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## Predictors of duration of hospitalization among preterm infants admitted at kangaroo mother care unit in a tertiary hospital: A retrospective study

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**Abstract Objective:** We studied the association of factors related to duration of hospital stay among preterm infants admitted for Kangaroo Mother Care.

**Methodology:** This retrospective study reviewed existing charts of preterm infants who received kangaroo mother care from January 2016 to June 2019 at the Muhimbili National Hospital, a tertiary hospital in Tanzania. Descriptive statistics were summarized using mean (standard deviation) for continuous variables and frequency for categorical variables. Difference in mean was tested using student t-test, and chi square test was used for difference in proportions. Linear regression was used to determine the predictors of length of hospital stay; level of statistical significance was determined at  $P < 0.05$ .

**Results:** A total of 341 charts were analyzed. The mean duration of hospital stays and mean weight gain among preterm infants at kangaroo mother care were  $29.1 \pm 13.57$  days and  $16.5 \pm 9.067$  grams/kg/day respectively. And for preterm infants with birth weight  $< 1000$  grams had mean duration of hospital stay of  $46 \pm 10$  days ( $p$ -value  $< 0.01$ ). The length of stay decreased by 2.4 days for every 100 grams increase of weight at birth and by approximately three days for every weight gain of 10 grams/kg/day.

**Conclusion:** The gestational age, birth weight and rate of weight gain are determinants of hospital stay and should be considered in the management of these infants in a hospital setting.

**Résumé: Objectif:** Nous avons

étudié l'association des facteurs liés à la durée du séjour à l'hôpital chez les prématurés admis en soins mère kangourou.

**Méthodologie:** Cette étude rétrospective a examiné les dossiers existants des nouveau-nés prématurés qui ont reçu des soins mère kangourou de janvier 2016 à juin 2019 à l'hôpital national Muhimbili, un hôpital tertiaire en Tanzanie. Les statistiques descriptives ont été résumées en utilisant la moyenne (écart-type) pour les variables continues et la fréquence pour les variables catégorielles. La différence de moyenne a été testée à l'aide du test t de l'étudiant, et le test du chi carré a été utilisé pour la différence de proportion. La régression linéaire a été utilisée pour déterminer les facteurs prédictifs de la durée du séjour à l'hôpital. Le niveau de signification statistique a été fixé à  $P < 0,05$ .

**Résultats:** Au total, 341 dossiers ont été analysés. La durée moyenne du séjour à l'hôpital et la prise de poids moyenne chez les prématurés en soins mère kangourou étaient respectivement de  $29,1 \pm 13,57$  jours et de  $16,5 \pm 9,067$  grammes/kg/jour. Pour les prématurés dont le poids de naissance était inférieur à 1000 grammes, la durée moyenne du séjour à l'hôpital était de  $46 \pm 10$  jours ( $p$ -value  $< 0,01$ ). La durée du séjour a diminué de 2,4 jours pour chaque augmentation de 100 grammes du poids à la naissance et d'environ trois jours pour chaque gain de poids de 10 grammes/kg/jour.

**Conclusion:** L'âge gestationnel, le poids de naissance et le taux de prise de poids sont des déterminants de la durée d'hospitalisation et doivent être pris en compte dans la prise en charge de ces nouveau-nés en milieu hospitalier.

## Introduction

Kangaroo mother care (KMC) is continuous skin-to-skin contact between mother/parent and her/his newborn<sup>1,2</sup>. It comprises of Kangaroo mother care position, exclusively breastfeeding and discharge and follow up<sup>1,3</sup>. The “Kangaroo mother care” was established and used as alternatives to conventional methods for caring preterm babies in Bogota, Colombia in 1979<sup>4</sup> and has been increasingly recognized as an effective method of care of Low Birth weight babies. The World Health Organization (WHO) recommended KMC method since 2003, and Tanzania adopted it in 2008<sup>1,2</sup>

Among the proven benefits of KMC method is good weight and early hospital discharge to three weeks or less<sup>1,5,6</sup>. However, other studies in Brazil, Asia and Kenya reported the longer duration of hospital stay of more than four weeks<sup>7,8,9</sup>. In addition, a study in Kenya found that adequate weight gain; birth weight, gestation and older maternal age are the predictors of the duration of hospital stay<sup>9</sup>. We also speculated that other factors like mode of delivery, place of birth would also influence the duration of hospital stay.

