The Research of Medical Science Review
ISSN: 3007-1208 & 3007-1216 Volume 3, Issue 8, 2025

IMPACT OF KANGAROO MOTHER CARE ON PRETERM NEONATAL OUTCOMES IN RESOURCE-LIMITED SETTINGS

Salma Ahmed Mahar[*1], Liaquat Ali[2], Anosha Nasir[3], Madiha Taufeeq[4] Saaduzzaman Siddiqui[5], Muhammad Tayyab Rahman[6], Aqsa Kabir[7]

[*1]*Isra University Hospital, Hyderabad*
[2,3,4,5,6]*PNS Shifa Hospital, Karachi*
[7]*Dow Medical College/Dow University of Health Sciences, Karachi*

[*1]noman_ahmed678@outlook.com

DOI: https://doi.org/10.5281/zenodo.17097184

Keywords
Kangaroo Mother Care, Preterm Neonates, Neonatal Mortality, Hypothermia, Exclusive Breastfeeding

Article History
Received: 03 May, 2025
Accepted: 16 July, 2025
Published: 11 August, 2025

Corresponding Author: *
Salma Ahmed Mahar

Abstract

Preterm birth is the leading cause of neonatal morbidity and mortality globally, with the burden highest in resource-limited settings where advanced neonatal care is frequently limited. This study aims to evaluate the effect of KMC over conventional thermal care on preterm, low-birth-weight neonates between 28-34 weeks of gestation at JPMC, Karachi Pakistan. Globally, the literature indicates that KMC is a biologically plausible, low-cost, and feasible-to-scale intervention that has been proven to enhance survival, thermoregulation, and breastfeeding in low- and middle-income countries. Between January and December 2024, consecutive sampling will be used to enrol 1100 neonates (550 in the KMC group and 550 in the Conventional Care Group) in a prospective observational design. Method Maternal and neonatal characteristics, feeding practices, clinical outcomes, and 28-day survival were recorded in data abstraction forms. Statistical analyses were performed using SPSS version 26.0, applying chi-square tests, t-tests and multivariate regression. Significantly lower values for neonatal mortality were shown in the KMC versus the Conventional Care group (8.5% vs 14.9%, p = 0.002). Compared with standard care, KMC was also associated with a lower incidence of hypothermia (20.4% vs 34.3%, p < 0.01), fewer cases of culture-confirmed sepsis (7.5% vs 12.4%, p = 0.01), better rates of exclusive breastfeeding at discharge (75.8% vs 53.8%, p < 0.01), higher rates of daily weight gain (16.2 vs 13.8 g/kg/day, p < 0.01), and shorter lengths of stay (8.7 vs 10.5 days, p < 0.01). KMC was independently associated from other factors with mortality (OR 0.55), hypothermia (OR 0.52), and breastfeeding (OR 2.31), as multivariate analysis. These findings further establish KMC as an effective, context-relevant intervention with a high-impact on neonatal outcomes for preterm infants and provide a practical scalable solution for health and survival in resource-constrained hospitals.

INTRODUCTION

Preterm birth is the leading cause of neonatal death and the second leading cause of death among children under five globally. The global number of preterm births, which averages around 1 in every 10 births, are stagnating as other areas of improvement continue to progress: approximately 13.4 million babies were born preterm in 2020, with inequalities both between and within

countries remaining (Bradley *et al.*, 2025). Low and middle-income countries (LMICs) bear a disproportionately large share of this burden where combinations of fragile health systems, a shortage of trained staff and limited access to technology combine to maximise the risk of mortality and long-term neurodevelopmental impairment in preterm and low birthweight (LBW) infants. These realities represent an inflection point for context appropriate, high-impact, scalable and implementable solutions with impact in the hardest hit resource-limited countries.In low- and middle-income country (LMIC) hospitals continually, incubator-based thermal care, complex respiratory assist, and invasive monitoring practises common in conventional neonatal intensive care are limited by equipment availability, failure of electricity, lack of space and infection control. Kangaroo Mother Care (KMC), uninterrupted and extended skin-to-skin contact and breastfeeding support, has been advocated as a biologically sound, operationally viable, and inexpensive alternative or adjunct to incubator care in such settings (Forde, 2018). We postulate that KMC provides physiologic warmth via maternal contact, stabilizes cardiorespiratory parameters, promotes early and exclusive human milk feeding, and reduces exposure to nosocomial pathogens, mechanisms that directly impact the most critical pathways to preterm mortality and morbidity. The World Health Organization (WHO) recently changed its recommendation for standard of care for small and preterm babies (those born before ~32 weeks' gestation) to immediate or early KMC (including before complete clinical stabilization where possible) which aligns with new trial evidence (Adejuyigbe *et al.*, 2023).Well beyond biologic plausibility, large multicounty randomized evidence now shows survival benefits of early, continuous KMC in low- and middle-income country hospitals. The WHO-coordinated Immediate KMC (iKMC) trial of moderate preterm infants 1.0–<1.8 kg in Ghana, India, Malawi, Nigeria, and Tanzania (n=3211) found an approximately 25% mortality reduction at 28 days with immediate continuous KMC compared with conventional care with deferred KMC until stabilization (Linnér, 2022). Such results resulted in a world-wide policy change to maintain mothers with small babies together from the moment of birth in facility locations with enough ability for continuous exposure to the family members.Yet, implementing trial effectiveness into regular program functioning is only possible if they are housed on delivery platforms that address structural challenges, such as limited space around neonatal units, practices that separate mothers and infants, and staff workflow which prioritises incubator care. Such an approach includes innovations such as the mother–Newborn Care Unit (Mncu) model, which collocates mothers with their small or sick newborns 24 hours a day to allow safe monitoring and constant kangaroo mother care and feeding assistance (Chellani *et al.*, 2022). MNCUs, when applied at scale with training, protocols, and family engagement, can reduce mortality, hypothermia, and infection risk as evidenced from programmatic experiences from India and WHO regional initiatives.In light of this evidence and policy continuum, we investigated the effectiveness of KMC in improving neonatal outcomes among preterm babies in low- and middle-income hospitals, where KMC is at least feasible by the form of immediate, uninterrupted mother–baby contact (Ariff *et al.*, 2021). All-cause 28-day mortality, hypothermia, sepsis/infection, exclusive breastfeeding at discharge, daily weight gain and length of stay- these are clinically important outcomes for survival and healthy discharge operational dimensions: Coverage, duration of KMC per day, and adherence- when aiming to achieve real world effectiveness.The Tanner trial is designed to provide setting-relevant evidence of the effect of facility-based, uninterrupted KMC on outcomes in preterm newborns in low- and middle-income countries in a usual care context. This work is a research study, with a prespecified design, outcomes and analysis plan consistent with WHO guidance and recent trials, but modified for feasibility within the limitations commonly experienced within neonatal units in LMICs. The innovation is in mapping impact alongside fidelity (e.g. KMC hours per dyad per day) and modelling this to help understand (modelling) scale-up shapes, particularly for configurations that retain mothers and babies together such as MNCU (Washington, 2021).

