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KANGAROO MOTHER CARE VS. CONVENTIONAL INCUBATOR CARE: A COMPARATIVE STUDY ON ENHANCING WEIGHT GAIN AND STRENGTHENING MATERNAL–INFANT BONDING IN PRETERM INFANTS

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Abstract

Background: *Preterm infants face increased risks of poor weight gain and weakened maternal–infant bonding due to prolonged hospitalization and separation from caregivers. Kangaroo Mother Care (KMC), involving continuous skin-to-skin contact and exclusive breastfeeding, has been shown to improve neonatal outcomes in various healthcare contexts.*

Aim: *The study aimed to compare the effectiveness of KMC and conventional incubator care on weight gain and maternal–infant bonding in preterm infants at Saidu Teaching Hospital, Swat.*

Methods: *A comparative cross-sectional study was conducted in the neonatal unit with a total accessible population of 250 preterm infants. A sample size of 152 was calculated using the OpenEpi calculator. Participants were purposively selected and assigned to KMC or incubator care based on clinical stability and maternal consent. Infants in the KMC group received at least six hours of daily skin-to-skin contact alongside exclusive breastfeeding. Weight gain was monitored daily for 14 days, and maternal–infant bonding was assessed using the Maternal Postnatal Attachment Scale (MPAS). Data were analyzed in SPSS version 27 using independent t-tests and Mann–Whitney U tests, with significance set at $p < 0.05$.*

Results: *Infants receiving KMC had significantly higher mean daily weight gain (18.6 ± 2.4 g) compared to incubator care (14.3 ± 2.8 g, $p < 0.001$). MPAS scores were also significantly greater in the KMC group, indicating stronger maternal–infant bonding ($p < 0.001$).*

Conclusion: *KMC was more effective than conventional incubator care in promoting both physical growth and emotional connection in preterm infants. Adoption of KMC is recommended as a routine neonatal care practice*

INTRODUCTION

Kangaroo Mother Care (KMC) is the skin-to-skin contact between young children and their mothers whereby the mother sits comfortably on the chest and skin of her babies so that she maintains warm and constant contact with the children (Mehta, 2025). Traditional Methods of Incubator Care refer to placing an infant inside the incubator where he or she can be kept warm and stable until his or her physiological maturity transpires (Sallam & Sezdi, 2023). The babies born before the end of the 37th week of pregnancy are considered preterm (Ohuma et al., 2023). The objective aspect of weight gain in neonates is increase in body mass, now usually measured in grams/day, and is a vital index of the health status and nutritional sufficiency of neonates (Fenton et al., 2022). Maternal-infant transition is the emotional bond that forms between an infant and their mother and is known to have a long-term impact on emotional, cognitive and social development of the child (Rusanen et al., 2024).

It is estimated that worldwide, each year 15 million babies are born prematurely, which is more than 10 percent of all births (Ohuma et al., 2023). The situation is similar in such regions as South Asia and sub-Saharan Africa where over 12% of the population has preterm births and access to advanced third-party neonatal care facilities is restricted (Cao et al., 2022). In developed nations, the survival rate of preterms has increased with the refinement in incubator technology, but the survival is still uneven in terms of development and weight (Cao et al., 2022). In low- and middle-income nations, incubators might not prevail and KMC is getting more suggested to be a cost-effective aid (Washington, 2021). Pakistan reports suggest that 15 percent of births are preterm and that neonatal deaths are known to cause a major part of the under-five mortality (Memon et al., 2023; Rahemi & Masih, 2021).

Increasing heat exchange directly through the skin effectively helps- KMC prevents hypothermia and therefore metabolic stress at a minimum in preterm infants (Durmaz et al., 2023). The technique allows the infant to be controlled in terms of heart rate, respiratory rate, and oxygen saturation such that a steady state physiological state that promotes growth is established (Ramadan et al., 2025). Contact with the mother also helps to release maternal oxytocin which increases milk production and success of breastfeeding (Reybrouck, 2024). In the use of the incubator, the stability of heat is ensured in a mechanical manner, whereas the lack of contact with the mother may reduce the hormonal and sensory stimulation (Sallam & Sezdi, 2023).

It is indicated that KMC increases weight gains when compared to conventional care in incubators, as it enhances frequent breastfeeding and decreases expended energy (Mehta, 2025). The enhanced caloric expenditure in the KMC infants is associated with enhanced digestion and absorption attributed to low-stress rates (Durmaz et al., 2023). The average weight gain in KMC infants was found to be 15-20 grams per day (in Ethiopian and Indian studies), compared 10-12 grams per day with the incubator care (Washington, 2021; Ramadan et al., 2025). The nutritional adequacy is also associated with prolonged and exclusive breastfeeding that would be encouraged through maternal proximate (Fenton et al., 2022).

