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Original Research Article

Impact of Kangaroo mother care plus massage therapy on growth of preterm low birth weight infants at discharge

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ABSTRACT

Background: To assess the impact of kangaroo mother care plus massage therapy on growth of preterm low birth weight infants at discharge.
Methods: This randomized controlled trial was conducted in Department of Neonatology in Bangabandhu Sheikh Mujib Medical University over a period of 15 months from March 2022 to June 2023. Total 122 newborns were admitted in neonatal intensive care unit (NICU) of BSMMU during the study period with birth weight 800g to <2000g and gestational age 28 weeks to <34 weeks were enrolled in the study after getting informed written consent from parents or caregiver. Infants with major congenital anomalies were excluded from this study. All data were analyzed by statistical package for social sciences (SPSS) version 25 (IBM, USA).
Results: Total 122 newborns were admitted in neonatal intensive care unit (NICU) of BSMMU during the study period with birth weight 800g to <2000 g. Among them, 80 infants fulfilled inclusion criteria. Growth was significantly better in KMC plus massage therapy group. Mean weight gain per kg per day in KMC plus massage therapy group was 13.34±10.20 g and it was nearly half in KMC group 6.18±11.84 g only (p-value-0.01). Increase in length was 0.95±0.62 cm in KMC plus massage therapy group vs KMC group 0.66±0.49 cm (p-value-0.04). Increase in OFC was 0.59±0.29 cm in KMC plus massage therapy group vs KMC group 0.42±0.33 cm at discharge (p-value-0.03). Hospital stay in KMC group was 6.36±3.52 days, alternatively it was more 8.33±2.39 days in KMC plus massage therapy group. The dissimilarity was statistically significant (p-value-0.01) Study implication: Massage therapy potentiates benefits of kangaroo mother care in respect to better growth, so massage can be added along with KMC for better outcome.
Conclusions: Massage therapy added to KMC is more effective than KMC alone in improving growth, although it did not affect the hospital stay.

Keywords: Kangaroo mother care, Low birth weight, Massage therapy

INTRODUCTION

Newborn delivered before completion of 37 weeks are known as premature neonates. The survival rate of premature neonates has been increased in the past two decades due to rapid improvement of medical technology in the field of neonatal intensive care. Globally, an estimated 20 million neonates are born prematurely each year, indicating global preterm birth rate 13% and this number is rising and most of them (96%) are in developing countries.[1,2] Despite a declining neonatal mortality rate globally, marked disparities in neonatal mortality exist across regions and countries.

Regionally, neonatal mortality was highest in Sub-Saharan Africa (i.e., the combination of the West and Central Africa and Eastern and Southern Africa regions) and South Asia, with the neonatal mortality rate estimated at 27 and 23 deaths per 1,000 live births, respectively, in 2021. A newborn born in South Asia was nine times more likely to die in the first month than a newborn in a high-income country.[3] According to Bangladesh health and demographic survey, 2022, the under-5 mortality rate was 31 deaths per 1,000 live births and neonatal mortality rate was 20 deaths per 1,000 live birth among this prematurity and LBW contributes 32%.

There has been a steady downward trend in childhood mortality in Bangladesh, with a 35% decline in neonatal mortality and a 28% decline in under-five mortality in last 5 years. Prematurity is the leading cause of neonatal mortality due to its multiple complications. Among commonly experienced complications hypothermia, hypoglycemia, feeding intolerance, intraventricular hemorrhage, respiratory morbidities and sepsis are identified causes for death. In spite of being a lower-middle income country Bangladesh has made significant progress in reducing child mortality but neonatal mortality is still high. Burden of prematurity is increasing with advancement of health facilities.