Review of Literature

There are several lines of evidence supporting the reduction in mortality linked to KMC. The iKMC randomized trial recruited 3,211 low-birthweight

infants born at five African and Asian countries, providing continuous KMC soon after delivery and adhering to mother-baby contact 24/7 Linnér, 2022 #7080). When compared to standard care (incubator/warmer and postpone KMC, until stabilization), immediate KMC was associated with about 25% lower 28-day mortality, a clinically meaningful effect in the very settings where neonatal deaths aggregate. Importantly, the intervention was beneficial despite challenges typically found in LMIC hospitals, reinforcing the robustness of KMC even in an environment of resource limitations (Medvedev *et al.*, 2020).In addition to trial data, who 2023/2024 operational guidance integrates the evidence base and embeds immediate KMC as a high-impact innovation for small and preterm infants, suggesting continued skin-to-skin contact (ideally 8–24 hours/day) and continuous separation from mother–baby pairs to achieve optimal physiologic stabilization, thermoregulation, and breastfeeding (Ekwueme *et al.*, 2024). For services counting fidelity in a gradient manner versus a dichotomy of initiation not complete, the guidance lays emphasis that contact time is an active "dose" with a greater benefit associated with longer daily KMC duration (Key program points).This survival mechanism is further backed by KMC which affects the relatively higher morbidities. Components between various individuals is something such as this: an innate protection against thermoregulation (that's a hot-shock), making hypothermia a valid cause of significant mortality in LMICs due to its independence as a physiological aggregator (Brambilla Pisoni *et al.*, 2022). MNCU platforms reporting early KMC program experiences noted 35% fewer low-temperature events and 18% lower suspected sepsis compared to standard incubator-based care (mechanistic expectation: reduced cold stress, more breastfeeding, less invasive handling).This is particularly relevant within high workload neonatal units where prevention of sepsis is a priority. A recent synthesis published in the Lancet Child & Adolescent Health (2025) identifies mounting evidence that promoting early/immediate KMC reduces infection-related outcomes in line with biologic pathways: (stabilized microbiome, reduced exposure to hospital pathogens, and enhanced immune factors in colostrum) (Konlan *et al.*, 2024). Although the magnitude is setting and fidelity dependent, convergence across trials and implementation studies supports clinically meaningful risk reductions for clinical sepsis and likely for culture-proven sepsis, where diagnostics can facilitate estimates of effect size, as well.Previous Cochrane-type syntheses assessed KMC following stabilization and found large reductions in mortality and increased breastfeeding. This policy-defining change was preceded by iKMC, which brought KMC into the post-natal period, given that a majority of neonatal deaths occur in the first week of life and many come in the first 24 hours, too early for KMC to wait until full stability. This magnitude of mortality difference between the two kinds of KMC is likely to be due to KMC initiated during this highest-risk window (as opposed to KMC started later in life) as immediate KMC is likely to provide warmth and support for breast feeding (Esewe, 2018).New updates were released by WHO which partially include similar notion of early and immediate KMC while enhancing its recommendations ensuring the immediate/early KMC even before complete stabilization whereby the KMC supported by the teams in safe areas maintaining close observation–most convincingly with a MNCU style where mothers are included inside neonatal care unit (L Jiang *et al.*, 2025). This recommendation is particularly important for LMIC health systems since it supports contact-based care models that require the reorganization of wards and workflows rather than bundles of care that focus only on incubator–admitted infants.The intensity and continuity of KMC determines its effectiveness. Scoping reviews and the operational literature highlight that duration of exposure (hours/day) is crucial, as intermittent short sessions may not confer the same physiologic benefits as extended periods of contact. Facilities with systematic tracking and coaching of 8–24 h/day of skin-to-skin, with lactation support to achieve exclusive human milk feeding, have better improvements in thermal stability, weight gain, and readiness for discharge. New measurement frameworks suggest KMC dose be recorded as part of a routine quality indicator using simple bedside logs and electronic tools (Tuti *et al.*, 2022).Evidence translation into everyday practice must overcome structural and behavioral barriers: lack of space next to neonatal beds, policies to separate mothers and infants, reduced privacy, safety concerns and, finally, staff accustomed to

work flows centered around incubators. MNCU model from India does these by having mothers 24/7 co-located to mother neonate space enabling continuous KMC whilst being monitored for early breastfeeding and prompt escalation if needed. Four empirical reports and WHO features document mortality reductions (35%), and fewer suspected infections (MNCU-supported immediate KMC vs. routine services ~18%), signals that point to this service model being both impactful and scalable within district and tertiary facilities (S Jiang *et al.*, 2020).Hybrid approaches in sub-Saharan Africa combine KMC with low-cost adjuncts (e.g., bubble CPAP, early antibiotics per sepsis protocols, simplified feeding regimens). However, with the aim to enhance mother–infant responsivity, which is an implementation lever needed for KMC adherence maintenance, recent studies from Malawi propose that KMC can be naturally absorbed within nurse-led units and incorporate interventions aimed to coach caregiver behaviours (e.g., H-HOPE) during long hospital stays and post discharge (Usac, 2024).The global strategy on KMC has moved from whether to implement it at scale to how to do it. The total shortfall (152 million preterm births over the past decade and stagnation of preterm rates) is quantified in the Born Too Soon (2023) report, which positions KMC as the definitive survival intervention and central to newborn action plans (Adejuyigbe *et al.*, 2023). Guidance on implementing KMC for 2023/2024 WHO update and partner toolkits guides facility re-design, family caregiver-inclusive staffing models, infection-prevention controls compatible with rooming-in, and monitoring indicators (KMC initiation, hours/day and exclusive breastfeeding at discharge). These priorities are compatible with LMIC hospital realities while expressing a departure towards family-centred care that treats maternal presence as a clinical resource as opposed to a visiting right.Despite progress, key gaps persist. Many hospitals start KMC, but then do not deliver enough duration, which is where many benefits of KMC lie, with no routine, standardised dose tracking of feasibility (Tumukunde *et al.*, 2024). Second, although WHO recommends implementation of KMC pre-stabilization, the practice remains only partially implemented owing to challenges related to space, staffing, or safety. KMC fidelity is infrequently related to hard outcomes (mortality, hypothermia, sepsis) in routine data, and is unlikely to be useful for quality improvement efforts or to support investments in MNCU-type spaces. Lastly, more robust evidence is required on contextual moderators such as gestational age, birthweight strata, availability of respiratory support and maternal preparedness, to inform triage and counselling. Such gaps warrant an impact study that is original, facility-based, measures both outcomes as well as fidelity under real-world conditions.

Research Methodology This study adopted a prospective observational design at Jinnah Postgraduate Medical Centre, Karachi, enrolling 1,100 preterm neonates. Data on clinical outcomes, feeding practices, and survival were systematically collected and analyzed to assess the effectiveness of Kangaroo Mother Care compared with conventional care.

3.1 Study Design and Setting

It was a cross-sectional observational study performed at the Neonatology Department, Jinnah Postgraduate Medical Centre (JPMC), Karachi, Pakistan, one of the largest tertiary-care referral hospitals of the country. This facility has a well-staffed labor ward and neonatal intensive care unit (NICU) catering for inborn and outborn neonates, with a significant proportion of them being preterm and/or low-birth-weight. Kangaroo Mother Care (KMC) was already part of the neonatal unit strategy mentioned in the data collection period in line with updated guidelines from the World Health Organization (Group, 2021). The study covered 12 months from January to December 2024.

3.2 Study Population

The study population consisted of all live-born preterm neonates born at or referred to JPMC who met the inclusion criteria. Preterm birth occurred at gestation < 37 weeks' using maternal last menstrual period (LMP) and/or localized ultrasound findings. Inclusion criteria were: birth weight 1,000– 1,800 grams and/or gestational age < 37 weeks. Infants who were admitted to the neonatal unit within 6 hours of birth and had a mother or primary caregiver available to provide Kangaroo Mother Care were eligible for the trial

(Group, 2021).Criteria were designated to safely/appropriately exclude KMC. Neonates with lethal congenital anomalies, including anencephaly or severe cardiac malformations were not included. Infants excluded were those who either required immediate surgical intervention or advanced life support (limiting the safe initiation of KMC). Furthermore, our study population did not include critically unstable neonates: those that present to the NICU in shock or severe respiratory distress and could not tolerate skin-to-skin care.

3.3 Sample Size and Sampling Metho

This was a consecutive sampling study, as all preterm neonates eligible during the study period were enrolled until the intended sample size was reached.Sample size was calculated using the WHO sample size calculator for comparison of two proportions. Based on previous data regarding a 25% decrease in neonatal mortality with immediate KMC (expected mortality reduced from 18% to 13.5%), the sample size was calculated to be 1,000 neonates (500 neonates in KMC group and 500 neonates in conventional care group) level of significance 95% and power 80%. Enrolment of 1,100 neonates to allow for attrition and loss to follow-up.

3.4 Group Allocation

We identified neonates according to the type of care they received. KMC Group: Infants who were commenced on Kangaroo Mother Care within 2 h after birth and continued at least 8 h per day with exclusive breastfeeding support Neonatal nurses trained mothers in safe positioning, and offered continuous skin-to-skin contact and lactation support for this subgroup of mothers. Conventional Care Group: Infants who received routine incubator or radiant warmer care until clinically stable. KMC was started later in the day as per the clinical decision and availability of the caregivers. This natural grouping served to operationalize routine practice variation at JPMC that remained ethical, while allowing comparison (Washington, 2021).

