

PHYSIOLOGICAL EFFECTS OF KANGAROOING ON THE NEWBORNS WEIGHING LESS THAN 2000 GRAMS

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Abstract: Background: Low birth weight (LBW<2500 g), which is often associated with preterm birth, is a common problem in India. Both are recognized risk factors for neonatal mortality. Kangaroo mother care (KMC) is a non-conventional, low-cost method for newborn care based upon intimate skin-to-skin contact between mother and baby. **Aim and Objectives:** To assess the change in physiological parameters of LBW babies before and after KMC. **Method:** Study cohort comprised in-born LBW babies and their mothers. Initially, KMC was started for 1 hour duration (at a stretch) on first day and then increased by 1 hour each day for next 2 days. Axillary temperature, respiratory rate (RR/ min), heart rate (HR/ min), and oxygen saturation (SpO₂) were assessed immediately before and after KMC. **Result:** Improvements occurred in all 4 recorded physiological parameters during the KMC sessions. Changes in heart rate and respiratory rate after kangaroo care were insignificant ($p>0.05$) whereas kangaroo care is highly effective in maintaining skin temperature and oxygen saturation ($p<0.0001$). **Conclusion:** Thus, without using special equipment, the KMC strategy can offer improved care to LBW babies especially in developing countries like India.

Key Words: India, Kangaroo mother care, Low birth weight, New born, Physiological parameter

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Introduction:

Low birth weight for our country is a serious public health problem and contributes to high neonatal mortality. According to the report published in Lancet almost all (99%) neonatal deaths occur in low income and middle income countries^{1,2}. In India around one million babies die each year before they complete their first month of life, contributing to one-fourth of the global burden^{1,3}. Prematurity is one of the common causes of neonatal deaths in developing countries like India. These neonates need special care as they have several handicaps, the most important being maintenance of body temperature. To overcome this problem Kangaroo Mother Care is originally a package of care including continuous skin-to-skin contact and exclusive breast-feeding for low-birth weight infants and their mothers⁴. The package was invented in Colombia as an alternative to an incubator, and has spread around the world, mainly where resources are relatively limited⁵. A systematic review as well as randomized controlled trials on this care found significantly better cost and clinical effectiveness including reduction in neonatal morbidity, increase in breast-feeding rates, and improved psychological and behavioural change in both mothers and babies, compared with standard

incubator care in such settings. Studies had clearly depicted advantages of kangarooing like weight gain in KMC babies, increased breast milk secretion and early discharge from NICU⁶. However the effect of Kangaroo care on physiological parameters is still controversial. Scanty research article is available on the effect of KMC on physiological variables⁷⁻¹². Kangarooing promotes closeness of mother and baby making the baby to relax thus stabilizing heart rate and Respiration rate of the baby. Based on this hypothesis we planned this prospective longitudinal study in a teaching hospital of central India. Thus the aim of the present study was to determine the changes in physiological parameters of low birth weight babies weighing less than 2000gms after kangarooing.

Material and Methods:

This hospital based observational study was conducted over the period of six months. Low birth weight babies weighing <2000 grams who got admitted in the NICU of Paediatric department and in the postnatal wards were included in the study. Included low birth weight babies were not having any neurological, cardiac and /or respiratory deficiencies. Babies with major congenital anomalies were also excluded from the study.

There were 213 infants admitted during the data collection period. Of those 187 meeting the selection criteria, 169 were approached, 105 accepted to participate in the study. 10 mothers withdraw from the study and results of the 10 babies excluded due to mothers failed to give kangaroo care correctly. So data of 90 low birth weight babies were included for the study. Kangarooing was provided to these babies from day one of delivery /admission to NICU or from the time they stabilized. KMC was done by the mother either in NICU or the adjacent room provided to mothers. Mothers were doing kangarooing by either sitting on reclining chair or lying down on the hospital bed with the head rest raised to 45°. Assessments were made before and after 30 minutes of kangaroo mother care daily for 3 consecutive days. Pre KMC heart rate (HR), respiratory rate (RR) and temperature was recorded just before starting KMC while newborn was on warmer or lying down on a cradle. Post KMC assessments were made after 30 minutes of kangarooing. The evaluations (respiratory rate, heart rate and temperature measurements) were done once a day, for three consecutive days and the mean values were taken for analysis. For these evaluations a pulse oximeter and a mercury thermometer were utilized. The first assessment was done for breathing movements by counting the respiratory rate over one minute. Next measurement was done for heart rate. For that a sensor was placed on the sole of the newborn's right toe and then heart rate and oxygen saturation were noted down. In the last the skin temperature was measured by keeping thermometer beneath the baby's axillary folds for three minutes. Most of the babies slept during Kangaroo Care and appeared relaxed. Participation was voluntary and the mothers were allowed to withdraw from the study at any time. Informed consent was taken from all the mothers participating in the study.

