

Review Article

Comparative Analysis of kangaroo mother care versus Standard Care in neonatal sepsis

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Abstract

Background: Neonatal sepsis is a leading cause of newborn death, and kangaroo mother care, comprising skin-to-skin contact, breastfeeding support, and early discharge with follow-up, has been proposed as a low-cost intervention that may reduce sepsis alongside its established benefits for growth and mortality.

Objective: This review synthesizes trials, meta-analyses, and mechanistic studies comparing kangaroo mother care with standard incubator-based care on neonatal sepsis outcomes, and the pathways proposed to explain any difference.

Methods: We reviewed Cochrane reviews, the WHO multicountry immediate kangaroo mother care trial, facility-based and community-initiated randomized trials, and supporting literature on sepsis and mortality in low-birthweight infants.

Findings: Pooled evidence indicates kangaroo mother care reduces possible serious bacterial infection and clinically diagnosed sepsis relative to standard care, with the largest effect when care begins early and is sustained; proposed mechanisms include reduced nosocomial exposure, improved thermal stability, enhanced breastfeeding, and closer maternal surveillance.

Conclusions: Kangaroo mother care is associated with a consistent reduction in neonatal sepsis compared with standard care, supporting its role as a core component of low-birthweight infant care across resource settings, though heterogeneity in sepsis case definitions warrants standardized surveillance.

Keywords: kangaroo mother care; neonatal sepsis; low birthweight; skin-to-skin contact; standard care

1. Introduction

Neonatal sepsis accounts for a substantial share of the roughly 2.4 million newborn deaths that occur globally each year, concentrated among low-birthweight and preterm infants in resource-constrained settings [1]. Presentation is frequently nonspecific, the immature immune response is poorly equipped to contain invading organisms, and case fatality remains high even with intravenous antibiotics and intensive support [2,3]. Late-onset sepsis acquired within the neonatal unit is disproportionately common among the smallest, longest-hospitalized infants, who are also most exposed to nosocomial pathogens circulating in incubator-based standard care [4].

Kangaroo mother care was first described in Bogotá in the early 1980s as a response to a shortage of functioning incubators, comprising continuous skin-to-skin contact, exclusive breastfeeding, and early discharge with close follow-up [5]. Over four decades of trial evidence it has been shown to confer benefits well beyond thermoregulation, including reduced mortality, improved weight gain, more stable cardiorespiratory physiology, and enhanced bonding [6,7,8], and is now recommended by the World Health Organization as standard practice for stable low-birthweight infants everywhere, not merely a low-resource substitute [9].

Because sepsis is a principal driver of mortality and prolonged hospitalization, and because mechanisms plausibly linked to kangaroo mother care, reduced nosocomial exposure, enhanced breastfeeding and passive immunity, and closer maternal observation, bear directly on infection risk, sepsis is increasingly examined as an outcome in kangaroo mother care trials rather than an incidental finding [10,11]. This review synthesizes trial evidence, systematic reviews, and mechanistic literature comparing kangaroo mother care with standard care on neonatal sepsis outcomes, and considers implications for both high- and lower-resource settings.

2. Defining kangaroo mother care and standard care

Kangaroo mother care is not a single intervention but a bundle of practices delivered with varying intensity, a heterogeneity that complicates comparison of sepsis outcomes across trials [12]. Continuous kangaroo mother care refers to skin-to-skin contact for close to twenty hours per day, typically reserved for infants stabilized after birth, while intermittent kangaroo mother care describes shorter daily sessions superimposed on otherwise conventional incubator care [13]. Immediate kangaroo mother care, evaluated in the World Health Organization's multicountry trial, begins skin-to-skin contact within minutes of birth, before an infant would traditionally be considered stable enough for anything other than incubator support [14].

