
ORIGINAL ARTICLE**Effect of Kangaroo Mother Care on Growth and Morbidity Pattern in Low Birth Weight Infants***Keerti Swarnkar^{1*}, Jayanta Vagha¹**¹Department of Pediatrics, Jawaharlal Nehru Medical College, Sawangi, Wardha-442005 (Maharashtra) India*

Abstract:

Background: Kangaroo Mother Care (KMC) is defined as skin-to-skin contact between a mother and her newborn baby derived from practical similarities to marsupial care giving, proximately exclusive breastfeeding and early discharge from hospital. This concept was proposed as an alternative to conventional methods of care for low birth weight (LBW) infants, and in replication to quandaries of earnest overcrowding in Neonatal Intensive Care Units (NICUs). KMC essentially utilizes the mother as a natural incubator **Aim and Objectives:** The aim was to assess the feasibility, acceptability and the effectiveness of KMC in LBW infants. It avoids agitation routinely experienced in busy ward. **Material and Methods:** A pilot open-labeled quasi-randomised clinical trial was conducted in Level III NICU of a teaching institution. 60 newborn infants <2500 g, meeting inclusion criteria were alternatively randomised into two groups: Kangaroo Mother Care (KMC) and Conventional Methods of Care (CMC). Kangaroo mother care was practiced with minimum total period of eight hours a day intermittently for the intervention group while the controls remained in incubators or cots. Weight, head circumference, length, morbidity episodes, hospital stay, feeding patterns were monitored for all infants till post-menstrual age of 42 weeks in preterm babies or till a weight of 2500 g is achieved in term SGA babies. **Results:** The pilot study confirmed that trial processes were efficient, the intervention was acceptable (to mothers and nurses) and that the outcome measures were appropriate; KMC babies achieved significantly

better growth at the end of the study (For preterm babies, weight, length and head circumference gain were significantly higher in the KMC group (weight 19.28±2.9g/day, length 0.99±0.56cm/week and head circumference 0.72±0.07 cm/week) than in the CMC group ($P < 0.001$). A significantly higher number of babies in the CMC group suffered from hypothermia, hypoglycemia, and sepsis. **Conclusion:** Kangaroo mother care improves growth and reduces morbidities in low birth weight infants. It is simple, acceptable to mothers and can be continued at home.

Keywords: Kangaroo Mother Care, Skin-To-Skin Contact, Thermal Care, Low Birth Weight Infant, Breastfeeding, Sepsis, Post Natal Growth

Introduction

The Kangaroo Mother Care (KMC) method is a humane, low cost, standardized, protocol-predicated care system for preterm and/or Low Birth Weight (LBW) infants and is predicated on skin-to-skin contact between the preterm baby and the mother and exclusive breastfeeding. The point is to engage the mother by continuously exchanging the aptitudes and responsibility regarding turning into the child's essential parental figure and meeting each physical and emotional need. KMC was initiated at the Instituto Materno Infantil in Bogota, Colombia, by Dr Edgar Rey in 1978. The programme consolidated in its first 15 years and became known as the

'Kangaroo Mother Programme' [1]. Every year about 18 million babies are of low birth weight and account for 60-80% of neonatal deaths [2]. Morbidity and mortality can however be reduced by appropriate interventions for management of these infants which include: skilled care at delivery; basic neonatal resuscitation when needed; attention to thermal control; prevention of hypoglycemia through early breastfeeding; exclusive breastfeeding; supplementation with vitamins and minerals; prevention of infection; and early detection and treatment of illness. Conventional neonatal care of LBW infants is expensive and needs both trained personnel and permanent logistic support. In developing countries, limited financial and human resources for care of LBW infants often results in overcrowding, leading to high morbidity and mortality. Thus, there is need for interventions that reduce neonatal morbidity, mortality and costs, which would be an important advance in care. Studies both in developed and developing countries highlight the practice of KMC in different settings, as well as its benefits and limitations. These studies have shown that KMC results in faster growth, earlier discharge from hospital and high exclusive breastfeeding rates [3-7]. KMC also allows discharge at a lower weight than conventionally done. A multicenter RCT in three developing countries to evaluate the effectiveness and costs of kangaroo care, demonstrated that the running costs for kangaroo care were about 50% less than for conventional care [7]. This study was undertaken to determine feasibility, and impact of KMC on, growth rates of LBW, morbidity pattern and duration of hospitalisation.

