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Comparative effect of tactile kinetic stimulation versus intermittent kangaroo mother care on body weight in Pre-term low birth weight infants

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Abstract

Background: Low birth weight (LBW) and pre-term birth remains significant contributors to neonatal morbidity and mortality, particularly in resource-constrained settings, such as Bangladesh. Kangaroo Mother Care (KMC) is a well-established intervention for improving growth and clinical stability in pre-term LBW infants. Tactile Kinetic Stimulation (TKS) is a lesser-known alternative involving systematic touch and motion. This study compared the effects of TKS and intermittent KMC on growth and clinical outcomes in pre-term LBW infants.

Methods: A randomized controlled trial was conducted at Dhaka Shishu (Children) Hospital from January 2019 to December 2020. Forty pre-term LBW infants (gestational age 28–33 weeks, birth weight 1200–1800 g) were randomly assigned to Group A (TKS) or Group B (KMC). Group A received 15-min TKS sessions 4 times daily, while Group B received 2-h KMC sessions 4 times daily. Key outcomes included weight, length, occipito-frontal circumference (OFC), heart rate, temperature, time to achieve full feeding, and incidence of apnea. Data were analyzed using Statistical Package for the Social Sciences version 20.0.

Results: Baseline characteristics were comparable between the groups. The mean time to achieve full feeding was 5.63 ± 2.63 days in Group A and 5.50 ± 2.50 days in Group B ($P = 0.48$). Both groups showed progressive growth in weight, length, and OFC, with no significant differences at any time point. On the 21st day, the mean weight was 2080.94 ± 152.87 g in Group A versus 2038.57 ± 68.43 g in Group B ($P = 0.21$). Heart rate and temperature remained stable, with no significant differences. The incidence of apnea was low and comparable between groups (11% vs. 9%; $P = 1.00$).

Conclusion: Both TKS and KMC were equally effective in promoting growth and maintaining clinical stability in pre-term LBW infants. TKS offers a viable alternative to KMC, particularly in settings with barriers to traditional KMC implementation. These findings highlight the potential of integrating either intervention into neonatal care strategies in resource-limited settings.

Keywords: Kangaroo mother care, low birth weight, neonatal growth, neonatal interventions, pre-term infants, resource-limited settings, tactile kinetic stimulation.

Introduction

Low birth weight (LBW), defined as a birth weight of <2,500 g, and pre-term birth remain significant global health challenges, contributing to 60–80% of neonatal mortality annually.[1,2] Worldwide, an estimated 15% of all births are LBW, with rates even higher in developing countries, where access to specialized neonatal care is limited.[2] In Bangladesh, LBW prevalence exceeds global averages, with rates reported between 22% and 28%, placing an immense burden on an already resource-constrained healthcare system. LBW infants face heightened risks of hypothermia, infections, poor weight gain, and developmental delays, underscoring the urgent need for effective, cost-efficient interventions to mitigate these outcomes.[3,4] Inadequate weight gain among LBW and pre-term infants is a critical determinant of neonatal morbidity and mortality, as well as long-term health and developmental outcomes. Sufficient postnatal weight gain supports thermoregulation, enhances metabolic stability, strengthens immune defenses, and optimizes neurodevelopment, significantly improving survival rates. Studies indicate that pre-term infants who achieve early fat-free mass gains demonstrate superior cognitive and motor development outcomes at 12 months of corrected age compared to those with slower growth trajectories.[5] Conversely, poor postnatal growth velocity correlates with higher risks of metabolic disorders, neurodevelopmental delays, and long-term morbidity, emphasizing the importance of early, targeted nutritional and developmental interventions.[6] Among the established strategies to improve outcomes for LBW infants, Kangaroo Mother Care (KMC) has emerged as a globally recognized, low-cost intervention. KMC involves early, prolonged skin-to-skin contact between the infant and caregiver, exclusive breastfeeding, and frequent follow-up care. Originating in Colombia as a practical alternative to incubators, KMC has demonstrated robust evidence for reducing neonatal mortality by 36% and sepsis incidence by 53%, while significantly improving weight gain, breastfeeding success, and thermoregulation.[7] In Bangladesh, studies have shown that implementing KMC reduces hospital costs, shortens hospital stays, and decreases rates of hypothermia and late-onset sepsis among LBW infants.[8] Despite its documented efficacy, barriers to the widespread adoption of KMC persist, particularly in rural Bangladesh, where cultural norms, logistical constraints, and caregiver availability limit its feasibility.[9] Tactile Kinetic Stimulation (TKS), a less well-known but promising intervention, involves systematic touch and motion techniques designed to enhance sensory input and promote physical development. Emerging evidence suggests that TKS positively influences weight gain, neurodevelopment, and stress regulation in neonates, offering a viable alternative or complement to KMC in settings where skin-to-skin care may be challenging. For instance, studies have demonstrated that pre-term infants receiving TKS exhibit significant improvements in daily weight gain and feeding tolerance compared to those receiving standard care, highlighting its potential applicability in resource-limited contexts.[10] Despite the individual merits of KMC and TKS, there remains a critical gap in the literature regarding direct comparisons of their efficacy in promoting weight gain and developmental outcomes in LBW infants. Such comparative research is particularly relevant in Bangladesh, where neonatal intensive care units are scarce, and the healthcare system faces challenges in training and retaining skilled personnel. Understanding the relative advantages of KMC and TKS could inform evidence-based guidelines and optimize care strategies tailored to the needs and constraints of low-resource settings.

