

**THE IMPACT OF PARTIAL  
KANGAROO MOTHER CARE ON GROWTH RATES  
AND DURATION OF HOSPITAL STAY OF LOW  
BIRTH WEIGHT INFANTS IN KENYATTA  
NATIONAL HOSPITAL**

**BY**

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**DEDICATION**

**I DEDICATE THIS THESIS TO MY LOVING HUSBAND AND MY  
DAUGHTER BECKY FOR THEIR FORTITUDE THAT ENABLED ME  
COMPLETE THIS WORK.**

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**DECLARATION:**

I declare that this dissertation is my own original work and has not been published elsewhere, or presented for a degree in any other university.

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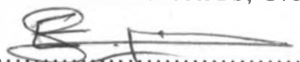
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## **ABBREVIATIONS:**

IUGR: Intrauterine Growth Retardation

LBW: Low Birth Weight

VLBW: Very Low Birth Weight

KMC: Kangaroo Mother Care

KNH: Kenyatta National Hospital

NBU: New Born Unit

UON: University of Nairobi

MUAC: Mid Upper Arm Circumference

GBD: Gestation By Dates

RCT: Randomized Controlled Trial

## **DEFINITIONS OF TERMINOLOGY:**

1. Low birth weight infant: infant weighing less than 2,500 grams at birth.
2. Very low birth weight: infant weighing less than 1,500 grams at birth.
3. Premature or preterm infant: infant born before 37 weeks' gestation.
4. Intrauterine growth retardation: denotes a foetus whose weight is below the 10th percentile or two standard deviations below the mean.
5. Stable preterm: premature infant whose vital functions (breathing and circulation) do not require continuous medical support and monitoring, and are not subject to rapid or unexpected deterioration regardless of intercurrent illness.
6. Exclusive breastfeeding is feeding an infant with breast milk only.
7. Neonatal mortality is death of a live-born infant in the first 28 days of life.
8. Gestational age: duration from last menstrual period to birth.
9. Major congenital malformations: those deformities involving organs such as the cardiovascular, central, renal, respiratory, skeletal and gastrointestinal systems.
10. Minor congenital malformations: those deformities that do not involve major organ systems for example deformities of the musculoskeletal system such as extra digits and foot disorders.

## **SUMMARY:**

### **Introduction:**

Neonatologists Rey and Martinez in Bogota, Colombia introduced kangaroo mother care in order to cope with the overcrowding, recurrent nosocomial infections and scarcity of resources in hospitals caring for low birth weight infants (4). This method of care consists of three components: Kangaroo position, Kangaroo nutrition and Kangaroo discharge policies with strict follow-up (5). Numerous studies both in developed and developing countries highlight the practice of KMC in different settings, as well as its benefits and limitations. This study assesses the impact of KMC on the duration of hospitalization and growth rates of LBW infants subjected to it.

**Objective:** To determine the effect of KMC on the rates of growth and duration of hospital stay of LBW infants at the Newborn Unit of KNH.

**Design:** Randomized controlled trial.

### **Methods:**

The study was carried out in Kenyatta National Hospital Newborn Unit over a period of nine months. Growth rates and durations of hospital stay of the low birth weight infants on Kangaroo mother care were compared with those of the infants on the traditional method of care. A total of 166 infants were recruited with 81 infants in the control group and 85 infants in the KMC group. Each group was stratified into two weight categories, the 1000-1499g and 1500-1750g categories. KMC was practised for eight hours per day.

**Main outcome measures:** Durations of hospital stay and growth rates of the infants in the two groups were the outcome measures observed.

## **Results:**

Baseline characteristics were similar in the two groups except for mothers' age. The mean age of the mothers in the KMC group was 26.5 years while that of the mothers in the control group was 24 years, P value of the difference being 0.04. The mean weight at recruitment of the control group was 1489g while that of the KMC group was 1480g. The mean gestation at recruitment of the KMC group was 34 weeks while that of the control group was 34.8 weeks. The KMC group infants demonstrated significantly higher growth rates as shown by the higher mean weight gain of 22.5g/kg/day compared with 16.7g/kg/day in the control group, P value < 0.001; higher mean head circumference gain of 0.91cm/week compared with 0.54cm/week in the control group, P value < 0.001 and higher mean MUAC gain of 0.76cm/week compared with 0.48cm/week in the control group, P value 0.002. The KMC group stayed in the hospital for a mean duration of 16.3 days compared with the 18.1 days in the control group, P value 0.199.

When the KMC and control groups in the two weight categories were compared separately, the KMC infants demonstrated significantly higher mean weight, head and mid upper arm circumference gains, P values < 0.05. The duration of hospital stay was significantly shorter in the KMC infants in both weight categories, P values < 0.05. Using logistic regression analysis, KMC was the strongest predictor of mean weight, mean head circumference and mean MUAC growth while mother's older age was the strongest predictor of mean duration of stay, with KMC being an independent predictor of duration of stay.

## **Conclusion:**

The low birth weight infants offered KMC at KNH Newborn Unit demonstrated higher growth rates and were discharged earlier. The results of this study suggest that KMC should be promoted actively and mothers encouraged to start it as soon as their LBW babies are stable.



