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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

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ABSTRACT

Objective: **To determine the effect of partial Kangaroo Mother Care (KMC) on growth rates and duration of hospital stay of Low Birth Weight (LBW) infants.**
Design: **Unblinded, randomised clinical controlled trial.**
Setting: **Kenyatta National Hospital, Nairobi, Kenya.**
Subjects: **Over a nine month period, consecutive recruitment of eligible LBW infants weighing 1000g to 1750g was done until a sample of 166 infants was reached.**
Intervention: **Kangaroo mother care was practised over an eight hour period per day for the intervention group while the controls remained in incubators or cots. Weight, head circumference, and mid upper arm circumference were monitored for all infants till discharge at 1800g.**
Results: **Of the 166 infants recruited 157 were followed up to discharge. Baseline characteristics were similar for the two groups except for mother's age, with the KMC group mothers having a mean age of 26.5 years while the control group mothers had a mean age of 24 years, (p = 0.04). The KMC group had significantly higher growth rates as shown by the higher mean weight gain of 22.5g/kg/day compared with 16.7g/kg/day for the control group, (p < 0.001); higher mean head circumference gain of 0.91cm/week compared with 0.54cm/week for the control group, (p < 0.001) and higher mean mid upper arm circumference gain of 0.76cm/week compared with 0.48cm/week for the control group, (p = 0.002). Although overall duration of stay was similar between study arms, when infants were stratified into those above or below 1500g KMC infants' duration of stay was significantly shorter than those in regular care. Using logistic regression, KMC was the strongest predictor for mean weight, mean head circumference and mean MUAC gain while mother's age (older) was the strongest predictor for mean duration of stay with KMC being an independent predictor of duration of stay.**
Conclusion: **Low birth weight infants in this cohort achieved rates of growth within the recommended intrauterine growth but babies managed using partial KMC grew faster and were thus discharged earlier than those on standard of care. Since partial KMC was beneficial, it should be fully implemented for all eligible infants.**

INTRODUCTION

KMC consists of three components: the Kangaroo position (skin-to-skin contact), the Kangaroo nutrition which is exclusive or nearly exclusive breastfeeding (breast milk fortification or preterm formula may be given whenever necessary), and Kangaroo discharge policies (early discharge with strict follow-up). In KMC the baby falls into a deep sleep, thereby conserving their energy for weight gain. Left alone on a warming table, a baby cries more and sleeps less. This results in better weight gain and shorter hospital stay (1).

Every year about 18 million babies are of low weight at birth and they 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. Monitoring of growth is essential (3). 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 (4,5,6,7,8). 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 (8). In Recife, Brazil the daily cost of US$20 per day compared favorably with the US$66 per day for incubator-based care (9).

Though KMC has revolutionalised care of LBW infants in other countries, it is a recent introduction at Kenyatta National Hospital (KNH) newborn unit and has not been fully implemented for all eligible LBW infants. To augment a preliminary study of Simiyu (10), the current study was carried out to assess the impact of KMC on duration of hospitalisation and growth rates of LBW. We chose to use partial KMC because a room for full implementation was not available.

MATERIALS AND METHODS

Setting: Neonatal care at the KNH newborn unit (NBU) is kind of level II with an admission of 120-150 infants per month. With this number of infants it is not unusual for babies to share an incubator or a cot. The study was conducted between June 2005 and March 2006.

Study design sampling procedure: Consecutive sampling of stable LBW infants with a weight of 1000-1750g was done until a total of 166 infants were recruited. The infant and mother pairs were the randomised into the KMC and control groups. For each group the babies were stratified into two weight categories: 1000g-1499g and 1500-1750g.

Intervention and follow up: Demographic data included: sex, birth weight, post conception age at admission, and corrected age at discharge for all babies and maternal age and education level.

During the first session, the mothers were shown how to place the babies in the kangaroo position and a cloth was then tied firmly enough to secure the baby. After the session, the mothers were shown how to safely move the baby back to the incubator or cot. KMC was practised for eight hours per day with babies being returned to the incubators or cots for the night.

All mothers in KMC were supervised during the sessions and both the baby and the mother were assessed for adaptation, which was considered complete when the mother was comfortable with the method and the baby was thriving as reflected by progressive growth. Mothers in both groups were encouraged to breastfeed or use expressed breast milk and where this was not possible; supplementation with formula milk was used only if the mother was not producing enough breast milk.

Weight was taken three times per week, while mid upper arm circumference and head circumference were done once a week. Any major illness after recruitment was recorded.

The infants were discharged on achieving a weight of 1800g provided they were gaining weight satisfactorily and had met the hospital's discharge criteria.