Result:

Out of 90 babies 48 babies were male and only 2.2% of the newborn were extremely LBW.

Table:1 Distribution of the newborn included in the study

Neonates Characteristics	Study group (N=90)	
	No.	%
1.Gestational Age (Weeks):		
• <32	6	6.66
• 32 – 34	14	15.5
• 35-37	54	60
• >37	16	17.7
2.Birth weight (Grams):		
• <1000	2	2.2
• 1001- 1500	41	45.5
• 1501- 1800	33	36.6
• 1801 - 2000	14	15.5

Majority of the babies were between 1000-1500 grams and three fourth of the babies were above 34 weeks (Table-1).

Table:2 : Various parameters of the new born included in the study

Parameter	Mean	SD
Mean Birth Weight (gm)	1545	265.05
Mean Gestational Age (Weeks)	35.7	2.4
Male :female ratio	1.14:1	
Mean Weight gain (Grams)	19.289	2.82
Mean Hospital stay (Days)	11.62	2.46

Mean birth weight of the babies was 1545 grams and mean gestational age of the babies was 35.7 weeks. Male 48 (53.3) babies outnumbered female

babies. Mean duration of hospital stay was 11.62 days and mean weight gain was 19.289 grams per day.(Table -2)

Table:3 : Vital parameters measured before and after kangaroo care

Vital Parameters		Mean	SD	t-value	p-value
Temperature	Before KMC	35.72	1.62	6.579	<0.0001
	After KMC	36.9	0.52		
HR/ minute	Before KMC	145.6	4.7	1.95	>.05
	After KMC	144.2	4.9		
RR/ minute	Before KMC	44.5	4.9	0.918	>.05
	After KMC	43.9	3.8		
SPO ₂	Before KMC	92.3	1.6	9.516	<0.0001

HR-Heart Rate, RR- Respiratory Rate, SPO₂- Oxygen saturation

Mean heart rate before starting KMC was 145.6/minute and after 30 minutes of kangarooing HR was 144.2/minute. Mean RR before starting KMC was 44.5/minute and after accomplishment of KMC means RR was 43.9/minute while oxygen saturation from 92.3% to 94.5% after KMC. Of these findings change in temperature and oxygen saturation were statistically significant while change in RR and HR were statistically insignificant (Table-3).

Discussion:

KMC is a simple and low-cost intervention for the care of LBW infants. It enhances both infant and maternal well-being and can be practiced in any situation without needing special equipment (e.g. special cots, heaters, incubators). Although initially conceived for use in developing countries with limited resources, its use has expanded worldwide as caregivers, parents, and administrators become increasingly familiar with the physiological, psychological, and cost benefits associated with the practice¹³⁻¹⁵.

The results of our study regarding temperature control during KMC are consistent with various previous research and showing that KMC is highly favourable to new born in controlling body temperature ($p < 0.0001$)^{1,16,17}. A mother has actual "thermal synchrony" with her infant. When a baby is placed in the kangaroo position, skin to skin with his mother, the temperature of the mother's breasts actually change so that her baby can better maintain his own temperature. If the baby gets too cold the mother's body temperature will actually warm up one degree to aid warm the baby¹⁶. If the baby gets too hot, the mother's body temperature will decrease one degree to cool the baby. This even works when twins are kangarooed¹⁸. Furthermore, the flexed position that the baby assumes on his mother's chest as opposed to lying on his back in an incubator is a more efficient position for conserving heat. The extra sleep that the infant gets snuggling with mom and the assistance in regulating body temperature helps the baby conserve energy.