## **INTRODUCTION:**

Low birth weight is one of the principal contributors to neonatal morbidity and mortality worldwide, and accounts for up to 70% of neonatal deaths in some countries. Intrauterine growth retardation is commonly associated with LBW in the developing countries (60% of LBW), whereas prematurity is the main cause of low birth weight in developed countries (1).

One in five infants born in developing countries weighs less than 2,500 grams (United Nations Children's Fund, 1999). Appropriate interventions for management of these infants include skilled care at delivery, immediate evaluation of the infant at birth, basic neonatal resuscitation when needed, attention to thermal control, prevention of hypoglycaemia through early breastfeeding, exclusive breastfeeding, supplementation with vitamins and minerals; prevention of infection, early detection and treatment of illness; and monitoring of breastfeeding and neonatal growth (2).

Conventional neonatal care of LBW infants is expensive and needs both trained personnel and permanent logistic support. In developing countries, financial and human resources for neonatal care are limited and hospital wards for LBW infants are often overcrowded, leading to high morbidity and mortality. Thus, there is a need for interventions that reduce neonatal morbidity, mortality and costs, which would be an important advance in care. KMC is one of these appropriate interventions.

Research provides strong support for the contention that it is the skin-to-skin care which the mother provides that caters for the basic needs of warmth and nutrition. The stimulation the newborn gives the mother during KMC elicits care giving and protective behaviour from the mother (3).

## **BACKGROUND AND LITERATURE REVIEW:**

Kangaroo mother care has been studied in depth since 1978 when neonatologists Rey and Martinez first implemented it in Bogota, Colombia. Due to lack of reliable equipment and overcrowding in their neonatal units, Kangaroo care was found to be an inexpensive and very beneficial experience to babies in Bogota. The mortality rate fell from 70 % to 30 % (4). Kangaroo care consists of placing a diaper clad premature baby in an upright position on a mother's bare chest with the baby facing the mother. The baby's head is turned so that the ear is above the mother's heart. Kangaroo mothering is based on the premise that low birth weight premature infants grow best in an environment similar to the intrauterine environment (5).

KMC consists of three components: the Kangaroo position which provides adequate warmth for the infant; the Kangaroo nutrition which is exclusive or nearly exclusive breastfeeding (although breastfeeding is the prime source of nutrition, infants also may be supplemented with preterm formula and vitamins whenever necessary) and Kangaroo discharge policies (early discharge in the Kangaroo position irrespective of weight or gestational age) with strict follow-up. In some settings, a fourth component namely, Kangaroo support has been introduced. This describes the physical and emotional support given to mothers and their families when KMC is practised. KMC offers an appropriate technology for developing countries as well as the benefits of safety (5).

KMC is now practised in 25 developing countries in Asia, Africa, and Latin America. Its use is also supported in industrialized countries such as France, Sweden, the United Kingdom, and the United States of America. (6) Most studies have shown that Kangaroo care has major, positive impact on babies and their parents; some studies have shown no change; but no study has shown Kangaroo care to be detrimental to either parent or baby (4).

Summary of main studies:

Author/ Year	Study design	N	Outcome	Results
Ludington S, 1997 (8)	RCT	Total 41	Apnoea of prematurity	Reduced duration and frequency of apnoea in KMC infants
Charpak N et al, 1997 (28)	Open RCT	Total 1084 KMC 382 Control 364	Duration of stay, infection and mortality	Shorter duration of stay in the KMC group, increased and more severe infections in the control group. Mortality similar.
Gomez P et al, 1998 (14)	Descriptive study	Total 651	Breastfeeding Temperature stability	Increased breastfeeding if KMC was > 50 min. Temperature stable in proportion to duration of KMC
Simiyu et al, 2003 KNH Preliminary results (29)	RCT	Total 149 KMC 74 Control 75	Weight gain, duration of stay, infections and mothers' attitude towards KMC	Higher weight gain and shorter duration of hospital stay in the KMC group. Infection rates similar but more severe in the control group. Mothers in KMC more confident and fulfilled.
Royeen et al, 1999 (17)	Audit	Total 388	Breastfeeding rates, weight gain and duration of stay	Weight gain 23g/kg/day, 75% of infants on KMC breastfed, mean duration of stay 13 days

KMC has various benefits as demonstrated by studies done in different settings. These include: increased sleep time and less colic; less apnoea and stabilization of oxygen saturation; stabilization of body temperature; and reduction in severity of infections and improved immunity.

*Increased sleep time and less colic.*

Colic is caused by, among others, a baby's inability to transition from one sleep state to another, which is from an alert state into a sleep state and back again. The excessive crying during these transitions causes swallowing of too much air that leads to the development of colic. Kangaroo care provided in a quiet, low light environment reduces crying and helps the baby learn to transition from one sleep state to another. Messmer et al found a significant increase in sleep time of the neonates during Kangaroo care (7).

