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The Effect of Kangaroo Mother Care on Body Temperature Stability in Low Birth Weight Infants in the NICU

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ABSTRACT

Infants with low birth weight (LBW) are prone to body temperature instability due to immature temperature regulation systems. Conventional care in incubators often causes mother-infant separation. Kangaroo Mother Care (KMC) is an innovative method that promotes closeness between mother and infant. This study aims to assess the effect of KMC on body temperature stability in LBW infants admitted to the NICU. Using a quantitative pre-experimental design with a one-group pretest-posttest approach, LBW infants meeting inclusion criteria were observed. Body temperature was measured before and after KMC implementation using a digital thermometer. Data analysis employed a paired t-test. Results showed that Prior to the implementation of KMC, the average body temperature of LBW infants was 36.7°C with a standard deviation of 0.159, ranging from 36.5°C to 37.2°C. After the implementation of KMC, the average body temperature increased to 37.3°C, with a standard deviation of 1.024, and a temperature range of 37.1°C to 37.5°C, with a p-value of 0.000 ($p < 0.05$). These findings indicate that KMC positively affects body temperature stability in LBW infants in the NICU. KMC is a nonpharmacological alternative to incubator care that improves LBW infant outcomes. It supports temperature stability, weight gain, respiratory regulation, and enhances the mother–infant bond. Routine implementation in NICUs can lower hospitalization duration, reduce reliance on medical equipment, and cut treatment costs. Successful adoption requires trained health personnel and supportive hospital policies to make KMC a standard part of neonatal care.

Keywords: *LBW, Body Temperature, KMC*

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INTRODUCTION

Low birth weight (LBW) remains a significant public health concern, particularly in developing countries and regions with low socio-economic conditions. Neonatal deaths often occur during the early neonatal period, and although many contributing factors have been identified, determining the most dominant causes remains a challenge. Premature birth and LBW are among the leading contributors to neonatal mortality. LBW can result not only from preterm delivery but also from intrauterine growth restriction (IUGR), where fetal development is impaired during pregnancy.

The World Health Organization (WHO) estimates that approximately 15–20% of all births globally—around 20 million babies annually—are categorized as LBW. In Indonesia, the 2022 Health Profile reported a 7.1% prevalence of LBW among live births. LBW remains one of the primary contributors to the country's still-elevated neonatal mortality rate, which stands at 10 per 1,000 live births. As one of Southeast Asia's developing nations, Indonesia has among the highest numbers of newborn deaths. In 2021, the infant mortality rate was recorded at 17.2 per 1,000 live births, decreasing slightly to 16.9 per 1,000 in 2022—a 1.74% decline. The Ministry of Health reported that 29.5% of perinatal deaths were due to intrauterine fetal death (IUFD), while 11.2% were caused by LBW.

Newborns weighing less than 2,500 grams fall into the LBW category and are especially vulnerable to numerous health complications, one of the most serious being temperature instability. These infants often struggle to regulate their body temperature, which puts them at risk for hypothermia. This condition can trigger metabolic imbalances, hypoglycemia, and significantly increase neonatal morbidity and mortality. Therefore, maintaining thermal stability is a top priority in the care of LBW infants, especially in Neonatal Intensive Care Units (NICUs).

One of the critical issues faced by LBW infants is the immature thermoregulatory system and insufficient brown fat reserves, making them highly susceptible to hypothermia. This condition can disrupt vital organ function, weaken the immune system, increase infection risk, and further deteriorate the infant's clinical state. As a result, maintaining optimal body temperature becomes a central focus in LBW management, particularly within NICU settings.

LBW infants frequently suffer from thermoregulatory disturbances, along with respiratory, cardiovascular, hematologic, gastrointestinal, neurologic, and renal complications. Among these, temperature regulation remains one of the most critical challenges during the early neonatal period. LBW infants are unable to effectively adapt to the transition from intrauterine to extrauterine environments, and exposure to cold stress forces them to rely on limited brown fat for heat production. Their reduced subcutaneous fat, brown adipose tissue, and glycogen stores increase their susceptibility to hypothermia.

The consequences of hypothermia in LBW infants include acute complications such as metabolic acidosis, hypoglycemia, and a heightened risk of respiratory distress. Without adequate thermal support, the risk of complications and mortality escalates significantly. Key management strategies for LBW infants include nutritional support (preferably breast milk), infection control,

regular weight monitoring, and consistent temperature maintenanceWhile incubators have traditionally been used to maintain body temperature, their availability is often limited in under-resourced health facilities. Moreover, incubators do not facilitate emotional bonding between mother and infant. In response, Kangaroo Mother Care (KMC) has been introduced as an effective, simple, and low-cost alternative.

