2 hours) was done using "repeated measures analysis of variance" or by "Friedman repeated measures analysis of variance" depending on 'normality test'. All pairwise multiple comparison was done using Sidak test or by Tukey test. Appropriate statistical software, including but not restricted to MS Excel and PSPP version 0.8.5 was used for statistical analysis.

## RESULTS

On analysis of birth characteristics, distribution of babies was equal in terms of sex (male and female 35 each) with majority of them being first by birth order (45) (64.3 %). The mean birth weight (in grams) was 1847.94±333.62. of which majority fell into the LBW category (59) (84.3%) while the remaining were very LBW babies (11) (15.7 %) (Table 1).

**Table 1: Distribution of neonates according to birth weight.**

| Birth weight (g) | No. | Percentage |
|---|---|---|
| Very LBW (1000-1499 g) | 11 | 15.7 |
| LBW (1500-2499 g) | 59 | 84.3 |
| Total | 70 | 100.0 |

The mean age at the time of initiation of KMC in these neonates was 7.54±5.17 days. Majority of the neonates (51%) belonged to the gestational age of 33-36 weeks (Table 2).

**Table 2: Distribution of neonates according to gestation.**

| Gestational age (weeks) | | Sex | | Total |
|---|---|---|---|---|
| | | Male | Female | |
| 29 to 32 | N | 2 | 5 | 7 |
| | % | 5.71 | 14.28 | 10 |
| 33 to 36 | N | 18 | 18 | 36 |
| | % | 51.42 | 51.42 | 51.42 |
| ≥37 | N | 15 | 12 | 27 |
| | % | 42.85 | 34.28 | 38.57 |
| Total | N | 35 | 35 | 70 |
| | % | 100.0 | 100.0 | 100 |

In present study, authors compared various physiological parameters (arterial oxygen saturation, heart rate, respiratory rate and BP) taken 10 min before initiation of KMC and at intervals of 1 hour and 2 hours after KMC (Table 3). On analysis of the physiological parameters, the mean pulse oximetry saturation (in%) before 10 minutes of initiation of KMC was 95.69±1.29 while the mean $SpO_2$ at the end of first hour and second hour were 96.37±1.11 and 96.83±1.08 respectively. Above changes in SpO2 at the end of first hour and at the end of second hour (compared with $SpO_2$ at 10 mins before initiation of KMC) were found to be statistically significant (P values being ≤0.05 each). Twelve cases (17.1%) showed further increase in $SpO_2$ at 2 hours when compared to 1 hour and this change was also statistically significant (P value ≤0.05). Further on analyzing blood pressure, the mean SBP/DBP/MAP (in mm of Hg) ten minutes before initiation of KMC were 55.76±4.85/ 31.49±3.35/ 39.47±3.36 respectively. At the end of first and second hours, the mean values stabilized to 54.7±4.59/ 30.69±2.99/ 38.77±3.19 and 53.7±4.6/ 30.00±2.84/ 37.90±3.01 respectively. The above changes in SBP were found to be statistically significant with respective P values at the end of first hour as well as second hour being 4.18E-05 and 4.11E-13. Similarly, DBP also showed a statistically significant decline both at the end of first and second hour (P values being 5.01E-07 and 7.08E-14 respectively). Mean MAP values also confirmed a similar pattern of decline at the end of first and second hour and the changes again were statistically significant (P ≤0.05 each).

The changes were further compared between readings at first hour to those at second hour and it was found that SBP, DBP and MAP all showed further stabilization when KMC was continued to an extended duration of 2 hours (P values for SBP/DBP/MAP being 1.69E-06/1.34E-06/ ≤0.05 respectively). Heart rate evaluation revealed that mean HR (/minute) ten minutes before initiation of KMC was 142.03±6.39 which showed a decreasing trend compared to HR readings at the end of first and second hour (mean being 140.04±5.95/ 138.20±5.36 respectively). The above changes were statistically significant both at the end of first as well as second hour (P value being ≤0.05 each). On comparison of HR at the end of first with that of second hour, 46 cases (65.7%) registered a further stabilizing trend which was also statistically significant (P value ≤0.05).

