

“Role of Kangaroo Mother Care in Premature and Low Birth Weight Neonates”

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Introduction: Kangaroo Mother Care is a non conventional, low cost method for newborn care based upon intimate skin-to-skin contact between mother and baby. **Aims and Objectives :** To find out the effectiveness and outcome of Kangaroo Mother Care on Premature and Low Birth Weight neonates in terms of: a. Mortality and morbidities .b. Maternal and social acceptability and feasibility. c. Cost-effectiveness. **Materials and Methodology:** This hospital based observational study was conducted on 105 preterm and low birth weight neonates who were admitted in the NICU of Department of Paediatrics, at Gauhati Medical College and Hospital, Guwahati, and fulfilled the inclusion criteria over a period of one year from 1st July 2018 till 30th June 2019. **Results and Observation :** The study showed better and earlier weight gain (p value <0.01), reduced episodes of sepsis (p value < 0.01) , hypoglycemia and apnea, better growth in HC and Length, better temperature handling and physiological parameters like HR and RR. Mothers were more confident, with better lactation and family acceptability was better. Mortality too was reduced. **Conclusion:** Therefore this study showed positive impact of KMC towards rearing a premature and LBW neonate.

Keywords: NICU (Neonatal Intensive Care unit), HC (Head Circumference), HR(Heart Rate), RR (Respiratory Rate).

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I. Introduction:

Globally 44% of under 5 deaths occur during the neonatal period¹, and approximately 99 % of them occur in low income and middle income countries. According to the UNICEF's report on the newborn mortality rate first published on Feb 20th 2018, every year 26 lakhs babies die worldwide within 28 days of birth. The current mortality rate of 24 deaths/1000 live births in India makes it the 12th worst among 52 lower and middle income countries in the world² Every year 3.5 million babies are born premature in India alone, out of the 15 million preterm babies globally. LBW babies contributes to 60 to 80% of neonatal death. Approximately 30 % of neonates are born with low birth weight of less than 2500 grams in India, which accounts for 42% of the global burden³. As per SRS 2017 data IMR of Assam is 44 (India 33) and NMR of Assam is 22 (India 23). Kangaroo Mother Care is the care of preterm or low birth weight babies carried skin-to-skin with the mother. This method does not need expensive and sophisticated equipment and for its simplicity it can be applied almost everywhere including peripheral maternity units of very low income countries. Experience with KMC is limited in South Asia. There is insufficient data in our own country India regarding the acceptability of Kangaroo Care to the mothers and health staffs, early discharge policies and long term outcomes. This simple method if found suitable and culturally acceptable may prove as a new primary modality which can be incorporated into the essential newborn care package of the “Reproductive and Child Health Programme”⁴.

AIMS AND OBJECTIVES: To find out the effectiveness and outcome of Kangaroo Mother Care on Premature and Low Birth Weight neonates in terms of;

- Mortality and morbidities.
- Maternal and social acceptability and feasibility.
- Cost-effectiveness.

II. Materials And Methodology :

The Hospital based Observational Study was conducted on all the preterm and low birth weight neonates who were admitted in the NICU of Department of Paediatrics, at Gauhati Medical College and Hospital, Guwahati, over a period of one year from 1st July 2018 till 30th June 2019. A 105 neonates (babies within 28 days of life) who fulfilled the inclusion criteria were enrolled in the study.

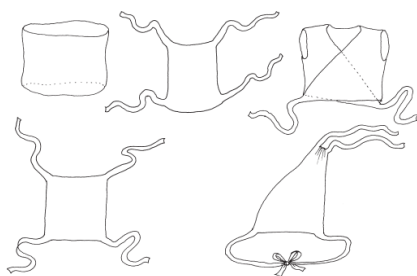
Inclusion Criteria:

1. All low birth weight and preterm babies who were hemodynamically stable and were admitted in the Neonatal Intensive Care Unit and then enrolled into the KMC Centre of the Unit were included in the study.

Exclusion Criteria:

1. Neonates who were not hemodynamically stable or died before initiation of KMC.
2. All term Appropriate for Date (AFD) neonates
3. Neonates who were admitted in the NICU only for Neonatal hyperbilirubinemia and required phototherapy.
4. Neonates who needed advance life support like ventilation and eventually died.
5. Neonates with major congenital malformation or life threatening anomaly.
6. Refusal to participate in the study.

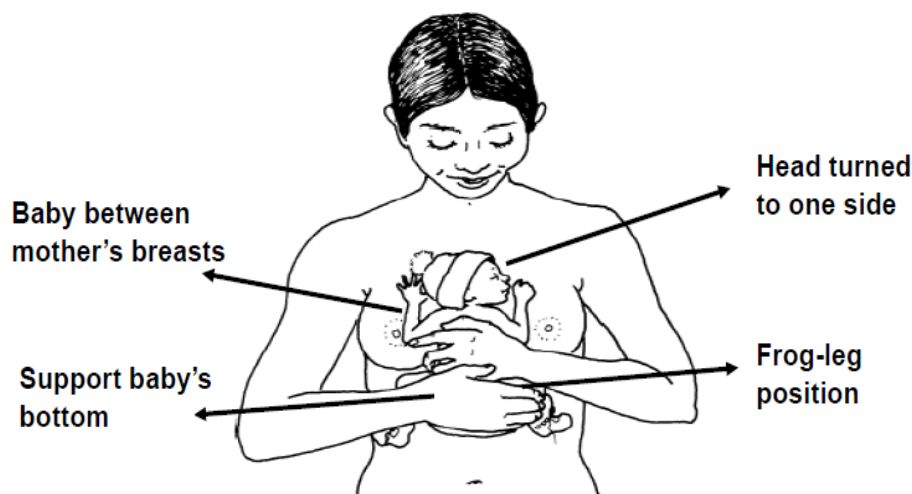
Methods: All neonates with birth weight less than 2500gms and gestational age less than 37 weeks were chosen for the study once they were hemodynamically stable. However, if the cases deteriorated during the Kangaroo Mother Care and became hemodynamically unstable they were removed from the care and put under the radiant warmer and necessary interventions done. A specially designed proforma was used to record the general details of the neonate and their mother’s details. Detailed history, examination and anthropometry of the neonates were done and gestational age was calculated as per New Ballard Scoring system. If the neonate did not cry at birth, then status of the baby on admission, resuscitation required or not, Apgar scoring etc was done. Sepsis screen and blood cultures were sent for all neonates who presented with signs and symptoms of sepsis or had any risk factors for sepsis. Temperature was recorded using the thermister probe and SpO₂ was measured using pulse oximeter. Weight was measured daily using a digital weighing scale with (±5gms error), weight was evaluated by keeping the baby completely undressed on the weighing scale everyday at the same time before initiating KMC, the weighing machine was calibrated daily. Length was assessed using an infantometer and Head Circumference using a non stretchable measuring tape at the time of admission, weekly and till discharge, blood glucose was evaluated using the glucometer available in the NICU which was standardized with control from time to time. The mothers were asked to wear loose fitting gown or front open gowns and the babies were wrapped to their chests using stoles and specially designed KMC flannel bags whenever or wherever possible. Babies wore socks and front open dresses. The baby was placed between the mother’s breast in an upright position. The head turned to one side and in a slightly extended position. The hips flexed and abducted in a “frog” position; the arms were also flexed. Baby’s abdomen was at the level of the mother’s epigastrium. Baby’s bottom was supported with a sling/binder.