KMC involves placing the infant upright on the mother's chest, allowing direct skin-to-skin contact, which has been proven to naturally stabilize the infant's body temperature. A WHO (2020) study indicated that LBW infants receiving KMC showed a 70% reduction in hypothermia risk and a 25% improvement in survival rates compared to those who did not receive KMC. Furthermore, KMC has been linked to enhanced maternal-infant bonding, earlier breastfeeding initiation, and shorter hospital stays.

Weni (2018) conducted a study at Dr. Achmad Mochtar Hospital in Bukittinggi and found that KMC significantly increased body temperature among LBW infants, with a p-value of 0.000 (≤ 0.05). The intervention was applied for one hour daily in the NICU, showing measurable benefits. Similarly, research by Sri Ismaya (2022) at Sekarwangi Regional Hospital in Sukabumi demonstrated that KMC positively influenced both weight gain and thermal stability in LBW infants ($p < 0.05$).

Bhayangkara Hospital in Padang, a type C referral hospital, provides NICU services and reported 96 LBW cases in 2020, rising to 104 cases in 2021, and 98 cases in 2022. Between November 2023 and January 2024, 28 LBW cases were recorded, averaging 10–12 cases per month.

KMC offers a practical and effective solution to address thermal regulation challenges in LBW newborns. It involves placing the infant in a vertical position on the mother's bare chest, with the baby wearing only a diaper and cap. The mother also exposes her chest area to ensure uninterrupted skin-to-skin contact, allowing heat transfer via conduction (Proverawati, 2014).

Despite its proven benefits and global recommendations, KMC is still underutilized in some health care settings, including NICUs. This may be due to limited healthcare worker training, lack of awareness among families, and misconceptions that KMC is less effective than incubator-based care.

Given these challenges, it is essential to investigate the effect of Kangaroo Mother Care on the thermal stability of low birth weight infants in the NICU, to provide stronger scientific evidence and advocate for its broader implementation as a standard component of neonatal care in health facilities.

METHODS

This study employed a **quasi-experimental design** using a **pretest-posttest approach without a control group**. In this design, the infant's body temperature was measured before the intervention (pretest), and again after the completion of the Kangaroo Mother Care (KMC) intervention (posttest) to assess changes attributable to the treatment.

Pretest	Treatment	Posttest
O1	X	O2

Description:

O1 : Measurement of baby's temperature before KMC.

X : Treatment (KMC implementation)

O2 : Measurement of baby's temperature after KMC.

The research was conducted in the Neonatal Intensive Care Unit (NICU) at Bhayangkara Hospital, Padang. The study population consisted of all mothers with low birth weight (LBW) infants receiving treatment in the NICU. The sample comprised 16 mothers who met the inclusion criteria and whose babies were admitted to the NICU during the study period.

To evaluate the effectiveness of KMC, data were analyzed using the paired t-test, which was used to determine whether there was a statistically significant difference in the body temperature of LBW infants before and after the KMC intervention.

RESULTS

This study involved 16 mothers of LBW babies who were treated in the NICU. Body temperature measurements were taken before (pretest) and after (posttest) KMC was given. The results obtained are as follows:

1. Body Temperature Before Kangoroo Mother Care (KMC)

The results of the study obtained body temperature before KMC on LBW in the NICU Room of Bhayangkara Padang Hospital can be seen in the table below:

Tabel 1. Average Body Temperature Before Kangoroo Mother Care (KMC) in LBWs

Variabel	Mean	SD	Min	Max	*N*
Body Temperature Before KMC	36,7	0,159	36,5	37,2	16

These results show that the average body temperature in LBW before Kangoroo Mother Care (KMC) is 36.7°C with a standard deviation of 0.159, with the lowest temperature being 36.5°C and the highest being 37.2°C.

2. Average Body Temperature After Kangaroo Mother Care (KMC)

The results of the study obtained body temperature after KMC on LBW in the NICU Room of Bhayangkara Padang Hospital can be seen in the table below:

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Table 2. Average Body Temperature After Kangoroo Mother Care (KMC) in LBWs

Variabel	Mean	SD	Min	Max	*N*
Body Temperature After KMC	37,3	1.024	37,1	37,5	16

These results shows that the average body temperature of LBW after kangoroo mother care (KMC) is 37.3°C with a standard deviation of 1.024 with the lowest temperature of 37.1°C and the highest of 37.5°C.