To address this government of Bangladesh has taken multiple initiatives, these are application of 7.1% chlorhexidine as part of routine emergency newborn care for umbilical cord care to reduce infection, Giving antenatal corticosteroid (ACS) e.g., Betamethasone, Dexamethasone injection during threatened preterm labor by skilled providers to reduce complication of prematurity, Kangaroo mother care (KMC) for thermal protection of preterm/low birth weight newborns and management of sepsis using simplified treatment protocol in lower level facilities. Kangaroo mother care is defined as "Early, prolonged and continuous skin to skin contact between the mother or any care giver of low-birth-weight infant both in the hospital and after discharge with exclusive breast feeding and proper follow-up".[4]

In 2015, kangaroo mother care was included as one of the key strategies in the Bangladesh every newborn action plan. The target was to establish kangaroo mother care at 20% of public health facilities by 2016 and at 50% of public health facilities by 2020. Kangaroo mother care has three main components- Kangaroo position, which involves skin to skin contact between mother and infant, up to 24/7. The baby lies in a strict upright position, placed between the mother's breasts and under her clothes. Second component kangaroo nutrition which provides exclusive breast feeding, based on infant's need. The third component is kangaroo discharge and follow-up policies.[5]

Clinical trials, observational studies and systematic reviews of the literature have shown that kangaroo mother care has short term and middle term benefits.[6] This massage intervention involves a systematic external application such as touching, stroking, stretching, kneading, vibration, friction, percussion, compression and active or passive flexion and extension movements within the normal range of physiologic motion.

Tactile and kinesthetic stimulation are motions linked with the stimulation of social-emotional and neuromotor development in preterm infants.[7] Massage intervention can be applied as a noninvasive and easily learned method, which improves the attachment bond between mothers and their infants, along with improving their well-being.

METHODS

Study place

This randomized controlled trial was conducted in Department of Neonatology in Bangabandhu Sheikh Mujib Medical University.

Study duration

The study was conducted over a period of 15 months from March 2022 to June 2023.

Sample size

Total 122 newborns were admitted in neonatal intensive care unit (NICU) of BSMMU during the study period with birth weight 800g to <2000 g and gestational age 28 weeks to <34 weeks were enrolled in the study after getting informed written consent from parents or caregiver. Infants with major congenital anomalies were excluded from this study.

Inclusion criteria

Includes neonates birth weight from 800g to<2000g and gestational age 28 to<34 weeks, hemodynamically stable.

Exclusion criteria

Hemodynamically unstable critically ill neonates. Neonates with severe perinatal asphyxia and seizure.

Neonates requiring exchange transfusion. Neonates with major congenital. Neonates with repeated septic event (more than 2 times), IVH. Neonates with major surgical illness.

Study procedure

This randomized controlled trial was conducted in Department of Neonatology in BSMMU, a tertiary care hospital of Dhaka after approval by Institutional Review Board over a period of fifteen months. All neonates with gestational age 28 to <34 weeks and birth weight 800g to <2000 g admitted to NICU, BSMMU fulfilling the inclusion criteria were enrolled in the study after getting informed written consent from parents / guardians.

There was control and intervention group, randomization done with Random allocation software. In intervention group mothers were trained how to give massage therapy along with kangaroo mother care by giving direct instructions and showing procedure of massage by the principal investigator to ensure quality of care.

Mothers gave massage to newborns 3 times daily each time for 15 minutes (5 minutes tactile stimulation then 5 minutes kinesthetic movement followed by 5 minutes of tactile stimulation). To maintain standardization principal investigator monitored the massage procedure by herself in intervention group. Mother applied olive oil to the whole body of the infant before starting massage therapy.

Control group got Kangaroo mother care

The baseline characteristics of the mother and newborn such as maternal age, type of gestation (single/multiple), place and mode of delivery, gestational age, birth weight, length, occipitofrontal circumference, APGAR score were recorded in data collection forms. Neonates were weighed daily in morning, naked on an electronic weighing scale during enrollment and subsequently done once daily at morning until discharge. The weight was measured in grams using weighing scale with sensitivity of ±5 g (KINLEE EBST-20) and records were kept in data sheet.

Length was measured in recumbent position on the infantometer. The supine crown-heel length to the nearest centimeter was recorded with the help of an assistant at enrollment and discharge. Head circumference was measured by placing a flexible non-stretchable tape, circumferentially from supraorbital ridge to the occiput at enrollment and discharge. Growth parameters were monitored in both groups till discharge. As discharging criteria unit protocol was followed.