Materials used for KMC



Preparing the baby for KMC



KMC Positioning

All these information were noted in a predesigned proforma. The questions were asked in the local language and were duly explained in case of any difficulty in understanding or misinterpretation. Outcome was noted and data obtained was analyzed.

Data analysis: The data collected was subsequently scrutinized individually and analyzed manually. The data were tabulated in Excel format and the statistical analysis performed using SPSS version 21.0. Tables and charts were prepared using Excel. A P value of <0.05 was taken as significant and <0.01 as highly significant. Continuous data was compared using Student's t test or ANOVA where appropriate and non-parametric data were compared using chi-square tests.

Ethical Clearance: The study was approved by the Institutional Ethical Committee.

III. Results And Observations

Our objective was to determine the effectiveness and outcome of KMC on the weight gain, temperature regulation and various morbidity profiles and overall mortality of the preterm (premature) or low birth weight neonates. Various factors like period of gestation, birth weight, mode of delivery etc were also taken into account. Apart from these maternal factors other factors like level of maternal education was also looked into. Effects of KMC was assessed in terms of outcome indicators like discharged, LAMA or expired.

Table 1 : Admission distribution

Admission	Frequency	Percent
Outborn(O)	40	38.1
Inborn(I)	65	61.9
Total	105	100

Table 2 : Birth weight distribution

Admission	Birth weight				P value
	<1500gms	1500-1800gms	>1800gms	Total	
Outborn(O)	35	4	1	40	<0.05
Inborn(I)	42	20	3	65	
Total	77	24	4	105	

Table 3: Gender distribution

Sex	Frequency	Percent
Male(M)	63	60
Female(F)	42	40
Total	105	100
Male:Female		1.5:1

Table 4 : Distribution as per Mode of delivery

Mode of delivery	Frequency	Percent(%)
NVD	83	79
LSCS	22	21
Total	105	100

Table 5 : Distribution as per Sepsis

Sepsis	Frequency	Percent (%)
No	100	95.2
Yes	5	4.8
Total	105	100

Table 6 : Distribution as per baseline parameters at birth

Parameters	N	Mean	SD	Minimum	Maximum
POG	105	33.33	2.56	28	40
BW at birth	105	1301.64	261.78	800	2200
Length at birth	105	45.59	1.93	40	49
HC at birth	105	31.92	1.66	27	34
DOHS	105	24.66	8.82	13	60

Table 7: Distribution according to maternal parameters and neonatal apnea

Day	MWB absent	FA absent	Apnea absent	Bonding absent	ML absent
D1	0	0	1	0	0
D2	0	0	0	0	0
D3	0	0	0	0	0
D4	1	0	3	0	0
D5	1	0	3	0	0
D6	0	0	1	0	0
D7	0	0	1	0	0

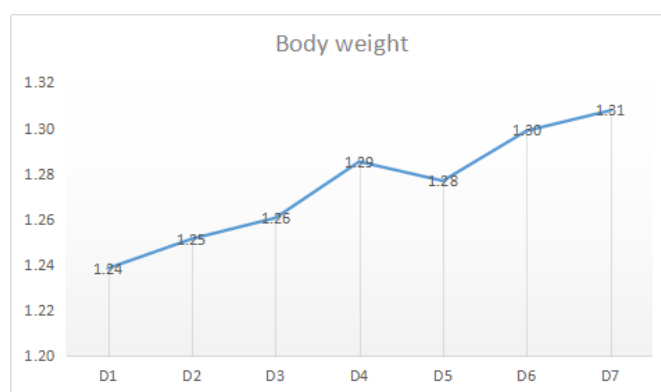


Table 8 : Weight Trend during KMC care.