Data Analysis: Data collected from the study was coded and entered in the computer database for statistical analysis, which was done using the Statistical Package for Social Sciences. The mean weight gain and the mean duration of hospital stay were compared between the two groups using the t-test. This was done for the full sample and also separately for babies in each stratum of weight. Logistic regression was applied with the growth parameters and duration of hospital stay dichotomized into two groups as above and below median. Various factors were then entered into the model as potential predictors including mother's age, gestational age and randomization group. In this way, the effect of the Kangaroo method was examined even after controlling for possible confounders. Other differences that were analyzed were infection, mortality and breastfeeding rates between the control and Kangaroo groups. Differences were considered significant if $P<0.05$. Results were presented in tables as was appropriate.

Ethics: the study was reviewed and approved by the KNH/UoN ethical committee and mothers signed a written consent for participation in the study.

RESULTS

The study lasted nine months over which 157 of the 166 recruited infant-mother pairs were followed up

to discharge. All the dropouts (4 in KMC and 5 in controls) were due deaths as a result of illness. The KMC group had 85 infants while the control group had 81 infants. There were 86 (51.8%) males and 80 (48.25%) females. The two weight categories 1000-1499g and 1500-1750g had 85 and 81 mother/infant pairs respectively.

As shown in Table 1, baseline characteristics were similar for the two groups except for the mother's age, where the KMC group mothers were significantly older than controls(a mean age of 26.5 years versus 24 years in the control group), with a p value of 0.04. The rates of growth measured in this study (weight, head circumference and mid upper arm circumference) were all significantly higher in KMC compared with the controls (P = 0.001; P < 0.001; P =0.002), as shown in Table 2. The mean duration of hospital stay was shorter for the KMC group by 2 days compared to the control group though this was not statistically significant, (P =0.199).

We repeated the analysis comparing duration of hospital stay between the two study arms stratified by birth weight (1000-1499g and 1500-1750g weight categories (Tables 3 and 4). In the weight category 1000-1499g, the infants in the KMC group had a significantly shorter duration of stay of 21.8 days compared to the 26.3 days in the control group infants, (P =0.006) (Table 3). Similarly, in this weight category the KMC group infants achieved a higher mean weight gain of 23.6g/kg/d compared to 18.1 g/kg/d in the control group infants, (P < 0.001). The mean head circumference gain in the KMC group was significantly higher than that in the control group, 0.66 cm/week versus 0.4 cm/week, (P < 0.001). The mean MUAC gain in the KMC group was 0.55cm/week compared to 0.39 cm/week in the controls, (P =0.008). In the weight category 1500-1750g, infants in the KMC group had a significantly shorter

mean duration of stay of 8.6 days compared to the 12.7 days in the control group infants, (P < 0.001) (Table 4). The KMC group infants achieved a higher mean weight gain of 21g/kg/d compared to 15.7 g/kg/d in the control group infants, (P =0.023). Mean head circumference gain in the KMC group was significantly higher than that in the control group (P < 0.001), while the mean MUAC gain in the KMC group was 0.99 cm/week compared to 0.53 cm/week in the controls, (P < 0.001).

Using logistic regression analysis, the effect of the Kangaroo method was examined after controlling for possible confounders including maternal age which was significantly different between study arms at baseline. KMC was independently associated with higher mean weight gain, OR 13.19 (95% CI 5.53-31.8), mean head circumference gain, OR 1.65 (95% CI 1.32-2.07) and mean MUAC gain, OR 1.58 (95% CI 1.28-1.96). Higher maternal age was the strongest independently predictor of shorter mean duration of hospital stay (OR 1.58 (95% CI 0.97-1.17), although KMC was an independent predictor of mean duration of stay.

Other factors that were compared between the KMC and the control group were infections, mortality and breastfeeding rates. Infection rates after recruitment were found to be similar in the two groups (KMC 33%, versus 34% in the control) but the KMC group infants had less severe infections. Among those with severe infections, the frequency of severe infections was 36% in the KMC group and 64% in the control group. The mortality rate among the KMC infants was 4.7% while that among the control group infants was 6.2%. Breast feeding rates were similar in the two groups but the onset of breastfeeding of the KMC infants was earlier with 40.3 % starting to breastfeed within the first week after recruitment compared to the 14.9% in the control group.

