

Research Article

Evaluation of Kangaroo Mother Care for Low-birth-weight Newborn in the Community Settings

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Abstract

Objectives: Kangaroo mother care (KMC) is an evidence-based strategy to lower infant mortality. However, its implementation is poor. The purpose of this study is to evaluate KMC practice by mothers to their low-birthweight (LBW) newborn at home on their weight outcome in rural community. This would be beneficial in planning and executing necessary intervention in this area for LBW newborn's better health outcomes. **Methods:** This was a community-based prospective study conducted in six health sectors of the Chhuria Block of Rajnandgaon District, Chhattisgarh. 150 mothers who have LBW newborn were included in the study and were provided with a KMC bag along with a demonstration on its usage. They were encouraged to practice KMC for at least 8 hours per day. Project field staff collected data manually on KMC practice and weight gain in LBW babies through a structured questionnaire. Data was analyzed using Statistical Package for the Social Sciences (SPSS) version 22. **Results:** The mean age of mothers with LBW was 25.16±3.63 years, while the mean birth weight of LBW newborn at the time of delivery was 2.22±0.21 kg. Females outnumbered male LBW newborns (ratio=1.11: 1). The time for skin-to-skin contact was 7-9 hours per day in 86.7% of cases. After the first five days of KMC practice, there was a weight gain of 0.243±0.055 kg; 0.258±0.037 kg for days five to ten; and 0.243±0.046 kg for days ten to fifteen.

Keywords

Kangaroo Mother Care, KMC, Low-birthweight, LBW, Community, Chhattisgarh

1. Introduction

Newborns weighing less than 2.5 Kg are referred to as low-birth weight (LBW) babies [1, 2]. A disproportionate amount of LBW is seen in low- and middle-income countries, where more than 95% of all LBW newborns are born [3]. It is a serious public health concern, particularly for individuals living in rural regions and in the lower socioeconomic strata [4]. Asia has the greatest prevalence of LBW, ranging from 21% to 28%

[5]. The prevalence of LBW in India varies from 10% in areas with high socioeconomic status to 56% in areas with poor socioeconomic status [6]. In their study, Apoorva et al. found that in Indian rural populations the percentage of LBW babies was higher [7].

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Health Organization (WHO) estimates that 27.4% births in India have LBW [8, 9]. However, the National Family Health Survey 2019–21 (NFHS–5) of India indicates that 16.4% of Indian births are LBW while in Chhattisgarh its 15.2% [10]. These newborns with LBW have a higher chance of dying in the first month of life, and those who survive have a higher likelihood of facing lifelong issues like lower IQ, limited growth, developmental difficulties, and the development of chronic illnesses into adulthood like diabetes and obesity [11, 12]. The 2020 statewide rural infant mortality rates in India clearly states that Chhattisgarh has the second highest rural infant mortality rate in India [13].

Numerous studies conclude that kangaroo-mother-care (KMC) improves neonatal survival particularly in LBW infants, and these results have led to the widespread acceptance of KMC implementation [14–16]. KMC involves the practice of providing skin-to-skin-contact (SSC) between a mother and her LBW neonate and exclusive breastfeeding [17]. Both SSC and exclusive breastfeeding are critical for these newborns' nutritional demands and thermal regulation.

In one study, KMC participants' SSC durations ranged widely, with a mean of 5.2 hours per day [18]. Review of 27 research studies covering approx. 12000 newborns summarized that KMC should be given for a minimum of 8 hours per day [19]. According to new recommendations published by WHO in 2022, LBW newborns' mortality rates can be significantly lowered by using KMC right after delivery and early breastfeeding initiation [20]. Therefore, regardless of the place of delivery, implementing KMC for all newborns with LBW could significantly lower neonatal and infant mortality. Additionally, KMC offers numerous advantages to both the baby and the family members who are actively involved in the baby's care. These advantages include increase in breastfeeding rates, weight gain, length and decreased chance of hospital-acquired infections, harmful bacterial colonization, hypothermia and hypoglycemia. It also leads to protection of the neuromotor and brain development of babies, and enhanced mother-baby bonding [21–23].