*Less apnoea and stabilization of oxygen saturations.*

Ludington et al found a four-fold decrease in apnoea during Kangaroo care and mechanically ventilated babies were able to tolerate transfer and position changes without increased oxygen requirements (8). Cleary et al, in a case study of 29 week gestational age twins given maternal and paternal Kangaroo care for 2 hours on the 19<sup>th</sup> day of life when on nasal cannula, found that all physiologic patterns were more stable. There was no bradycardia, central or obstructive apnoea; periodic breathing or oxygen desaturations during KMC and this pattern persisted more than 2 hours after KMC ended (9).

Gale and Vandenburg concluded that heart rate was more regular in infants offered KMC (10).

*Stabilization of body temperature.*

Bauer et al concluded that one hour of skin-to-skin contact was no cold stress to preterm infants (6). Infants removed from incubators and offered KMC, showed a rise in temperature and a dramatic drop in glucocorticoids (3). Mothers were able to control the infant's temperature within a very narrow range. To accomplish

this, the mother's core temperature rose by two degrees Centigrade if the baby was cold, and fell by one degree if the baby was hot.

*Reduction in severity of infections and improved immunity.*

Immunity is improved, demonstrable as far as 6 months later. LBW infants are susceptible to allergies, infections and feeding problems in the first year of life. Early KMC dramatically reduces these problems. Infections are reduced when low birth weight infants are offered KMC and are exclusively breastfed. Breastfeeding protects against late neonatal deaths (from 8 - 28 days), which are primarily due to infections, such as sepsis, pneumonia, meningitis, omphalitis, and diarrhoea (11).

A review by the Cochrane Neonatal Collaborative Review Group of three randomized controlled trials done in developing countries showed that KMC was associated with reduced risk of nosocomial infections at 41 weeks' corrected gestational age, severe illness and lower respiratory tract disease at 6 months follow-up (12).

Benefits to parents include increased parent-infant bonding, increased breast milk supply, earlier breast-feeding as well as continuous breast-feeding for longer periods of time. Parents have shown increased readiness for discharge, increased confidence in one's ability to care for the baby, increased sense of control and increased ability to cope with the stress and emotions of having a high-risk infant (13)

Gomez et al observed that infants on Kangaroo care for about 50 minutes were 8 times more likely to breast feed spontaneously (14). Two studies done in low-income countries found that there was increased prevalence and duration of breastfeeding (15,16,17). Other studies conducted in high-income countries where KMC was applied late and for a limited amount of time per day, also showed a beneficial effect on breastfeeding (18,19,20,21,22,23). In a study performed in Recife (Brazil), the improved mother-child relationship that the

kangaroo method encouraged resulted in higher breast-feeding rates of 63% three months after discharge (24).

Kangaroo care allows for easy access to the breast, and the skin-to-skin contact increases milk letdown. Nutrition is improved, both with respect to the mother's ability to breastfeed, and the newborn's utilization of the feed (4). The volume of the mother's milk and the frequency of feeds are greatly increased. Even without the increased milk, the vagal stimulation the infant receives enables the gut to use the milk provided and the infant thus grows faster. When a baby is born prematurely, the mother's milk contains more protein than mature milk. Preterm babies need extra protein and they grow faster on the mother's preterm milk than on donated mature milk (25). Weight gain of infants weighing less than 2000 grams at birth should be adequate when human milk or "humanized" milk (40% casein and 60% whey) with a protein intake of 2.25-2.75 g/kg/24 hours is fed. Richardson observed rapid weight gain in infants offered KMC (26). Kangaroo care allows the baby to fall into a deep sleep, thereby conserving energy for weight gain. Left alone on a warming table, a baby cries more and sleeps less (4). The increased weight gain also leads to shorter hospital stay. Charpak et al reported a shorter hospital stay in the Kangaroo care group, primarily in infants less than 1800 grams (27).

Ramanathan, in a study to determine the effect of Kangaroo mother care on breast feeding rates, weight gain and length of hospitalization of very low birth weight neonates, found that the neonates in the KMC group had better weight gain, earlier hospital discharge and higher exclusive breast-feeding rates (15). A multicentre RCT in three developing countries to evaluate the effectiveness and costs of kangaroo care showed that on discharge breastfeeding rates were higher in the KMC group than in the control group (88% versus 70%). They gained more weight and were discharged early. The running costs for kangaroo care were about 50% less than for conventional care. The authors concluded that kangaroo care helps with scarce resources in poor countries (28).

To assess the value of introduction of a Kangaroo mother care unit into Kalafong Hospital, Pretoria (South Africa), data was collected on a number of infants admitted with their mothers to the unit each month. Out of the total number, 85% of the mothers breastfed their infants and a mean weight gain of 23 g/kg/day was achieved. A significant number (39%) of infants were discharged at a lower weight, resulting in a decrease in the length of stay in the KMC unit (17). In Recife, Brazil, the daily cost of US\$20 per day was far much lower than the US\$66 per day for incubator-based care (24).