Standard care, the comparator arm, is itself heterogeneous, ranging from a radiant warmer or closed incubator with intermittent parental contact in well-resourced units, to open cots with minimal thermal support and infrequent maternal access in lower-resource facilities [15]. This asymmetry matters for sepsis outcomes, because incubator-based standard care in a high-income unit already incorporates strict infection-control protocols that a low-resource open-cot comparator may lack, so any kangaroo mother care effect on sepsis risk is plausibly setting-dependent [16,17]. It is also worth distinguishing this literature from the brief, routine early skin-to-skin contact practiced for healthy term newborns; the Cochrane review of that separate practice reports benefits for breastfeeding and early cardiorespiratory stability but was not powered to detect sepsis differences, and should not be conflated with the sustained, low-birthweight-focused literature reviewed here [18]. Reviews of implementation barriers similarly find that fidelity to the full bundle, particularly daily skin-to-skin duration achieved, varies by staffing and whether a dedicated kangaroo mother care ward exists, a source of between-trial variation [13,19].

Table 1: Components of kangaroo mother care and the standard care comparator across the trial literature reviewed here [12,15,9].		
Component	Kangaroo mother care	Standard care
Thermal contact	Continuous or near-continuous skin-to-skin, ~18-20 h/day	Radiant warmer or incubator; intermittent parental contact
Feeding approach	Exclusive or near-exclusive breastfeeding, on-demand access	Scheduled feeds; formula supplementation more common
Care location	Dedicated kangaroo mother care ward or bedside chair	Open bay or closed incubator, shared equipment
Discharge model	Early discharge once stable, structured outpatient follow-up	Discharge once weight/clinical criteria met, standard follow-up

3. Evidence from randomized controlled trials

The foundational randomized evidence comes from facility-based trials conducted from the mid-1990s onward. Sloan and colleagues, in the first large randomized comparison from Ecuador, found fewer serious illness episodes in infants allocated to the kangaroo mother method after stabilization than in conventional incubator care [7]. Cattaneo and colleagues' multicenter trial across three countries reported lower infection-related morbidity in the kangaroo mother care groups alongside improved weight gain [20]. Bergman, Linley, and Fawcus randomized very low-birthweight infants in South Africa to skin-to-skin contact from birth versus incubator care and found more stable physiological parameters during early stabilization, a plausible upstream contributor to lower downstream infection risk [21].

Suman, Udani, and Nanavati's trial in a tertiary Indian hospital reported significantly lower sepsis incidence in the kangaroo mother care arm, alongside improved weight gain and fewer hypothermia episodes [22]. Ramanathan and colleagues, in an earlier Indian trial, similarly found reduced infection episodes with kangaroo mother care versus conventional open-ward care [23]. Worku and Kassie's trial in Addis Ababa likewise reported fewer infections and better outcomes with early kangaroo mother care in a low-resource public hospital [16].

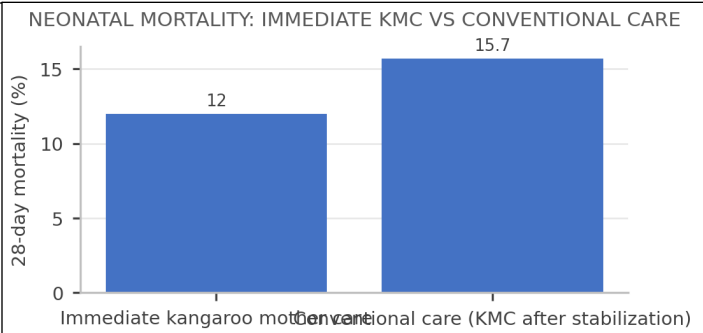


Figure 1: Neonatal mortality by treatment allocation in the WHO multicountry Immediate Kangaroo Mother Care trial, comparing infants randomized to immediate kangaroo mother care against those receiving conventional care with kangaroo mother care initiated only after stabilization [14].