Despite of the large burden of preterm deliveries in Tanzania, we have limited data on the assessment of kangaroo mother care provision in the country since it was established 14 years ago<sup>10,11,12</sup>. This study aimed to determine the predictors of duration of hospital stay among preterm and low birth weight infants who received kangaroo mother care at Muhimbili National Hospital from January 2016 to June 2019.

## Materials and methods

**Study design and setting:** This was a retrospective observational study from the available records of KMC, conducted at Muhimbili national hospital (MNH), a tertiary referral hospital in Tanzania with 1500 bed capacity. The hospital kangaroo mother care ward has approximately 40 admissions per month, and receives stable preterm babies weighing less than 1500 grams transferred from hospital neonatal care unit. All medical information of preterm/low birth weight infants is usually recorded in special books from the ministry of health.

**Sample size and sampling technique:** A minimum sample size calculated was 270 clients; however, 341 charts, which met inclusion criteria, were analyzed to increase the power of the study.

**Data collection method:** Participant’s information was extracted from MNH-KMC, labour and neonatal wards register books, as well as patient’s clinical notes. And because Preterm and low birth weight infants were referred to MNH within 24 hours of delivery, the total duration of hospital (recorded in days) was calculated from birth date to the discharge date. The average weight gains in grams/kg/day of preterm infant while in

hospital KMC was obtained by dividing total weight gain for the entire duration of hospital KMC by the number of days spent in hospital KMC and average body weight and this was recorded in grams/kg/day.

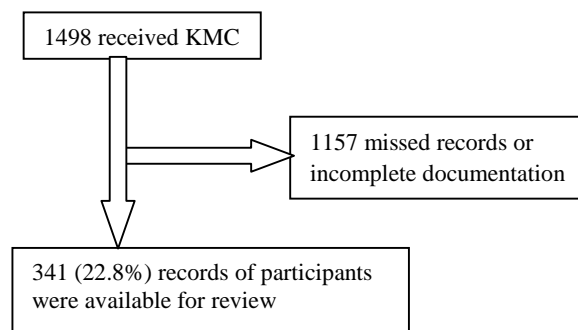
**Data analysis:** Data were analyzed using SPSS version 20. The continuous variables (Duration of hospital stay in days and weight gain in grams) were analyzed using mean and standard deviation. The frequency distribution table was used to summarize categorical data (demographic/baseline characteristics). Mean duration of hospital stay and associated factors were compared using t-test and chi square test was used for difference in proportions. Linear regression model was used to determine the predictors of duration of hospital stay. Statistical significance was determined at P-value <0.05.

**Ethical issues:** The study was permitted by MUHAS IRB (reference no: DA.287/298/01A and Muhimbili National Hospital management (reference no: MNH/TRCU/Permission/2019/183).

## Results

From January 2016 to June 2019, total of 1498 preterm/low birth weight infants were transferred to the KMC ward from MNH neonatal care unit. Out of preterm/low birth weight infants transferred to KMC ward, only 341 (22.8%) records were available for review (figure 1).

**Fig 1:** Flow chart of the study participants



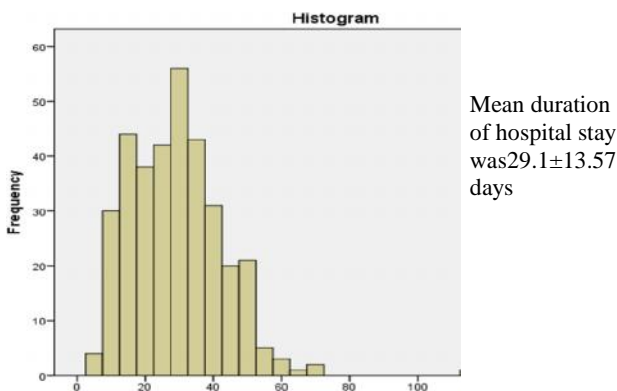
Among 341 charts reviewed, 229 (67.2%) were of female patients. Mean Gestation age was 31±2.76 weeks. Mean birth weight was 1366.7±277.57 grams and 189 (55.4%) had birth weight between 1000 to less than 1500 grams. Majority of the charts reviewed 193 (56.6%) were of infants born at MNH. Average daily weight gain was 16.51±9.07 grams/kg/day and 188 (55.1%) had weight gain of at least 15 grams/kg/day (table 1)