The KMC programme was introduced in KNH newborn unit in December 2002. The programme has been partially implemented with the mothers visiting the unit 2hrs in the morning and 2hrs in the afternoon to provide KMC to their babies. The requirements for those offered KMC were the babies with a weight of 1000g to 2000g, those who were stable and those at least 24hrs of age. In a study to determine suitability of KMC at KNH Simiyu et al showed that KMC improved the rate of weight gain, shortened duration of hospital stay and mothers were more confident in taking care of their LBW infants at discharge (29). The limitations in that study were the high attrition rates for the VLBW infants due to overcrowding before inclusion in the study, inability to practise Kangaroo care for 24 hours as well as early discharge due to logistic reasons.

#### **UTILITY OF THE STUDY:**

1. To strengthen the existing KMC programme.

This study will help identify the benefits of KMC on the LBW infants in the KNH newborn unit. This will be crucial in strengthening the current KMC programme by providing useful information to the health care providers on the effectiveness of the programme.

Acceptability is very key among health care workers who provide a highly supportive hospital environment, with an interdisciplinary team that will favour continuation and expansion of the programme.

### **JUSTIFICATION OF THE STUDY:**

1. Overcrowding in the newborn unit results from the high numbers admitted and this results in sharing of incubators as well as overstretching the staff. Infection rates are, therefore, high due to rapid spread and the high patient to staff ratio minimizes optimal care given to these infants. These factors are key contributors to the high mortality rate seen in the NBU.

If KMC shortens the duration of hospital stay and contributes to faster growth, it will play a significant role in alleviating the problems mentioned above.

2. The cost of in-patient care is high and this is more so because both mother and baby are admitted. Early hospital discharge made possible by KMC would be cost effective both for the parents and the hospital. This also frees the parents to take care of their baby in a home environment while at the same time being able to attend to other responsibilities.

### **MAIN OBJECTIVE:**

To determine the effect of KMC on the rates of growth and duration of hospital stay of LBW infants at the Newborn Unit of KNH.

### **SPECIFIC OBJECTIVES:**

1. To compare the rates of growth of LBW infants on KMC with those on traditional care in KNH.

2. To compare the duration of stay of LBW infants on KMC with those on traditional care in KNH.

### **HYPOTHESIS:**

KMC leads to increased growth rates and shorter duration of hospital stay in LBW infants on KMC compared to those on traditional care.



## **STUDY METHODS:**

### **Study design:**

Randomized controlled trial

### **Study Area:**

Kenyatta National Hospital: Newborn Unit

### **Study population:**

LBW infants 1000g to 1750g and their mothers.

### **Sample size estimation:**

A minimum sample size of 148 was sufficient to detect a difference in duration of hospital stay of 4 days between KMC and the control group, with a power of 80%, and a significance level of 5%. The number that was recruited was 166, to allow for possible dropouts of about 15%. The standard deviation for mean duration of hospital stay in a Simiyu's study was 8.71, and a difference of 4 days (between the two groups) was considered to be of clinical importance (29). The formula used is shown below:

$$N = \frac{(Z_{\alpha} + Z_{\beta})^2 \times 2\sigma^2}{\delta^2}$$

Standard deviation ( $\sigma$ ) = 8.71 points

Size of difference of clinical importance ( $\delta$ ) = 4 days

Significance level = 5%

Power = 80%

$Z_{\alpha}$  = 1.96

$Z_{\beta}$  = 0.84

Type of test = two-sided

$$N = \frac{(1.96 + 0.84)^2 \times 2 \times (8.71)^2}{(4)^2}$$

N=74 for each group, thus 148 for both groups, and a total of 166 to cater for dropouts.

### **SELECTION CRITERIA:**

#### **Inclusion criteria**

1. Stable LBW babies with birth weight of 1000g-1750g
2. Mothers who gave consent.

#### **Exclusion criteria**

1. Sick babies – those on oxygen, on treatment for sepsis and those on phototherapy
2. Babies with major congenital malformations, involving the cardiovascular, renal, nervous, respiratory and musculoskeletal systems.
3. Babies without mothers or mothers who were not available to visit their infants for KMC.

#### **Recruitment**

Consecutive sampling of patients meeting the inclusion criteria was done.

### **CLINICAL PROCEDURES:**

The study area was visited between 8.00 am and 5.00 pm to examine and recruit study subjects. Initial evaluation included a complete history, assessment of gestation and physical examination. Assessment of gestation was done using the new Ballard score, which is a valid and accurate gestational assessment tool for extremely premature infants and remains valid for the entire newborn infant population (30).

Informed consent was obtained from mothers of those who qualified. The babies were stratified into two weight categories: 1000g-1499g and 1500-1750g.

Simple randomization lists were prepared in advance using computer generated random numbers. Two randomization lists according to the birth weight categories were used. Mothers selected an envelope from a box of envelopes to determine allocation to the KMC or control group.

Clinical data was recorded and included: sex, birth weight, post conception age at admission, and corrected age at discharge. Kangaroo care was started as soon as the

babies were in stable clinical state. Parameters that were used to monitor growth were weight, mid upper arm circumference and head circumference. Weight was monitored every Monday, Wednesday and Friday using an electronic weighing scale that was already in the unit for the KMC programme to ensure accuracy. Head circumference and mid upper arm circumference to the nearest 0.1cm were taken once a week on Mondays, using a non-stretchable plastic tape measure. Weight, head and mid upper arm circumference measurements were taken by the investigator and an independent person separately. Where there was a difference, a third reading was taken by a nurse working in the Newborn unit who was blinded to what group the infant belonged to and the average of the three readings was used. This helped in reducing bias since it was not possible to blind the investigator.