3. Effect of Kangoroo Mother Care (KMC) Implementation on Body Temperature

The results of the study of the implementation of KMC on body temperature stability in LBW in the NICU Room of Bhayangkara Hospital TK III Padang, can be seen in the table below:

Table 3. Effect of Kangoroo Mother Care (KMC) Implementation on Body Temperature in LBW

	Selisih Mean	Std Devias i	Std Error mean	5% Confidence Interval of the Difference		*P value*
				Lower	Upper	
Pre test dan Post test	-5, 56	1,59	0,39	-6.40	-4.71	.000

The results of the analysis of table 3 obtained body temperature before and after the implementation of KMC is -5, 56. The results of the analysis using paired t-test obtained the effect of KMC implementation on body temperature stability in low birth weight babies (LBW) in the NICU Room of Bhayangkara Tk III Padang Hospital with a p value of 0.000 (p <0.05).

DISCUSSION

1. Body Temperature Before the Implementation of Kangaroo Mother Care (KMC)

The findings of this study showed that the average body temperature of the 16 respondents before the Kangaroo Mother Care (KMC) intervention was 36.7°C, with a standard deviation of 0.159°C. The lowest recorded temperature was 36.5°C, while the highest was 37.2°C. These results indicate that prior to receiving KMC, the infants' body temperatures tended to be above the normal range, suggesting a tendency toward hyperthermia rather than hypothermia.

Comparable results were reported in a study by Nour Siyanah et al. (2021) titled *"Providing the Kangaroo Mother Care (KMC) Method on Body Temperature Stability of Low Birth Weight Infants in the Perinatology Room of RSIA Catherine Booth Makassar."* In that study, the average body temperature of LBW infants prior to KMC was 35.92°C with a standard deviation of 0.935°C, indicating that the infants were below the normal thermal threshold and exhibited signs of hypothermia.

According to Herdman T. Heather (2012), as cited in Proverawati (2017), low birth weight (LBW) infants are defined as neonates born weighing less than 2,500 grams. These infants frequently

experience impaired thermoregulation, stemming from inadequate heat production and accelerated heat loss. This condition is primarily due to the absence or deficiency of subcutaneous fat, which normally functions as insulation to maintain body heat (Maryunani, 2021).

Firdaus (2019) explains that newborns typically lose heat at a rate four times faster than adults, placing them at significant risk of experiencing a drop in body temperature. For LBW infants, thermoregulatory instability is a major concern, with temperatures often falling below 36.5°C, meeting the criteria for hypothermia. Contributing factors include immature thermogenic mechanisms, weak respiratory effort, low oxygen uptake, reduced muscular activity, and inadequate nutrition. Additionally, the relatively large body surface area and the thin subcutaneous fat layer exacerbate heat loss (Pratiwi, 2019).

The Ministry of Health (2022) defines body temperature as the equilibrium between internal heat production and external heat loss. In full-term neonates, the normal range is 36.5°C to 37.5°C, while for premature infants it lies between 36.3°C and 37.0°C. When infants are exposed to a room temperature of around 25°C, they may lose heat through evaporation, convection, and radiation at a rate of 200 calories/kg/minute. However, their own capacity for heat production is only one-tenth of that loss. As a result, a newborn's body temperature may decrease by up to 2°C within just 15 minutes, a dangerous situation, especially for premature and LBW infants, who may face life-threatening conditions such as asphyxia due to their inability to generate sufficient heat.

2. Body Temperature After Kangaroo Mother Care (KMC)

Following the initial body temperature measurement of low birth weight (LBW) infants using a standardized thermometer, the Kangaroo Mother Care (KMC) intervention was administered continuously for one hour. Subsequent temperature readings were taken using the same instrument and procedures. The analysis revealed that the mean post-KMC body temperature of the 18 infants was 37.3°C, with a standard deviation of 1.024°C. The lowest post-intervention temperature recorded was 37.1°C, while the highest was 37.5°C. These findings suggest that infants' body temperature increased following the KMC intervention, and the values observed were generally above the upper limit of the normal range for neonates.