Material and Methods:

Study design:

An open labeled quasi-randomised clinical trial was conducted at Neonatal intensive care in the AVBRH New Born Unit (NBU) between May 2015 and October 2015. The stable 60 LBW babies meeting inclusion criteria were alternatively randomised into two groups: KMC and Conventional Methods of Care (CMC). The approval from the Institutional Ethics Committee was obtained prior to the study. A written informed consent was taken from the mothers after the babies who were stable and ready for enrolment into the study.

Inclusion Criteria: Singleton intramural neonates with birth weight <2500 g

Exclusion Criteria: Critically ill babies requiring ventilatory or inotropic support, babies with chromosomal and life threatening congenital anomalies, babies requiring transfer, or whose mothers were critically ill, or unable to comply with the follow up schedule were excluded.

Intervention and Follow Up:

KMC group:

Mothers in the KMC group were explained in detail about KMC adoption in the presence of their family. KMC was initiated as soon as the baby was stable. The mothers provided skin to skin contact using a specially tailored "Kangaroo bag" made of soft flannel cloth in Fig1. The mothers were encouraged to keep the baby in KMC as long as possible during the day and night with minimum total period of eight hours a day intermittently. Once the baby was on full feeds, she was

introduced to provide kangaroo care on the reclining cot in the semi upright position with the help of pillows. When the baby was not in KMC, the baby was to be placed either under a servo controlled radiant warmer or in the cradle under hot lamp adequately clothed and covered. When the baby is not in KMC, the baby is placed either under a servo controlled radiant warmer or in the cradle under hot lamp adequately clothed and covered. The mothers were given a “KMC chart” to keep a record of the duration of kangaroo care provided. In case mother is illiterate, close family member was alternative.



Fig 1: Kangaroo Mother Care

CMC group:

The babies assigned to CMC group were managed under either servo controlled radiant warmers or in a cradle under hot lamps in NICU. The babies in postnatal wards were adequately clothed and bedded in with their mothers.

Anthropometry: Babies were weighed naked on an electronic weighing scale immediately, after birth and subsequently daily one hour after feeds till discharge. The length was measured at birth, on discharge and on each follow-up visit by using an infantometer. Head Circumference (HC) was

measured by standard methods at birth, on discharge and on each follow-up visit with a non-stretchable tape.

Feeding:

All babies were exclusively breastfed, and also received calcium (100 mg/kg/d), phosphorus (50 mg/kg/d) and multivitamin supplements. Babies unable to take direct breastfeeds were given expressed breast milk by orogastric tube or using a paladai or sterile wati and spoon.

Monitoring:

Babies in both the groups were monitored for hypothermia, hypoglycemia, apnea, sepsis, feeding problem and other morbidities. Babies who develop a life threatening event like convulsions, hypothermia, and severe sepsis were considered as critically ill and were temporarily withdrawn from the KMC group. Babies requiring phototherapy were also temporarily withdrawn from KMC group.

Discharge and follow up:

Babies were discharged when they showed a weight gain of 10-15 g/kg/d for three consecutive days, and feeding well, maintaining temperature without assistance and when the mother felt confident of caring for her baby.

