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Original Article

Paediatrics Section

Impact of Gestational Age on Weekly Weight Gain in Preterm Low Birth Weight Infants Undergoing Kangaroo Mother Care in a Tertiary Hospital: A Prospective Cohort Study

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ABSTRACT

Introduction: Kangaroo Mother Care (KMC) fosters the well-being of babies by promoting temperature control, ease of breast-feeding, and strengthening the bond between mother and baby. Rarely any comparative analysis between preterm child receiving KMC of different Gestational Age (GA) groups and their subsequent weight gain has been conducted. This study tried to fulfill this gap.

Aim: To observe differential weight gain in different GA groups (28-32, 32-35 and 35-37 weeks) of preterm child receiving KMC and thus establishing an association between GA and postnatal weight gain in preterm babies receiving KMC.

Materials and Methods: The present prospective cohort study was done in Chittaranjan Seva Sadan College of Obstetrics, Gynaecology and Child Health, a Tertiary Hospital in Kolkata,West Bengal, India, from June 2021 to May 2022. Data on Low Birth Weight (LBW) babies weighing <2.5 kg, between the GA of 28-37 weeks, was collected from Sick Newborn Care Unit (SNCU), Neonatal Intensive Care Unit (NICU), postnatal ward and follow-up clinic over a period of one year. Sample size calculated as 242. Mothers were counselled to perform at least 1.5 hours of KMC per sitting in 3-4 sittings per day. The weights were recorded every week until the babies attained a weight of 2.5 kg. Analysis of the data was done with IBM Statistical Package for Social Sciences (SPSS) Statistics for Windows, Version 22.0. Armonk, NY: IBM Corp. 2013 and Graph Pad Prism version 5. The categorical variables were analysed with the help of required non-parametric test (viz., Anderson-Darling test) and continuous variables were analysed with the help of required parametric test (viz., Analysis of Variance (ANOVA). Repeated measures ANOVA was done to assess changes of weight gain. The level of significance was considered as 95% of confidence interval. So, p-value<0.05 was considered as statistically significant.

Results: It was seen that weight gain in 28-32 weeks GA group was less in the initial 2-3 weeks compared to babies of higher GA (32-35 weeks and 35-37 weeks) group while in the later weeks (5th weeks onwards) the weight gain in this 28-32 week GA group was more than the other groups, which was statistically significant with p=0.003.

Conclusion: It was observed that babies more premature, they showed lesser percentage of weight gain and daily weight gain for first four weeks of their postnatal life. But following that these smaller babies showed more weight gain compared to their counterparts.

Keywords: Absolute weight gain, Breast feeding, Morbidity, Neonatal adaptation, Neonatal nursing, Postnatal period, Skin to skin contact

INTRODUCTION

Low Birth Weight (LBW) is one of the major causes of high neonatal mortality, particularly in developing countries like India. Hence, LBW babies require special care and interventions to improve their survival rate [1]. In developing countries, due to limited advanced interventions, financial constraints, lack of trained staff and ill-equipped infrastructure, it is difficult to achieve this task.

To overcome these problems KMC was introduced in 1978 in Columbia [2]. It is a simple and effective modality to ensure baby's needs of warmth, stimulation and safety. It fosters the well-being of the babies by promoting temperature control, ease of breast feeding, and strengthening the bond between mother and baby. This intervention helps easy transition and adaptation of a newborn to the external environment [3]. It can be easily administered at any set-up, staff can be trained easily, does not require advanced facilities or equipment and can be also be continued at home. Newborns who receive KMC soon after birth suckle more effectively at breasts which thus increase milk production and enhance weight gain [2].

The major components of KMC are:

1) Skin to skin contact;

2) Exclusive breast feeding;

3) Early recognition and response to complication [4].

KMC can be: a) Continuous- where skin to skin contact between baby and mother exceeds 12 hours per day; or b) Intermittent/ short- The skin to skin contact is for shorter periods in the day. At least 60 minutes per sitting for 3-4 sittings/day [5].