The most influential recent trial is the WHO Immediate Kangaroo Mother Care Study Group's multicountry trial, enrolling infants weighing 1.0-1.799 kg at five African and Asian sites and randomizing them to immediate kangaroo mother care, begun before full stabilization, versus conventional care with kangaroo mother care started only afterward [14]. The trial found significantly reduced neonatal mortality with immediate kangaroo mother care, and possible serious bacterial infection, a composite sepsis proxy used where blood culture is unavailable, was also significantly less frequent in that arm. Mazumder and colleagues' large community-initiated cluster-randomized trial in South Asia found improved survival when families were supported to begin kangaroo mother care at home, with secondary analyses suggesting a lower burden of suspected infection contributed to that difference [24].

4. Systematic reviews and pooled sepsis outcomes

The Cochrane review by Conde-Agudelo and Díaz-Rossello, updated across several cycles, remains the most comprehensive pooled analysis and consistently reports a statistically significant reduction in sepsis or infection risk with kangaroo mother care, alongside reductions in mortality, nosocomial infection, and length of stay [11]. The effect appears most robust in trials with high daily dose started relatively early, consistent with a dose-response relationship [10].

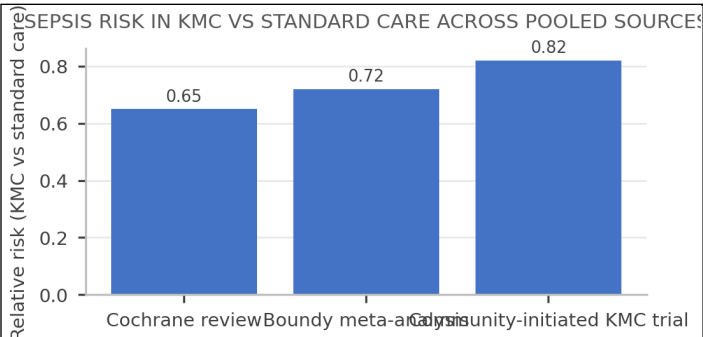


Figure 2: Relative risk of sepsis or clinically suspected infection in kangaroo mother care versus standard care across three pooled evidence sources, each showing a reduction in risk favoring kangaroo mother care [11,10,24].

Boundy and colleagues' independent meta-analysis, including both randomized and observational studies, similarly found reduced risk of sepsis, hypothermia, hypoglycemia, and mortality with kangaroo mother care, generally consistent in direction with the Cochrane estimate [10]. Lawn and colleagues' modeling analysis projected that a substantial share of preventable neonatal deaths from preterm birth complications, including sepsis, could be averted by scaling up kangaroo mother care in low-resource settings [25]. Chan and colleagues' systematic review reached a consistent conclusion: infection-related morbidity is among the outcome domains most reliably improved, alongside thermal stability and breastfeeding [12].

5. Mechanistic pathways linking kangaroo mother care to reduced sepsis

Several biologically plausible mechanisms have been proposed, broadly consistent with the trial signal though not themselves powered to detect infection endpoints. First, skin-to-skin contact reduces proximity to shared equipment, staff hands, and communal air in a crowded unit, plausibly lowering exposure to nosocomially transmitted organisms compared with an open incubator bay [26,15]. Second, kangaroo mother care improves thermal stability, and hypothermia is itself a risk factor for infection and decompensation, so the thermoregulatory benefit documented by Ludington-Hoe and by Nimbalkar and colleagues may act as an upstream contributor to

reduced sepsis [27,28].

Table 2: Proposed mechanistic pathways linking kangaroo mother care to reduced neonatal sepsis risk, with supporting evidence [26,27,29,30,32].