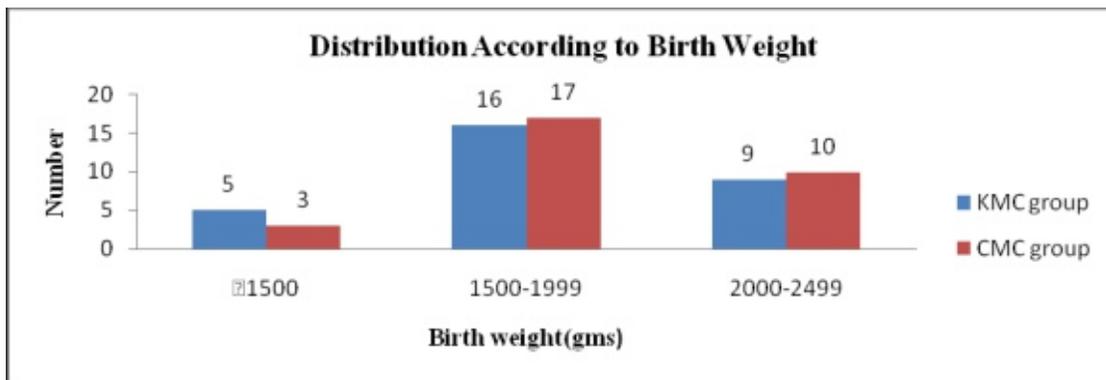
They were followed up weekly for anthropometry and compliance with KMC, in the high risk OPD till post-menstrual age of 42 weeks in preterm babies or till a weight of 2500 g was reached in term SGA babies. Mothers in the KMC group were interviewed on a pre-structured questionnaire to assess the acceptability and feasibility of KMC in the hospital and at home.

Statistical Analysis:

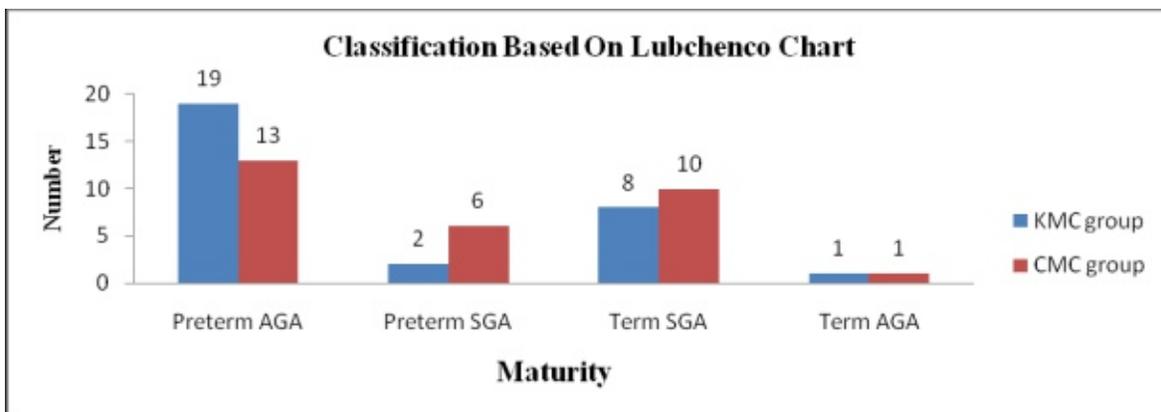
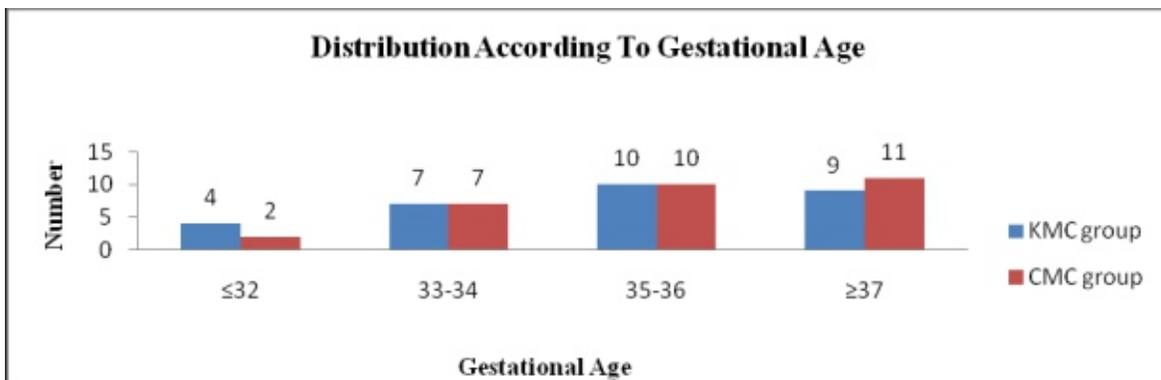
Data were recorded on a predesigned proforma, tabulated and the results were analyzed statistically by SPSS statistical software (version 17.1). A p-value of <0.05 was considered significant.