Procedure of data analysis

After collection, data were entered into a personal computer then edited, analyzed, plotted and were presented in graphs and tables. Qualitative data were expressed in proportion or percentage and statistical test were done by chi-square test and quantitative data were expressed as mean and SD and statistical test were done by student t test. All data were analyzed by SPPS software for windows, version 25. P value<0.05 was considered as level of significance.

RESULTS

Total 122 newborn were born with the birth weight 800g to less than 2000 g and gestational age 28 weeks to less than 34 weeks during this study period. According to the inclusion and exclusion criteria, 80 infants were eligible for this study. So, remaining 80 neonates who fulfilled the inclusion criteria were enrolled in this study and underwent randomization, 42 neonates were assigned to KMC plus massage therapy group and 38 to KMC group.

Among 42 neonates who were assigned to KMC plus massage therapy group, 9 newborns were excluded as 2 had parent or caregiver who did not provide consent, 4 parents denied to continue massage therapy till discharge and 3 infants died. Finally, 33 newborns remained in intervention group.

The 38 neonates who were assigned to KMC group, 5 newborns were excluded as 3 had parent or caregiver who did not provide consent, and 2 infants died. So, 33 newborns remained in control group. The primary and secondary outcomes were followed up, analyzed, and compared between the two groups. Outcomes were available for all the patients until discharge from neonatal intensive care unit (NICU) (Figure 1).

Baseline demographic characteristics of the mothers of studied neonates were presented in Table 1. Mean maternal age was 27.84±5.89 in KMC group and 27.36±5.18 in KMC plus massage therapy group. There was no significant difference in both groups (p=0.72).

Among the study population, most were singleton neonates. In the KMC group, 2/3rd (22) was singleton gestation and 1/3rd (11) was multiple gestation and in the KMC plus massage therapy group, 3/5th (19) and 2/5th (14) were singleton and multiple gestation respectively.

Most of the neonates were delivered by LSCS in both groups. KMC plus massage therapy group 28 (84.8%) neonates were delivered by LSCS and 5 (15.2%) delivered per vaginally. In KMC group 29 (87.8%) and 4 (12.2%) neonates were delivered by LSCS and per vaginally respectively.

Around 77% of the mothers completed their course of antenatal steroid. In KMC plus massage therapy group was 25 (75.8%) and in KMC group it was 26 (78.8%). There was no significant difference in both groups regarding type of gestation, mode of delivery and exposure to antenatal corticosteroid.

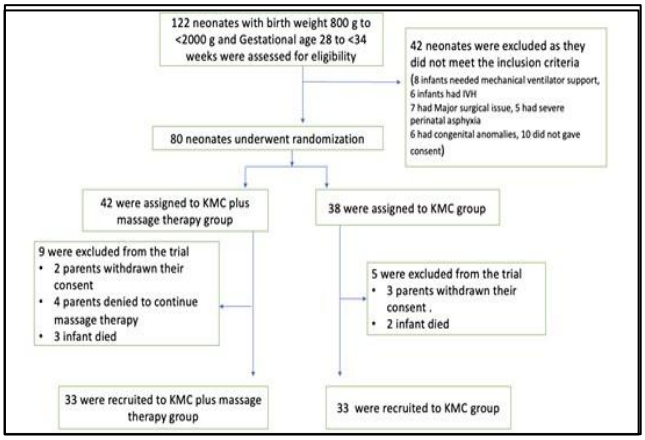

Figure 1: Patient enrolment in both groups.