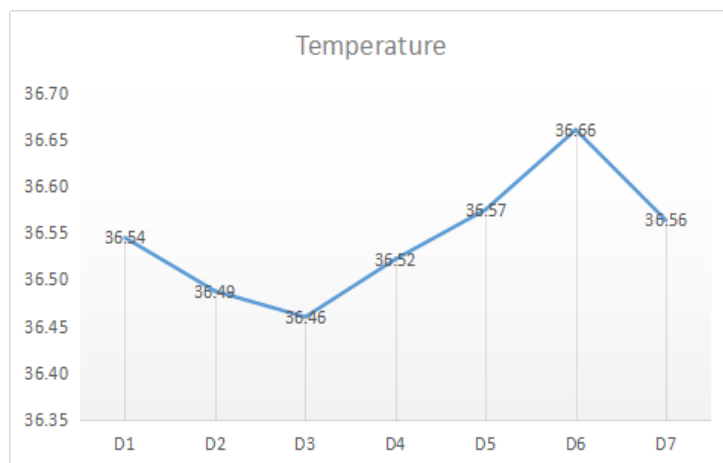


Table 9 : Temperature trend During KMC care

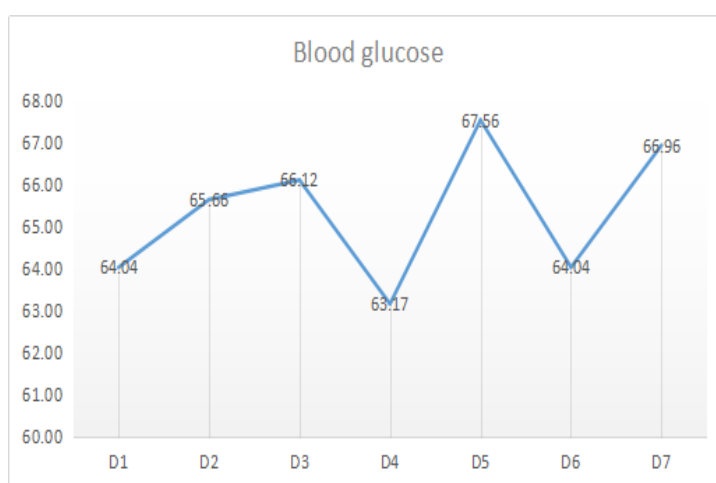


Table 10 : Blood Glucose(BG) trend during KMC care

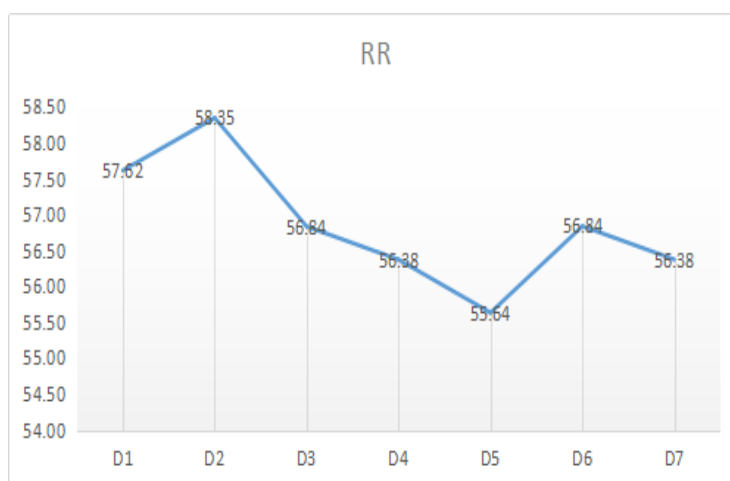


Table 11 : Respiratory Rate trend during KMC

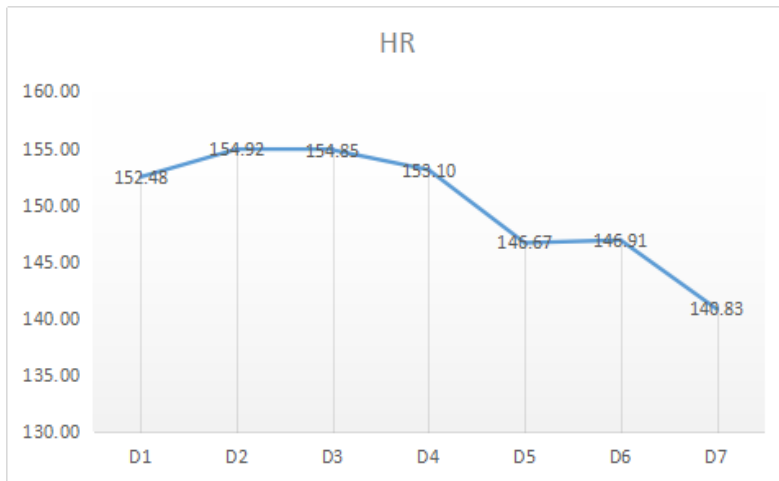


Table 12: Heart Rate (HR) trend during KMC

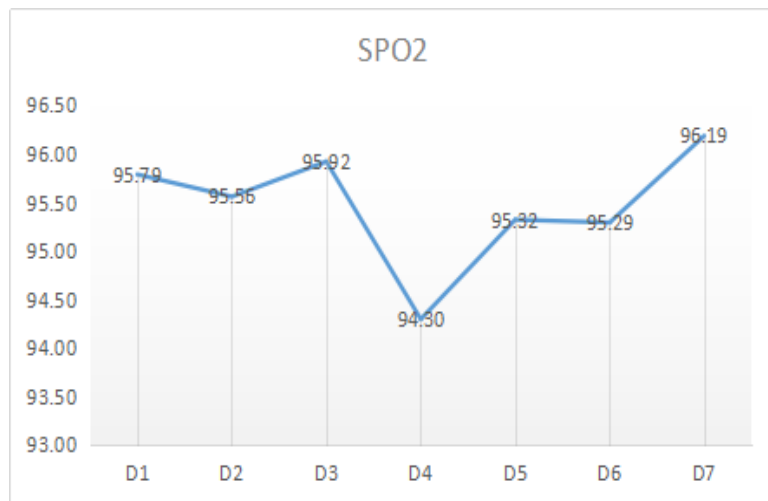


Table 13 : Oxygen Saturation (SpO₂) trend during KMC

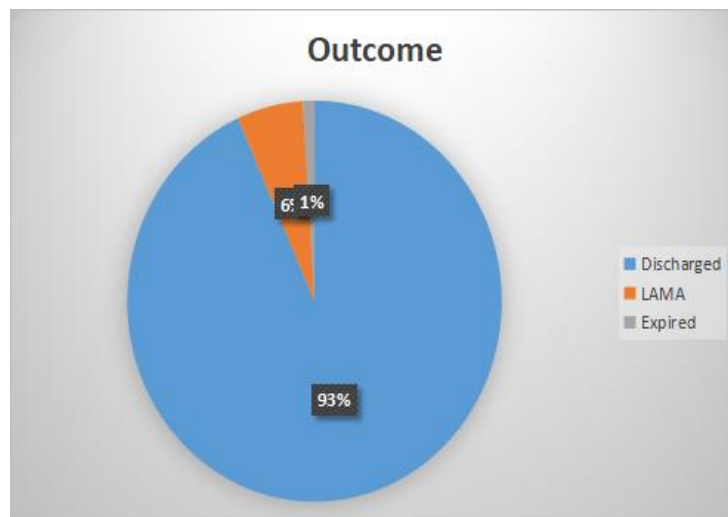


Table 14 : Distribution as per Outcome

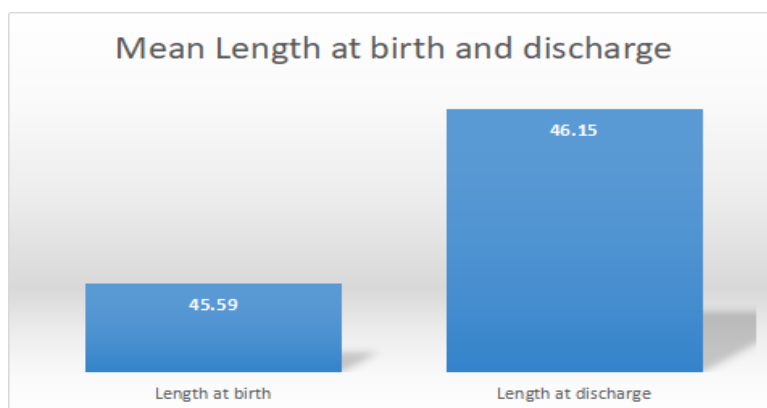


Table 15: Length at birth and at discharge

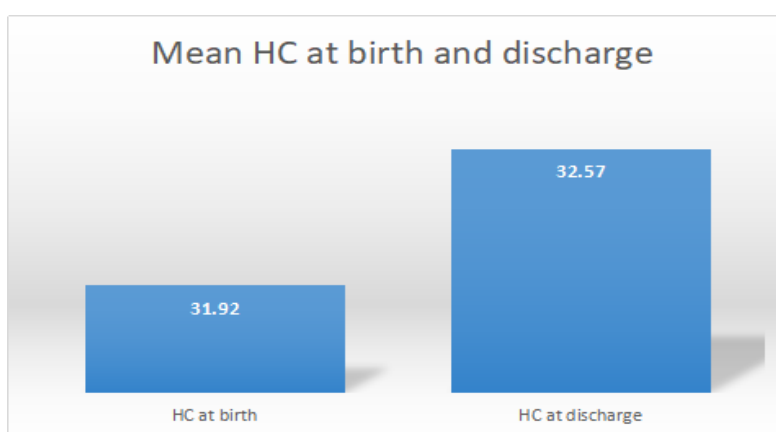


Table 16: Head Circumference at discharge

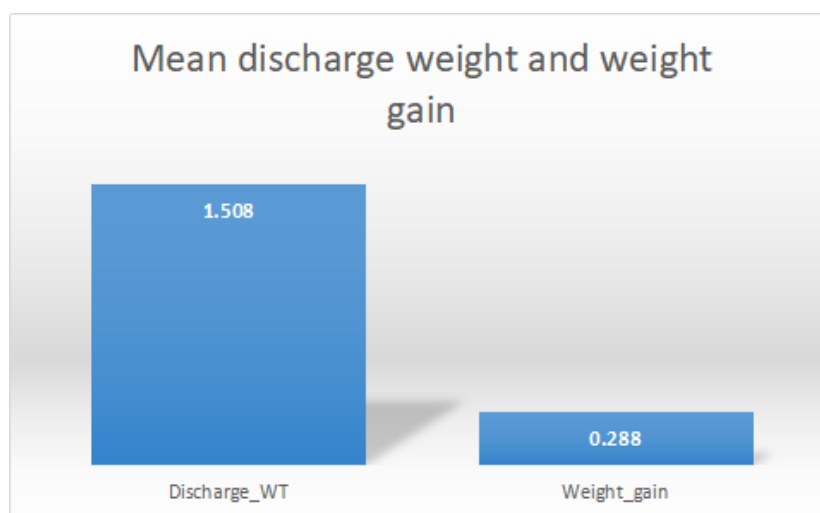


Table 17: Mean discharge weight and weight gain

IV. Discussion

By using proper criteria for defining low birth weight and preterm neonates we studied the effects of Kangaroo Mother Care on the various physiological parameters that influenced a preterm and low birth weight neonate's growth pattern and physiological stability. Most of the studies on the effects of KMC were conducted using a control group but in our study it was not possible to use a control group as it was not ethically correct to deny any neonate of the care it should receive to ensure adequate