Episodes of infections after recruitment were recorded for the control and KMC groups. The primary clinicians in the NBU diagnosed infection based on the clinical presentation and laboratory support of a positive blood culture and a total white blood cell count, differential count with immature to total neutrophil count ratio that was suggestive of sepsis. Severity of infection was categorized based on the need of changing of medication from first line antibiotics (Crystalline penicillin and Gentamicin) to second line antibiotics such as ceftriaxone, ceftazidime, vancomycin among others. All information was entered in the data sheets.

KMC was practiced for eight hours per day and not 24hrs due lack of enough room and personnel to supervise the mothers during the sessions for a 24 hour period. The babies were returned to the incubators or cots for the night. Mothers in both groups were encouraged to breastfeed or give expressed breast milk by cup or nasogastric tube to babies who could not breastfeed. Supplementation with formula milk was used only if the mother was not producing enough breast milk. The infants were discharged if they met the hospital's discharge criteria which is a well baby, weight above 1800g, gaining weight satisfactorily and feeding optimally. The KMC early

discharge criteria was not adopted since these babies would thereafter need strict follow up which was beyond the time for follow up intended in this study.

### **TRAINING PROGRAMME FOR THE MOTHERS:**

After randomization, the times for going to the unit for the Kangaroo sessions depended on the established unit schedules. The mothers were encouraged to wear gowns that were open at the front for easier positioning of the baby. Before the procedure, the babies were dressed only in a diaper. During the first session, the mothers were shown how to place the babies on their bare chests in an upright position, facing the mother with the baby's head turned to one side in a slightly extended position, (to keep the airway open and to allow eye to eye contact) the hips flexed and knees extended in the frog position. A cloth was then tied firmly enough to secure the baby. After the session, the mothers were shown how to move the baby safely back to the incubator or cot.

Subsequent sessions entailed supervising the mothers as they carried out the procedure as well as assessing how well both the baby and the mother were adapting. Adaptation was considered complete when the mother was comfortable with the method and the baby was thriving (reflected by progressive growth). The mothers' questions were answered and problems were solved as they arose. The mothers of the infants in the control group were instructed on the routine care of babies in the traditional method (incubator or cot nursing). They came to the unit in accordance with the hospital schedules.

**Outcome measures:** The growth rates and durations of hospital stay were calculated for the two groups from recruitment to discharge by the investigator.

### **DATA ANALYSIS:**

Data collected from the study was coded and entered in the computer database for statistical analysis, using the Statistical Package for Social Sciences.

The mean weight gains in grams/kg/day in the two groups were compared using the t-test. The mean duration of hospital stay in days in the two groups were similarly

compared using the t-test. Besides the comparisons between the groups, comparisons between the two weight strata were also done. Secondly, logistic regression was applied with the growth parameters and 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, we examined the effect of the Kangaroo method only after controlling for possible confounders. Other parameters that were analyzed were infection, mortality and breastfeeding rates between the overall control and Kangaroo groups. Differences were considered significant if  $P < 0.05$ . Results were presented in tables as was appropriate.

**ETHICAL CONSIDERATION:**

1. Only those mothers who gave a signed informed consent participated in the study.
2. Permission to carry out the study was sought from the KNH Research and Ethical Committee.

## RESULTS:

Recruited into the study was a total number of 166 infants of whom 157 were followed up to discharge. The KMC group had 85 infants while the control group had 81 infants. Of those in the KMC group, 81 (95.3%) were discharged and 4 (4.7%) died. From the control group, 76 (93.8%) were discharged while 5 (6.2%) died. The overall dropout rate was 5.4% and all the dropouts were due deaths as a result of illness.

The males were 86 (51.8%) while the females were 80 (48.25%).

The mean age at recruitment was 10 days with a range of 1-44 days.

There were two weight categories: the 1000-1499g (85) and the 1500-1750g (81)

TABLE 1: Baseline characteristics of the study population.

CHARACTERISTICS	CONTROL N= 81	KMC N= 85	P VALUE
<u>Baby's characteristics:</u>	Mean (range)	Mean (range)	0.50
Birth weight -grams	1536 (950-1900)	1514 (1000-1900)	
Mean weight at recruitment -grams	1489 (1000-1740)	1441 (1000-1720)	0.11
Mean age at recruitment -days	10.8 (1-44)	9.6 (2-29)	0.31
Mean GBD –weeks	33.3 (26-36)	32.7 (28-36)	0.06
Sex : number of males	N (%)	N (%)	0.22
	46 (56.8)	40 (47.1)	
<u>Mother's characteristics:</u>	Mean (range)	Mean (range)	0.04
Age –yrs	24.5 (15-33)	26 (17-34)	
Number married	N (%)	N (%)	0.53
	50 (61.7)	48 (56.5)	
Number with Primary education	32 (39.5)	37 (43.5)	0.639

Table 1 above shows that the characteristics at baseline were similar in the two groups except for the mother's age, which was slightly higher in the KMC group (26.5 years versus 24 years in the control group), P value 0.04.