3.5 Data Collection

A predefined proforma was used for data collection. A number of baseline maternal variables were obtained: age, parity, mode of delivery, antenatal steroid use and pregnancy complications. Neonatal variables extracted included birth weight, gestational age, sex, Apgar scores, and resuscitation needs at birth (Dueñas-Espín *et al.*, 2025). Hospitalisation nurses recorded on the KMC daily monitoring form; hours of KMC provided daily, exclusive or mixed breast feeding or formula feeding and physiological parameters including temperature, respiration rate and oxygen saturation. We also recorded clinical outcomes such as the number of hypothermia episodes, suspicion of sepsis, weight gain in g/kg/day, time to stabilization, and length of hospital stay. The follow-up was done by telephone on day 28 post-discharge to assess survival status and incidence of any readmission.

3.6 Data Analysis

We entered data and analyzed it by SPSS version 26.0. Continuous variables (e.g., birth weight, gestational age, weight gain, hospital stay) were presented as mean ± standard deviation (SD), and were compared using independent t-test. Categorical variables (mortality, hypothermia, sepsis, breastfeeding status) were reported by frequencies and percentages and compared by Chi-square test (Getaneh *et al.*, 2022). Multivariate logistic regression was performed, adjusting for possible confounding factors including gestational age, birth weight and use of antenatal steroids. Statistical significance was defined as p value <0.05.

3.7 Ethical Considerations

Ethical Considerations The study was carried out after the approval of the Institutional review board (IRB) of Jinnah Postgraduate Medical Centre (JPMC), Karachi. Mothers or legal guardians provided individual written informed consent prior to enrollment. Study codes were used to maintain confidentiality and all procedures were in accordance with the ethical principles outlined in the Declaration of Helsinki.

Results

The findings revealed that Kangaroo Mother Care significantly reduced neonatal mortality, hypothermia, and sepsis while improving exclusive breastfeeding, weight gain, and reducing hospital stay duration. Multivariate analysis confirmed KMC as an independent predictor of better neonatal outcomes.

4.1 Baseline Characteristics of Mothers and Neonates

Table 4.1 shows a summary of the main characteristics of the study population. 1,100 mother–neonate pairs were enrolled (Kangaroo Mother Care [KMC] group n = 550; Conventional Care group n = 550. Maternal demographic characteristics were similar between both groups. There was no difference of maternal age between the groups: KMC: 27.1 ± 5.3 years, Conventional Care: 27.4 ± 5.6 years, p = 0.42. As well as, the percentage of mothers who were primiparous was comparable between groups (38.5% in the KMC arm and 39.8% in the Conventional care arm, p = 0.67). Antenatal steroids, a key intervention in preterm labor was nearly equivalent with 47.5% in the KMC group vs. 45.3% in the Conventional group, p = 0.46.

In terms of delivery and pregnancy-related factors, the caesarean section was virtually the same between groups (44.3% in KMC and 43.1% in Conventional care, p = 0.71). Pregnancy complications were equally distributed; 34.0 % in the KMC group versus 34.9 % in the Conventional care group (p = 0.78). These results indicate that the two groups were closely matched on various obstetric variables and thus comparison of the groups during outcome analyses could be considered appropriate. This level of comparability in maternal and obstetric factors is instrumental for reducing selection bias and increasing the validity of any differences in neonatal outcomes between the two intervention approaches.

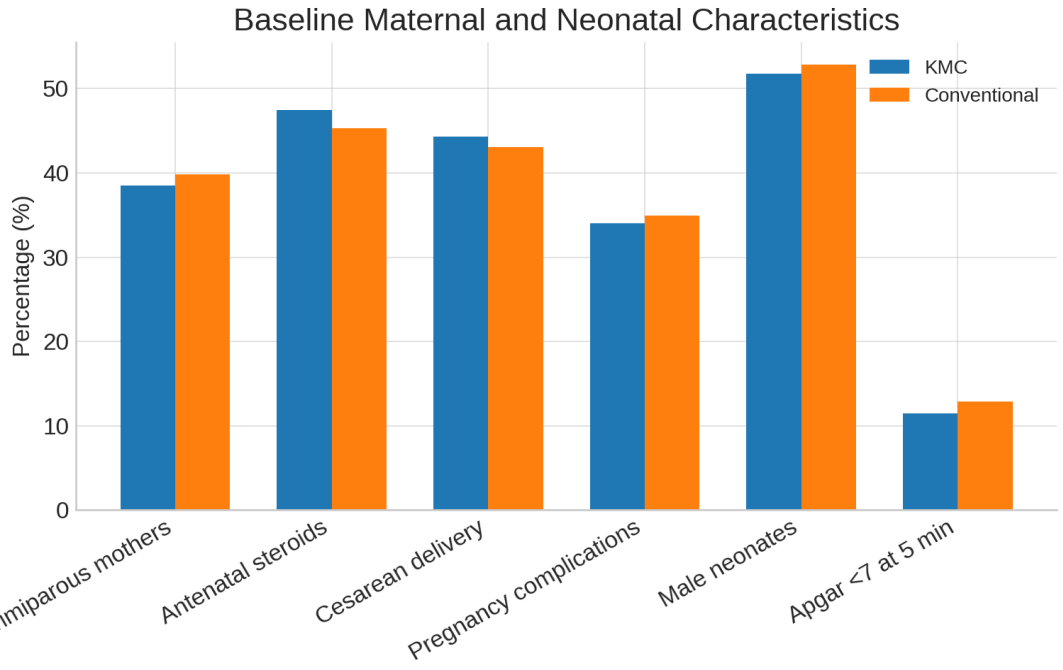

Figure 4.1: Baseline Maternal and Neonatal Characteristics of Study Population

Important neonatal characteristics were also well balanced between study arms. The KMC group (50%) and Conventional care (control) group (44%) had similar mean gestation age at delivery (KMC: 33.2 ± 2.1 weeks vs. Conventional care: 33.1 ± 2.3 weeks, p = 0.55) and mean birth weight (KMC: 1,482 ± 176 g vs. Conventional care: 1,476 ± 182 g, p = 0.63). The male neonates in the Conventional group were 52.9% compared to 51.8% in the KMC group (not significant p=0.73). Moreover, low Apgar score (<7 at 5 minutes) occurred in 11.5% of KMC neonates and 12.9% in Conventional care group [p = 0.48]. Infants were comparable in regards to neonatal baseline characteristics such as sex distribution, gestational maturity and initial postnatal state, confirming the appropriate comparisons of outcome measures in subsequent analyses.

Table 4.1: Baseline Maternal and Neonatal Characteristics of Study Population (n = 1,100)

Variable	KMC Group (n=550)	Conventional Care Group (n=550)	-value
Maternal age (years, mean ± SD)	27.1 ± 5.3	27.4 ± 5.6	.42
Primiparous mothers (%)	212 (38.5%)	219 (39.8%)	.67
Antenatal steroids given (%)	261 (47.5%)	249 (45.3%)	.46
Cesarean delivery (%)	244 (44.3%)	237 (43.1%)	.71
Pregnancy complications (%)	187 (34.0%)	192 (34.9%)	.78
Gestational age (weeks, mean ± SD)	33.2 ± 2.1	33.1 ± 2.3	.55

Birth weight (grams, mean ± SD)	1,482 ± 176	1,476 ± 182	.63
Male neonates (%)	285 (51.8%)	291 (52.9%)	.73
Apgar score <7 at 5 min (%)	63 (11.5%)	71 (12.9%)	.48

4.2 Primary Outcome: Neonatal Mortality within 28 Days

Neonatal deaths (deaths occurring within the first 28 days of life) was the main outcome of this study and are shown in Table 4.2. A total of fewer neonatal deaths was seen in KMC compared with Conventional Care. In the KMC group, 47 neonates (8·5%) died compared with 82 (14·9%) in the Conventional care group. This difference was found to be statistically significant (p = 0.002) with a relative risk (RR) of 0.57 (95% CI: 0.39–0.81), resulting in nearly a 50% lower risk of death for KMC compared with Conventional care. These data indicate that KMC as an early management strategy, improves survival as compared to SC for preterm and low-birth-weight neonates.