growth and further physiological and cognitive development. This study was not conducted on all the neonates admitted to the NICU and specific cohorts like low birth weight and preterm babies were chosen.

1. **Admission Distribution:** In our study it was seen that the pattern of distribution as per admission was inborn unit had more babies (61.9%) going into the KMC unit than Outborn unit (38.1%). [Table 1, Fig 1.]. This result

was comparable to the study conducted by Kondapalli CS et al⁷² where there were more Inborn babies (202) enrolled into KMC than Outborn babies (98).

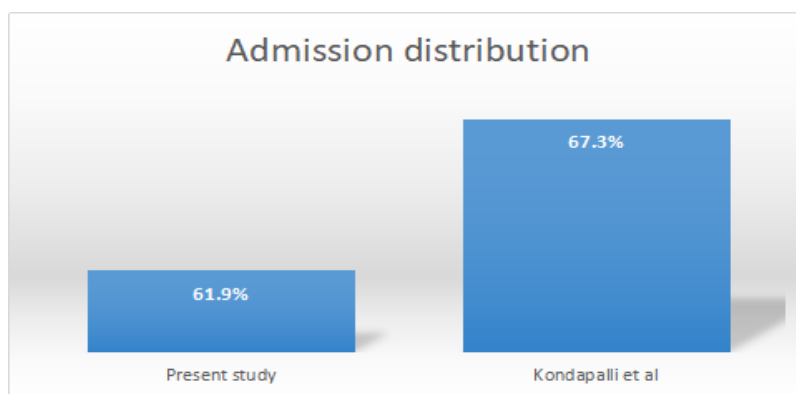


Fig 1

2. Distribution of birth weight : In our study the babies who later went into KMC were first divided on the basis of their BW into 3 Groups . Group A <1500gms, Group B 1500 - 1800gms and Group C >1800gms. And in this study majority of the babies are in the Group A (77 babies = 73.3%).This was in accordance to the study conducted by Swarnakar K et al¹⁴.In contrast, to the study conducted by Parmar VR et al¹³ .Bhavana D et al¹⁷ who also divided their KMC babies into similar weight groups and had majority of their babies into the Group D of >1800gms (53.33%) and Suman Rao PN et al⁹ where also it was seen that the majority of the babies were >1800gms (41.8%). [Table 2, Fig 2]