In the current study decrease in mean HR can be explained by the fact that babies, both preterm and full-term, cry less when placed in skin to skin contact with their mothers. Kangarooing also increases sleep time, as well as time spent in quiet sleep¹⁹. During KMC the c-afferent nerves of the mother's and infant's chest surfaces respond to the pleasing human touch of KMC and send the pleasing touch message straight to the insular cortex of the limbic area of the brain. Upon pleasing touch stimulation, oxytocin is released within the brain and travels along neurons to 14 different areas of the brain. The first target is the brain stem where oxytocin immediately calms and stabilizes cardio-respiratory variables as the brain

stem shifts from sympathetic (stress, hyper alertness and reactivity, sense of threat) to parasympathetic (relaxation, calm, contentment, safety) control. The increase in the heart rate may occur because of the change in the new-born's body position from supine to vertical and the handling, which leads to increased stress for the newborn. Heart rate may rise by 5-10 beats per minute during kangarooing rising initially in response to the head tilting upward and later due to infant warming^{16,18}. Some researchers reported no or minimal change in heart rate during KMC. Whereas others reported increased heart rate within normal limit²⁰.

The findings of the study revealed that mean respiratory rate decreased by 0.4/ minute during KMC which was within normal limit having no statistical significance. A possible explanation for the decreased respiratory rate is based on the upright position of the infant. 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. However, the heart and breathing rates are uncertain data, because the mother's respiratory and cardiac patterns may be superimposed on the new born¹⁶. There was distinct improvement in oxygen saturation during the KMC sessions. This is relevant for sick newborns, particularly those requiring oxygen supports. Earlier studies also report decrease in apnea and improvement in oxygen saturation in mechanically ventilated babies able to tolerate transfer and position changes^{21,22}.

This study had its share of limitations. It was observational in nature rather than a randomized controlled trial. Despite being motivated, several mothers failed to provide KMC correctly, even after repeated demonstrations, and their data had to be excluded. This emphasizes the need for perseverance for both mothers and nursing staff towards proper KMC technique²³. The study was conducted in the postnatal ward and NICU setting where healthcare providers are strongly motivated and maintain close supervision. Similar close supervision may not be possible in general ward and domiciliary settings. Therefore, we cannot claim that improvement of physiological

parameters, with its attendant clinical implications, would be obtainable in any setting. Indeed, implementation of KMC requires organized planning and effort, and lack of these are barriers towards extending the benefits to all babies in need of such care^{24,25}.

Conclusion:

Even with these limitations, it can be stated that low birth weight babies receiving KMC show statistically significant rise in temperature and oxygen saturation through kangaroo care, without the need for any special equipment. This can help to avoid complications and the need for more elaborate interventions.

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References:

1. J. E. Lawn, S. Cousens, and J. Zupan, "4 Million neonatal deaths: when? Where? Why?" *The Lancet* 2005; 365: 891–900.
2. J. E. Lawn, S. Cousens, Z. A. Bhutta et al., "Why are 4 million newborn babies dying each year?" *The Lancet*, 2004 ;364: 399–401.
3. National Health Profile Report, Central Bureau of Health Intelligence, Ministry of Health and Family Welfare, pp. 9–16,2010, <http://cbhidghs.nic.in/writereaddata/mainlinkfile/file1131.pdf>.
4. Conde-agudelo A, Diaz-Rossello JL, Belizan JM. Kangaroo mother care to reduce morbidity and mortality in low birth weight infants. *Cochrane Database Syst. Rev.* 2000; (4): CD002771.
5. Bergman NJ, Jurisoo LA The "kangaroo-method" for treating lowbirth weight babies in a developing country. *Trop. Doct.* 1994; 24:57–60.
6. Ramanathan K, Paul VK, Deorari AK, Taneja U, George Kangaroo Mother Care in very low birth weight infants. *Indian J Pediatr* 2001; 68: 1019-23.
7. Neu M, Browne JV, Vojir C. The impact of two transfer techniques used during skin-to-skin care on the physiologic and behavioral responses of preterm infants. *Nurs res* 2000 Jul-Aug; 49 (4):215-23.
8. Bosque EM, Brady JP, Affonso DD, Wahlberg V Physiologic measures of kangaroo versus incubator care in a tertiary-level nursery. *J*