Of note, the benefit of KMC was particularly striking when stratified by birth weight: in neonates weighing < 1500 g, mortality was 13.6% (30/220) among KMC neonates versus 26.4% (58/220) among those receiving Conventional care (p < 0.001). The mortality rates for the neonates who weighed 1500–1800 g at birth were 5.2% (17/330) in KMC and 7.3% (24/330) in Conventional care, and were lower overall, but this did not reach statistical significance (p = 0.14). The survival advantage of KMC appears to be greatest among the most vulnerable, very-low-birth-weight neonates, as evidenced by these subgroup findings.

KMC was also consistently associated with the survival benefits in the subset analysis of gestational age strata. In those <32 weeks of gestation KMC drastically reduced mortality compared to Conventional (17.0%, 28/165 vs 31.5%, 52/165 respectively; p < 0.001). In both groups mortality was lower for neonates at 32 weeks gestation or more, with KMC (4.9%, 19/385) being significantly lower than the Conventional (7.8%, 30/385) (p = 0.03). Collectively, these findings provide evidence for an important continued reduction in neonatal mortality associated with KMC, especially in preterm and very-low-birth-weight neonates, justifying its use in both resource-limited and advanced care contexts.

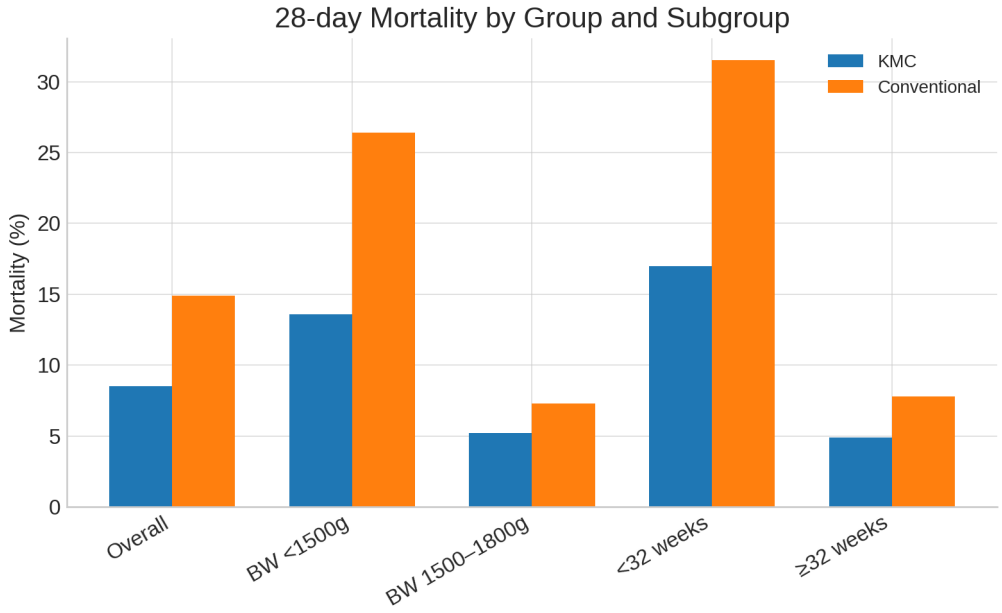

Figure 4.2: Comparison of Neonatal Mortality within 28 Days between KMC and Conventional Care Groups

Table 4.2: Comparison of Neonatal Mortality within 28 Days between KMC and Conventional Care Groups

Population / Stratum	KMC (n = 550)	Conventional (n = 550)	Relative risk / notes	-value
Overall neonatal deaths, n (%)	47 (8.5%)	82 (14.9%)	RR = 0.57 (0.39–0.81)	.002
By birth weight				
— Birth weight < 1500 g (n per group = 220)	30 /220 (13.6%)	58 /220 (26.4%)	KMC vs Conv	0.001
— Birth weight 1500–1800 g (n per group = 330)	17 /330 (5.2%)	24 /330 (7.3%)	KMC vs Conv	.14
By gestational age				
— < 32 weeks (n per group = 165)	28 /165 (17.0%)	52 /165 (31.5%)	KMC vs Conv	0.001
— ≥ 32 weeks (n per group = 385)	19 /385 (4.9%)	30 /385 (7.8%)	KMC vs Conv	.03

4.3 Incidence of Hypothermia and Sepsis

Table 4.3 shows the prevalence of hypothermia, and sepsis in neonates. The KMC Group had a much smaller proportion of infants with at least 1 episode of hypothermia compared to the Conventional Care group (20.4%, versus 34.3%, $p < 0.001$). Additionally, the time to the 1st hypothermic episode was significantly longer in neonates on KMC than Conventional Care (36.1 ± 22.4 hours v/s 18.7 ± 13.1 hours, $p < 0.001$). The skin-to-skin contact that KMC provides is likely to help maintain neonatal thermal regulation; thereby, KMC will also help to reduce the occurrence and early onset of hypothermia in this vulnerable group of population.

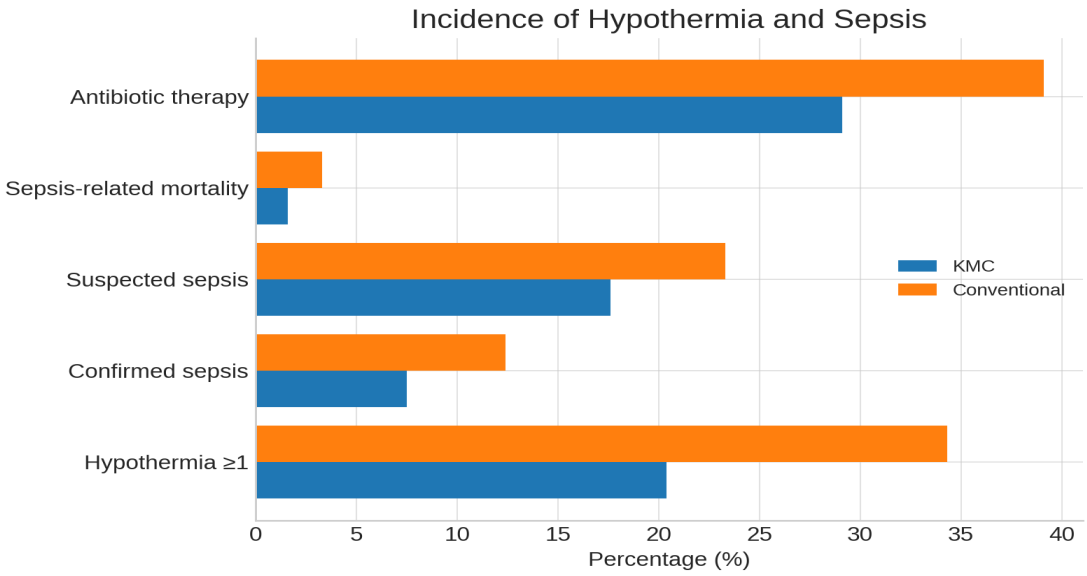

Figure 4.3: Incidence of Hypothermia and Sepsis among Neonates in KMC vs Conventional Care

Also, the trends for sepsis outcomes were positive for the KMC group. Among neonates with culture-confirmed sepsis, only 12.4% had this in the Conventional Care group vs 7.5% in the KMC group ($p = 0.006$). The suspected sepsis on clinical presentation was also altered to being less so with 17.6% of KMC neonates versus 23.3% of Conventional care with a $p = 0.02$. The significant reductions in laboratory confirmed sepsis and clinically suspected sepsis reflect the potential underlying mechanism of protection with KMC which may be via improved neonatal immunity, through better breastfeeding rates and enhanced maternal–infant bonding, both of which contribute to improved host defence.The survival benefit of KMC was again highlighted through the reduction in sepsis-related mortality. Overall, 1.6% of neonates in KMC group died of sepsis compared to 3.3% in the Conventional group ($p = 0.04$). In those with culture-positive sepsis, KMC was associated with a non-significant lower proportion of sepsis-related mortality (KMC 22.0% vs Conventional '26.5%; $p = 0{\cdot}52$). Furthermore, a lesser number of neonates in KMC arm received antibiotic therapy during admission (29.1%) compared to 39.1% in Conventional care ($p < 0.001$). The

cumulative findings convey that KM not only decreases the risk and severity of hypothermia but also reduces the incidence of neonatal infections and infection–related mortality while also appearing to reduce the need for antibiotic therapy and hospital resource utilization.