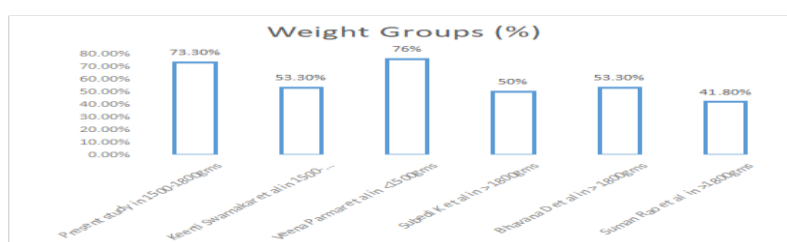


Fig 2

3. Distribution of Gender : In our study it was seen that most babies that were enrolled into the study were males (60%) and the Male : Female ratio was 1.5:1. The male babies were more in the inborn unit and were more in the 1500-1800gms group and in the 32-37 weeks gestational age group. This is comparative to the study conducted by Swarnakar K et al¹⁴ , Suman Rao PN et al⁹ , Dandekar RH et al¹¹ , Ramanathan KP et al¹⁰ , Gupta M et al¹⁵ and Kondapalli CS et al⁷² where males were more in number than females. However in the study conducted by Subedi K et al¹⁶ the females were more in no than the males. And in the study conducted by Bhavana D et al¹⁷ the male:female ratio was 1:1. [Table3, Fig 3]

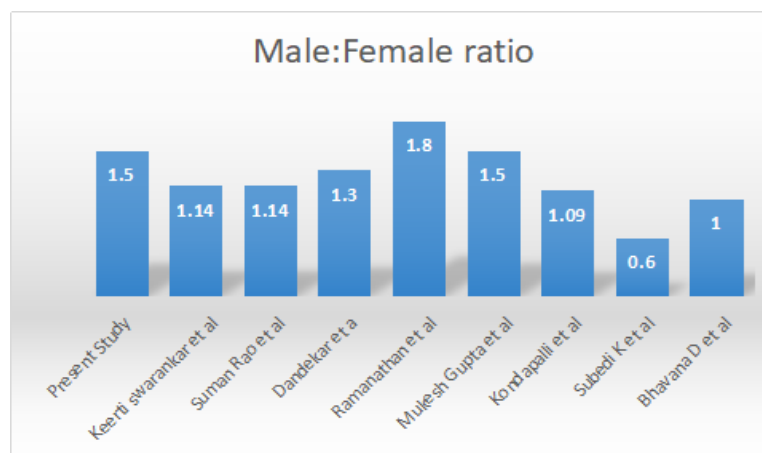


Fig 3

4. **Comparison by Mode of Delivery :** In our study it was observed that most of the study subjects were born by NVD (79%) as compared to LSCS (21%). This was in accordance to the studies conducted by Bhavana D et al¹⁷, Gathwala G et al⁸, and Kondapalli CS et al¹². [Table 4, Fig 4]

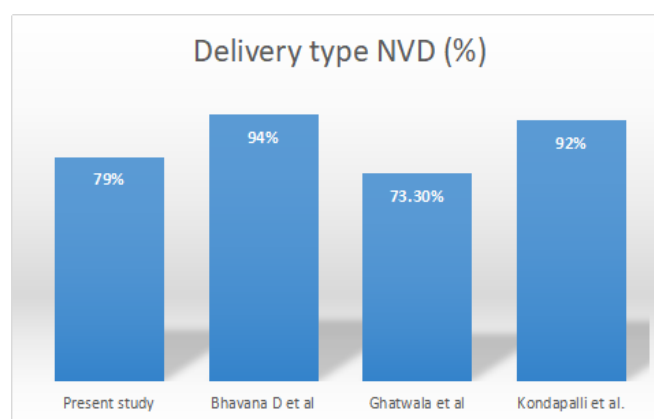


Fig 4

5. **Comparison as per sepsis :** In our study it was seen that majority of the babies did not have sepsis (95.2%) and only 5 babies had sepsis (4.8%) of which 4 were from the outborn unit (80%) which was statistically significant at $p < 0.05$ and most of these babies belonged to the < 1500 gms birth weight group and belonged to 32-36weeks gestational age group . It was also seen that the female babies had higher incidence of sepsis than the male babies. This was in accordance to the study conducted by Dandekar RH et al¹¹(3.33%), Suman Rao PN et al⁹ (3.9%), Subedi K et al¹⁶ (4.7%), Gathwala G et al⁸ (4%) and Swarnakar K et al¹⁴ (6.7%). However, a significantly higher percentage was seen in the study conducted by Kondapalli CS et al¹² (33.33%). In the study conducted by Boundy EO et al⁷ where KMC was associated with 47% lower risk of sepsis and most babies were < 2250 gms. Since they had a meta analysis of various studies in all the study modalities it was shown that KMC was associated with lower risk of Sepsis.