On analyzing the respiratory rate (/min), the mean RR at 10 minutes before initiation of KMC, 1 hour and 2 hours after KMC were 46.91±2.25, 45.60±2.24 and 44.46±2.27 respectively. This reduction in RR post KMC was statistically significant both at end of first as well as the second hour (P values being ≤0.05 each). At the end of second hour, it was noticed that 35 neonates (50%) had a further stabilization in RR when compared to that at the end of first hour (P value ≤0.05). Thus, in present study it was evident that the neonates undergoing KMC had a better control on all the physiological parameters studied (arterial oxygen saturation, blood pressure, heart rate and respiratory rate) and these changes were statistically significant and the stabilization of all these parameters was better when KMC was instituted for a longer time.

**Table 3: Comparison of physiological parameters between 10 min before initiation of KMC, at 1 hour and at 2 hours.**

| | Mean values with difference of ranks/mean difference (as applicable) | | |
|---|---|---|---|
| **Physiological parameters** | **Before 10 minutes vs at 1 hour** | **Before 10 minutes vs at 2 hours** | **At 1 hour vs at 2 hours** |
| ***Arterial oxygen saturation (%)** | 95.69 vs 96.37 | 95.69 vs 96.83 | 96.37 vs 96.83 |
| (Difference of ranks) | 39.000 | 69.000 | 30.000 |
| P value | ≤0.05 | ≤0.05 | ≤0.05 |
| Difference significant/not | Significant | Significant | Significant |
| **^Systolic blood pressure (mmHg)** | 55.76 vs 54.74 | 55.76 vs 53.71 | 54.74 vs 53.71 |
| (Mean difference) | 1.014 | 2.043 | 1.029 |
| P value | 4.18E-05 | 4.11E-13 | 1.69E-06 |
| Difference significant/not | Significant | Significant | Significant |
| **^Diastolic blood pressure (mmHg)** | 31.49 vs 30.69 | 31.49 vs 30.00 | 30.69 vs 30.00 |
| (Mean difference) | 0.800 | 1.486 | 0.686 |
| P value | 5.01E-07 | 7.08E-14 | 1.34E-06 |
| Difference significant/not | Significant | Significant | Significant |
| ***Mean blood pressure (mmHg)** | 39.47 vs 38.77 | 39.47 vs 37.90 | 38.77 vs 37.90 |
| (Difference of ranks) | 35.500 | 90.500 | 55.000 |
| P value | ≤0.05 | ≤0.05 | ≤0.05 |
| Difference significant/not | Significant | Significant | Significant |
| ***Heart rate (/minute)** | 142.03 vs 140.04 | 142.03 vs 138.20 | 140.04 vs 138.20 |
| (Difference of ranks) | 38.500 | 93.500 | 55.000 |
| P value | ≤0.05 | ≤0.05 | ≤0.05 |
| Difference significant/not | Significant | Significant | Significant |
| ***Respiratory rate (/minute)** | 46.91 vs 45.60 | 46.91 vs 44.46 | 45.60 vs 44.46 |
| (Difference of ranks) | 46.000 | 87.500 | 41.500 |
| P value | ≤0.05 | ≤0.05 | ≤0.05 |
| Difference significant/not | Significant | Significant | Significant |

*If data failed 'normality test', Friedman repeated measures analysis of variance on ranks applied followed by Tukey test for pairwise multiple comparison; ^if data passed 'normality test', one-way repeated measures analysis of variance applied followed by Sidak test for pairwise multiple comparison.

## DISCUSSION

The term Kangaroo was taken up from the concept of marsupial care, that consists of early skin-to-skin contact between the mother and her newborn and has the advantages of improving the mother-child bond; stimulating breastfeeding by the mother, improving the thermal control, alleviating pain in sick neonates, minimizing the nosocomial infection rate; and reducing complications like hypoglycemia and apnea in the

newborn.[2-4] KMC also plays a vital role in triggering opioid mediated maturation of neuronal pathways and thus improves the neuro-behavioral development in the neonates.[5]

In present study, arterial oxygen saturation showed statistically significant improvement with KMC and the effect was more prominent on extending KMC sessions to two hours period. This can be attributed to the fact that KMC ensures decrease in neonatal anxiety and improves bonding, thus relaxing the neonate. Moreover, it helps in a reduction in sympathetic tone, causing a balanced vasculature tone and augments blood flow and oxygenation to the peripheries.[2] The findings of present study were similar to a randomized controlled trial (RCT) done by Ali SM et al which showed a significant increase in $SpO_2$ after 1 hour of KMC (P value being <0.001).[6] Another RCT conducted by Dehghani K et al also observed an improvement in $SpO_2$ with KMC. Similarly, quasi-experimental studies by Princley RJ et al, Bera A et al and Jain PK et al also showed an increase in $SpO_2$ with KMC.[5,7,8] However, a meta-analysis conducted by Mori et al concluded that there was a decrease in SpO2 of babies after KMC which was not in concordance to present study.[9] This could be attributed to the non-uniformity in the comparison of studies with relation to different durations of KMC in the various studies used in the meta-analysis.