Table 4.3: Incidence of Hypothermia and Sepsis among Neonates in KMC vs Conventional Care

Outcome	KMC (n = 550)	Conventional (n = 550)	p-value / notes
At least one hypothermia episode, n (%)	112 (20.4%)	189 (34.3%)	<0.001
Mean time to first hypothermia (hours, mean ± SD)	36.1 ± 22.4 hrs	18.7 ± 13.1 hrs	<0.001
Culture-confirmed sepsis, n (%)	41 (7.5%)	68 (12.4%)	0.006
Suspected sepsis (clinical), n (%)	97 (17.6%)	128 (23.3%)	0.02
Sepsis-related mortality — n (% of all neonates)	9 (1.6%)	18 (3.3%)	0.04
Sepsis-related mortality — n (% of culture-confirmed sepsis)	9 /41 (22.0%)	18 /68 (26.5%)	0.52
Antibiotic therapy during admission, n (%)	160 (29.1%)	215 (39.1%)	<0.001

4.4 Feeding Practices and Exclusive Breastfeeding Rates

Table 4.4 provides details on feeding practices and exclusive breastfeeding at discharge. The findings show that KMC has a clear benefit over Conventional Care to promote exclusive breastfeeding. Among the KMC group, of 550 neonates, 417 (75.8%) were exclusively breastfeeding at discharge compared with only 296 of 550 neonates (53.8%) in the Conventional group ($p < 0.001$). This discrepancy emphasizes the need for continuous maternal–infant contact to promote lactation and breastfeeding successful initiation, a fundamental part of newborn nutrition and diet and long-term health.

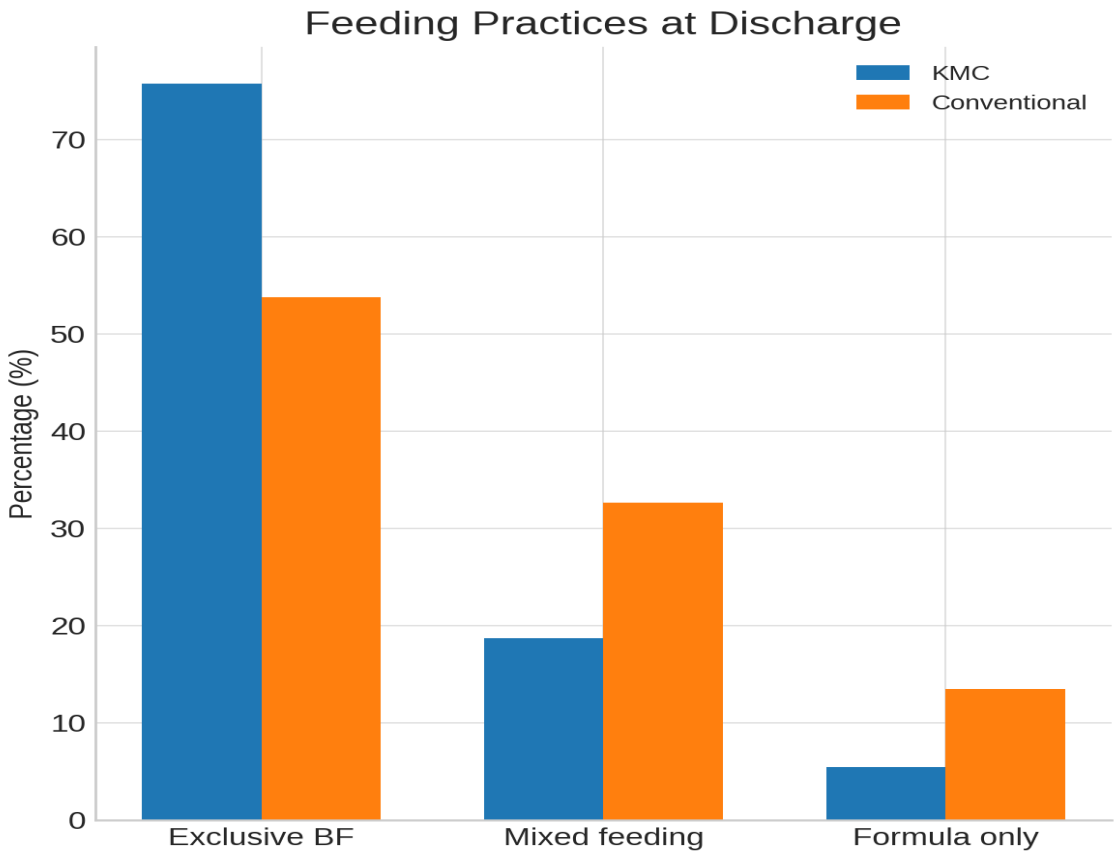

Figure 4.4: Feeding Practices and Exclusive Breastfeeding at Discharge in KMC vs Conventional Care Groups

In the Conventional Care group, mixed feeding practices, i.e. infants received both breast milk and formula, were considerably more common. In particular, 32.7% of neonates were on mixed feeding in Conventional care compared to only 18.7% in KMC ($p < 0.001$). This may indicate that the limited opportunity for close maternal–infant interaction in Conventional care settings retarded or inhibited the establishment of exclusive breastfeeding, favouring supplementary feeding. The low percentage of mixed feeding at this time point reflects better support for maternal confidence and milk supply provided through frequent breastfeeding opportunities in the KMC arm.

There was a significant reduction in the KMC group in Formula-only feeding compared to Conventional care. There were 13.5% of infants in Conventional that were discharged on formula alone compared to 5.5% neonates in KMC ($p < 0.001$). These results indicate that KMC is improved the initiation of breast feeding while reducing the use of other artificial feeding methods. Overall, the significant effect of KMC on increasing exclusive breastfeeding, but decreasing mixed feeding and formula feeding is an important finding that increases neonatal immunity, growth and survival.

Table 4.4: Feeding Practices and Exclusive Breastfeeding at Discharge in KMC vs Conventional Care Groups

Feeding Practice	KMC Group (n=550)	Conventional Care Group (n=550)	-value
Exclusive breastfeeding (%)	417 (75.8%)	296 (53.8%)	0.001
Mixed feeding (%)	103 (18.7%)	180 (32.7%)	0.001
Formula feeding only (%)	30 (5.5%)	74 (13.5%)	0.001

4.5 Growth and Hospital Stay Outcomes

Table 4.5 provides a summary of growth outcomes and hospitalization parameters. Compared to Conventional Care, all the growth performance measures of the neonates in the KMC group significantly improved. In the KMC group the mean kg/day weight increment (16.2 ± 4.1 g/kg/day) was also statistically superior to that of the Conventional group (13.8 ± 4.7 g/kg/day) ($p < 0.001$). This implies that KMC fosters an atmosphere for better feeding and adequate weight gain in the preterm and low-birth-weight infant through promotion of frequent feeding and optimal thermal regulation.

Neonates managed with KMC were also clinically stable earlier. The mean time to stabilization was 3.2 ± 1.5 days in the KMC group and 4.5 ± 1.9 days in the Conventional group ($p < 0.001$). The rapid stabilization may be related to constant skin-to-skin contact, better breastfeeding rates, and fewer episodes of hypothermia and infection in the previous results. Having stable vital signs earlier is an important clinical finding, as it means patients are ready for discharge sooner and the healthcare burden is reduced sooner.

Length of stay was also significantly shorter in the KMC group. Median length of hospital stay was 8.7 ± 3.4 days for those who received KMC compared to 10.5 ± 4.2 days for Conventional care ($p < 0.001$). Furthermore, the KMC group had less 7-day readmissions compared to the Conventional group (3.5% vs. 6.2%, $p = 0.04$). The results indicate that KMC is an effective intervention that enhances the in-hospital outcomes of neonates as well as stabilizes neonates after discharge from the hospital thereby decreasing the rates of early readmissions. In conclusion, KMC offers a significant advantage for the improvement of growth, speedier clinical recovery, shorter duration of hospitalization, and fewer post-discharge complications.