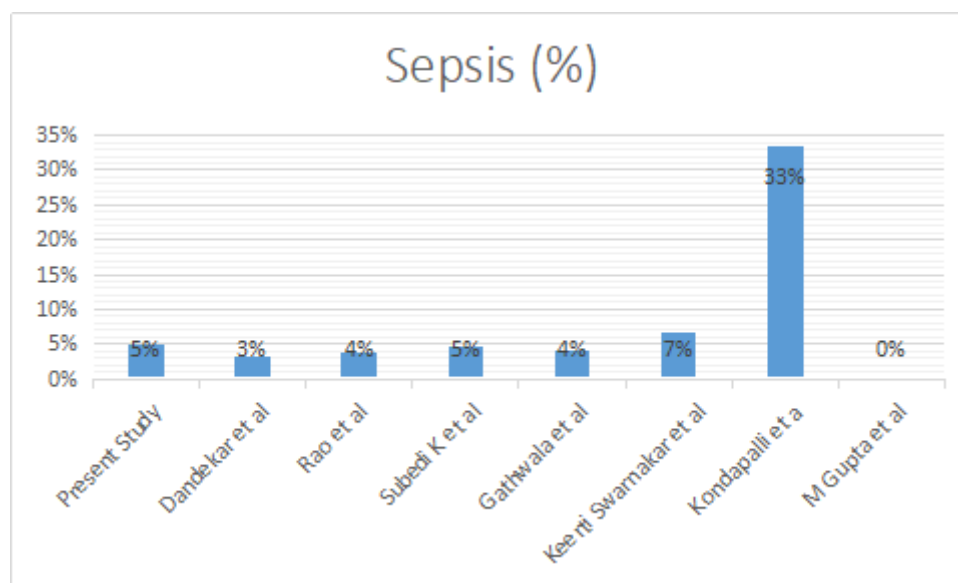


Fig 5 : Sepsis Pattern

6. Comparison of the baseline parameters when the cases were enrolled into the KMC unit of our NICU:

It was seen that the mean weight of all babies on Day 1 of admission was 1240 ± 220 gms, their temperature was $36.54 \pm 0.13^\circ\text{C}$, blood glucose 64.04 ± 7.66 mg/dl, Respiratory Rate (RR) 57.62 ± 2.95 /min, Heart Rate (HR) 152.48 ± 14.86 / min, SpO₂ of 95.79 ± 0.62 %. It was however seen that mean weight at enrollment was 1607.6 ± 278 gms in the study conducted by Suman Rao PN et al⁹ In the study conducted by Swarnakar K et al¹⁴ the mean weight at enrollment was 1815 ± 318.4 gms and in the study conducted by Dandekar RH et al¹¹ it was 1610.16 ± 199.83 gms which was higher than our study. Whereas, in the study conducted by Kondapalli CS et al¹² the mean temperature was 36.75°C , mean respiratory rate 30.28 beats/min, mean HR was 136.21beats/min,

mean SpO₂ was 98.41% before initiating KMC. In the study conducted by Bera A et al⁵ the mean temperature was 36.5 ± 0.12°C, mean RR 39.7 ± 5.75 beats/min, mean HR 140.5 ± 10.62 beats/min and mean SpO₂ was 91.9 ± 3.47%. The mean duration of Hospital stay was seen as 24.66 ± 8.82 days. [Table 6]

7. Comparison of maternal parameters and neonatal apnea: In our study it was seen that there was 100% family acceptability, bonding and good maternal lactation. However there were 2 days when 1 mother was sick on day 4 and day 5. Overall the mothers were willing to provide KMC and showed a positive response. This was comparable to the study by Suman Rao PN et al⁹, Ramanathan KP et al¹⁰, Kondapalli CS et al¹² and Parmar VR et al¹³, Bhavana D et al¹⁷, Gupta M et al¹⁵ and Ghatwala G et al⁸ where the maternal acceptance was good and concurred with other studies. The family acceptance and the father was supportive. In the study by Suman Rao PN et al⁹ it was seen that majority of mothers expressed happiness (71.5%), practised KMC easily (75.5%) without assistance (80.39%) and felt their babies preferred KMC (65%). KMC mothers showed statistically significant high levels of satisfaction, comfort and increase in confidence in handling their babies. The mothers also had better lactation after starting KMC. There was essentially better bonding between the mother and her baby in all these studies. It was seen that there was much lesser episodes of apnea and the incidence was 8.5% with 3 babies developing apnea on Day 4 and day 5 and 1 baby each on day 1, day 6, day 7. This was also seen in the study conducted by Dandekar RH et al⁷¹ where the incidence of apnea was 5% in their KMC group. In the study conducted by Swarnakar K et al¹⁴ and Parmar VR et al¹³ the incidence of apnea was 0%. Suman Rao PN et al⁹ found the incidence of apnea in their study group as 4.3 % and Ali SM et al¹⁸ had 1.7% apnea incidence. Also in the study conducted Ramanathan KP et al¹⁰ it was seen that only 0.33% babies had apnea. There were 0 cases of apnea in the study conducted by Bhavana D et al¹⁷. However there was 4% cases who had respiratory distress in the study conducted by Gathwala G et al⁸ and 1 case of respiratory distress in the study conducted by Bhavana D et al¹⁷.

8. Comparison of Temperature : In our study it was seen that the temperature was stable with a mean of 36.54 ± 0.13°C on day 1 of enrollment into KMC and 36.56 ± 0.11°C on day 7 of KMC and there were no episodes of hypothermia, therefore the incidence of hypothermia in our study was 0%. This was in contrast to the study conducted by Suman Rao PN et al⁹ where the incidence of hypothermia was 5.9%, Dandekar RH et al⁷¹ and Swarnakar K et al⁷⁵ both had 5% and 10 % incidence of hypothermia respectively. However similar to our study the incidence of hypothermia was 0% on the study conducted by Kondapalli CS et al¹², Parmar VR et al¹³, Bhavana D et al¹⁷, Ramanathan KP et al¹⁰. In our study also there were no incidences of hyperthermia which was seen in the study conducted by Swarnakar K et al¹⁴ 13 %, Suman Rao PN et al⁹ 12.6%. Parmar VR et al⁷⁴ also observed that the body temperature rose from 36.74°C to 37.23°C and was sustained during KMC. And in the study conducted by Kondapalli CS et al¹² the mean rise in temperature was 0.23°C.

9. Comparison of hypoglycaemia : In our study none of the babies had hypoglycaemia and the mean blood glucose on day 1 and day 7 were 63.75±7.84mg/dl and 66.62±5.56 mg/dl respectively. Therefore, the incidence of hypoglycemia was 0% in our study. This was in contrast to the study conducted by Suman Rao PN et al⁹ where the episode of hypoglycaemia was 3.9%, Swarnakar K et al¹⁴ where it was 6.7 % . However, in the study conducted by Subedi K et al¹⁶ only 1.6% babies had hypoglycaemia. In the study conducted by Bhavana D et al¹⁷ KMC babies had higher blood glucose level as compared to their control group.