Methods

This randomized controlled trial was conducted at Dhaka Shishu (Children) Hospital from January 2019 to December 2020 to compare the effects of TKS and intermittent KMC on pre-term LBW infants. The study included neonates weighing 1200–1800 g, with gestational ages between 28 and 33 weeks, aged ≤10 days, and meeting specific clinical stability criteria. Exclusion criteria included neonates with unstable clinical

conditions, major surgery, or congenital anomalies. 73 neonates meeting the inclusion criteria were randomly allocated into Group A (TKS) or Group B (KMC) using the envelope lottery method. Among them, 38 were places into Group A, and 35 were placed into Group B. Baseline data, including weight, length, occipito-frontal circumference (OFC), heart rate, and temperature, were recorded prior to the intervention. Group A underwent TKS based on the Field massage therapy protocol, which involved 15-min sessions performed 4 times daily. Each session included tactile stimulation and passive kinesthetic stimulation using olive oil as a medium. Sessions were conducted with proper hygiene and at a controlled ambient temperature to ensure neonatal comfort and safety. Group B received intermittent KMC, where neonates were placed in skin-to-skin contact with their caregiver for 2-h sessions, 4 times daily, totaling 8 h/day. Both groups were closely monitored daily for changes in weight, length, OFC, heart rate, and temperature. Neonates were discharged based on the following criteria: Consistent weight gain of 10–20 g/kg/day for at least three consecutive days, ability to maintain normal temperature independently, absence of apnea or bradycardia, successful breastfeeding without respiratory complications, and demonstrated parental confidence in neonatal care. Data were collected using a structured questionnaire and analyzed using Statistical Package for the Social Sciences version 20.0. Quantitative data were analyzed with *t*-tests, while Chi-square or Fisher's exact tests were used for qualitative data. Statistical significance was set at a $P < 0.05$. Ethical approval for the study was obtained from the Dhaka Shishu Hospital Ethics Committee. Informed consent was secured from all guardians prior to the enrollment of their neonates in the study.

Results

The baseline characteristics of the studied neonates (n = 73) were comparable between Group A (TKS, n = 38) and Group B (KMC, n = 35). The mean gestational age was 31.08 ± 1.55 weeks in Group A and 31.28 ± 1.07 weeks in Group B, with no statistically significant difference (P = 0.22). Similarly, the mean birth weight was 1435.78 ± 106.55 grams in Group A and 1502.42 ± 288.43 g in Group B, which was also not significantly different (P = 0.32). The gender distribution was balanced across groups, with males comprising 42% in Group A and 49% in Group B, and females making up 58% and 51%, respectively (P = 0.35). The mode of delivery showed no significant variation, with normal vaginal delivery accounting for 42% in Group A and 40% in Group B, while lower uterine cesarean section was 58% in Group A and 60% in Group B (P = 0.48). The distribution of neonates by birth weight categories was similar, with 61% of Group A and 60% of Group B falling in the 1200–1499 g category, and 39% and 40% in the 1500–1800 g category, respectively (P = 0.63). Age group distribution also showed no significant differences, with 52% of neonates in Group A and 46% in Group B aged 1–5 days, and 48% in Group A and 54% in Group B aged 6–10 days (P = 0.47) (Table 1).

The time to achieve full feeding was comparable between Group A (TKS) and Group B (KMC). The mean time to reach full feeding was 5.63 ± 2.63 days in Group A and 5.50 ± 2.50 days in Group B, with no statistically significant difference between the two groups (P = 0.48) (Table 2).