With relation to blood pressure, present study concluded statistically significant stabilization of mean, systolic and diastolic blood pressure with KMC and the effect was more prominent on extending KMC sessions to two hours period. An RCT conducted by Almeida CM et al concluded that the median of mean arterial pressure (in mmHg) before KMC was 51.4 and 30 minutes after applying KMC declined to 44.3. This stabilization in MAP was similar to present study, though the difference was statistically not significant with P value of 0.625.[10] Contrary to the findings of present study, an increase in MAP was noted in the study by Azevedo et al.[11] Authors couldn't find any study assessing the effect of KMC on systolic and diastolic BP till date to the best of our knowledge.

On evaluating the trend of heart rate variations, present study showed statistically significant reduction in HR within the normal range with KMC and the effect was more prominent on extending KMC sessions to two hours period. An observational study by Phirke D also showed similar results with stabilization of HR and RR (P <0.0001).[12] Another quasi-experimental study by Azevedo et al in intubated neonates concluded statistically significant decrease in the HR within the normal range with KMC (P<0.001).[11] Thus, the findings of above-mentioned studies were in concordance to the results of present study. There was a statistically significant increase in HR in studies conducted by Gunjana et al and Bera et al.[7,15] However, a meta-analysis by Boundy et al and a RCT conducted by Dehghani et al didn't show any statistically significant stabilization of heart rate.[13,14] Similarly, observational study by Jain PK also found insignificant change in HR with KMC.[5] These findings are inconsistent with the findings of present study.

On evaluating trends of changes in respiratory rate (RR), present study revealed a statistically significant improvement stabilization of RR with KMC and the effect was more prominent on extending KMC sessions to two hours period. Similar findings of statistically significant stabilization of RR was seen in studies conducted by Almeida et al (P<0.001), Princely JR et al (P<0.001), Kumar G (P<0.05) and Parmar VR et al (P<0.05).[8,10,15,16] Though, a meta-analysis by Boundy et al and a RCT conducted by Dehghani et al didn't show any statistically significant stabilization of respiratory rate.[13,14] Similarly, observational studies by Jain PK and Verma P also found insignificant change RR with KMC.[5,17] These findings are inconsistent with the findings of present study.

The stabilization of both BP and HR after an adequate duration of KMC can be attributed to the receptor and hormonal interactions. Upon pleasing touch stimulation, oxytocin is released within the brain which stabilizes the heart rate as brainstem shifts from sympathetic to parasympathetic control. A possible explanation for the decreased respiratory rate is based on the upright position of the infant.[18] This method allows the infant to be held in a ventral position at an angle of ~60 degrees which decreases the compression of the diaphragm. Ventilation and perfusion are gravity dependent, so an upright position optimizes respiratory function.[19,20] Therefore, neonates kept in KMC position show stabilization of BP and respiratory rate.

## CONCLUSION

Babies receiving KMC showed modest but statistically significant improvement in all the vital physiological parameters ($SpO_2$, SBP, DBP, MAP, HR and RR). So, without using special and costly equipment, the KMC strategy can offer developmentally supportive care to newborns. Present study also highlights the importance of giving KMC for extended periods to achieve even better effects in physiological parameters of the neonates. These findings support wider implementation of this strategy especially in resource limited countries where KMC can serve as a valuable alternative to conventional care.

## ACKNOWLEDGEMENTS

Authors would like to thank Dr. Ramesh Bharmal, Dean, TNMC and BYL Nair Hospital, Mumbai, Maharashtra for giving permission to publish this article.

*Funding: No funding sources*
*Conflict of interest: None declared*

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

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**Cite this article as:** Ranjan A, Malik S. Effect of Kangaroo mother care on physiological parameters in low birth weight neonates. Int J Contemp Pediatr 2019;6:791-5.