Results:

Of the 60 included infants, 30 were randomized to the KMC and 30 to the conventional care group. Complete follow-up data were obtained for 60 infants till 42 weeks postmenstrual age in preterm babies reaching weight of 2500 g in term SGA and analyzed.



Tvalue-0.93, p value-0.36, not significant at $p < 0.05$



As evident there was no statistically significant difference of birth weight, gestational age and maturity in both the group, Majority of neonates in

both the groups were preterm AGA followed by term SGA.

Table1: Baseline Characteristic of Neonates upon Enrolment

Variable (Mean±SD)	KMC group	CMC group	P value
Weight at enrolment(gm)	1815.5±318.4	1859±319.4	0.59
Age at enrolment(days)	3.68±1.26	3.34±.54	0.16
Gestational age	35.46±2.44	35.9±2.38	0.36
Male: female	1.14:1	1:1	0.00
Total length(cm)	42.9±2.96	43.4±2.09	0.48
Head circumference(cm)	29.68±1.27	29.94±1.4	0.44

Apparently lower mean weight at enrolment, apparent difference in age of babies in days of enrolment, male: female ratio, total length and

head circumference were not statistically significant in KMC and CMC groups.

Table 2: Effect of KMC on Growth (At 42 Weeks Postmenstrual Age in Preterm Babies and After Attainment of 2500g in Term SGA Babies)

Variable	KMC group	CMC group	P value
Weight gain (gm/day)	19.28±2.9	10.1±1.05	<0.001
Length gain (cm/week)	0.99±0.56	0.70±.13	<0.001
Head circumference (cm/week)	0.72±.07	0.46±.05	<0.001

KMC babies achieved significantly better growth at the end of the study. Weight, length and head circumference gain were significantly higher in the KMC group (weight 19.28±2.9g/day, length .99±0.56cm/week and head circumference

0.72±.07 cm/week) than in the CMC group (weight 10.1±1.05 g/day, length .70±.13cm/week and head circumference .46±.05 cm/week) ($P<0.001$).

Table 3: Effect of KMC on Feeding Pattern

Variable	KMC group	CMC group	P value
Time to start breast feed	3.30±.58	4.14±.58	<0.01
Exclusive breast feeding at 42 weeks	25(83.3%)	20(66.7%)	<0.01

As evident that time to start breast feeding was significantly lower in KMC group ($p<0.01$). Most

babies in KMC group were exclusively breast fed at 42 weeks.

Table 4: Effect of KMC on Morbidities

Variable	KMC group (N=30)	CMC group (N=30)	Chi-square (χ^2)	P value
Hypothermia	03(10%)	10(33%)	15.67	0.0001
Hyperthermia	04(13%)	05(16.6)	00.62	0.42
Hypoglycemia	02(6.7)	08(20.7)	08.14	0.004
Apnea in <1500g	00.00	02(6.7%)	07.25	0.007
Sepsis	02(6.7%)	04(13%)	02.00	0.15
Hospital stay	11.49 ± 1.70	12.59 ± 2.63	00.18	0.66

A significantly higher number of babies in the CMC group suffered from hypothermia, hypoglycemia, and nosocomial sepsis. KMC significantly reduced the incidence of apnea in VLBW babies. There was reduced duration of hospital stay in KMC group by one day.