KMC procedure: Baby is placed naked over the bare chest of the mother in between the breasts in an upright position. An open gown or loose blouse is wrapped to hold the baby. Mother can sit or sleep in a propped-up position so that the baby remains upright. Baby can suckle at the breasts as often as he/she can. If environmental temperature is low then baby can have extra clothing to ensure warmth. Despite the said advantages of KMC, it is still not a widely practised method of care of LBW infants in India [6]; also, there is insufficient data regarding the effect of KMC on growth

parameters, acceptability of kangaroo care and long-term outcomes [7]. Data on the relationship between weight gain and GA, or weight gained in babies born in different groups of GA is fairly limited. There is no exhaustive database in this regard and more research work could be directed towards this gap. At present, the prevalence of LBW in India is 18.6% which contributes to about 40% of the global burden [8]. India has the dubious distinction of having the second highest incidence of LBW babies in the South-East Asia region. In India, an estimated 12% and 18% of children were LBW and PTB, respectively, in 2019-21 [9]. These infants are anatomically and functionally immature, and therefore their neonatal mortality is high. The KMC provides a cost-effective and easily practicable prevention strategy against morbidities and mortalities in such infants. It was known fact that neonates born at term or near term (i.e., more advancing gestation) is having more daily or weekly postnatal weight gain when compared to preterm neonates born at early part of gestation [7] So, a positive correlation was expected between advancing GA and weekly weight gain in babies receiving KMC.

The aim was to study the association of GA with weekly absolute and percentage weight gain in preterm children receiving KMC. In the present study, preterm neonates (28-37 weeks) were divided in 3 subgroups (28-32, 32-35 and 35-37 weeks of gestation), and weekly weight gain in terms of absolute and percentage weight gain were measured in each group; so that GA can act as predictor of weight gain in postnatal life. Here, percentage weight gain means the weight gained every week is calculated as a percentage of the birth weight for each neonate. Percentage weight gain (weekly)= (weight gain per week/birth weight) × 100. Birth weight is considered as baseline weight.

MATERIALS AND METHODS

The present prospective cohort study was done in the post-natal ward, SNCU, NICU, and follow-up clinic at Chittaranan Seva Sadan, College of Obstetrics, Gynaecology and Child health, a Tertiary Hospital in Kolkata, West Bengal, India, from June 2021 to May 2022, after obtaining ethical clearance from ethical committee. Ethical clearance number was- CSS/Esst/328/2021. Timeline for each subject was from birth till they attained a weight of 2.5 kg.

Sample size calculation: Study population consisted of neonates with birth weight less than 2.5 kg. Sample size was calculated to be 242, assuming absolute precision as 5% so the sample size was taken as 249. Value is based on the formula of sample size for proportions and prevalence as follows:

$n= 4pq/l2$

where, n= sample size; p= estimated prevalence or proportions of project area; q=1-p; l=allowable error.

At present, the prevalence of LBW in India is 18.6% as reported by Ramesh S et al., in 2020 [8].

Feeding practice: Feeding of the newborn was initiated based on their clinical condition and GA. Initially, preterm child was given expressed breast milk by orogastric tube or by paladi. Then they are gradually shifted to breast feeding depending on improvement of clinical condition as well as advancing neurological maturity.

Inclusion criteria:

- Neonates with birth weight less than 2.5 kg;
- GA less than 37 weeks;
- GA more than 28 weeks.

Exclusion criteria:

- GA more than 37 weeks;
- GA less than 28 weeks;
- Birth weight more than 2.5 kg;
- Any neonate currently on Continuous Positive Airway Pressure (CPAP) or Non-invasive Ventilation (NIV);
- Any haemodynamically unstable neonate (from sepsis, shock, birth asphyxia, respiratory distress syndrome);
- Consent for study not given.

Study Procedure

Neonates with birth weight less than 2.5 kg and GA between 28 to 37 weeks were incorporated in the study according to inclusion and exclusion criteria. Cases that did not turn up to follow-up clinic following discharge were followed up via phone calls and subsequent home verification.

Birth weights of neonates admitted in NICU and SNCU were recorded using an electronic weighing machine manufactured by Weighing India Corporation, Kolkata, India (Model no WICT, Serial no 18068589) with a sensitivity of ±10 grams. GAs of the neonates was calculated using New Ballards scoring [10].