The comparison of physical parameters between Group A (TKS) and Group B (KMC) showed no statistically significant differences in weight, length, or OFC across the study period. For weight, both groups exhibited progressive increases over the study period. The mean weights before the procedure were 1474 ± 50.65 g in Group A and 1490 ± 57.86 g in Group B (P = 0.54). On the 7th, 14th, and 21st days, the mean weights in Group A were 1581.32 ± 39.94 g, 1755.26 ± 21.63 g, and 2080.94 ± 152.87 g, respectively, compared to 1584.86 ± 53.33 g, 1805.57 ± 13.02 g, and 2038.57 ± 68.43 g in Group B (P = 0.24, 0.84, and 0.21, respectively). For length, both groups demonstrated gradual increases without significant differences. The mean lengths before the procedure were 41.21 ± 0.14 cm in Group A

and 41.17 ± 0.14 cm in Group B (P = 0.92). By the 21st day, the lengths were 44.35 ± 0.26 cm in Group A and 44.35 ± 0.25 cm in Group B (P = 0.42). Similarly, for OFC, both groups showed consistent growth over the study period. Before the procedure, the mean OFCs were 31.39 ± 0.33 cm in Group A and 31.42 ± 0.31 cm in Group B (P = 0.44). On the 21st day, the OFCs were 33.17 ± 0.36 cm in Group A and 33.40 ± 0.31 cm in Group B (P = 0.10) (Table 3).

The comparison of clinical parameters, including heart rate and temperature, between Group A (TKS) and Group B (KMC), showed no statistically significant differences at any time point during the study period. For heart rate, the baseline values were similar, with a mean of 135.05 ± 2.6 beats/min in Group A and 134 ± 2.6 beats/min in Group B (P = 0.55). Over the study period, heart rates in both groups steadily decreased, reaching 123.44 ± 2.6 beats/min in Group A and 122.86 ± 3.4 beats/min in Group B by the 21st day (P = 0.55). For temperature, the baseline mean values were 96.3 ± 1.8°F in Group A and 96.4 ± 1.9°F in Group B (P = 0.36). Both groups demonstrated gradual increases in temperature over time, with the 21st-day mean temperatures being 98.7 ± 1.1°F in Group A and 98.8 ± 1.8°F in Group B (P = 0.27) (Table 4).

The incidence of apnea among the neonates was similar between the two groups. In Group A (TKS), 4 infants (11%) developed apnea, compared to 3 infants (9%) in Group B (KMC), with no statistically significant difference between the groups (P = 1.00). The majority of neonates in both groups did not experience apnea, with 89% in Group A and 91% in Group B being apnea-free (Table 5).

Discussion

This study aimed to compare the effects of TKS and Intermittent KMC on the growth and clinical outcomes of pre-term LBW infants in a resource-limited setting. The baseline characteristics of the two groups were comparable, ensuring the validity of the comparative findings. Consistent with prior studies, no significant differences were observed between the groups in gestational age, birth weight, gender distribution, or age categories at enrollment, aligning with the methodological rigor necessary for robust analysis.[10,11] The mean time to achieve full feeding did not differ significantly

Table 1: Baseline characteristics of the studied infants (n=73)

Variables	Group A (n=38) (%)	Group B (n=35) (%)	P-value
Gestational age (mean±SD weeks)	31.08±1.55	31.28±1.07	0.22ns
Birth weight (g; mean±SD)	1435.78±106.55	1502.42±288.43	0.32ns
Gender			
Male	16 (42)	17 (49)	0.35ns
Female	22 (58)	18 (51)	
Mode of delivery			
NVD	16 (42)	14 (40)	0.48ns
LUCS	22 (58)	21 (60)	
Birth weight groups			
1200–1499 g	23 (61)	21 (60)	0.63ns
1500–1800 g	15 (39)	14 (40)	0.90ns
Age groups			
1–5 days	20 (52)	16 (46)	0.47ns
6–10 days	18 (48)	19 (54)	0.15ns

SD: Standard deviation, NVD: Normal vaginal delivery, LUCS: Lower uterine cesarean section, ns: not significant

Table 2: Time of achieving full feeding between the study groups (n=73)

Times of achieving full feeding (days)	Group A (=38)	Group B (*n*=35)	*P*-value
Mean±SD	5.63±2.63	5.50±2.50	0.48ns

SD: Standard deviation, ns: not significant

Table 3: Comparison of physical parameters between Group A and Group B (*n*=73)

Parameters	Group A (*n*=38)	Group B (*n*=35)	*P*-value
Mean±SD weight in grams			
Before procedure	1474±50.65	1490±57.86	0.54ns
7th day	1581.315±39.94	1584.857±53.33	0.24ns
14th day	1755.26±21.63	1805.571±13.02	0.84ns
21st day	2080.94±152.87	2038.57±68.43	0.21ns
Mean±SD length in cm			
Before procedure	41.21±0.14	41.17±0.14	0.92ns
7th day	41.44±0.14	41.59±0.14	0.30ns
14th day	42.72±0.21	42.85±0.15	0.25ns
21st day	44.35±0.26	44.35±0.25	0.42ns
Mean±SD OFC in cm			
OFC before procedure	31.39±0.33	31.42±0.31	0.44ns
7th day	31.96±0.35	31.93±0.28	0.35ns
14th day	32.60±0.35	32.50±0.28	0.60ns
21st day	33.17±0.36	33.40±0.31	0.10ns