Discussion:

Despite the existence of properly trained personnel and good quality equipment centralized in a few referral institutions, the sizably voluminous demand for tertiary care far exceeds

capacity, leading to a suboptimal quality of care for many. The complete KMC, including early discharge, skin-to-skin contact, and good quality nutrition based primarily on breastfeeding, has the largest potential for benefit in this environment. This pilot study was set up to test out processes and therefore large differences were not anticipated. The primary aim was to assess the feasibility of trial to evaluate the effectiveness of KMC in LBW infants rather than to look for the statistical differences and clinical outcomes. The

main outcomes that were evaluated were growth pattern, length of time in the study, breastfeeding exclusively at discharge.

KMC aids food absorption by increase in oxytocin release [8]. The ultimate end point of metabolism is somatic growth, measured by weight gain. The data showed an increased rate or rapidity of weight gain for infants who received the intervention (KMC) than for the control groups who received the standard protocol neonatal care. (19.28 ± 2.9 gm/day vs 10.1 ± 1.05 gm/day, p value $< .001$). Weight gain is of some significance in the NICU when dealing with premature or low birth weight babies, and is considered one of the key markers for indicating infant wellbeing and also considered a key feature of readiness for discharge from intensive care unit. Similar results were also seen in study by Ramanathan 2001 [5], Ali 2009 [9], Gathwala 2008 [10], Suman 2008 [11]. Head circumference growth has been found to correlate with brain volume, cellularity, and associated with better childhood cognitive ability. The mean head circumference gain was significantly greater in the KMC group compared with the control group ($0.72 \pm .07$ cm/week vs $.46 \pm .05$ cm/week, p value $< .001$), which compares well with other reports [10-13]. This was higher than the normal expected head circumference growth of LBW infants of 0.5 cm/week [14]. Similarly length gain cm/week was more in KMC group (0.99 ± 0.56 cm/week vs 0.70 ± 0.13 cm/week, p value < 0.001), which supported by other studies [10, 11]. An important mainstay of kangaroo mother care is breastfeeding encouragement. Although evidence shows countless benefits of breastfeeding for

preterm babies [15-19]. The Preterm infant breastfeeding duration – including breast milk feeding – has been found to be shorter than full-term infants. [20] In a randomized controlled study conducted in Sweden with 71 preterm babies weighing less than 1500 g, Whitelaw *et al* [21] found that babies submitted to KMC had a two times higher prevalence of breastfeeding than the control group at six weeks of life (55 versus 28%). Ramanathan *et al* in New Delhi, India [5], found similar results in a study with 28 preterm babies, in which the frequency of breastfeeding at six weeks of life amounted to 85.7% for babies submitted to KMC versus 42.8% for control individuals. Charpak *et al*, in two studies revealed higher prevalence of breastfeeding at 1, 6 and 12 months of life in babies submitted to KMC compared with control individuals [4, 22]. In our study we found that time to start breast feeding in KMC group was significantly less and associated with an increase in the likelihood of exclusive breastfeeding at discharge or 42 weeks' postmenstrual age (83.3% vs 66.7%) [9, 11].

Muscular activity and non shivering thermogenesis is minimal or absent in LBWI [23]. KMC provides warmth and prevents heat loss. It is more effective in rewarming infants [24] than any other technique, including swaddled holding, radiant warmers, incubators, plastic shields, warming mattresses. Infants are warmer in KMC because maternal breasts thermoregulate the infant's body temperature [25]. In our study a significantly higher number of babies in CMC group suffered from hypothermia than KMC group. Small for gestation and preterm babies are likely to develop

hypoglycemia due to low hepatic glycogen stores or increased utilization of glucose [23]. Blood glucose levels are found to be higher in KMC babies [26] compared to control babies protecting against hypoglycemia. In an RCT a significantly higher number of babies in CMC suffered from hypoglycemia ($p=0.00005$) as compared with KMC babies [11]. Cochrane meta-analysis 2003 [27] has confirmed that full term infants with KMC had higher blood glucose levels than CMC.