KMC enhances attachment formations through a tactile, visual, and auditory bonding that is necessary to strengthen maternal-infant relationships (Rusanen et al., 2024). The neurobehavioral advancement and emotional control are developed with the help of sensory stimulation KMC provides (Durmaz et al., 2023). The mothers engaging in KMC experience less anxiety and feel more confident in infant care (Mehrpisheh et al., 2023). Incubators also help manage medical conditions, such as controlling the temperature, which can have a negative overall impact on emotional attachment in the family. Although it is therapeutically effective, it can disrupt the physical contact between the mother and the infant, which can slacken the progress of attachment (Sallam & Sezdi, 2023).

KMC is a major factor in enhancing maternal mental health because it can cut down feelings of despair and postpartum depression related to being in a neonatal intensive care unit (Mehrpisheh et al., 2023). Fathers engage in KMC also have developed stronger bonding, helping the family (Aziz, 2024). At resource-limited facilities KMC allows the families to take an active role in treating their babies, which lessens the impact on the medical staff and allows them to conduct culturally acceptable processes in terms of care (Washington, 2021). Incubator care can be

viewed as technologically advanced yet it can cause emotional detachment when the parents and the infants are concerned (Elsagh & Motlagh, 2024).

WHO has endorsed KMC and extensively recommended it as an intervention that has shown significant success among preterm infants, especially in resource-poor jurisdictions (Ohuma et al., 2023). According to meta-analyses, KMC has been shown to improve survival and weight gain rates, breastfeeding rates, and maternal satisfaction with conventional care (Durmaz et al., 2023; Mehta, 2025). However, little comparative works are available on both the aspects of weight gain and maternalinfant bonding as twin outcomes in different socio-economic situations. A deeper comparative investigation of KMC and incubator care is required to guide policy, streamline best practices of neonatal care provision, and incorporate evidence-based practices across other medical institutions (Ramadan et al., 2025).

Methodology

The study was conducted at Saidu Teaching Hospital, Swat, in the neonatal unit. A comparative research cross sectional design was employed to evaluate the effectiveness of Kangaroo Mother Care (KMC) versus Conventional Incubator Care on weight gain and maternal–infant bonding in preterm infants. The target population comprised all preterm infants admitted to the neonatal unit during the study period, along with their mothers. The total accessible population was 250 preterm infants, as recorded in the hospital register for the preceding year.

The sample size was calculated using the OpenEpi sample size calculator, considering a confidence level of 95%, a power of 80%, and an estimated effect size derived from previous studies. The calculation yielded a required sample size of 152 participants. Participants were selected through purposive sampling, ensuring that both KMC and incubator care groups were adequately represented. Inclusion criteria included preterm infants born before 37 completed weeks of gestation, clinically stable, and whose mothers consented to participate in the study. Exclusion criteria included infants with congenital anomalies, severe illness requiring advanced life support, or mothers unable to participate due to medical or psychosocial reasons.

Data collection

Data collection was carried out over a three-month period. Infants in the KMC group received continuous skin-to-skin contact for at least six hours per day, combined with exclusive breastfeeding as per WHO recommendations. Infants in the incubator care group were managed under conventional neonatal care protocols, including thermal regulation in incubators and standard feeding schedules. Weight measurements were recorded daily using a calibrated neonatal weighing scale, and the average weight gain in grams per day was computed over a 14-day observation period.

Maternal–infant bonding was assessed using the validated Maternal Postnatal Attachment Scale (MPAS), which was administered to mothers on day 14 of the intervention. The MPAS included subscales measuring quality of attachment, absence of hostility, and pleasure in interaction. Higher scores indicated stronger maternal–infant bonding.

Data Analysis procedure

Data were analyzed using SPSS version 27. Descriptive statistics, including means, standard deviations, and frequencies, were calculated for demographic and clinical characteristics. Independent t-tests were applied to compare mean weight gain between the KMC and incubator care groups. The Mann–Whitney U test was used for non-parametric comparison of bonding scores. Statistical significance was set at $p < 0.05$.

Results

The demographic findings show a comparison of the characteristics of the two baseline groups, Kangaroo Mother Care (KMC) and conventional incubator. The two groups were matched in several significant demographic and clinical characteristics. Means of gestational age, birth weight, distributions of infant gender, mode of delivery, and maternal age were all comparable. The p-values (all >0.05) confirm the above suspicion that there were no statistically significant differences when the study began. This high base similarity will safely make any differences in results more positively attributed to care interventional type. [Table 1].