SD: Standard deviation, OFC: Occipito-frontal circumference, ns: not significant

Table 4: Comparison of clinical parameters between group A and group B (n = 73)

Parameters	Group A (*n* = 38)	Group B (*n* = 35)	*P*-value
Mean ± SD heart rate			
Before procedure	135.05 ± 2.6	134 ± 2.6	0.55ns
3rd day	132.84 ± 3.1	132.91 ± 3.5	0.96ns
7th day	128.65 ± 3.5	127.86 ± 2.6	0.63ns
10th day	126.44 ± 2.4	125.76 ± 2.8	0.36ns
14th day	125 ± 2.6	124.88 ± 3.5	0.45ns
18th day	124.63 ± 2.4	123.42 ± 1.6	0.85ns
21st day	123.44 ± 2.6	122.86 ± 3.4	0.55ns
Mean ± SD temperature			
Before procedure	96.3 ± 1.8	96.4 ± 1.9	0.36ns
3rd day	96.8 ± 1.6	97.3 ± 1.2	0.12ns
7th day	97.8 ± 1.0	97.5 ± 0.8	0.19ns
10th day	97.4 ± 1.8	97.0 ± 1.6	0.44ns
14th day	98.1 ± 1.5	98.2 ± 1.4	0.37ns
18th day	98.4 ± 1.3	98.5 ± 1.3	0.13ns
21st day	98.7 ± 1.1	98.8 ± 1.8	0.27ns

SD: Standard deviation, ns: not significant

Table 5: Comparison of patients who developed apnea between group A and group B (*n*=73)

Incident of apnea	Group A (*n*=38) (%)	Group B (*n*=35) (%)	*P*-value
Apnea	4 (11)	3 (9)	1.00ns
No apnea	34 (89)	32 (91)	

ns: not significant

between TKS (5.63 ± 2.63 days) and KMC (5.50 ± 2.50 days), suggesting that both interventions were equally effective in facilitating feeding progression. These findings are consistent with prior research showing that KMC and similar interventions promote earlier feeding readiness due to improved physiological stability and neurobehavioral benefits.[12,13] In terms of physical parameters, both TKS and KMC promoted progressive weight gain, length growth, and OFC increases without statistically significant differences. On the 21st day, both groups achieved comparable mean weights, lengths, and OFCs. These findings align with prior studies that demonstrated the effectiveness of KMC in promoting weight gain, length, and OFC growth in pre-term infants due to the thermal stability and neuroendocrine benefits of skin-to-skin contact.[14,15] Similarly, TKS has shown comparable benefits in weight gain and neurodevelopment through systematic touch and motion techniques that stimulate sensory pathways and improve feeding behavior.[16] For clinical parameters, such as heart rate and temperature, both TKS and KMC maintained stability throughout the study, with no significant differences between groups. Heart rates in both groups steadily decreased, and temperatures increased to normal ranges over the 21-day observation period. Similar trends were observed in previous studies, where KMC maintained stable heart rates and body temperatures due to thermal insulation provided by skin-to-skin contact.[17,18] TKS also ensured physiological stability through the stimulation of the parasympathetic system, enhancing metabolic and temperature regulation. The incidence of apnea was low and comparable between groups, with no statistically significant differences. Apnea rates of 11% in the TKS group and 9% in the KMC group are consistent with other findings suggesting that both interventions minimize apnea episodes by enhancing respiratory stability and reducing stress.[19,20] Overall, both TKS and KMC proved effective in supporting growth and maintaining physiological stability in pre-term LBW infants. The findings highlight that TKS, as a structured touch-based intervention, offers outcomes comparable to KMC, suggesting its potential applicability in contexts where traditional KMC faces barriers, such as cultural constraints or caregiver availability. Future research should further investigate the long-term neurodevelopmental outcomes and scalability of these interventions in resource-limited settings.

Limitations of the study

The study was conducted in a single hospital with a small sample size. Hence, the results may not represent the whole community.

Conclusion

This study demonstrated that both TKS and KMC are effective, comparable interventions for promoting growth and maintaining clinical stability in pre-term LBW infants. No significant differences were observed between the two groups in key outcomes, including weight gain, length, OFC, heart rate, temperature regulation, and time to achieve full feeding. The low and comparable incidence of apnea further highlights the safety and feasibility of both approaches. TKS, as a structured touch-based intervention, offers outcomes similar to KMC and can serve as an alternative in settings where traditional KMC is challenging to implement due to cultural, logistical, or caregiver-related barriers. These findings support the integration of either intervention into neonatal care strategies, particularly in resource-limited settings, such as Bangladesh. Further research is warranted to explore long-term neurodevelopmental outcomes and the scalability of these interventions in diverse contexts.

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Conflicts of Interest

None declared.

Ethical Approval

The study was approved by the Institutional Ethics Committee.

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