LBW infant whether preterm or SGA are vulnerable to develop infections due to deficient humoral and cellular immune mechanism and ineffective immunologic responses [23]. KMC contributes to better hydration of stratum corneum and may be an occlusive agent to promote skin barrier thereby minimizing nosocomial infections [28]. Breastfeeding rate with KMC is higher which provides protective maternal antibodies. Cochrane meta-analysis revealed that KMC was associated with reduction of nosocomial infections/sepsis (RR 0.45, 95% CI 0.27 to 0.76) with continuous or intermittent KMC [29].

Apneic spells are common in LBW infants due to various environmental and systemic causes. Most apneas occur during indeterminate sleep and arousals from sleep [30]. KMC decreases arousals by 90% and prevents indeterminate sleep [31]. Desaturation episodes or Apnea episodes decreased [11] or prevented [31] during KMC as compared to incubator care in randomized controlled trials [30, 32]. KMC decreased length of hospital stay by 2.4 days (95%CI 0.7 to 4.1) in a meta-analysis of nine studies that used intermittent KMC [29].

Conclusion:

In conclusion, the low birth weight infants offered KMC demonstrated higher growth rates and were discharged earlier. KMC prevented or reduced almost all morbidities of low birth weight infant. It also promotes exclusive breastfeeding practice and increases mother's confidence in handling small babies and builds good mother-baby bonding. KMC should be promoted and mothers should be encouraged to start it as soon as their LBW babies are stable.

References

1. Martinez G, Rey S, Marquette C. The mother kangaroo programme. *Int Child Health* 1992;3:55-67.
2. Lawn JE, Cousens S, Zupan J, Team LNSS. 4 million neonatal deaths: when? Where? Why? *The Lancet* 2005; 365(9462):891-900.
3. Richardson H. Kangaroo Care: why does it work? *Midwifery today with international midwife*. 1997 (44):50.
4. Charpak N, Ruiz-Peláez JG, Charpak Y. A randomized, controlled trial of kangaroo mother care: results of follow-up at 1 year of corrected age. *Pediatrics* 2001;108(5):1072-9.
5. Ramanathan K, Paul V, Deorari A, Taneja U, George G. Kangaroo Mother Care in very low birth weight infants. *The Indian Journal of Pediatrics*. 2001;68(11):1019-23.
6. Van Rooyen E, Pullen A, Pattinson R, Delpont S. The value of the kangaroo mother care unit at Kalafong Hosp. *Geneeskunde The Medical Journal* 2002;6-10.
7. Charpak N, Ruiz-Peláez JG, Zita Figueroa de C M, Charpak Y. Kangaroo mother versus traditional care for newborn infants ≤ 2000 grams: a randomized, controlled trial. *Pediatrics* 1997;100(4):682-8.
8. M Ludington-Hoe S. Evidence-based review of physiologic effects of Kangaroo Care. *Current Women's Health Reviews* 2011;7(3):243-53.
9. Ali SM, Sharma J, Sharma R, Alam S. Kangaroo Mother Care as compared to conventional care for low birth weight babies. *Dicle Medical Journal* 2009;36(3).
10. Gathwala G, Singh B, Balhara B. KMC facilitates mother baby attachment in low birth weight infants. *The Indian Journal of Pediatrics* 2008;75(1):43-7.