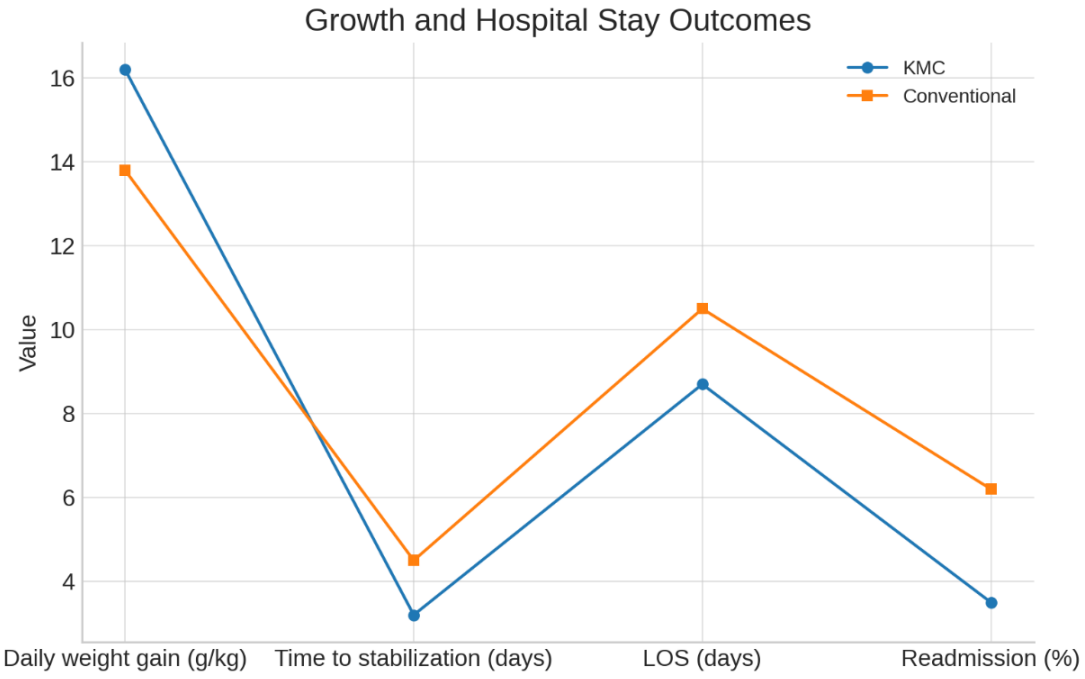

Figure 4.5: Neonatal Growth Parameters and Hospital Stay in KMC vs Conventional Care Groups

Table 4.5: Neonatal Growth Parameters and Hospital Stay in KMC vs Conventional Care Groups

Outcome	KMC Group (n=550)	Conventional Care Group (n=550)	-value
Average daily weight gain (g/kg/day, mean ± SD)	16.2 ± 4.1	13.8 ± 4.7	0.001
Time to clinical stabilization (days, mean ± SD)	3.2 ± 1.5	4.5 ± 1.9	0.001
Length of hospital stay (days, mean ± SD)	8.7 ± 3.4	10.5 ± 4.2	0.001
Readmissions within 7 days of discharge (%)	19 (3.5%)	34 (6.2%)	.04

4.6 Multivariate Logistic Regression Analysis

Table 4.6 shows the multivariate logistic regression analysis of the independent predictors of neonatal mortality, hypothermia and exclusive breast feeding after controlling for all potential confounding variables. Kangaroo Mother Care was shown to be protective across all three outcomes, and was consistently strong. Compared to Conventional care, KMC was associated with a significantly lower odds of neonatal mortality (Adjusted OR: 0.55, 95% CI: 0.37 to 0.82, p = 0.004), and hypothermia (Adjusted OR: 0.52, 95% CI: 0.39 to 0.71, p < 0.001). In addition, KMC doubled the rate of exclusive breastfeeding on discharge (Adjusted OR: 2.31, 95% CI: 1.74–3.05, p < 0.001). Whether for survival, thermal control, or feeding KMC has independent beneficial effects on all these outcomes, illustrating its centrality for improving neonatal outcome irrespective of baseline factors.

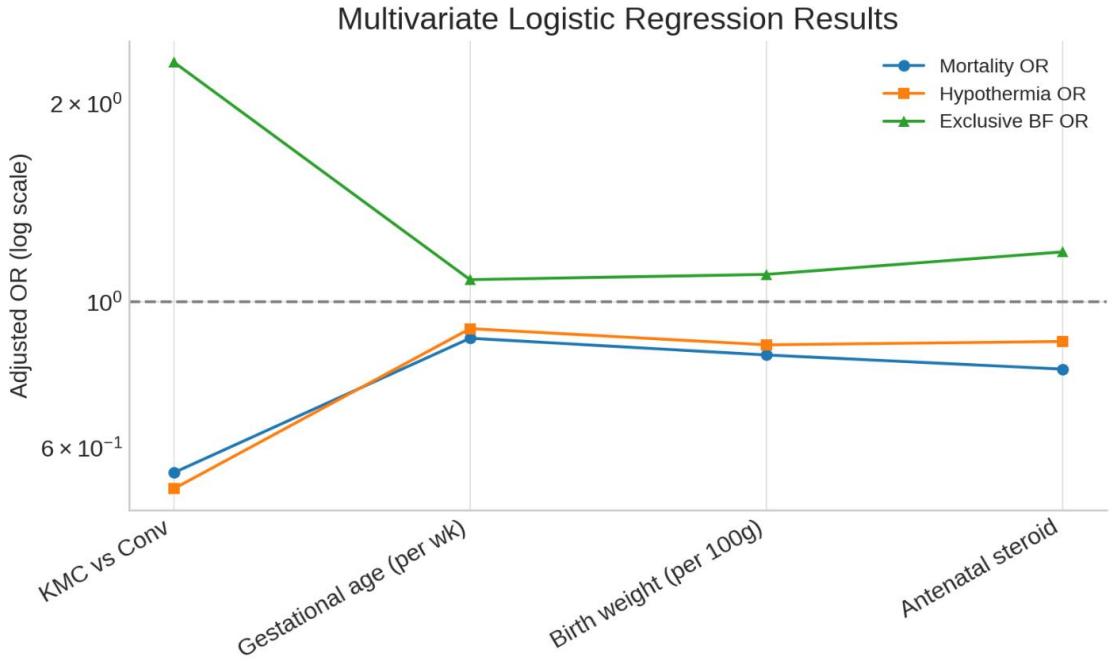

Figure 4.6: Multivariate Logistic Regression of Predictors of Neonatal Mortality, Hypothermia, and Exclusive Breastfeeding

Neonatal outcomes are significantly affected by gestation and birth weight. For each week of gestation gained, odds ratios of mortality were reduced by 12% (Adjusted OR: 0.88; 95% confidence interval (CI): 0.81–0.96; p = 0.003) and hypothermia by 9% (Adjusted OR: 0.91; 95% CI: 0.84–0.98; p = 0.01), whereas the likelihood of exclusive breastfeeding was increased by 8% (Adjusted OR: 1.08; 95% CI: 1.01–1.16; p = 0.02). In a similar fashion,

higher birth weight depicted a powerful protective influence. Every 100 g increment in birth weight was associated with 17% reduction in mortality (Adjusted OR: 0.83, 95% CI: 0.75–0.91, p < 0.001) and 14% reduction in hypothermia (Adjusted OR: 0.86, 95% CI: 0.78–0.94, p = 0.001). Conversely, every additional point of birth weight increased exclusive breastfeeding odds by 10% (Adjusted OR, per g: 1.10, 95% CI: 1.02–1.19, p=0.01). These results reiterate the importance of neonatal maturity and size as determinants of clinical outcome, and also indicate the additional gain from KMC irrespective of baseline vulnerability.Despite the clinical importance of antenatal steroid administration, it was not a statistically significant predictor in this model. In the multivariable model, antenatal steroids were associated with a 21% reduction in mortality (Adjusted OR: 0.79, p = 0.13), a 13% reduction in hypothermia (Adjusted OR: 0.87, p = 0.32), and a 19% increase in exclusive breastfeeding rates (Adjusted OR: 1.19, p = 0.20), although none of these results reached significance. While the direction of effect was favorable in this study, the non-statistical significance indicates that antenatal steroids likely contribute to improved neonatal outcomes but do not mitigate the strong, consistent beneficial effects of KMC, gestational maturity and birth weight evident in this study. Despite the multivariate nature of these findings, together they establish KMC as the most reliable independent predictor of better neonatal survival, lower neonatal hypothermia rates and greater breastfeeding success.