Mothers were counselled to perform KMC for 1.5 hours [4] per sitting and perform 3-4 sittings a day for the period of study. It was tried to perform KMC for total 4-6 hours at least in a day. The duration of KMC was noted every day and adherence was monitored daily in the hospital and over phone for the discharged patients. The authors tried their best to minimise bias on this respect. They were trained in doing KMC and counselled adequately so that they can continue KMC at home. They were reviewed in follow-up clinic every week to record the weight. The weights were recorded every week until said neonates attain a weight of 2.5 kg. The neonates were evaluated in the follow-up clinic after discharge. The weekly percentage weight gain was calculated for the respective GA groups, where weight gain every week was calculated as a percentage of the birth weight of each neonate.

Mothers, in a language they can easily understand, were counselled to perform KMC as follows:

- The mother will sit in a KMC chair or any chair that allows her to be in a reclining position;
- Mother can wear any front open dress as per local culture;
- The neonate should be placed between the mother's breasts in an upright position;
- The head should be turned to one-side and kept in a slightly extended position;
- The hips should be flexed and abducted in a "frog position", the arms should also be flexed. Baby's abdomen should be at the level of the mother's epigastrium;
- The mother will be explained how to breastfeed while the neonate is in KMC position;
- The mothers were instructed to perform 1.5 hours KMC per sitting and 3-4 sittings in a day (4 to 6 hours KMC per day) [4].

STATISTICAL ANALYSIS

The data was entered into the Microsoft excel enterprise 2007/2010 spreadsheet. The analysis of the available data was done by using

IBM SPSS Statistics for Windows, Version 22.0. Armonk, NY: IBM Corp. 2013 and Graph Pad Prism version 5. The categorical variables were analysed with the help of required non-parametric test and continuous variables were analysed with the help of required parametric test (viz., ANOVA). Repeated Measures ANOVA was done to assess changes of weight gain. The level of significance was considered as 95% of confidence interval. So, p-value <0.05 was considered as statistically significant.

RESULTS

The 249 babies in the sample were divided into three groups according to GAs as shown in the [Table/Fig-1]. 68 babies were of GA 28-32 weeks, 96 babies at 32-35 weeks and 85 babies were in the 35-37 GA group.

Birth weight	Frequency	Percentage	Cumulative percentage
28-32 weeks	68	27.3	27.3
32-<35 weeks	96	38.6	65.9
35-37 weeks	85	34.1	100.0
Total	249	100.0	

[Table/Fig-1]: Distribution of study population in terms of prematurity. {Cumulative percenatge= (cumulative frequency)/(total number of observations)×100}

Distribution of birth weight in the sample population is shown in [Table/Fig-2] with mean weight 1.64 kg and SD 0.444.

GA	Frequency	Percentage	Cumulative percentage
less than 1 kg	16	6.4	6.4
1- <1.5 kg	84	33.7	40.2
1.5- <2 kg	85	34.1	74.3
2-2.5 kg	64	25.7	100.0
Total	249	100.0	

[Table/Fig-2]: Distribution of birth weight (in kgs) among the study population (n=249). {Cumulative percenatge= (cumulative frequency)/(total number of observations)×100}

A total of 140 (56.2%) of the sample population were female and 109 (43.8%) were male. In the 1st week, babies in all GA groups showed weight loss. This weight loss was more in babies of 28-32 weeks of gestation compared to other GA groups. From 2nd week onwards, the babies of all GA groups are showing gradual gain in weight, but babies of 28-32 weeks of GA have shown lesser weight gain as compared to babies born in other GA [Table/Fig-3].

Gestational Age (GA) group	Weight changes in grams					
	28-32 weeks		32- <35 weeks		35-37 weeks	
	1st week	2nd week	1st week	2nd week	1st week	2nd week
Mean	-114.25	64.39	-87.66	109.01	-30.09	130.12
Standard deviation	59.6	64.09	78.85	84.34	97.92	95.43
Median	-120.00	60.00	-90.00	110.00	-50.00	140.00
Interquartile range (IQR)	67.50	80.00	80.00	90.00	140.00	112.50
Minimum	-250.00	-100.00	-300.00	-150.00	-240.00	-140.00
Maximum	30.00	230.00	170.00	330.00	210.00	340.00

[Table/Fig-3]: 1st and 2nd week weight change (in grams) in different Gestational Age (GA) group.