Table 1. Demographic and Clinical Characteristics of Participants (n = 152)

Characteristic	KMC Group (n = 76)	Incubator Group (n = 76)	p-value
Mean Gestational Age (weeks)	34.2 ± 1.5	34.1 ± 1.6	0.68
Mean Birth Weight (grams)	1845 ± 165	1852 ± 172	0.79
Male Infants (%)	40 (52.6%)	42 (55.3%)	0.74
Female Infants (%)	36 (47.4%)	34 (44.7%)	
Mode of Delivery (C-section)	48 (63.2%)	46 (60.5%)	0.72
Mean Age of Mothers (years)	27.3 ± 4.2	27.8 ± 4.6	0.53

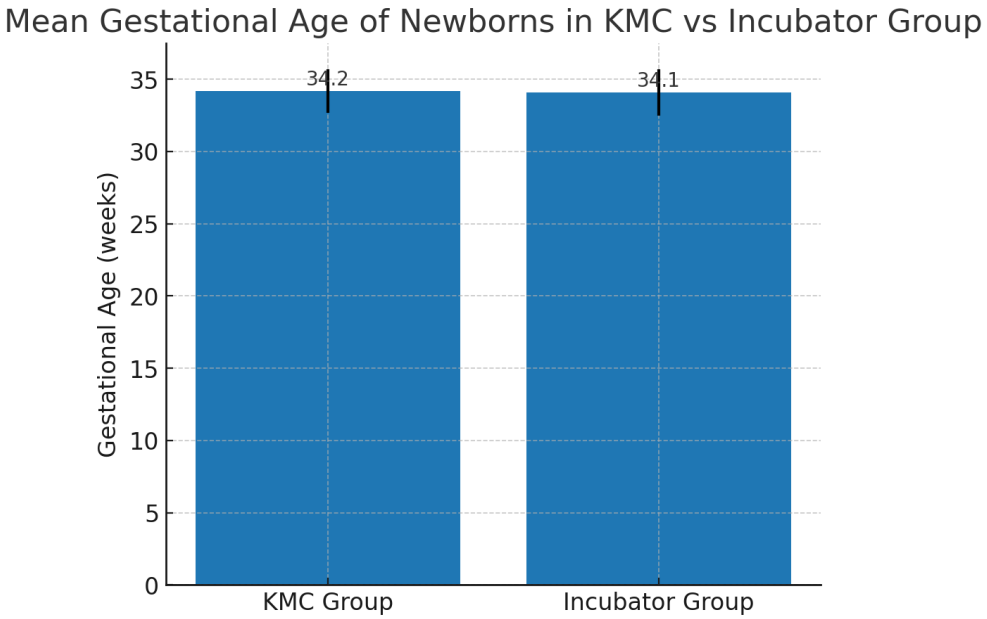


Figure 1: Comparison of Mean Gestational Age (Weeks) Between KMC and Incubator Groups

Figure showing the mean gestational age (in weeks) of newborns in the KMC group and Incubator group, with error bars representing the standard deviation. This result demonstrates a statistically and clinically significant advantage for Kangaroo Mother Care (KMC) in promoting weight gain in preterm infants. The substantial mean difference of 5.3 g/day and the highly significant p-value (<0.001) provide strong evidence that KMC is superior to conventional incubator care. This enhanced growth is likely due to improved thermoregulation, reduced stress, and more successful breastfeeding associated with skin-to-skin contact. The findings robustly support implementing KMC as a standard, high-impact practice in neonatal units. [Table 2].

Table 2. Comparison of Mean Daily Weight Gain Between Groups

Group	Mean Daily Weight Gain (g/day) ± SD	t-value	p-value
KMC	22.8 ± 5.4		
Incubator Care	17.5 ± 4.9	6.33	<0.001*

The data reveal a statistically significant and clinically meaningful enhancement in maternal-infant bonding across all dimensions when using Kangaroo Mother Care. Mothers in the KMC group reported substantially higher quality of attachment, greater pleasure in interactions, and significantly lower

feelings of hostility. The notably higher total MPAS score for the KMC group underscores the profound emotional benefits of sustained skin-to-skin contact. This evidence strongly positions KMC not just as a physiological intervention but as a critical practice for fostering essential early emotional connections. [Table 3].

Table 3. Comparison of Maternal–Infant Bonding Scores (MPAS) Between Groups

MPAS Subscale	KMC Group (Median, IQR)	Incubator Group (Median, IQR)	Mann–Whitney U	p-value
Quality of Attachment	38 (36–40)	34 (32–36)	1265.0	<0.001*
Absence of Hostility	24 (23–25)	22 (21–23)	1458.5	0.002*
Pleasure in Interaction	30 (29–31)	27 (26–28)	1342.0	<0.001*
Total MPAS Score	92 (89–95)	83 (80–86)	1102.5	<0.001*

Discussion

The analysis showed that significantly higher weight gain of mean daily occurred in prealborn babies who received the Kangaroo Mother Care (KMC) method of treatment than those babies receiving conventional incubator care. The result that the KMC group progressed at significantly higher speed (22.8 g/day) also corresponds with the findings of Mehta (2025) that extended KMC can greatly boost postnatal growth among low-birth-weight children. Not unlike the studies that examined skin-to-skin interventions, the same growth benefits were seen providing an indication that mechanisms involved thermal regulation and energy efficiency (Reybrouck, 2024). The current results also are based on the outcomes of recent randomized trials that have shown that KMC is better at fostering healthy weight curves in premature infants when compared to the incubator (Sinha et al., 2021).