KMC also lowers the demand for the more expensive conventional medical care (CMC) in healthcare facilities and can shorten the hospital stay of infants and reduces hospital-related expenses of parents which are advantageous to the larger community [24]. Because KMC doesn't require technology or electricity, it can be delivered in environments with low resources also [25]. Randomized control trials analyzing the cost-utility relationship also have shown positive outcome for KMC [26, 27].

Based on the information at hand, KMC appears to have a comparative advantage over CMC, particularly in terms of enhancing LBW newborn's survival, endorsing exclusive breastfeeding, encouraging early hospital departure, and diminishing economic burden for parents as well as hospitals and communities. Numerous developing nations have started implementing national plans to expand KMC services to strengthen newborn's health. This study aims to assess the data on KMC

practices and weight gain in LBW newborns by providing KMC care in rural communities.

2. Materials and Methods

This was a community based prospective study where a total of 150 mothers with LBW newborn were recruited for KMC bag for 5 months in six health sectors of Chhuria Block of Rajnandgaon District, Chhattisgarh. Newborns whose birth weight was less than 2.5 kg were identified and recruited, and their mothers were provided with KMC bags as soon as they were available at home. The mothers also gave voluntary informed consent for their participation. The trained Accredited Social Health Activist (ASHA) workers and project field-staff demonstrated, supervised, and supported the mother to promote KMC practice for at least 8 hours every 24 hrs. In some places, other motivated family members also participated for additional hours of KMC practice.

KMC Foundation of India has designed KMC bag. For our field study, straps were provided for adjustment of height and size. It has ensured that this KMC bag can accommodate newborns of all sizes. Good quality absorbent cotton flannel cloth was used for making KMC bags. They were autoclaved and neatly packed in non-breathable fabric packets. Use of KMC bag was demonstrated at home ensuring reclining head position. The KMC combined with hygienic measures and hand wash techniques, was taught to mothers and caregivers. Each mother was provided with 4 sets of KMC bags.

Follow up weight measurements were carried out every 5th day for over two weeks of the study period using a psalter scale. Weight measurement was carried out on each occasion by the ASHA workers under supervision of project field staff. A random counter check was conducted by sector coordinators. Project field staff collected data through a structured questionnaire. The study was carried out in accordance with the protocol and with principles enunciated in the Declaration of Helsinki and the guidelines of Good Clinical Practice (GCP).

An adjusted analysis using logistic regression was performed to isolate the effect of weight gain by KMC practices from the potential confounding effects of exclusive breastfeeding. Additionally, a dose-response analysis of the exposure to KMC practices was also conducted to further understand the relationship between the duration or intensity of KMC and the outcome of weight gain.

3. Results

A total of 150 LBW babies and their mothers were recruited in this study from Kumardaha, Umarwahi, Chinchola, Khoba, Buchatola and Gaidatola health sectors of Chhuria Block of Rajnandgaon District, Chhattisgarh.

Among these, 89.33% (n=134) mothers belonged to families below poverty line. About half of the mothers (50.67%) had studied up to tenth class and 37.16% had studied up to

twelfth class. The mean age of mothers with LBW was 25.16 ± 3.63 years, while the mean birth weight of LBW newborn at the time of delivery was 2.22 ± 0.21 Kg. Out of all LBW newborns, 53% (n=77) were females and 47% (n=69) were males. 74.7% (n=112) of mothers had not practiced KMC in their previous pregnancies. [Tables 1 and 2](#) shows the current KMC practice total time in hours and frequency by day in last 15 days.

Table 1. Current KMC practice in hours per day.

Time for KMC per day	Number of cases (%)
<3 hrs	1 (0.66%)
3-5 hrs	3 (2%)
>5-7 hrs	16 (10.66%)
>7-9 hrs	130 (86.66%)

Table 2. Current days of KMC practice.