11. Suman Rao P, Udani R, Nanavati R. Kangaroo mother care for low birth weight infants: a randomized controlled trial. *Indian Pediatrics* 2008;45(1):17.
12. Boo NY, Jamli FM. Short duration of skin-to-skin contact: Effects on growth and breastfeeding. *Journal of Paediatrics and Child Health* 2007;43(12):831-6.
13. Mwendwa A, Musoke R, Wamalwa D. The impact of partial kangaroo mother care on growth rates and duration of hospital stay of low birth weight infants at the Kenyatta National Hospital, Nairobi. *East African Medical Journal* 2013;89(2):53-8.
14. Doyle LW. Kangaroo mother care. *The Lancet* 1997;350(9093):1721-2.
15. Gartner LM, Morton J, Lawrence RA, Naylor AJ, O'Hare D, Schanler RJ, et al. Breastfeeding and the use of human milk. *Pediatrics* 2005;115(2):496-506.
16. Amin SB, Merle KS, Orlando MS, Dalzell LE, Guillet R. Brainstem maturation in premature infants as a function of enteral feeding type. *Pediatrics* 2000;106(2):318-22.
17. Carlson SE, Cooke RJ, Rhodes PG, Peeples JM, Werkman SH, Tolley EA. Long-term feeding of formulas high in linolenic acid and marine oil to very low birth weight infants: phospholipid fatty acids. *Pediatr Res* 1991;30(5):404-12.
18. Lucas A, Morley R, Cole T, Lister G, Leeson-Payne C. Breast milk and subsequent intelligence quotient in children born preterm. *The Lancet* 1992;339(8788):261-4.
19. Saenz P, Quero J. Estudio de la maduración intestinal en neonatos con isótopos estables. *Rev Med Univ Navarra* 1999;42:77-82.
20. Flacking R, Wallin L, Ewald U. Perinatal and socioeconomic determinants of breastfeeding duration in very preterm infants. *Acta Paediatr* 2007;96(8):1126-30.
21. Whitelaw A, Heisterkamp G, Sleath K, Acolet D, Richards M. Skin to skin contact for very low birthweight infants and their mothers. *Archives of Disease in Childhood* 1988;63(11):1377-81.
22. Charpak N, Ruiz-Peláez JG, Charpak Y, Rey-Martinez. Kangaroo Mother Program: an alternative way of caring for low birth weight infants? One year mortality in a two cohort study. *Pediatrics* 1994;94(6):804-10.
23. Singh M. Care of newborn. 7th ed ed. New Delhi: Sagar Publications; 2010. 200-24.
24. Byaruhanga R, Bergstrom A, Okong P. Neonatal hypothermia in Uganda: prevalence and risk factors. *Journal of Tropical Pediatrics* 2005;51(4):212-5.
25. Ludington-Hoe SM, Nguyen N, Swinth JY, Satyshur RD. Kangaroo care compared to incubators in maintaining body warmth in preterm infants. *Biological Research for Nursing* 2000;2(1):60-73.
26. Christensson K, Siles C, Moreno L, Belaustequi A, De La Fuente P, Lagercrantz H, et al. Temperature, metabolic adaptation and crying in healthy full-term newborns cared for skin-to-skin or in a cot. *Acta Paediatrica* 1992;81(6-7):488-93.
27. Conde-Agudelo A, Díaz-Rossello JL, Belizan J. Kangaroo mother care to reduce morbidity and mortality in low birthweight infants. *Birth* 2003;30(2):133-4.
28. Abouelfetoh A, Ludington-Hoe SM, Burant CJ, Visscher MO. Effect of skin-to-skin contact on preterm infant skin barrier function and hospital-acquired infection. *Journal of Clinical Medicine Research* 2011;3(1):36.
29. Conde-Agudelo A, Belizán JM, Diaz-Rossello J. Kangaroo mother care to reduce morbidity and mortality in low birthweight infants. *Cochrane Database Syst Rev* 2011;3(3).
30. Lehtonen L, Martin RJ, editors. Ontogeny of sleep and awake states in relation to breathing in preterm infants. *Seminars in Neonatology*; 2004: Elsevier.
31. Ludington-Hoe SM, Johnson MW, Morgan K, Lewis T, Gutman J, Wilson PD, et al. Neurophysiologic assessment of neonatal sleep organization: preliminary results of a randomized, controlled trial of skin contact with preterm infants. *Pediatrics* 2006;117(5):e909-e23.
32. Hadeed A, Ludington S, Siegel S, editors. Skin to skin contact (SSC) between mother and infants reduces idiopathic apnea of prematurity (LAOP). *Pediatric Research*; 1995: Williams & Wilkins 351 West Camden St, Baltimore, MD 21201-2436.

*Author for Correspondence: Dr Keerti Swarnkar, M4/F-10, Meghdoot Apartment, Sawangi (Meghe), Wardha-442001 Maharashtra, India Email: drkeerti1978@gmail.com Cell: 09921613920