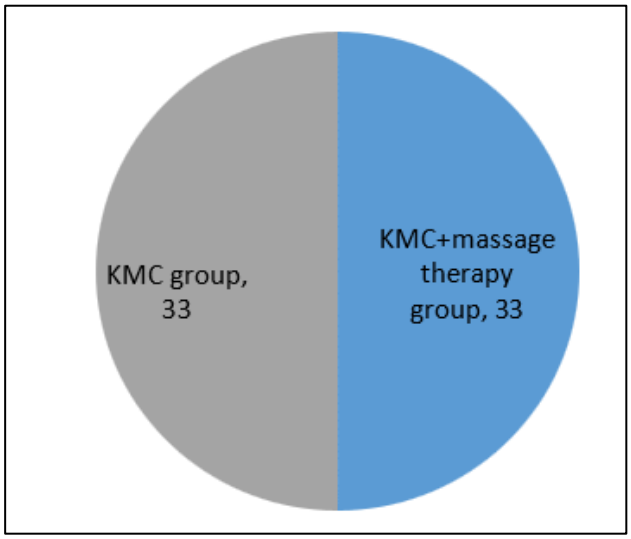

Figure 2: Distribution of finally enrolment in both groups.

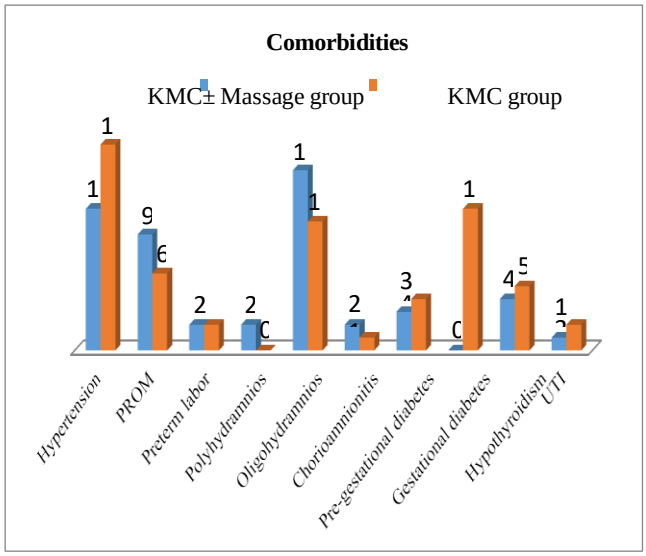

Figure 3: Comparison of maternal comorbidities between KMC plus massage therapy group and KMC group (n=66).

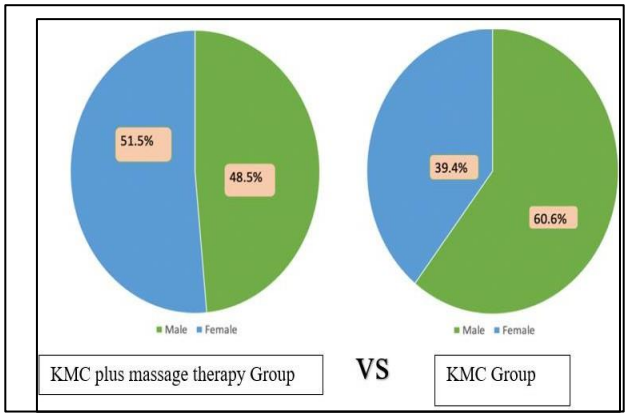

Figure 4: Comparison of gender distribution between KMC plus massage therapy group and KMC group (n=66).

Comparison of maternal comorbidities was shown in figure 3. Mothers from both groups had several comorbidities. In KMC plus massage therapy group, mothers suffering from hypertension were 11 (33.3%), had PROM 9 (27.2%) and Preterm labor 2 (6%), Polyhydramnios 2 (6%), Oligohydramnios 14 (42.4%), Chorioamnionitis 2 (6%), pre-gestational diabetes 3 (9%), Hypothyroidism 4 (12%), urinary tract infection 1 (3%). On the other hand, mothers of KMC group with hypertension were 16 (48.5%), had PROM 6 (18.2%) and Preterm labor 2 (6%), Oligohydramnios 10 (30.3%), Chorioamnionitis 1 (3%), pre-gestational diabetes 4 (12%), Hypothyroidism 5 (15%), urinary tract infection 2 (6%). There was no significant difference in both groups regarding maternal comorbidities except gestational diabetes (p-value-0.00), 11 (33.3%) mothers in KMC group had gestational diabetes and none in KMC plus massage therapy group.