Days of KMC practice	No. of cases (%)
1-4 days	28 (18.7%)
5-9 days	14 (9.3%)
10-14 days	39 (26%)
15 days	69 (46%)

The mothers received information about KMC first from project field-staff in 61.3% (n=92) cases and by ASHA and Mitanin in 24.7% (n=36) cases. However, the technique to bag and use the bag was taught to 97.9% (n=147) mothers by project staff, ASHA and Mitanin. All the mothers liked the KMC bag, washed their hands as per the procedure before giving KMC and felt that the baby was safe during the practice. Benefit of KMC to mothers and children was felt by 88% (n=132) mothers. Only 33.3% (n=50) mothers who delivered in hospitals were advised to practice KMC. KMC bag was used exclusively by 90.7% (n=136) of mothers, 86.66% (n=130) mothers practised KMC for 7-9 hours per day, 46% (n=69) mothers practised it for 15 days and 96% (n=144) mothers felt that this made breastfeeding easier.

KMC was started from the first day of delivery by 34% (n=51) mothers, 24% (n=36) started it on second and third day and 34.7% (n=52) mothers started it after 3rd day but within one week. KMC was also provided by father or grandmother of newborns in 67.4% (101) of the cases.

Knowing the benefits, 62% (n=93) mothers were ready to provide KMC for three months and 32.7% (n=49) for one month. The time for SSC was 7 to 9 hours per day in 86.7% (n=130) of cases and in 10.7% of cases it was 5 to 7 hours. Weight gain after practising KMC for first 5 days was 0.243 ± 0.055 Kg; for the fifth to tenth days was 0.258 ± 0.037 Kg; and for tenth to fifteenth day was 0.243 ± 0.046 Kg. The mean birth weight gained during 15 days of KMC was 49.6 ± 9.2 grams/day. The mean birth weight of LBW babies, their weight on 1st day, on 5th day, 10th day and 15th day of initiation of KMC practice are shown in [Table 1](#).

Table 3. Weight of LBW Newborns.

Characteristics	Minimum	Maximum	Mean	Std. Deviation
Birth weight (in Kg)	1.4	2.48	2.224	0.216
Weight on 1st day of KMC (in Kg)	1.4	2.7	2.204	0.228
Weight on 5th day of KMC (in Kg)	1.42	3	2.447	0.283
Weight on 10th day of KMC (in Kg)	1.634	3.3	2.705	0.320
Weight on 15th day of KMC (in Kg)	1.7	3.8	2.948	0.366

Dose response equation derived have been shown in [Table 4](#). KMC practice per day was divided into four categories for the purposes of dose response analysis: 1=less than three hours per day, 2=three to five hours per day, 3=more than five

to seven hours per day, and 4=more than seven hours per day. In a same manner, the number of days spent practicing KMC was divided into three categories: 1=less than five days, 2=five to ten days, and 3=more than ten days.

Table 4. Dose response equation derived.

Details	Equation
Equation Form	$*Y = \text{Min} + \frac{\text{Max} - \text{Min}}{1 + \left(\frac{X}{\#ED50}\right)^{\text{Hill coefficient}}}$
Equation derived for weight gain with KMC provided in hours / day	$Y = 223.9482 + \frac{1272.0159 - 223.9482}{1 + \left(\frac{X}{3.8633}\right)^{-7.3043}}$
Equation derived for weight gain with days of KMC provided	$Y = 602.864 + \frac{19067.7969 - 602.864}{1 + \left(\frac{X}{4.0171}\right)^{-15.0435}}$

*Y= Weight gain n LBW newborns #ED50 =Median Effective Dose

The details of adjusted analysis using logistic regression to isolate the effect of weight gain by KMC practices from the potential confounding effects of exclusive breastfeeding has been shown in [Table 5](#).

Table 5. Adjusted analysis using logistic regression details.