**Table 1:** Demographic and baseline characteristics of study participants (N=341)

Variable	No(%)
Sex of infant	
Male	112(32.8)
Female	229(67.2)
Gestational age (weeks)	
<28	20(5.9)
28-<32	166(48.7)
32-37	155(45.4)
Mode of delivery	
SVD	216(63.3)
Caesarian section	125(36.7)
Birth weight (grams)	
<1000	26(7.6)
1000-1499	189(55.4)
1500-2000	126(37)
Parity	
Multipara	193(56.6)
Primipara	148(43.4)
Place of birth	
MNH	260(76.2)
Other health facilities	81(23.8)
Maternal age (years)	
<19	13(3.8)
19-24	115(33.7)
>24	213(62.5)
Weight gain (g/kg/day)	
15	153(44.9)
15	188(55.1)

The mean length of hospital stay was 29.1±13.57 days for all preterm infants who were admitted in Kangaroo mother care ward at MNH (figure 2).

**Fig 2:** Duration of hospital stay among 341 who received KMC at MNH



Duration of hospital stay while in KMC in days

Mean duration of hospital stay was 46±10 days, 32±12.6 days and 21±10.5 days for birth weight less than 1000 grams, 1000 to less than 1500 grams and 1500 to 2000 grams respectively (p-value 0.001). Mean duration of hospital stay was 40±9.2 days, 32±13.7 days and 24±11.9 days for infants born at gestation age less than 28 weeks, 28 weeks to less than 32 weeks and 32 weeks to 37 weeks respectively (p-value <0.001). Infants who were born at Muhimbili national hospital had mean duration of hospital stay of 27±12.1 days compared to 34±16.3 days for those born at other health facilities (p-value <0.001) (table 2).

**Table 2:** Mean duration of hospital stay in relation to participants' characteristics

Variable	Mean duration of hospital stay in days μ (SD)	p-value
Sex		
Male	28 (14.5)	0.34
Female	29.6(13.1)	
Maternal age in years		
<18	32(17)	0.51
19-24	29.6(13.7)	
>24	28.6(13.3)	
Place of birth		
MNH	27.4(12.13)	0.000
Other health facilities	34.6(16.3)	
Parity		
Primepara	28(13.2)	0.2
Multipara	29.9(13.8)	
Mode of delivery		
Spontaneous Vaginal	30.9(13.9)	0.001
Delivery Caesarian section	26(12.3)	
Gestation age (weeks)		
<28	40.3(9.2)	0.000
28-<32	32.4(13.7)	
32-37	24.2(11.9)	
Birth weight (grams)		
<1000	45.7(10.3)	0.000
1000-1499	31.9(12.6)	
1500-2000	21.3(10.5)	
Weight gain (g/kg/d)		
<15	30(14.9)	0.01
15	28(12.4)	

Duration of hospital stay among preterm infants who was admitted in KMC ward at MNH decreased significantly by 2.4 days (p-value 0.001) for every 100 grams increase in birth weight, by one day (p-value 0.001) for every week increase of Gestation Age and by 2.5 days (p-value 0.05) for every 10 grams/kg/day increase in daily weight gain (table 3).

**Table 3:** Predictors of duration of hospital stay (Multi-variate analysis)

Variable	Linear coefficient	p-value
Intercept (days)	91.99	0.000
Weight gain (grams/kg/d)	-0.25	0.000
Gestation age (weeks)	-0.76	0.002
Birth weight (grams)	-0.024	0.000
Place of birth	-2.75	0.07
Mode of delivery	-0.56	0.66

## Discussion

Kangaroo mother care is an essential thermal care method for all preterm and low birth weight infants. This was started in few hospitals in Tanzania 16 years ago, and is now being practiced all over the country in more than 23 centers. Despite this roll-out, the data on various aspects of its implementation have been scarce.

This is the first chart review done at Muhimbili national hospital to determine the duration of hospital stay and associated factors among infant received Kangaroo mother care which is the first center where Kangaroo mother care was started.