Table 1
Baseline characteristics of the study population

Characteristics	Control N= 81	KMC N= 85	P-Value
Baby's characteristics:			
Mean birth weight-grams	1536 (950-1900)	1514 (1000-1900)	0.50
Mean weight at recruitment	1489 (1000-1740)	1441 (1000-1720)	0.11
Sex (male)-%	46 (56.8)	40 (47.1)	0.22
Mean age at recruitment -days	10.8 (1-44)	9.6 (2-29)	0.31
Mean Gestation at birth -weeks	33.3 (26-36)	32.7 (28-36)	0.06
Mother's characteristics:			
Age-years	24.5 (15-33)	26 (17-34)	0.04
Number married	50 (61.7)	48 (56.5)	0.53
Number with Primary education	32 (39.5)	37 (43.5)	0.639

Table 2
Comparison of growth parameters and duration of hospital stay between KMC and control groups

Parameters	Control N=76	SD	KMC N=81	SD	P-Value
Mean weight gain (g/kg/day)	16.7	3.38	22.5	3.92	<0.001
Mean duration of stay (days)	18.1	8.83	16.3	8.82	0.199
Mean head circumference gain (cm/week)	0.54	0.20	0.91	0.62	<0.001
Mean MUAC gain (cm/week)	0.48	0.33	0.76	0.72	0.002

Table 3
Growth parameters and duration of hospital stay for the weight category 1000 – 1499g

Parameters	Control N=30	SD	KMC N=47	SD	P-Value
Mean weight gain (g/kg/day)	18.1	3.80	23.6	4.25	<0.001
Mean duration of stay (days)	26.3	5.74	21.8	7.28	0.006
Mean head circumference gain (cm/week)	0.40	0.12	0.66	0.20	<0.001
Mean MUAC gain (cm/week)	0.39	0.47	0.55	0.16	0.008

Table 4
Growth parameters and duration of hospital stay for the weight category 1500-1750g

Parameters	Controls N= 46	SD	KMC N=34	SD	P-Value
Mean weight gain (g/kg/day)	15.7	2.73	21	2.83	0.023
Mean duration of stay (days)	12.7	5.89	8.6	3.16	<0.001
Mean head circumference gain (cm/week)	0.63	0.19	1.24	0.81	<0.001
Mean MUAC gain (cm/week)	0.53	0.18	1.13	0.99	<0.001

DISCUSSION

Kangaroo mother care is now a recognised mode of care of LBW infants but it is a new introduction to KNH hence the lack of space to perform full 24 hours KMC. We, therefore, opted to assess the use of partial KMC before preparation are complete for full KMC. Mothers practised KMC during the day (8 hours) but babies were returned into the incubators or cots for the night. There was no pre-existing planned post- KMC discharge policy hence we maintained the standard hospital discharge weight of 1800 g.

Infants in the partial KMC arm achieved significantly higher mean weight gain and had shorter hospital stay than those under standard of care. However, infants in both study arms achieved

adequate recommended weight gain of >15 g/kg/day for LBW infants (12). The weight gain of the KMC infants in our study was very close to that reported by other workers. Van Royeen *et al* (7) reported a weight gain of 23g/kg/day while the infants in Cattaneo *et al* (12) report gained 21.3 g/kg/day. Ramanathan and co-workers, on the other hand reported a lower mean weight gain of 15.9 g/kg/day in the KMC group (6). Their control group's weight gain of 10.6 g/kg/day was lower than what we reported in our study and is below recommended value for LBW infants. However, our infants in the control group the mean daily weight gain of 16.7g/kg/day is similar to the 17.7 g/kg/day reported by Cattaneo. In all these reports the differences in weight gain between the KMC and the control groups were all significant showing that KMC was an excellent adjunct in the care of LBW infants in these set-ups. It is noted that when the weights are stratified the lower weight group (1000-1499g) the weight gain is higher than the 1500- 1750g group. In a preliminary study at the same setting and KMC was practised for eight hours per day like in the present study, the KMC infants demonstrated a mean weight gain of 17.7g/kg/day versus the 7.4g/kg/day of the control group infants (10). It is possible that the staff in the unit were now more confident and probably also cared for the controls better than before.

A Cochrane review by Conde – Agudelo of three studies conducted in developing countries, reported a higher mean daily weight gain in the KMC infants than in the control group infants. The difference of the mean daily weight gain between the two groups in that review was 3.6 g/kg/day, 95% CI 0.8-6.4 (13). This is in contrast to our study where the difference in mean daily weight gain between the KMC and control group was 5.8g/kg/day.

The mean head circumference gain was significantly greater in the KMC group compared with the control group (0.91 cm/week versus 0.54 cm/week), which compares well with other reports (5,14). Charpak *et al* (5) reported a mean head circumference growth of 0.95 cm/week for KMC infants which is close to what we found in our study. This was higher than the normal expected head circumference growth of LBW infants of 0.5cm/week (11).