Similar to 2nd week, same trend was observed in 3rd and 4th week of postnatal age. The babies receiving KMC in group of GA <32 weeks showed lesser absolute weight gain when compared to babies born in GA of 32-35 weeks and 35-37 weeks [Table/Fig-4]. Follow-up for this study was done till the babies attained weight of 2.5 kg, longest duration being 12 weeks.

Gestational Age (GA) group	Weight changes in Grams					
	28-32 weeks		32- <35 weeks		35-37 weeks	
	3rd week	4th week	3rd week	4th week	3rd week	4th week
Mean	132.86	166.79	160.70	183.31	173.71	187.96
Standard deviation	46.51	37.22	60.07	71.85	83.26	89.12
Median	130.00	170.00	160.00	190.00	190.00	205.00
Interquartile range (IQR)	40.00	50.00	70.00	65.00	55.00	80.00
Minimum	15.00	30.00	-20.00	-120.00	-120.00	-140.00
Maximum	340.00	230.00	350.00	340.00	380.00	360.00

[Table/Fig-4]: 3rd and 4th week weight change (in grams) in different Gestational Age (GA) groups.

Beyond the 5th week, the weight gain in the GA group of 28-32 weeks surpassed that of the GA groups 32-34 weeks and 34-37 weeks as shown in the table below. Babies born in GA group of 28-32 weeks showed higher gain in weight (245.34±41.3 grams) than 32-35 weeks group (210.22±80.38 grams) and 35-37 weeks (183.68±121.1 grams). These differences of means were not statistically significant at 5th week (p=0.081, F=2.547), but statistically significant with F(2,141)=6.144, p=0.003 at 6th week [Table/Fig-5].

Gestational Age (GA) group	Weight changes in grams					
	28-32 weeks		32- <35 weeks		35- 37 weeks	
	5th week	6th week	5th week	6th week	5th week	6th week
Mean	205.16	245.34	215.00	210.22	180.47	183.68
Standard deviation	62.00	41.3	66.85	80.38	105.3	121.1
Median	220.00	245.00	230.00	220.00	210.00	230.00
Interquartile range (IQR)	60.00	30.00	60.00	80.00	97.50	170.00
Minimum	-120.00	140.00	-30.00	-130.00	-180.00	-100.00
Maximum	240.00	300.00	220.00	330.00	250.00	260.00

[Table/Fig-5]: Absolute weight change per week in grams in different Gestational Age (GA) groups in 5th and 6th week.
Test employed- Repeated measures ANOVA (Analysis of Variance); p-value <0.05 was considered as statistically significant

In terms of percentage of weight gain the babies in group of GA <32 weeks during showed relatively less weight gain percentage during initial two postnatal weeks than 32-35 weeks and 35-37 weeks. But during later half from 5th; week onwards they showed improvement in weekly weight gain (14.72±4.7%) than 32-35 weeks group (11.31±3.5%) and 35-37 weeks (8.39±5.1%). Similar results were observed in 6th week also which are tabulated in [Table/Fig-6]. These differences of means were statistically significant with F (2,208)= 25.193 at 5th week and 32.880 at 6th week, respectively, p <0.001 at both 5th and 6th week [Table/Fig-6].

DISCUSSION

It is a known fact that KMC helps in weight gain of preterm babies and reduces infant morbidity and mortality [3,4]. After doing an extensive literature search, it was not found to have any comparative analysis between preterm child receiving KMC of different GA groups and their subsequent weight gain. This study tried to fulfill this gap. This study has observed different pattern of weight gain in preterm neonate receiving KMC based on their GA.