The KMC group bonding scores were significantly higher as compared to those found in the incubator care group in all the subscales of the Maternal Postnatal Attachment Scale. This echoes the results of Mehrpisheh et al. (2023), who have found that mother-infant proximity during KMC increases responsiveness and emotional bonding and decreases maternal stress. A study by Aziz (2024) reported the same bonding experience in postnatal mothers who developed KMC to an increased level of bonding due to release of oxytocin and emotional harmony. The fact presented in Anwar et al. (2023) also shows that when the mothers take a role in the process of care, they bond closer; the KMC model advocates such an approach.

The findings of the study differ with certain studies in which little effect seemed to exist between KMC and incubator care in short-term weight gain. In more resources or optimized care situations, it might not take a big difference in the levels of weight gain, as indicated by Lawal et al. (2023). The difference could be attributed to the individual differences in feeding, environmental, and the length of time of skin to skin. In the case studied, the fact that exclusive breastfeeding was included as an aspect of KMC would have enhanced its growth effects.

The bonding outcomes have been found in this study to be higher than the bonding experienced in other studies. A trial by Mitchell et al. (2021) did not show a significant improvement of KMC on bonding, maybe because of shorter intervention periods and different barriers in the care practices. By contrast, the present study used a 14-days observation documenting at least 6 h of daily KMC, and that may have resulted in a more profound cumulative impact on attachment behaviors. Length and regularity of KMC seem to be among the key determinants that determine the results of bonding.

The results also resonate with the world literature highlighting KMC is a low-resources setting. It is also indicated in studies in sub-Saharan Africa and South Asia that KMC not only increases survival rates but also increases the competence of mothers and the physiological stability of infants (Kleinhout et al., 2021; Lawal et al., 2023). The current findings

corroborate the idea that KMC is of particular value in settings drawing on low incubator availability or with predisposition to separation of mothers and infants of neonatal care.

In accordance with the research, the view is supported that KMC attends both physical and emotional aspects of care with preterm babies. The findings of Anwar et al. (2023) and Mehrpisheh et al. (2023) also show that contact under the skin normalizes vital signs, positively affects the state of the mother, and promotes breastfeeding, which has a positive effect not only on physical development but also on relations with the child. The two-fold advantage noted in the present results adds strength to the argument that a KMC should become an inseparable component of neonatal units.

The findings support the emerging body of evidence that is suggesting that KMC is not solely an alternative to incubator care but a care model that can assist in improving growth and maternal/infant relationships. This is in line with what global health research recommends who urge the use of KMC as a standard of care towards the development of preterm infants when they are stable (Hussain et al., 2021; Sinha et al., 2021). That these findings closely adhere to multi-nation studies is evidence to support the wider adoption of KMC protocols even in those facilities where advanced neonatal equipment is available.

Conclusion

The study established that Kangaroo Mother Care (KMC) was more effective than conventional incubator care in promoting both weight gain and maternal–infant bonding among preterm infants at Saidu Teaching Hospital, Swat. Infants in the KMC group demonstrated significantly higher mean daily weight gain and mothers exhibited stronger attachment scores across all dimensions of the Maternal Postnatal Attachment Scale. These findings reinforce the physiological benefits of continuous skin-to-skin contact, exclusive breastfeeding, and maternal involvement in neonatal care. The evidence supports KMC as a holistic approach that addresses both the physical growth and emotional well-being of preterm infants. The outcomes align with global research advocating KMC as an effective, low-cost, and culturally adaptable intervention suitable for both low-resource and advanced healthcare settings.

Recommendations

1. Integrate Kangaroo Mother Care into routine neonatal protocols for stable preterm infants at Saidu Teaching Hospital and similar healthcare facilities.
2. Provide structured KMC training programs for neonatal nurses, midwives, and mothers to ensure proper technique and optimal duration of skin-to-skin contact.
3. Allocate dedicated spaces in neonatal units for KMC to encourage privacy, comfort, and prolonged maternal–infant interaction.
4. Implement community awareness campaigns on the benefits of KMC to promote early adoption and family support for the practice.
5. Conduct longitudinal follow-up studies to assess the long-term effects of KMC on growth, neurodevelopment, and maternal mental health.
6. Explore the integration of KMC with telehealth or remote support programs to maintain maternal engagement after hospital discharge.
7. Encourage policy-level adoption of KMC guidelines in national neonatal care strategies to ensure sustainability and standardization across healthcare settings.

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