Baseline demographic and perinatal characteristics of the studied neonates were presented in table 2. Mean gestational age was 31.81±1.62 weeks in the KMC plus massage therapy group and 33.08±1.15 weeks in the KMC group, there was significant difference in both the groups (p=0.00). Among the study population, most were moderately preterm babies. In the KMC plus massage therapy group, 31 (94%) were moderately preterm and 2 (6%) were very preterm and in the KMC group, 33 (100%) were moderately preterm. Mean Birth weight was 1401±259.54 g in the KMC plus massage therapy group and 1617.87±256.60 g in the KMC group which was statistically significant, (p=0.001). 1000-1499 g birth weight category was more in the KMC plus massage therapy group 72.7%. On the other hand, in the KMC group, it was 33.3% only. But 1500-1999 g category was more (66.4%) in the KMC group than KMC plus massage therapy group (27.3%). None of the newborns belonged to birth category <1000 g from both the groups.

The majority of the babies were male 20 (60.6%) in the KMC group and female 17 (51.5%) in the KMC plus massage therapy group. Most of the babies were inborn in

both groups which was 81.8% and 60.6% in KMC and KMC plus massage therapy group respectively. No significant difference was found in number of gestations between two groups. Mean duration of kangaroo mother care per day was 4.39±0.82 hours in KMC plus massage therapy group and 4.03±1.15 hours in KMC group. No significant differences were found in gestational age category, gender and mean age of starting KMC, interruption and daily KMC duration between two groups. Total days of kangaroo mother care were significantly higher in KMC plus massage therapy group 6.54±3.17 days and was lower in KMC group 4.36±3.88 days (P value 0.01) (Figure 4). Primary outcome of this study regarding impact of KMC plus massage therapy in growth of preterm low birth weight infants were shown in table 3. Mean weight gain per kg per day in KMC plus massage therapy group was 13.34±10.20 g and it was nearly half in KMC group 6.18±11.84 g only. Mean increase in length was 0.95±0.62 cm in KMC plus massage therapy group, but it was less in KMC group 0.66±0.49 cm till discharge. Mean increase in OFC was 0.59±0.29 cm in KMC plus massage therapy group, but it was less in KMC group 0.42±0.33 cm at discharge.

Table 1: Comparison between baseline maternal characteristics of KMC plus massage therapy group and KMC group (n=66).

Parameter	KMC±massage therapy group (n=33)	KMC group (n=33)	P value
Maternal age in years, Mean±SD	27.36±5.18	27.84±5.89	0.72^{ns}
Number of gestations, N (%)			
Single	19 (57.6)	22 (66.7)	0.44^{ns}
Multiple	14 (42.4)	11 (33.3)	
Mode of delivery, N (%)			
NVD	5 (15.2)	4 (12.2)	0.72^{ns}
LSCS	28 (84.8)	29 (87.8)	
Antenatal corticosteroid course, N (%)			
Complete	25 (75.8)	26 (78.8)	0.33^{ns}
Incomplete	4 (12.1)	1 (3)	
Not given	4 (12.1)	6 (18.2)	

s- significant, ns- not significant, SD: Standard Deviation, NVD- normal vaginal delivery, LSCS- lower segment caesarian section.

Table 2: Comparison between baseline neonatal characteristics of KMC plus massage therapy group and KMC group (n=66).

Parameter	KMC±Massage group (n=33)	KMC group (n=33)	P value
Gestational age in weeks, Mean±SD	31.81±1.62	33.08±1.15	<0.001^{s}
Gestational age category (weeks) N (%)			
Very preterm (28 to 31 6/7 weeks) Moderately preterm (32 to 33 6/7 weeks)	16 (48)	05 (15)	0.004^{s}
Birth weight in grams	17 (52)	28 (85)	
Mean±SD	1401±259.54	1617.87±256.60	<0.001^{s}
Birth weight category, N (%)	24 (72.7)	11 (33.3)	
VLBW (1000-1499 g) LBW (1500-1999 g)	9 (27.3)	22 (66.4)	<0.001^{s}
Gender of the baby, N (%)			
Male	16 (48.5)	20 (60.6)	0.32^{ns}
Female	17 (51.5)	13 (39.4)	
Place of delivery, N (%)			
Inborn	31 (94)	27 (81.8)	0.57^{ns}
Out-born	2 (6)	6 (18.2)	
Average daily KMC duration in hours, Mean±SD	4.39±0.82	4.03±1.15	0.14^{ns}
Mean age of starting KMC, Mean±SD	6.24±2.13	5.06±2.96	0.06^{ns}
Total KMC duration in days, Mean±SD	6.54±3.17	4.36±3.88	0.01^{s}
Interruption of KMC, N (%)	6 (18)	8 (24)	0.54^{ns}