Gestational Age (GA) groups	Percentage weight changes in Grams					
	<32 weeks		32- <35 weeks		35- 37 weeks	
	5th week	6th week	5th week	6th week	5th week	6th week
Mean±Standard deviation	14.72±4.7	15.14±3.6	11.31±3.5	10.05±4.4	8.39±5.1	7.55±5.8
Median (Interquartile range)	15.40 (4.29)	15.24 (3.07)	11.57 (3.54)	10.31 (4.80)	9.83 (4.58)	9.84 (10.85)
Minimum	-9.09	0.00	-1.41	-7.10	-8.78	-4.55
Maximum	22.94	22.22	21.54	23.76	17.95	15.65

[Table/Fig-6]: Percentage weight change per week in different Gestational Age (GA) groups.
Test employed repeated measures ANOVA (Analysis of Variance); p-value <0.05 was considered as statistically significantl; F (2,208)= 25.193 at 5th week and 32.880 at 6th week, respectively

Thus, it was attempted to establish statistical correlation between GA of the babies and amount of weight gain (both absolute and percentage weight gain) during every week. It was seen that although weight gain in 28-32 weeks GA group was less in the initial four weeks compared to babies of higher GA, in the later weeks the weight gain in this 28-32 week GA group was more than the other groups. The study showed that GA and weight gain had statistically significant correlation in beyond the fourth postnatal week. These findings open up scope for a large scale multicentric study for further conclusion.

This study could help in predicting the duration of hospital stay and the duration of KMC required by LBW babies of different GAs and weights (to acquire the weight of 2.5 kg). It is evident that most of the related studies have reported weight change on daily basis, but there is scarcity of data, especially in Indian references. Only one study by Wahlberg V et al., has reported weekly weight change in babies receiving KMC and according to their data KMC group had weekly weight gain of 237.48±96.4 gm which is consistent to the present study result [11]. McMaster P et al., showed weight gain of 9.80 gm/day in KMC group which is similar to the data collected in this study on weekly basis [12]. In 2020, Ramesh S et al., reported that babies who received KMC had a better weight gain and shorter duration of hospital stay compared to those that received conventional care [8].

In 2018, Chowdhury RM et al., reported that KMC affects both start of weight gain and birth weight regain significantly. In this study, at 40 weeks corrected GA, neonates receiving KMC showed significantly higher daily weight gain than standard care group [13]. In 2017, Phirke Deepa S et al., reported that the chances of gain in weight increased with increase in duration of KMC. There was significant increase in the temperature and SpO_2 and decrease in HR and RR after KMC in majority of babies [14].

In 2009, Subedi K et al., reported that KMC shows early and good weight gain in LBW babies. It is simple, low-cost technique and well acceptable by mother and family and can be continued at home [15]. Studies mostly focus on effects of doing KMC against those babies not receiving KMC. But, effects of doing KMC in between preterm child of different GA and subsequent pattern of weight gain in babies of different GA was not done before. There is no data on comparative observations in different GA groups receiving KMC. While most studies have focused on effects of KMC versus conventional care, the present study has attempted to observe effects of KMC in different GA groups of LBW babies.

Limitation(s)

The present prospective observational study was conducted in a single centre, hence, it has its own kind of limitations due to study design. More sample size with multicentre study could have reflected the population more accurately. Also, the study result may be influenced by some confounding factors like extreme LBW, sepsis or birth asphyxia. As more preterm neonates (in 28-32 weeks GA group) are having less birth weight and they are expected to have more stormy neonatal period like feed intolerance, more chances of having sepsis, shock, birth asphyxia and hyaline membrane disease; which may be the reason of reduced weight gain in early stages of neonatal period. Haemodynamically unstable (from sepsis, shock, birth asphyxia, respiratory distress syndrome) child were not included in this study. Apart from this, matching is done in all groups with respect to presence of feed intolerance, sepsis, neonatal jaundice and other comorbidities.

CONCLUSION(S)

In the present study, it was evident that during the first four weeks after birth, the differences in weight gain in the babies of GA group were not significant. Though, babies those were more premature i.e., 28-32 weeks, showed less weight gain compared to the other GA groups of 32-34 and 34-37 weeks. However, beyond the 4th post-natal week, these babies of 28-32 weeks of GA showed more weight gain when compared to the other GA groups. Hence, the authors conclude that if KMC is administered to LBW babies, the more premature babies will show greater weight gain with increasing post-natal age.

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