In this study, the mean duration of hospital stays among preterm infants who received kangaroo mother care at Muhimbili national hospital was four weeks. This finding was similar to study done in India but one week longer than what is recommended by World health organization<sup>1,5,13</sup>. Similarity of our findings to what was found in India may be due to similar socio-economic status but also similar study population. However in other studies in Brazil and Kenya, the mean duration of hospital stay reported thirty six and sixteen days respectively<sup>7,9</sup>. When compared to our study duration of hospital stay among preterm infants received kangaroo mother care at Muhimbili national hospital is one week shorter than in Brazil and two weeks longer in Kenya. The longer duration of hospital in Brazil is because their study population had larger proportion of extremely low birth weight of 13% compared to 6% in our study. The mean difference of duration of hospital stay in Kenya and our study may be due to the fact that, the study in Kenya excluded extremely preterm babies, but we included also infant with less than one kilogram which are more likely to stay longer in the hospital. Moreover, when compared to pre-KMC era in our country, the mean duration of hospital stay was two weeks shorter (14), this indicates the potential achievements of Kangaroo mother Care method.

We also found that, the mean weight gains among preterm infants who received KMC at MNH was 16 grams/kg/day. This finding is within the WHO recommended weight gain of at least 15 grams/kg/day<sup>1</sup>. Gupta in Iran reported higher mean weight gain of 23 grams/kg/day and Mwendwa and co-workers in Kenya reported mean weight gain of 21 grams/kg/day<sup>9,15</sup>. Both findings were slightly higher than what we found, though it is within the WHO recommended weight gain for preterm/low birth weight Infants. Infants on KMC have low energy expenditure which facilitates adequate weight gain hence early hospital discharge<sup>9</sup>. We also found that hospital stay among recipient of KMC decreases by about three days for every 10 grams/kg/day increases in daily weight gain and adequate weight gain of at least 15 grams/kg/day was found to be independent predictor of length of hospital stay. Such that the length of hospital stays decreases with increase body weight. Our findings were similar from those reported in Kenya. Infants on KMC are more comfortable and sleep longer, which facilitates good growth and development. Thereby good weight gain and shorter length of hospitalization<sup>9</sup>. In order to improve weight gain, increased efforts to intensify lactational management and possible donor milk supplementation need to be considered in near future. Feeding volumes and proper maternal counseling are also needed.

The further analysis of demographic characteristics in relation to the duration of hospital found that the mean gestation age and birth weight was 31 weeks and 1366 grams respectively compared to 32 weeks and 1514 grams in Kenyatta Hospital in Kenya<sup>9</sup>. The birth weight and Gestation age were found to be independent predictors of duration of hospital stay in this study. The duration of hospital stays decreases with increase in birth weight and gestation age. Infants with birth weight less than thousand grams had duration of hospital stay of 46 days compared to 21 days for those with birth weight more than 1500 grams. Similarly, infants who born below 28 weeks of gestation age had duration of hospital stay of 40 days compared to 24 days for those born above 32 weeks of gestation age. Similar findings also found during pre-KMC era in the country and with study done in Ethiopia<sup>14</sup>. The lower the birth weight and gestation age the more prone to early preterm complications like respiratory distress, infections and anemia hence prolong the length of hospital stay. The study done in Kenyatta hospital in Kenya reported that old maternal age was independent predictor of length of hospitalization among preterm who received KMC<sup>9</sup>. Our study found no association between maternal age and length of hospital stay. This is because, the study in Kenya was a prospective cohort study and our study was retrospective chart review. Therefore, contrary findings may be due to different study design. But also study in Kenya was done before the KMC was full established compare to our study which done 12 years after introduction of KMC. Although, infants who were referred from other health facilities had mean length of hospital of 35 days compared to 27 days for those delivered at MNH. Further analysis shows no association between place of birth and duration of hospital stay. Hence the mean difference may be by chance

Our study showed that there is much more that need to be done further to improve care of infants in KMC. The record keeping is an area which needs improvement. With the advent of the NEST360 program and use of electronic data, in the last couple of years, we expect better data management.

### **Limitations of study**

We focused on duration of hospital stay alone. The presence of co-morbidities such as neonatal sepsis, and anaemia of prematurity was not studied. There were only 28% of records retrievable and was a single center hospital based study; hence it may not represent the entire population.

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### **Conclusion**

We report that the mean length of hospital stay is about 4 weeks, and the weight gain is proportional to the duration of stay. Improving measures to increase weight

gain, such as Lactational management are important. We recommend further prospective studies to determine other factors such as anemia, lactation and nutrition adequacy, neonatal infections, neonatal jaundice, need for intensive care at birth and so on, which may affect the duration of hospital stay.

**Conflict of interest:** None

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