s- significant, ns- not significant, SD- standard deviation, KMC- Kangaroo mother care, Inborn- Born in BSMMU, Out-born- Born outside BSMMU, very preterm <30 weeks, moderately preterm - 30 to 34 weeks.

Continued.

Table 3: Comparison of primary outcomes between KMC plus massage therapy group and KMC group (n=66).

Growth parameters	KMC±Massage therapy group (n=33)	KMC group (n=33)	P value
Weight gain in grams Mean±SD From enrollment to discharge	13.34±10.20	13.34± 10.20	0.01[s]
Increment of OFC in cm Mean±SD From enrollment to discharge	0.59±0.29	0.42 ± 0.33	0.03[s]
Increment in length in cm Mean±SD From enrollment to discharge	0.95±0.62	0.66 ± 0.49	0.04[s]

s- significant, OFC- Occipitofrontal circumference, SD- Standard deviation, g-Gram, cm- Centimeter.

Table 4: Comparison of Hospital stay between KMC plus massage therapy group and KMC group (n=66).

Parameter	KMC±Massage therapy group (n=33)	KMC group (n=33)	P value
Hospital stays in days Mean±SD	8.33±2.39	6.36±3.52	0.01s

s-significant, SD- standard deviation

On comparison between two group increment in all the growth parameters (weight, length and OFC) were statistically significant, p- values were 0.01, 0.04 and 0.03 respectively. Table 4 contrasted the hospital stay between the intervention and control group. Mean hospital stay in KMC group was 6.36±3.52 days, alternatively it was more 8.33±2.39 days in KMC plus massage therapy group. The dissimilarity was statistically significant (p value=0.01).

DISCUSSION

Slower growth is one of the most commonly encountered issues delaying discharge from hospital in premature neonates. There are several studies about kangaroo mother care, which showed that KMC have numerous short and long-term benefits including improvement of infant's growth parameters. On the other-hand a number of studies have been done on massage therapy too, which bears evidences that massage therapy also enhances growth of neonates, but few studies have assessed the effectiveness of these two low-cost simple interventions simultaneously. This randomized control trial was conducted involving preterm neonates born between 28 to weeks 34 weeks and birth weight 800g to<2000 g) in a tertiary care hospital, Dhaka, Bangladesh. In this study it was demonstrated that infants who received massage therapy along with kangaroo mother care in comparison to Kangaroo mother care alone had better weight gain and increment in length and occipitofrontal circumference.

However, the Maternal and neonatal characteristics were comparable between two groups except gestational diabetes mellitus which was significantly higher in KMC group, gestational age and weight at enrollment were higher in KMC group but septic events were more in KMC plus massage therapy group and all were statistically significant (p= 0.00, 0.00, 0.00 and 0.02). This randomized controlled trial was based on previously published randomized controlled trials those assessed the impact of kangaroo mother care and massage therapy on growth of preterm low birth weight babies separately, and few studies which have seen combined effects of both the interventions.[8-14]

The mean gestational age of the neonates who were included in this study was around 32 weeks in KMC plus massage therapy and 33 weeks in KMC group respectively. This was comparable with the study by S.Arya et al (WHO immediate KMC study group), a multisite, multi-country study conducted in low-resource hospitals (five hospitals in Ghana, India, Malawi, Nigeria, and Tanzania), on Continuous kangaroo mother care initiated immediately after birth in infants with a birth weight between 1.0 and 1.799 kg, they also included preterm neonates with gestational age around 33 weeks in their study. Brothenton et al, in the year in their randomized controlled trial done in Gambia, included neonates with birth weight < 2000g to see the impact of early kangaroo mother care versus standard care on survival of moderately unstable neonate.[15]