10. Comparison of HR : In our study it was seen that the average HR on Day 1 of KMC was 152.48 ± 14.86 beats/min and it dropped to 140.83 ± 10.73 beats/min on day 7 of providing KMC . This was similar to the study conducted by Kondapalli CS et al¹² where the mean HR dropped by 12.09 beats/min and Parmar VR et al¹³ where the HR dropped by 3-5 beats/ min but remained within physiological limits. In the study conducted by Bera A et al⁵ the HR increased by 5 beats/ min to achieve normal and stable HR. In the study conducted by Bhavana D et al¹⁷ no episodes of tachycardia or bradycardia were seen. However, in the study conducted by Boundy EO et al⁷ KMC did not have any significant effect on the HR.

11. Comparison of RR : In our study the RR was stable during the entire period of KMC and it was 57.62 ± 2.95 beats/min on day 1 and 56.38 ± 1.64 beats/min on day 7. There was no significant episodes of tachypnea or bradypnea and the RR remained within physiological limits during the study.

In the study conducted by Kondapalli CS et al¹² RR rose by 4.84 beats/min. In the study of Bera A et al⁵ the change in RR was 2.6 ± 3.49 beats/min on day 1, 33 ± 3.75 beats/min on day 2 and 3.7 ± 3.73 beats/min on day 3. Parmar VR et al¹³ observed that the RR dropped from 62 ± 5.3 beats/min to 52 ± 4.8 beats/min . Boundy EO et al⁷ found that KMC was associated with non statistical reduction in the risk of apnea. And it was protective thereby.

12. Comparison of Oxygen Saturation (Spo₂) : In our study it was seen that the oxygen saturation was maintained at 95.79 ± 0.62% on Day 1 and at 96.19 ± 1.29% at day 7. though not statistically significant there was a steady rise in the SpO₂ during KMC. Similarly it was seen in the study conducted by Kondapalli CS et al¹² Spo₂ raised by 1.14% after KMC. Bera A et al⁵ observed that the SpO₂ rose by 5% on all 3 days of their study. And in the study conducted by Parmar VR et al¹³ the SpO₂ rose by 2-3%.

13. **Comparison for increase in Length :** In our study it was seen that the length of the cases increased from a mean of 45.59 ± 1.93 cms at birth/ admission to 46.15 ± 1.97 cms. This is also seen in the studies conducted by Dandekar RH et al¹¹ where the increase in length was 0.99 ± 0.19 cms/week, Suman Rao PN et al⁹ where it was 0.99 ± 0.75 cms/week, Swarnakar K et al¹⁴ where it was 0.99 ± 0.56 cms/week and similar findings were seen in the study conducted by Ramanathan KP et al¹⁰. In contrast Boundy EO et al⁷ did not find any significant growth in length.

14. **Comparison of Increase in HC :** In our present study it was seen that the HC increased by an average of 32.57 ± 1.58 cms at discharge from 31.92 ± 1.66 cms at birth. Similar findings have been seen in the studies conducted by Swarnakar K et al¹⁴ where the mean HC gain was 0.72 ± 0.07 cms/week and Suman Rao PN et al⁹ 0.75 ± 0.48 cms/week and Dandekar RH et al¹¹ where the average gain in HC was found to be 0.99cms and Ghatwala G et al⁸ where it was 0.59cms. Similarly in the study conducted by Boundy EO et al⁷ the average gain in HC was found to be 0.19cms higher than their control groups per week. In the study conducted by Bhavana D et al¹⁷ the gain in HC was 31.74 ± 1.1 cms at discharge from 30.97 ± 1.38 cms at birth.

15. **Gain in weight :** In our present study it was seen that the gain in weight was around 288 ± 149 gms at discharge and the mean weight of all babies was around 1508 ± 117 gms at discharge. The gain in weight was higher for the babies weighing < 1500 gms and lowest for the babies in the group range of 1500- 1800gms and the weight gain was highest for the babies in the POG of < 32 weeks and lowest for the babies belonging to POG of > 36 weeks. The probable reason could be early discharge as the main criteria for discharge was babies attaining their birth weight or > 1400 gms or 3 consecutive days of weight gain at the rate of 10-30gms/day. This gain in weight has been seen in almost all studies conducted by various authors and has been described here. In the study conducted by Suman Rao PN et al⁹ the gain in weight was 23.99 ± 9.82 gms/day. Dandekar RH et al¹¹ found that the average gain in weight was 25.28 ± 7.38 gms/day, Swarnakar K et al¹⁴ gain in weight was 19.28 ± 2.9 gms/ days. In the study conducted by Kondapalli CS et al¹² the average weight gain was 20gms/day and Ramanathan KP et al¹⁰ found out that the gain in weight was 15.9 ± 4.5 gms/day at the end of the 1st week of his KMC study. Similar findings were seen in the studies conducted by Subedi K et al¹⁶ with an average weight gain of 30.35gms/day, Gupta M et al¹⁵ with an average weight gain of 23gms/day. Cattaneo A et al⁶ found the average weight gain to be 21.3gms/day and Ghatwala G et al⁸ 21.92gms/day. In the study conducted by Bhavana D et al¹⁷ the average weight gain in their KMC group was 15.731gms/kg/day.

16. **Length of Hospital stay:** In our study it was seen that the length of hospital stay was 24.66 ± 8.82 days which was statistically significant with p value < 0.01 and it was shorter for female babies than male babies, babies weighing > 1800 gms and babies with POG 32-36weeks. It was also seen that the mothers who were more educated had shorter duration of hospital stay.

17. **Outcome :** In our study it was seen that most babies were discharged and only 6 babies took LAMA (5.7%) of which 3 were male and 3 female and 1 baby expired (1%). Only the expired baby had sepsis none of the babies who took LAMA had sepsis. The babies who took LAMA most belonged to the weight group of < 1500 gms (5 babies) and POG of 32-36weeks and 1 belonged to the weight group of 1500- 1800gms and POG of < 32 weeks. The baby which expired was a female baby, belonged to the weight group of < 1500 gms and POG of 32-36weeks.