This pattern aligns with the findings of Nour Siyanah et al. (2021) in their study titled *"Providing the Kangaroo Mother Care (KMC) Method on Body Temperature Stability of Low Birth Weight Infants in the Perinatology Room of RSIA Catherine Booth Makassar."* They reported that the average body temperature of LBW infants increased from 35.2°C before KMC to 36.6°C after KMC, with a standard deviation of 0.371°C, demonstrating a notable improvement in thermal stability after skin-to-skin contact was applied.

According to Pratiwi (2015), Kangaroo Mother Care is a proven method for maintaining thermal regulation in LBW infants. The direct skin-to-skin contact between mother and infant facilitates heat transfer via conduction, significantly reducing the risk of hypothermia. Beyond temperature stabilization, KMC also offers psychosocial and clinical advantages, including

enhanced maternal-infant bonding, improved breastfeeding outcomes, lower infection risk, shorter hospital stays, and reduced treatment costs.

Based on the researchers' analysis, the increase in infant body temperature post-KMC is likely attributable to conduction-based heat transfer from the mother's warmer skin to the infant's cooler body. This supports the physiological stability of LBW infants and underscores the importance of KMC as a non-invasive and effective intervention in neonatal care.

3. Effect of Kangaroo Mother Care (KMC) Implementation on Body Temperature of Low Birth Weight Infants (LBW)

The results of this study indicate that the average difference in body temperature before and after the KMC intervention was -5.66, suggesting a significant rise following the intervention. Analysis using the paired *t*-test revealed a statistically significant effect of KMC on the body temperature stability of low birth weight (LBW) infants in the NICU of Bhayangkara Hospital TK III Padang, with a p-value of 0.000 ($p < 0.05$).

These findings are consistent with previous research demonstrating the effectiveness of KMC in stabilizing and increasing the body temperature of LBW infants. For instance, Modjo et al. (2020) reported a temperature increase from an average of 36.28°C to 36.70°C after KMC application at Prof. Dr. H. Aloei Saboe Hospital, Gorontalo, with a statistically significant p-value (<0.05). Similarly, Setiyawan et al. (2019) observed a positive temperature change in LBW infants after a one-hour KMC session at Pandan Arang Hospital, Boyolali.

In addition, Marliana et al. (2021) conducted research at Mutiara Bunda Islamic Hospital, Brebes, which showed a significant correlation between KMC and body temperature stability, with a p-value of 0.003. Supporting this, Suwarni et al. (2020) at Fitri Candra Hospital in Wonogiri found that maternal knowledge about KMC was positively associated with improved thermal regulation in LBW infants.

The consistent findings across these studies highlight the critical role of KMC in thermoregulation among LBW infants. In this study, the observed temperature increase can be attributed to the mothers' willingness and adherence to performing KMC correctly. Proper implementation of KMC allowed infants to benefit from the mother's body warmth, while the mother's embrace also helped reduce heat loss from environmental exposure. These factors collectively contributed to the improvement in the infants' body temperature post-intervention.

Physiologically, LBW infants are predisposed to hypothermia due to immature thermoregulatory systems, including reduced subcutaneous fat, a larger surface area relative to body weight, and limited metabolic heat production. As an alternative to incubators, Kangaroo Mother Care provides a practical and effective solution, especially in resource-limited settings. By maintaining direct skin-to-skin contact, KMC facilitates natural conductive heat transfer from the caregiver to the infant.

From the researchers' perspective, KMC is not only cost-effective and simple to perform, but also empowers mothers, increases confidence in caring for vulnerable infants, and fosters strong

emotional bonds. Following KMC implementation, mothers reported that their babies appeared calmer and more stable, with improved body temperature and better weight gain, reinforcing the value of KMC in neonatal care practice.

CONCLUSIONS

This study concludes that Kangaroo Mother Care (KMC) has a significant effect on the body temperature stability of low birth weight (LBW) infants in the NICU room. Prior to the implementation of KMC, the average body temperature of LBW infants was 36.7°C with a standard deviation of 0.159, ranging from 36.5°C to 37.2°C. After the implementation of KMC, the average body temperature increased to 37.3°C, with a standard deviation of 1.024, and a temperature range of 37.1°C to 37.5°C.

Statistical analysis using the paired *t*-test showed a significant effect of KMC on body temperature stability, with a p-value of 0.000 ($p < 0.05$). These findings indicate that KMC is an effective intervention in maintaining and improving the thermal stability of LBW infants in the NICU setting.

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