**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 growth (cm/week)	0.54	0.20	0.91	0.62	<0.001
Mean MUAC growth (cm/week)	0.48	0.33	0.76	0.72	0.002

Table 2 shows that the KMC group infants had achieved a significantly higher mean weight gain of 22.5g/kg/day compared to the 16.7g/kg/day in the control group infants, P value 0.001.

The mean duration of hospital stay in the KMC group was 2 days shorter than that of the control group, P value 0.199.

The mean head circumference growth in the KMC group was higher. The difference of the mean head circumferences in the two groups was 0.37cm/week and this was statistically significant, P value < 0.001.

The mean MUAC growth in the KMC group was higher than in the control group. The difference between the MUAC means in the two groups was 0.28cm/week and this was statistically significant, P value 0.002.

The mean durations of hospital stay and the growth rates of the infants in the 1000-1499g and 1500-1750g weight categories were also compared.

**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 growth (cm/week)	0.40	0.12	0.66	0.20	<0.001
Mean MUAC growth (cm/week)	0.39	0.47	0.55	0.16	0.008

Table 3 shows that in 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 value 0.006.

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 value < 0.001.



The head circumference growth in the KMC group was significantly higher than that in the control group. The mean head circumference growth for the KMC infants was 0.66 cm/week compared to 0.4 cm/week in the control group, P value < 0.001.

The mean MUAC growth in the KMC group was 0.55cm/week compared to 0.39 cm/week in the controls, P value 0.008.

**TABLE 4**

Growth parameters and durations of hospital stay for the weight category 1500-1750g

PARAMETERS	CONTROL 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 growth (cm/week)	0.63	0.19	1.24	0.81	<0.001
Mean MUAC growth (cm/week)	0.53	0.18	1.13	0.99	<0.001

Table 4 shows that in weight category 1500-1750g, the 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 value < 0.001.

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 value 0.023.

The head circumference growth in the KMC group was significantly higher than that in the control group. The mean head circumference growth for the KMC

infants was 0.81 cm/week compared to 0.63 cm/week in the control group, P value < 0.001.

The mean MUAC growth in the KMC group was 0.99 cm/week compared to 0.53 cm/week in the controls, P value < 0.001.

Using logistic regression analysis, the effect of the Kangaroo method was examined after controlling for possible confounders. KMC was the strongest predictor of 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). Mothers older age was the strongest predictor of a shorter mean duration of stay, OR 1.58 (95% CI 0.97-1.17)

Other factors that were compared between the KMC and the control group after recruitment were infections, mortality and breastfeeding rates. Infection rates were found to be similar in the two groups but the KMC group infants had less severe infections. The infection rates after recruitment were 33% in the KMC group and 34% in the control group. 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.

## DISCUSSION:

In our study, we found that the KMC group infants grew significantly more rapidly as shown by the higher mean weight gain, mean head circumference and mean MUAC growth than those in the control group. The mean duration of hospital stay of the infants in the KMC group was shorter than that of the infants in the control group by 2 days.

The mean weight gain of the KMC infants in our study was 22.5 g/kg/day versus 16.7g/kg/day of the control group infants, which is more than adequate weight gain (>15 g/kg/day) for LBW infants (31). The mean weight gain of the KMC infants in our study is very close to the 23g/kg/day reported by Royeen in South Africa (17). Ramanathan and co-workers, in India, reported a mean weight gain after the first week of life of 15.9 g/kg/day in the KMC group versus 10.6 g/kg/day in the control group (15) which was lower than what we reported in our study (22.5g/kg/d in the KMC group vs the 16.7g/kg/d in the control group). Cattaneo and co-workers showed that KMC infants experienced a higher mean daily weight gain (21.3 g/kg/day versus 17.7 g/kg/day in the control group) in work done in Ethiopia, Indonesia and Mexico (32), which is close to the 22.5g/kg/d in the KMC group vs the 16.7g/kg/d in the control group in our study. These 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.

A Conchrane 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 (12) while the difference in mean daily weight gain between the KMC and control group in our study was 5.8g/kg/day, with the KMC infants having a higher mean weight gain. The mean daily weight gains for the KMC and control groups in the

Conchrane review were not stated but the mean daily weight gains in the KMC and control groups in our study were 22.5g/kg/d and 16.7g/kg/d respectively.

In a study by Simiyu et al at KNH Newborn Unit- Kenya where KMC was practised for eight hours per day like in our 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 (29). Compared to our study, in which the KMC infants demonstrated a mean weight gain of 22.5g/kg/d versus the 16.7g/kg/d for the control group, the in mean daily weight gain of the KMC group in our study was much higher than that of the KMC infants in Simiyu's study. The reason why the KMC infants in Simiyu's study had a lower mean weight gain than the KMC infants in our study was because during Simiyu's study was there was only one nurse who was trained in KMC and when she was not on duty the programme did not run well compared to the present when more nurses have been trained.