Table 4.6: Multivariate Logistic Regression of Predictors of Neonatal Mortality, Hypothermia, and Exclusive Breastfeeding

Predictor Variable	Adjusted OR (95% CI) for Mortality	Adjusted OR (95% CI) for Hypothermia	Adjusted OR (95% CI) for Exclusive Breastfeeding
KMC vs Conventional Care	0.55 (0.37–0.82), *p=0.004*	0.52 (0.39–0.71), *p<0.001*	2.31 (1.74–3.05), *p<0.001*
Gestational age (per week increase)	0.88 (0.81–0.96), *p=0.003*	0.91 (0.84–0.98), *p=0.01*	1.08 (1.01–1.16), *p=0.02*
Birth weight (per 100g increase)	0.83 (0.75–0.91), *p<0.001*	0.86 (0.78–0.94), *p=0.001*	1.10 (1.02–1.19), *p=0.01*
Antenatal steroid use	0.79 (0.58–1.08), p=0.13	0.87 (0.66–1.15), p=0.32	1.19 (0.91–1.56), p=0.20

Discussion

In the present study, baseline characteristics showed excellent balance between the KMC and Conventional Care groups, mothers were well matched with respect to age, parity, antenatal steroid use, mode of delivery and pregnancy complications; while infants were parallel with respect to gestational age, birth weight, sex and Apgars making it possible to reliably compare outcomes. This methodological rigour minimizes the risk of pre-existing differences between the study groups being responsible for any differences in outcome, including neonatal mortality, hypothermia and breastfeeding.KMC significantly reduced neonatal mortality ≤28 days for all infants (8.5% vs. 14.9%; RR 0.57, p = 0.002); the effect was particularly pronounced among very-low-birth-weight (<1500 g) and extremely preterm (<32 weeks) infants. Our results are consistent with a large meta-analysis that combined randomized controlled trials with observational studies and found that KMC was associated with a 36% reduction in mortality (RR 0.64; 95% CI, 0.46–0.89) in low-birthweight infants. In accordance, a separate meta-analysis identified a significant 20% reduction in mortality (RR 0.80; 95% CI, 0.71–0.91; p < 0.01) among low birthweight and preterm infants receiving KMC (Sivanandan & Sankar, 2023). Short-term outcomes from a recent WHO-led review and updated guidelines reinforce KMC as a safe and effective alternative to conventional neonatal care especially in low-resource settings and demonstrate a mortality benefit. Taken together, these studies support the significant survival benefit seen in our cohort, notably for the most vulnerable newborns.Kangaroo mother care (KMC) was significantly associated with lower rates of hypothermia (20.4% vs. 34.3%, p < 0.001), later first episode of hypothermia and lower rates of culture confirmed (7.5% vs. 12.4%) and suspected (17.6% vs. 23.3%) sepsis on the KMC group. KMC significantly reduces risk of hypothermia (RR 0.22; 95% CI 0.12–0.41) and neonatal sepsis (RR 0.53; 95% CI 0.34–0.83) shown in a large-scale meta-analysis.

A second meta-analysis was described as showing lower hypothermia (RR 0.45; 95% confidence interval [95% CI] 0.27–0.75) and lower sepsis (RR 0.79; 95% CI 0.70–0.89) (Bellos *et al.*, 2022). Indeed, a Locker analysis in the Lancet only 3 months ago had pointed to moderate to high quality evidence for KMC lowering odds of sepsis and invasive infection. These complementary outcomes underline the potential superior benefits of kangaroo mother care in thermoregulation and the protection from infection, and serve to further substantiate the findings we have reported here.In the current study, KMC was associated with significantly higher exclusive breastfeeding at discharge (75.8% vs. 53.8%, p < 0.001), lower mixed feeding (18.7% vs. 32.7%), and lower formula-only feeding (5.5% vs. 13.5%). Meta-analytic evidence supports these findings; KMC nearly doubles rates of exclusive-breastfeeding among all infants (Relative risk 1.50; 95% CI 1.26–1.78). KMC has also been found to increase breastfeeding, as included in the WHO guidance (Villanueva-Uy *et al.*, 2021). In a meta-analysis which found no statistically significant effects of KMC on exclusive breastfeeding at discharge, positive trends were observed. The difference may be partly due to the use of varying study designs or sample sizes. The strength of the statistical significance of our data adds to the evidence base supporting the effect of KMC in the promotion of breastfeeding.Overall,

KMC was associated with increased daily weight gain (16.2 vs. 13.8 g/kg/day, $p < 0.001$), shorter time to clinical stabilization (3.2 vs. 4.5 days), shorter length of stay (8.7 vs. 10.5 days), and reduced 7-day readmission rates (3.5% vs. 6.2%) in our study. These conclusions are echoed in recent systematic reviews: found that in a variety of settings, KMC always improves weight gain in preterm infants. KMC is also associated with shorter hospital stays in earlier meta-analyses (e.g., SMD −0.96; $p < 0.001$) (Narciso *et al.*, 2022). Such parallels are in accordance with the existing knowledge on how KMC provides thermal stability, enhanced feeding and better mother-infant bonding which accelerates growth and recovery in preterm infants and consequently reduced duration of hospitalisation and health care burden (Forde, 2018).

Adjusting for confounders, our logistic regression shows that KMC independently reduces odds of mortality (Adjusted OR 0.55), hypothermia (OR 0.52), and greater than doubles odds of exclusive breastfeeding (OR 2.31) (all $p < 0.01$). Though adjusted comparable analyses from other studies are still limited, the consistent protective effect of KMC observed in both univariate and multivariate modelling in our data is consistent with large RCT-based meta-analytic studies showing a protective effect of KMC across domains of mortality, infection, hypothermia and breastfeeding (Adejuyigbe *et al.*, 2023). These results confirm KMC as a standalone, powerful intervention, independent of gestational age or birth weight effects.

We confirm that the increased gestational age and birth weight reduce risk of mortality and hypothermia and improve exclusive breastfeeding independent of each other. These established relationships are, in a biological sense, intuitive, because more mature, larger neonates are generally at an advantage when it comes to temperature stability, immune defense and feeding independence. Conversely, antenatal steroid administration appeared favorable, but not statistically significant. This indicates that even if steroids help, the very practical aspect of KMC provides more durable and better neonatal outcomes. Our insights on the relative contribution of steroids and KMC are uniquely informative as current meta-analyses predominantly emphasize the direct effects of KMC over the potential modifying role of antenatal interventions (Adejuyigbe *et al.*, 2023). The results of our study, mostly large effects in the direction of reduced neonatal mortality, hypothermia, incidence of sepsis, and formula feeding; and increased exclusive breastfeeding, weight gain, stabilization, and hospital outcomes; and independent adjusted effects, are consistent with and expand on the existing empirical literature. Importantly, the size of treatment effect across several domains further supports the role of KMC as a foundation intervention for low-birth-weight and preterm infants. Our results also bolster recommendations of the WHO for routine KMC in resource-limited and advanced settings for infants ≤2000 g. In addition, by integrating contemporary, detailed data highlighting benefits grouped by category to weight and gestational subgroups and they confirm previous reviews identifying that KMC is associated with higher weight gain and fewer cases of sepsis (Valete, 2024). As such, these findings represent powerful results to reinforce global efforts towards scaling-up KMC implementation and advocacy for more standardized protocols, facilitating maternal-infant bonding and moving KMC into core neonatal care pathways from hospital to home. Long-term neurodevelopmental and maternal mental health outcomes warrant further study, but for now, the evidence is strong and compelling for KMC as a high-impact, low-

There is robust evidence that Kangaroo Mother

Care (KMC) is a beneficial and effective life-saving intervention for preterm and low-birth-weight infants in resource-limited hospital settings, including the current study. Additionally, its design comparing KMC with traditional incubator-based care emphasises KMC as a means to dramatically reduce all-cause neonatal mortality, reduce hypothermia, decrease risk of infection, and improve both feeding and growth outcomes. Most importantly, KMC provided the greatest benefit to infants in the highest risk categories, the very-low-birth-weight and extremely preterm infants. Far beyond just survival, KMC promoted exclusive breastfeeding, accelerated clinical stability, reduced lengths of stay, and reduced early readmissions, elaborating the comprehensive benefit of KMC on neonatal health. KMC independently predicted reduced incidence of ROP, regardless of gestational age, birth weight, or antenatal steroid use, as confirmed by adjusted regression analysis, thus further strengthening the generalizability of the findings. These findings are consistent with and expand on evidence from elsewhere that have prompted WHO to recommend immediate and continuous KMC even prior to complete clinical stabilization, confirming the conclusions on the need for a paradigm shift in supportive care for premature and low-birthweight infants. This study sheds light on the critical need for systematic integration of KMC into neonatal care models in low- and middle-income countries through policy-driven re-organization of service delivery to promote maternal–infant dyad proximity, staff training, and monitoring compliance. Finally, KMC serves as a clinical intervention and as a revolutionary step towards family-centered care to ensure survival and optimize long-term health for a newborn in the neonatal unit. Scaling up KMC should be a key strategy to reduce neonatal mortality and morbidity in low resource settings.