MUAC has been used to assess nutritional status of older children but not so much in neonatal period. But there are reports of its use in assessing intrauterine growth and nutrition (15,16). The KMC subjects demonstrated a significantly higher mean MUAC gain with a mean difference of 0.28 cm/week between the KMC and control group infants. There is paucity of local literature on the effect of KMC on MUAC but the fact that the KMC infants had higher increments indicates better growth. The WHO booklet on KMC states that this measurement has not been assessed as a tool for growth monitoring of LBW infants (17).

In our study, the mean duration of hospital stay were 16.3 days and 18.1 days in the KMC and control groups respectively. This compares well with a report by Cattaneo et al in which the KMC infants were discharged 13.4 days versus the 16.3 days for the control group (12). The mean duration of stay for the KMC infants in our study was slightly longer than that in KMC infants in Cattaneo's study because we discharged the infants at 1800g while those in Cattaneo's study were discharged earlier in accordance with the Kangaroo discharge policy and the strict follow up which was not possible in our study. Collonna and co-workers in Mozambique reported a mean duration of stay of 16.3 days after admission into the kangaroo unit (18)

When the two weight categories in our study were compared separately, the Kangaroo group infants had a significantly shorter duration of stay compared to the control group in the same weight category. The mean duration of hospital stay (21.8 days) for the KMC infants in the 1000-1499g-weight category was significantly shorter compared to the 26.3 days of the controls. Our duration of stay was shorter than that reported by Ramanathan (6). Their infants weighing less than 1500g had mean duration of hospital stay of 27.2 days in the KMC group versus the 34.6 days in the control group in infants.

The earlier discharge of the KMC infants eased congestion and was cost effective for both the parents and the institution. Our study has helped to strengthen the programme and convince staff that KMC can be carried out safely.

Using logistic regression analysis, KMC was found to be the strongest predictor of weight gain, head circumference and MUAC circumference gains. Mother's older age was the strongest predictor of mean duration of hospital stay. The mothers of the KMC infants were older, with a mean age 26.5 years compared with the 24 years in the control group and this may have influenced positively the outcome of duration of hospital stay in the KMC infants, though KMC was an independent predictor of duration of stay.

Infection rates were similar in the two groups but the KMC group had less severe infections. The infection rates were 33% and 34.5% in the KMC and control groups respectively. Among those infected, the frequency of severe infections of 36% in the KMC group was significantly lower than the frequency of 64% in the control group. Conde- Agudelo reported a similar reduction in the incidence of severe diseases (RR 0.30; 95%CI 0.14-0.67) as well as a reduction in nosocomial infections at 41 weeks of corrected gestational age (RR 0.49; 95%CI 0.25-0.93) in the KMC infants (14). Charpak *et al* also reported a lower incidence of infections as well as less severe infections in the KMC group (8).

A comparison between the two infant groups

showed lower mortality rates among KMC infants at 4.7% compared to 6.2% among the control group. The risk of dying was not significantly different between the two groups (relative risk = 1.31, 95% confidence interval 0.37-4.71). Charpak *et al* found that the risk of dying and mortality rates were similar in the KMC and control groups (8). A study from Zimbabwe where babies were offered KMC from birth suggests that kangaroo care could reduce mortality (13). Further studies to evaluate the impact of the Kangaroo practice on mortality are needed to make a concrete conclusion on this.

Breastfeeding rates were similar in the two groups: 93.6% in the KMC group infants versus 92.8% in the control group. The KMC infants, however, were breastfed earlier with 40.3% starting to breastfeed within the first week after recruitment compared with 14.9% in the control group. Other workers have found higher breastfeeding rates in the KMC infants (6,9,11). Ramanathan reported that double the number of KMC infants were exclusively breastfed compared to the number in the control group (6). Doyle reported that 98% of the KMC infants were exclusively breastfed compared to the 92.5% of control group infants (11). The earlier breastfeeding in the KMC group is attributed to improved milk let down with the increased volumes and frequency of feeds facilitated by the close infant-mother contact.

Breast milk has important anti-infective properties, which play an important role in the prevention of infections. Also, KMC has been shown to enhance immunologic response in infants and this may be one of the reasons the KMC group infants had less severe infections (1).

In conclusion, the low birth weight infants offered partial KMC at KNH demonstrated higher growth rates and were discharged earlier. KMC should be promoted actively and mothers encouraged starting it as soon as their LBW babies are stable.

ACKNOWLEDGEMENTS

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