The kind of care given to the KMC group in the remaining 16 hours was incubator or cot nursing which depended on the weight of the baby. This was not a confounder because the same care was given to the control group.

The weekly growth rate of head circumference 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 reports by Charpak et al in Colombia (27) and Rogers et al (33). Charpak et al reported a mean head circumference growth of 0.95 cm/week (27) while the KMC infants in our study achieved a mean head circumference growth of 0.91cm/week. This was higher than the normal expected head circumference growth of LBW infants of 0.5cm/week (31). Increase in head circumference does signify brain growth having excluded post hemorrhagic ventricular dilatation and this growth may have an impact on future psychomotor development.

The KMC subjects demonstrated a significantly higher MUAC growth with a mean difference of 0.28 cm/week between the KMC and control group infants. This is an area where there is no published work but the fact that the KMC infants had higher increments indicates better growth.

In our study, the mean durations of hospital stay after recruitment were 16.3 days and 18.1 days in the KMC and control groups respectively. The mean duration of KMC infants was 2 days shorter than that of the control group. This compares well with a report by Cattaneo et al in which the KMC infants were discharged 13.4 days after enrolment versus the 16.3 days in the control group (32). Collonna and co-workers in Mozambique reported a mean duration of stay of 16.3 days after admission into the kangaroo unit (34). The mean duration of stay in 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 strict follow up, which was beyond the scope of our study. The mean duration of hospital stay of KMC infants in the 1000-1499g-weight category in our study was significantly shorter compared to the controls, with the KMC infants having a mean duration 21.8 days versus the 26.3 days of the controls. Ramanathan reported a mean duration of hospital stay of 27.2 days in the KMC group versus the 34.6 days in the control group in infants with weight of less than 1500g (15). No other studies were found that reported on KMC in VLBW.

The reason why the mean difference in durations of stay in our study was not statistically significant for the whole group was because the Kangaroo group had a higher number of babies in the weight category 1000-1499g, while the control group had a higher number in the 1500- 1750g-weight category. The 1000-1499g weight category babies by virtue of being lighter stayed longer before attaining the discharge weight and thus this lengthened the mean duration of stay for the overall Kangaroo group. When the two weight categories were compared

separately, the Kangaroo group infants had a significantly shorter duration of stay when compared with the control group in the same weight category. The earlier discharge of the KMC infants eased congestion and was cost effective for both the parents and the institution.

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 (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. Older age was a predictor of shorter duration of hospital stay probably because the older mothers were keener on following through on issues that influence the outcome of her baby and thus the instructions given for KMC were thoroughly adhered to. This then led to rapid growth and shorter stay. Other workers have not applied logistic regression analysis to their data for comparison with our findings.

The 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 32% 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 (12). Charpak et al also reported a lower incidence of infections as well as less severe infections in the KMC group (28)

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 (28). A study from Zimbabwe where babies were offered KMC from birth suggests that kangaroo care could reduce mortality (32). 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 (15, 24, 31). Ramanathan reported that double the number of KMC infants were exclusively breastfed compared to the number in the control group (15). Doyle reported that 98% of the KMC infants were exclusively breastfed compared to the 92.5% of control group infants (31). 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. Nutrition is improved, due to the mother's ability to breastfeed and infant's ability to utilize the milk provided and thus the infant grows faster. Breastfeeding 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 (4).

When compared to what has been done before in our set up, our study has demonstrated that the infants offered KMC had faster growth, less severe infections and were breastfed earlier. Our study has also improved on Simiyu's study in that we used weight, head circumference and MUAC measurements to demonstrate growth while Simiyu used weight alone as the growth parameter. Our study has helped to strengthen the programme and convinced staff that KMC can be carried out safely. The main strength of our study was that it was a randomized controlled trial and this means that differences seen between the KMC and the control groups

were attributed to the intervention (KMC) since each subject had an equal opportunity of falling in either group.

### **STUDY LIMITATIONS**

1. It was not possible to provide KMC for 24 hours. This was due to lack of a room where the mothers and their infants would be in the Kangaroo position for this period of time. The problem of shortage of staff has not been overcome and this was another reason why KMC could not be provided for 24 hours since the mothers still needed supervision and sorting out of any problems that came up, as well as teaching the new mothers who were continually being recruited into the study.
2. The problem of overcrowding has not been overcome because we were not able to discharge the KMC infants early in accordance with the KMC discharge criteria. Another reason was that there were factors that were beyond the scope of this study to address such as inability to pay hospital bills immediately infants were discharged, which led to longer hospital stay.
3. Some mothers in the control group felt the KMC group was receiving more care since the mothers came to the unit earlier and stayed longer for the kangaroo sessions but they were constantly assured it was the requirement for this group.
4. Follow up of babies to evaluate their outcomes after discharge was not possible due to lack of an outpatient component in our study.

### **CONCLUSION:**

The low birth weight infants offered KMC at KNH Newborn Unit demonstrated higher growth rates and were discharged earlier.