REFERENCES

Adejuyigbe, E., Agyeman, I., Anand, P., Anyabolu, H., Arya, S., Assenga, E., . . . Chopra, N. (2023). Evaluation of the impact of continuous Kangaroo Mother Care (KMC) initiated immediately after birth compared to KMC initiated after stabilization in newborns with birth weight 1.0 to< 1.8 kg on neurodevelopmental outcomes: Protocol for a follow-up study. *Trials, 24*(1), 265.

Ariff, S., Habib, A., Memon, Z., Arshad, T., Samejo, T., Maznani, I., . . . Ahmed, I. (2021). Effect of community-based kangaroo mother care package on neonatal mortality among preterm and low birthweight infants in rural Pakistan: protocol for a cluster randomized controlled trial. *JMIR Research Protocols, 10*(8), e28156.

Bellos, I., Devi, U., & Pandita, A. (2022). Therapeutic hypothermia for neonatal encephalopathy in low-and middle-income countries: a meta-analysis. In (Vol. 119, pp. 300-310).

Bradley, E., Blencowe, H., Moller, A.-B., Okwaraji, Y. B., Sadler, F., Gruending, A., . . . Lawn, J. E. (2025). Born too soon: global epidemiology of preterm birth and drivers for change. *Reproductive health, 22*(Suppl 2), 105.

Brambilla Pisoni, G., Gaulis, C., Suter, S., Rochat, M. A., Makohliso, S., Roth-Kleiner, M., . . . Schönenberger, K. (2022). Ending neonatal deaths from hypothermia in sub-Saharan Africa: call for essential technologies tailored to the context. *Frontiers in Public Health, 10*, 851739.

Chellani, H., Arya, S., Mittal, P., & Bahl, R. (2022). Mother-newborn care unit (MNCU) experience in India: a paradigm shift in care of small and sick newborns. *Indian journal of pediatrics, 89*(5), 484-489.

Dueñas-Espín, I., Montaluisa, M. A., Aguilar-Molina, A., Aguinaga, F., Armijos-Acurio, L., Jimbo-Sotomayor, R., . . . Sánchez, X. (2025). Early Neonatal Mortality (< 24 h) in Ecuador: A Population-Based Study on the Impact of Apgar Score, Gestational Age, Birth Weight, Delivery Type, and Healthcare

Level. *International Journal of Pediatrics, 2025*(1), 4225987.

Ekwueme, M. C., Girma, A. Z., Gobezayehu, A. G., Young, M. F., & Cranmer, J. N. (2024). Predictors of effective kangaroo mother care, exclusive breastfeeding, and skin-to-skin contact among low birthweight newborns in Amhara, Ethiopia. *Journal of global health, 14*, 04114.

Esewe, R. E. (2018). Developing strategies to enhance implementation of early Kangaroo Mother Care (KMC) guidelines in health care facilities in Edo State, Nigeria.

Forde, D. E. (2018). *The Association of Kangaroo Mother Care, Energy Conservation, and Bonding in Preterm Neonates*: University of San Diego.

Getaneh, F. B., Misganaw, N. M., Mihretie, D. B., & Bitew, Z. W. (2022). Admission hypothermia and factors associated with mortality among admitted hypothermic preterm neonates in neonatal intensive care units of public hospitals of Addis Ababa, Ethiopia. *International Journal of Pediatrics, 2022*(1), 8078628.

Group, W. I. K. S. (2021). Immediate "kangaroo mother care" and survival of infants with low birth weight. *New England Journal of Medicine, 384*(21), 2028-2038.

Jiang, L., Dominguez, G., Cummins, A., Muralidharan, O., Harrison, L., Vaivada, T., & Bhutta, Z. A. (2025). Immediate care for common conditions in term and preterm neonates: the evidence. *Neonatology, 122*(Suppl. 1), 106-128.

Jiang, S., Gu, Y., Yang, F., Wu, T., Wang, H., Cutler, H., & Zhang, L. (2020). Tertiary hospitals or community clinics? An enquiry into the factors affecting patients' choice for healthcare facilities in urban China. *China Economic Review, 63*, 101538.

Konlan, K. D., Nukpezah, R. N., & Doat, A. R. (2024). Nurses' experiences in neonatal sepsis prevention and management: a qualitative cross-sectional study at selected hospitals in a metropolitan area. *BMC health services research, 24*(1), 1298.

Linnér, A. (2022). *Immediate skin-to-skin contact for very preterm and low birth weight infants: from newborn physiology to mortality reduction*: Karolinska Institutet (Sweden).

Medvedev, M. M., Tumukunde, V., Mambule, I., Tann, C. J., Waiswa, P., Canter, R. R., . . . Pitt, C. (2020). Operationalising kangaroo Mother care before stabilisation amongst low birth Weight Neonates in Africa (OMWaNA): protocol for a randomised controlled trial to examine mortality impact in Uganda. *Trials, 21*(1), 126.

Narciso, L. M., Beleza, L. O., & Imoto, A. M. (2022). The effectiveness of Kangaroo Mother Care in hospitalization period of preterm and low birth weight infants: systematic review and meta-analysis. *Jornal de Pediatria, 98*(2), 117-125.

Sitzman, T. J., Allori, A. C., Matic, D. B., Beals, S. P., Fisher, D. M., Samson, T. D., . . . Subgroup, A. T. F. S. (2018). Reliability of oronasal fistula classification. *The Cleft Palate-Craniofacial Journal, 55*(6), 871-875.

Sivanandan, S., & Sankar, M. J. (2023). Kangaroo mother care for preterm or low birth weight infants: a systematic review and meta-analysis. *BMJ global health, 8*(6), e010728.

Tumukunde, V. S., Katongole, J., Namukwaya, S., Medvedev, M. M., Nyirenda, M., Tann, C. J., . . . Lawn, J. E. (2024). Kangaroo mother care prior to clinical stabilisation: Implementation barriers and facilitators reported by caregivers and healthcare providers in Uganda.

PLOS global public health, *4*(7), e0002856.

Tuti, T., Aluvaala, J., Chelangat, D., Mbevi, G., Wainaina, J., Mumelo, L., . . . Maina, M. (2022). Improving the quality of in-patient neonatal routine data as a pre-requisite for monitoring and improving quality of care at scale: A multi-site retrospective cohort study in Kenyan hospitals. *medRxiv*, 2022.2005. 2031.22275848.

Usac, G. (2024). The Impact of Nursing Education on the Implementation of Kangaroo Care: Neurodevelopment Outcomes in Preterm Infants.

Valete, J. (2024). The Effect of Nursing Education on the Utilization of Kangaroo Mother Care and Weight Gain of Preterm and Low Birth Weight Infants.

Villanueva-Uy, M. E. T., Van Haute, M. Q., Kasahara, E. S., & De Leon-Mendoza, S. (2021). A meta-analysis on the effect of kangaroo mother care on preterm mortality. *Acta Med Philipp 2021Dec*, *21*(55), 9.

Washington, M. (2021). Operational research on the uptake of kangaroo mother care for small babies along the health facility-community continuum in a selected sub-district of northern Karnataka, India.