- ObstetGynecol Neonatal Nurs. 1995 Mar-Apr; 24(3):219-26.
9. Bohnhorst B, Gill D, Dördelmann M, Peter CS, Poets CF. Bradycardia and desaturation during skin-to-skin care: no relationship to hyperthermia. *J Pediatr*. 2004 Oct;145(4):499-502.
 10. Ludington-Hoe SM, Thompson C, Swinth J, Hadeed AJ, Anderson GC. Kangaroo care: research results, and practice implications and guidelines. *Neonatal Netw*. 1994 Feb;13(1):19-27.
 11. Bulfone G, Nazzi E, Tenore A. [Kangaroo Mother Care and conventional care: a review of literature]. [Article in Italian]. *Prof In ferm* 2011 Apr-Jun; 64(2):75-82.
 12. Boju SL, Gopi Krishna M, Uppala R, Chodavarapu P, Chodavarapu R. Short spell kangaroo mother care and its differential physiological influence in subgroups of preterm babies. *Journal of Tropical Pediatric* 2012 Jun; 58(3):189-93.
 13. Thukral A, Chawla D, Agarwal R, Deorari AK, Paul VK. Kangaroo mother care — an alternative to conventional care. *Indian JPediatr* 2008; 75:497-503.
 14. Hendricks-Muñoz KD, Li Y, Kim YS, Prendergast CC, Mayers R, Louie M. Maternal and neonatal nurse perceived value of kangaroo mother care and maternal care partnership in the neonatal intensive care unit. *Am J Perinatol* 2013; 30:875-80.
 15. Pallás-Alonso CR, Losacco V, Maraschini A, Greisen G, Pierrat V, Warren I, et al.; European Science Foundation Network. Parental involvement and kangaroo care in European neonatal intensive care units: A policy survey in eight countries. *Pediatr Crit Care Med* 2012; 13:568-77.
 16. Schrod L, Walter J. Effect of head-up tilt position on autonomic function and cerebral oxygenation in preterm infants. *Biol Neonate*. 2002; 81: 255-259.
 17. Föhe, K., Kropf, S, & Avenarius, S. Skin-to-skin contact improves gas exchange in premature infants. *Journal of Perinatology* 2000; 20(5) : 311-315.
 18. Ludington-Hoe SM, Nguyen N, Swinth J, Satyshur R. Kangaroo care compared to incubators in maintaining body warmth in preterm infants. *Biol Res Nurs*. 2000;2(1):60-73.
 19. Ludington-Hoe SM, Johnson MW, Morgan K, Lewis T, Gutman J, Wilson PD, Scheir MS. Neurophysiological assessment of neonatal sleep organization: Preliminary results of a randomized, controlled trial of skin contact with preterm infants. *Pediatrics* 2006;117(5):e909-23.
 20. Fischer, C, Sontheimer, D, Scheffer, F., Bauer, J., & Linderkamp, O. Cardiorespiratory stability of premature boys and girls during kangaroo care. *Early Human Development* 1998 ; 52(2):145-153.
 21. Cleary GM, Spinner SS, Gibson E, Greenspan JS. Skin-to-skin parental contact with fragile preterm infants. *J Am Osteopath Assoc* 1997; 97:457-460.
 22. Hunt F. The importance of kangaroo care on infant oxygen saturation levels and bonding. *J Neonatal Nurs* 2008; 14:47-51.
 23. Blomqvist YT, Frölund L, Rubertsson C, Nyqvist KH. Provision of kangaroo mother care: Supportive factors and barriers perceived by parents. *Scand J Caring Sci* 2013; 27:345-53.
 24. Bergh AM, Rogers-Bloch Q, Pratomo H, Uhuadiyah U, Sidil P, Rustina Y, et al. Progress in the implementation of kangaroo mother care in 10 hospitals in Indonesia. *J Trop Pediatr* 2012; 58:402-5.
 25. Maulik PK, Darmstadt GL. Community-based interventions to optimize early childhood development in low resource settings. *J Perinatol* 2009; 29:531-42.

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