### **RECOMMENDATIONS:**

1. KMC should be promoted actively and mothers encouraged to start it as soon as their LBW babies are stable.
2. The existing KMC programme in KNH NBU should be strengthened by the establishment of a Kangaroo room that is conducive for both mother and baby during KMC and by training of more personnel to run the programme.



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**APPENDIX 1**

**STUDY QUESTIONNAIRE:**

Name:.....

IP NO.....

Randomization code .....

**A) Mother's socio-demographic data**

1. Age (Years).....

2. Marital Status:

Single

Married

3. What is your level of education? (years of school)

Primary

Secondary

College

4. Employment:

Formal

Self-employed

Other

**b) Baby's details**

1. Birth weight (grams) .....

2. Gestational age in weeks at admission (clinical assessment).....

3. Sex (Male.....Female.....)

4. DOA   /  /  

5. Date of eligibility   /  /  

6. DODeath /discharge   /  /  

7. Duration of stay .....

8. Age at discharge (days) .....

9. Weight at discharge (grams) .....

10. Follow up (problems arising)

i) Sepsis: Yes.....No.....

If yes, date of episodes 1. \_\_\_/\_\_\_/\_\_\_

2. \_\_\_/\_\_\_/\_\_\_

3. \_\_\_/\_\_\_/\_\_\_

Treatment received: 1<sup>st</sup> line antibiotics

2<sup>nd</sup> line antibiotics

ii) Breastfeeding:

Yes.....No.....

If yes, age at onset of breastfeeding:

< 48hrs

48hrs - 1 week

> 1 week

If no, why.....

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Date	Weight	Head/Circumference	MUAC



## APPENDIX 2

### CONSENT FORM

**Research Topic: Assessment of the impact of partial Kangaroo Mother Care on growth rates and duration of hospital stay on low birth weight infants in KNH.**

**Investigator: Dr. Mwendwa A.C, Department of Paediatrics, U.O.N  
Emergency contact: 0721431978**

**Supervisors: Professor R.N Musoke, Dr. D.E. Simiyu, Dr. D.C. Wamalwa  
Department of Paediatrics, U.O.N**

**Introduction:** Your baby has been admitted to nursery because he/she has not reached the appropriate weight and will need extra care. This includes provision of warmth, feeding and treatment of any medical problem the baby may have. For provision of warmth, incubators have been used but the Kangaroo method (which entails holding the baby next to your skin) has been introduced to help supplement incubator care. Kangaroo method has been shown to maintain the baby's temperature within normal limits. We want to see how this programme fits into our care as well as its effectiveness in our nursery. Babies will be assigned to the partial Kangaroo group (kangaroo method combined with incubator care) and traditional care (incubator) groups. To do this, you will be asked to pick an envelope, which will contain a number that will show which group your baby will belong to. In both groups you will be helped to feed your baby on breast milk, including breast milk expression if the baby is not able to suck on the breast. To monitor the growth of your baby, weight will be taken three times a week, while head circumference and mid arm circumference measurements will be taken once a week during the period of stay. The results in both groups will then be compared.

The purpose of this consent form is to provide you with information about the study, which will enable you to make a decision whether to participate in the study. Your decision to participate is completely voluntary and you may withdraw from the study at any time without risk of any consequences on you or your baby.

**Benefits:** The results of the study will be useful in taking care of your baby and other babies admitted to the unit in the future.

**Risks:** No risks are involved and all babies will receive all the management they will require.

**Mother's note:** My signature below indicates that I understand the above conditions and that my questions have been answered fully.

**I VOLUNTARILY AGREE/ DO NOT AGREE THAT MY BABY BE PART OF THE STUDY**

Mother.....Signature/thumbprint.....Date. ....

Investigation Officer.....Signature.....Date.....



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**Ref: KNH-ERC/01/2846**

**Date: 30th June 2005**

Dr. Anne Clare Mwendwa  
Dept of Paediatrics & Child Health  
Faculty of Medicine  
University of Nairobi

Dear Dr. Mwendwa

**RE; RESEARCH PROPOSAL: "ASSESSMENT OF THE IMPACT OF PARTIAL KANGAROO MOTHER CARE ON GROWTH RATES AND DURATION OF HOSPITAL STAY ON LOW BIRTH WEIGHT INFANTS IN K.N.H" (P74/05/2005)**

This is to inform you that Kenyatta National Hospital Ethics and Research Committee has reviewed and **approved** revised version of your above cited research proposal for the period 30<sup>th</sup> June 2005 to 29<sup>th</sup> June 2006. You will be required to request for a renewal of the approval if you intend to continue with the study beyond the deadline given.

On behalf of the Committee, I wish you fruitful research and look forward to receiving a summary of the research findings upon completion of the study.

This information will form part of database that will be consulted in future when processing related research study so as to minimize chances of study duplication.

Yours sincerely,

**Prof. A. N. GUANTAI**  
**SECRETARY – KNH-ERC**

c.c: Prof. K. M Bhatt, Chairperson, and KNH-ERC  
The Deputy Director (C/S). KNH  
The Dean, Faculty of Medicine, UON  
The Chairman, Dept. of Paediatrics & Child Health, UON  
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