V. Summary

Kangaroo Mother Care first suggested by Dr Edgar Rey and Martinez in 1978 is the care of Preterm or low birth weight infants carried skin-to-skin with the mother is not just a “cuddling, soft, warm thing” to do for the baby and mother but it is a therapy that accomplishes several benefits. In our study we tried to find out the benefits of KMC on the mother-baby dyad and found several beneficial effects of KMC on both mother and baby and the family as well. In accordance with our aims and objectives it was seen that in our study the KMC babies had .

1. **Better and earlier weight gain:** In our study it was seen that the KMC babies had better and quicker weight gain. It was seen that the mean birth weight was 1301.64 ± 261.78 gms and the mean weight gain was 288 ± 149 gms the average weight at discharge was 1508 ± 117 gms. This weight gain was more in the babies weighing < 32 weeks with an average weight gain being 431 ± 115 gms and in babies < 1500 gms with an average weight gain being 331 ± 134 gms. This helps us understand that due to prolonged skin-to-skin contact between the mother and her preterm or LBW infant KMC provides effective thermal control and is associated with a reduced risk of hypothermia. It also promotes physiologic stability, facilitates adaptation to the stresses of prematurity and low birth weight, and also help the infant’s brain mature and develop. Furthermore, by preventing sepsis, ability to maintain better physiological profile and bonding the babies gained weight quicker and earlier.

2. **Reduced episodes of apnea, hypoglycaemia and sepsis :** In this study it was seen that only 6 babies had apnea. It is seen that skin-to-skin contact helps to lessen stress, crying, and has helped in more settled sleep in the infant. Babies breathe better as the oxygen saturation is more stable and therefore have lesser apneic attacks. There were no episodes of hypoglycaemia in our study (mean RBS on Day 7 of KMC was 66.62 ± 5.56 mg/dl)

and only 4.8% incidence of sepsis was seen after the babies were put under KMC. Neonates exposed to skin-to-skin contact had better blood glucose control and KMC protected against nosocomial infections. Even after discharge from the hospital, the morbidity amongst babies managed by KMC is less. KMC is associated with reduced instances of severe illness including pneumonia during infancy. Therefore, there is reduced morbidity post discharge as well.

3. Better growth in length and Head Circumference :In our study it was seen that there was significant increase in length and HC which was earlier and faster in the KMC babies. The length increased from 45.59 ± 1.93 cms to 46.15 ± 1.97 cms and the HC increased from 31.92 ± 1.66 cms to 32.57 ± 1.58 cms.

4. Better temperature handling and better physiological parameters like stable HR and RR: In our study it was also seen that none of the babies in KMC had hypothermia or bradycardia /tachycardia or bradypnea/tachypnea. It has been seen that skin-to-skin contact stabilizes heart rate in the neonate and by prolonged skin-to-skin contact between the mother and her preterm or LBW infant KMC provides effective thermal control and is associated with a reduced risk of hypothermia. In our study the cases maintained all these physiological parameters well within range and also had better handling of all these parameters. It was seen that the recorded temperatures was 36.56 ± 0.11 °C, mean HR was 140.83 ± 10.73 beats/min and mean RR was 56.38 ± 1.64 beats/min towards the end of the first week of KMC.

5. The mothers had better lactation felt happier and there was better family acceptance towards rearing a low birth weight or preterm neonate :

In general it is seen that there is anxiety and apprehension amongst the mothers and family members as to the well being of a preterm or LBW neonate. They are worried regarding handling such a baby especially if the mother is a primiparous mother. However, once into KMC it was observed that the mothers has more confidence in holding their babies in KMC position and their lactation improved. Breastfeeding starts more easily because more breast milk is produced and as a result, babies gain weight faster. Better brain and emotional development has been observed in babies getting skin-to-skin contact. The mothers were more involved in handling their babies like changing diapers, oiling, and changing clothes of their babies. It was also observed in our study that the family members too had ready acceptance of the procedure and were more encouraging towards it. They expressed willingness to carry the baby in KMC position even when the mother was sick and also felt positive towards continuing it at their homes. Mothers practicing KMC are less stressed during kangaroo care as compared to a baby kept in incubator. They report a stronger bonding with the baby, increased confidence and a deep satisfaction that they were able to do something special for their babies. Fathers felt more relaxed, comfortable and bonding while providing KMC. Parents especially mothers are less depressed. Both parents and baby gets more sleep and so they become calmer. The fathers too were accepting of the procedure and were willing to participate as well. KMC provides emotional healing and they cope better even in the NICU.

6. Mortality was also reduced in the babies receiving KMC:

In our study it was seen that there was only 1 case which expired after going into KMC, it was a outborn baby and had developed sepsis during KMC. This was about 0.9% which was a very encouraging and positive impact of KMC on preterm and LBW mortality. Overall, KMC had a beneficial impact in improving the mortality and morbidity profile of the neonates, is socially acceptable and also cost effective and if further analyzed can be extended to the community as well.

VI. Conclusion

We therefore conclude that KMC is a very useful method of caring Preterm or LBW babies and in preventing neonatal mortality and morbidity in our set up. It can be considered the epitome of wellness, and naturalistic orientation to the care of premature / low birth weight infants. They are more alert when they are awake and hence can usually go home earlier. Better brain and emotional development has been observed in babies getting skin-to-skin contact. In terms of benefits to the mother KMC is seen to create more confident mothers in handling their babies and it has a more positive impact to create a healthy environment for the growth of a premature and low birth weight infant. Other advantages are the low cost to the family and health sectors in terms of treatment and hospital stay.

As the sample size in our study is small (105) and it is a hospital based observational study the generalization to community cannot be made. Since the study was not comparative, a future study with a larger sample size and a comparative study between KMC and CMC (Conventional Method of Care), is necessary to observe more reliable effect on the mortality and morbidity of neonates in our set up.

Therefore, further study into the benefits of KMC and more awareness about this practice into the common population can help extend the benefits of KMC into the community.

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