A meta-analysis by Wang et al. concluded that massage improved daily weight gain by 5.32 g (95% CI 4.15, 6.49 g, p<0.00001). A Cochrane systematic review by Vickers et al. also concluded that massage improved daily weight gain by 5.1g. In this study weight gain was nearly double (13.34 g/kg/day) in KMC plus massage therapy group in comparison to only KMC group (6.18 g) (p=0.01). In both above mentioned studies they gave only massage therapy to premature neonates, whereas we provided massage therapy along with Kangaroo mother care. Acosta et al. reported that daily weight gain was significantly higher (p=0.02) with kinesthetic stimulation in Kangaroo position with a growth at 5 days of 11.0 g/kg/day (95% CI 5.7:16.3) and at 15 days of 12.1

g/kg/day (95% CI 10.4:13.7) versus 2.1 g/kg/day (95% CI 3.1:7.4) at 5 days and 9.4 g/kg/day (95% CI 7.7:11.1) at 15 days in incubator. We got the similar results when tactile and kinesthetic stimulation were added to kangaroo mother care. Found that the mean increase in weight/day (29.94 vs 16.18 g/day, p=0.04) and mean a daily increase in weight/kg/day (16.90±15.60 vs. 8.96±11.12 g/kg/day, p=0.03) were almost double in the KMC±touch therapy group versus the KMC only group. They had better weight gain in both the group in contrast to this study. Factors responsible for this might be they included neonates with higher birth weight and gestational age.

The greater weight gain may also be associated with less stress and pain relief due to kinesthetic and tactile stimulation along with kangaroo mother care than only kangaroo mother care, as the mother's chest has been shown to be the best anti stress niche for premature neonates.[16] Results of our study was comparable to them only in relation to occipitofrontal circumference, which was in increasing trend from enrollment to discharge (p=0.00), whereas length of the newborns increased slowly and it was not statistically significant at discharge (p=0.17). Reason behind slower increase in length may be concurrent infection (neonatal sepsis). Rodovanski, Reus and Neves dos Santos in their systematic review and meta-analysis done to investigate the effectiveness of the ATVV (Auditory tactile visual-vestibular intervention), the TKS (Tactile- kinesthetic stimulation) and the KMC combined to standard care compared to standard care in the length of hospital stay and weight gain of hospitalized preterm infants in 2022, found that the addition of ATVV, TKS and KMC interventions to standard care may be more effective than standard care alone to improve weight gain of hospitalized preterm infants.[17]

The TKS combined to standard care may also be more effective than standard care alone to decrease the length of hospital stay. In the study of Mendes and Procianoy in 2008, massage therapy in very low birth weight infants decreased the length of hospital stay (42 vs. 46 days, CI: 42, 56) and lower incidence of late-onset neonatal sepsis (10.8 vs. 38.3%, p=0.005) compared with the control group (no massage).[18] The reduction in hospital stay among the massage group might be attributed to the faster weight gain, improved sleep wake states, and reduced stress behaviors and activity after the massage therapy.

In our study hospital stay was more in KMC plus massage therapy group in contrast to KMC group (8 vs 6 days) (p=0.01), this might be due to neonatal sepsis which was more in KMC plus massage therapy group (p=0.02) and delayed establishment of full feeding. Achievements of full feeding, type of feeding, episodes of feeding intolerance were not evaluated in this study. Most of the participants were inborn which will not reflect the whole newborn population.

CONCLUSION

In this study we found that growth of the infants who got massage therapy along with Kangaroo mother care were better than infants getting only kangaroo mother care at discharge. Massage therapy (Tactile and kinesthetic stimulation) done by mother or care giver during providing kangaroo mother care is a low-cost intervention, which can be initiated during hospital stay to reduce or attenuate initial physiological weight loss in preterm infants born before 34 weeks of gestational age.

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Ethical approval: The study was approved by the Institutional Ethics Committee

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