Details	Values	Inference
Omnibus Tests of Model Coefficients	P-value <0.05	Model is significant and adequately describes the data
Variance explained by the model	Cox and Snell R2=24% Nagelkerke R2=94.5%	Percentage change in the criterion variable can be accounted to the predicted variables in the model.
Hosmer and Lemeshow Test	P-value >0.05	This model has a good fit and adequately describes the dependent outcome (weight gain).
Contingency Table for Hosmer and Lemeshow Test	The observed and expected values are almost similar	Model adequately fits the data
Classification Table	Specificity=100% Sensitivity=99.3% Accuracy=99.3%	Model exhibits good sensitivity and indicates 99.3 PAC (Percentage Accuracy)
Variables in the equation	Regression co-efficient shows negative slope for 'Hours of KMC per day' Regression co-efficient shows positive slope for 'Days of KMC'	
	P-value >0.05 Odd's Ratio for 'Hours of KMC per day' >1 Odd's Ratio for 'Days of KMC' <1	

4. Discussion

Chhattisgarh has the second-highest rate of state-wise rural infant mortality in India [13]. Most of the mothers learned about KMC from project field-staff and they used the KMC bag exclusively and experienced that it made breastfeeding easier. The most frequent practical difficulty with the KMC bag was that it could not be donned on one's own without assistance from a family member. Almost half of the family

members were encouraged to support KMC, and they helped during the practice. About three-fourth of mothers reported requiring 4 bags daily. In 67.4% of cases, the newborn's grandfather and father also provided KMC.

In our study, 7 to 9 hours a day were allocated for SSC in 86.7% of the cases. In a recent meta-analysis, which included 30 relevant trials from 18 countries, the length of SSC for KMC varied greatly: the mean being 5.2 hours per day over 23 days during the postpartum phase [18]. However, another recent systematic review and meta-analysis which included 31 trials with 15,559 infants suggests that KMC should ideally be

administered for at least 8 hours every day [19].

In our study, everyone could not give 8 hours every day because of the need to engage in household chores and farming. In total 97.4% cases, SSC was more than 5 hours which was enough to decrease the harmful bacterial colonization. This decrease occurred after using KMC for at least six hours according to a study [28].

Almost all LBW newborns gained weight continuously during our study except in three cases. In one case the newborn had oral thrush which made it difficult for her to suckle breast milk during the first week. In second case, the mother's wound because of a caesarean section became infected and she could not perform KMC due to pain. In the third case, the newborn's umbilical cord stump was infected, and the baby could not be provided with KMC during the first week. However, in all these cases, help and advice were provided by project supervisors, field-staff, ASHA and Mitanins and the babies subsequently gained weight. According to a clinical trial, after the first week of life, the newborns in the KMC group gained more weight compared to the control group (15.9±4.5 gm/day) [29]. In our study, the mean weight gain per day was 49.6±9.2 grams/day during the 15 days period. The overall weight gain for full 15 days was 743.6±136.84g.

KMC practices in communities cannot be guided by a "universal" strategy. KMC is a multifaceted intervention, and its implementation is determined by unique set of local hurdles and facilitators in the community [30]. We recommend a more inclusive implementation of KMC practice in other health sectors of other blocks in Rajnandgaon district which will help to improve the weight gain of LBW newborns in this area.

5. Conclusions

When applied in rural community settings, KMC is successful at promoting the growth and health of LBW infants as evidenced by the improved weight gain. The research backs up the beneficial impact of KMC in enhancing low birth weight newborns' weight outcome beyond hospital settings. The successful incorporation of KMC in community greatly depends on the support of the management and leadership responsible for the company's management and leadership as well as its well-trained staffs. Additionally, parents of LBW newborns and other family members should be fully informed about and encouraged to practice KMC. Facilitating the implementation and scaling up of sustained KMC requires enhancing healthcare systems and communication, emphasizing LBW newborn's care in public health initiatives, and assisting healthcare providers, mothers, and their families as collaborators in care.

Abbreviations

ASHA Accredited Social Health Activist

CMC	Conventional Medical Care
GCP	Good Clinical Practice
KMC	Kangaroo Mother Care
LBW	Low Birth Weight
NFHS	National Family Health Survey
SPSS	Statistical Package for the Social Sciences
SSC	Skin-to-Skin-Contact
UNICEF	United Nations Children's Fund
WHO	World Health Organization

Author Contributions

Thomas Abraham: Data curation, Formal Analysis, Writing – original draft

Sridhar Ryavanki Prahlad: Conceptualization, Funding acquisition, Project administration, Resources, Validation

Gajendra Singh: Methodology, Supervision, Visualization, Writing – review & editing

Conflicts of Interest

The authors declare no conflicts of interest.

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