Pathway	Proposed effect	Supporting evidence
Reduced nosocomial exposure	Less contact with shared equipment and staff hands	[26,15]
Improved thermoregulation	Fewer episodes of hypothermia, a known infection risk factor	[27,28]
Enhanced breastfeeding / passive immunity	More secretory IgA and lactoferrin exposure via breast milk	[29,8]
Closer maternal observation	Earlier recognition of subtle illness signs	[30,31]
Reduced separation-related stress	Lower dysregulation of autonomic/endocrine/immune axes	[32]

Third, kangaroo mother care increases exclusive breastfeeding, both because proximity facilitates feeding and because skin-to-skin contact promotes oxytocin release and let-down, and breast milk delivers secretory IgA, lactoferrin, and other anti-infective components that plausibly reduce bacterial translocation relative to formula-predominant feeding [29,8]. Fourth, close maternal observation may enable earlier recognition of subtle changes that precede overt sepsis, a pathway supported indirectly by the improved autonomic and neurobehavioral organization Feldman and Eidelman documented in skin-to-skin infants [30,31]. Bergman's synthesis of the physiological cost of mother-infant separation frames these pathways within a toxic-stress model, in which separation dysregulates autonomic, endocrine, and immune function in ways that plausibly heighten infection vulnerability [32].

6. Implementation considerations and heterogeneity across settings

Translating the trial-level sepsis benefit into routine practice requires attention to implementation fidelity: achieved doses of skin-to-skin contact frequently fall short of trial protocols, particularly where staffing cannot support mothers through the demanding early days of

continuous kangaroo mother care [13,15]. Kadam and colleagues' feasibility study in a busy Mumbai unit illustrated both achievability and practical constraints, including space limitations and competing maternal responsibilities that may attenuate the trial-observed benefit if not addressed during program design [17]. Blomqvist and colleagues' work on paternal engagement suggests extending kangaroo mother care to fathers may help sustain the daily dose needed to preserve its infection-related benefit [33].

Heterogeneity in how sepsis is defined and ascertained is a further limitation. Many low-resource trials rely on the possible serious bacterial infection algorithm or clinically diagnosed sepsis rather than blood-culture-confirmed sepsis, while high-resource comparisons use stricter culture-positive definitions [4,1]. This variation likely explains some between-study heterogeneity noted by both the Cochrane review and the Boundy meta-analysis, and argues for standardized case definitions in future trials [11,10]. Comparative work on other developmental-care bundles, such as the individualized approach evaluated by Ohlsson and Jacobs, suggests infection outcomes are similarly sensitive to definitional heterogeneity across family-centered neonatal interventions generally [34].

7. Discussion

Taken together, the trial evidence, pooled meta-analyses, and mechanistic literature converge on a consistent conclusion: kangaroo mother care reduces the risk of neonatal sepsis and infection-related morbidity relative to standard care, most pronounced when skin-to-skin contact starts early and is sustained at high daily dose [14,11,10]. This benefit sits alongside, and plausibly contributes to, the intervention's established effects on mortality, thermoregulation, growth, and bonding, making it one of the few neonatal interventions with benefits across nearly every domain of low-birthweight infant outcome [6,25]. The consistency of the sepsis signal

across settings as varied as tertiary units and community programs in rural South Asia suggests the mechanism is not dependent on any single feature of the comparator environment [24,20].

At the same time, the magnitude of benefit should be interpreted cautiously given heterogeneity in sepsis case definitions, in the intensity of kangaroo mother care actually delivered, and in the baseline infection-control standard of the comparator arm [12,15]. Standard care in a well-resourced unit already incorporates rigorous infection control, so the marginal benefit of adding kangaroo mother care there, while still directionally favorable, may be smaller than in lower-resource comparator arms [16,23]. Future research would benefit from harmonized, culture-supported case definitions applied prospectively across settings, quantifying the infection-related benefit with the rigor already achieved for mortality [9,1].

8. Conclusion

Kangaroo mother care, comprising sustained skin-to-skin contact, enhanced breastfeeding support, and close maternal observation, is associated with a consistent, mechanistically plausible reduction in neonatal sepsis relative to standard incubator-based care across randomized trials and pooled reviews spanning four decades and multiple continents [7,11,14]. The evidence supports continued and expanded implementation as a core element of low-birthweight infant care across resource settings, while highlighting the need for standardized sepsis surveillance definitions and attention to implementation fidelity so the benefit demonstrated in trials is realized at scale [10,13].

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