

EFFECTIVENESS OF KANGAROO MOTHER CARE COMBINED WITH THE PRONE POSITION IN INCREASING WEIGHT GAIN AMONG LOW BIRTH WEIGHT INFANTS

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ARTICLE INFO	ABSTRACT
Article history Submitted : 2024-09-01 Revised : 2026-07-11 Accepted : 2026-08-21 Keywords: Kangaroo mother care; Prone positioning; Low Birth Weight; Neonates; NICU	The first month of life represents the most critical period for neonatal survival, particularly among low birth weight (LBW) infants, who are at increased risk of morbidity, mortality, and impaired growth due to physiological immaturity. Various interventions have been developed to improve neonatal outcomes, including Kangaroo Mother Care (KMC), which has been widely recognized for promoting thermoregulation, breastfeeding, parent–infant bonding, and weight gain. However, KMC alone may not always be sufficient to optimize neonatal growth and accelerate recovery during hospitalization. Therefore, combining KMC with additional supportive interventions, such as prone positioning, may further enhance neonatal outcomes. This study aimed to determine the effectiveness of a combination of Kangaroo Mother Care and prone positioning in increasing weight gain among low birth weight infants. This study employed a quantitative quasi-experimental design. A total of 40 low birth weight infants were recruited using a consecutive sampling technique and allocated into an intervention group and a control group. Infants in the intervention group received Kangaroo Mother Care combined with prone positioning, while those in the control group received standard Kangaroo Mother Care according to hospital practice. Body weight was measured using a calibrated digital infant scale before and after the intervention. Data were analyzed to compare weight gain between the two groups. The findings demonstrated a statistically significant difference in weight gain between the intervention and control groups, with infants receiving the combined intervention showing greater weight gain than those receiving standard care alone ($p = 0.016$). These results indicate that combining Kangaroo Mother Care with prone positioning is more effective in promoting weight gain among low birth weight infants. In conclusion, the combination of Kangaroo Mother Care and prone positioning may serve as a simple, feasible, and cost-effective nursing intervention to support optimal growth in low birth weight infants and may be considered as part of routine neonatal care.
Kata Kunci: Perawatan metode kanguru; Posisi Prone; Berat Badan Lahir Rendah; Neonatus; NICU This is an open access article under the CC BY-SA license: 	ABSTRAK Bulan pertama kehidupan merupakan periode paling kritis bagi kelangsungan hidup neonatus, terutama pada bayi dengan berat badan lahir rendah (BBLR) yang memiliki risiko lebih tinggi mengalami morbiditas, mortalitas, dan gangguan pertumbuhan akibat imaturitas fisiologis. Berbagai intervensi telah dikembangkan untuk meningkatkan luaran kesehatan neonatus, salah satunya adalah Kangaroo Mother Care (KMC) yang telah terbukti memberikan manfaat dalam menjaga stabilitas suhu tubuh, meningkatkan keberhasilan menyusui, memperkuat ikatan antara ibu dan bayi, serta mendukung peningkatan berat badan. Namun, penerapan KMC saja belum tentu cukup untuk mengoptimalkan pertumbuhan dan mempercepat pemulihan bayi selama masa perawatan. Oleh karena itu, diperlukan kombinasi intervensi tambahan, seperti posisi tengkurap (prone positioning), yang berpotensi meningkatkan efektivitas KMC dalam mendukung pertumbuhan bayi BBLR. Penelitian ini bertujuan untuk menganalisis efektivitas kombinasi Kangaroo Mother Care dan posisi tengkurap terhadap peningkatan berat badan pada bayi BBLR. Penelitian ini menggunakan desain kuantitatif dengan pendekatan quasi-experimental. Sebanyak 40 bayi BBLR direkrut menggunakan teknik consecutive sampling dan dibagi ke dalam kelompok intervensi dan kelompok kontrol. Kelompok intervensi mendapatkan kombinasi Kangaroo Mother Care dan posisi tengkurap, sedangkan kelompok kontrol mendapatkan perawatan standar sesuai prosedur yang berlaku di rumah sakit. Berat badan bayi diukur menggunakan timbangan digital bayi yang telah terkalibrasi sebelum dan sesudah intervensi. Data dianalisis untuk

	<i>membandingkan peningkatan berat badan antara kedua kelompok. Hasil penelitian menunjukkan adanya perbedaan yang signifikan dalam peningkatan berat badan antara kelompok intervensi dan kelompok kontrol, dengan peningkatan berat badan yang lebih tinggi pada kelompok yang menerima kombinasi intervensi ($p = 0,016$). Temuan ini menunjukkan bahwa kombinasi Kangaroo Mother Care dan posisi tengkurap lebih efektif dalam meningkatkan berat badan bayi BBLR dibandingkan perawatan standar. Kombinasi Kangaroo Mother Care dan posisi tengkurap dapat menjadi intervensi keperawatan yang sederhana, mudah diterapkan, dan berbiaya rendah untuk mendukung pertumbuhan optimal pada bayi BBLR serta berpotensi diintegrasikan ke dalam praktik perawatan neonatal rutin.</i>
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INTRODUCTION

The first month of life is the most vulnerable phase for newborns (neonates) to survive. As many as 2.4 million newborn babies were reported to have died in 2020 ([World Health Organization \(WHO\), 2022](#)). Newborn babies must make various physiological adjustments in order to survive as well as possible. If newborn babies are unable to adapt, this may trigger high levels of morbidity and mortality among newborns ([Riset Kesehatan Dasar, 2018](#)). The WHO South-East Asia Region continues to bear a substantial burden of neonatal mortality, accounting for more than one-third of global neonatal deaths despite considerable progress in recent decades ([World Health Organization Regional Office for South-East-Asia, 2019](#)). One measure of a country's success in improving people's health is the decline in the Infant Mortality Rate (IMR) ([World Health Organization \(WHO\), 2022](#)). Indonesia remains one of the countries contributing substantially to the global burden of neonatal mortality. In 2019, the country was estimated to have approximately 60,000 neonatal deaths, placing it among the countries with the highest absolute numbers of neonatal deaths worldwide (United Nations Inter-agency Group for Child Mortality Estimation [UN IGME], 2020). Globally, neonatal mortality is primarily attributed to complications of preterm birth, intrapartum-related complications, and neonatal infections, while low birth weight remains one of the most important risk factors associated with neonatal death ([World Health Organization \(WHO\), 2020](#)).

Based on data reported to the Bali Provincial Health Service in 2020, the proportion of premature births in Bali Province was recorded at 16.2%, with the largest cause of death in the 0–28-day age group being LBW at 40.08% ([Riset Kesehatan Dasar, 2018](#)). The incidence of LBW in Badung District from 2019 to 2020 experienced an increase of 6 births, while the highest number of neonatal deaths in 2020 was among LBW babies, with 5 babies. Preterm birth and LBW reached 10–12 cases every month in 2021 ([Dinas Kesehatan Pemerintah Provinsi Bali, 2020](#)). Various efforts have been made by the hospital to minimize the negative impact of premature birth and LBW, one of which is the implementation of Kangaroo Mother Care (KMC). The implementation of KMC involves parental participation in having skin-to-skin contact with the newborn, which can help stabilize thermoregulation and support the baby's growth ([Narciso et al., 2021](#)). However, the implementation of KMC is still carried out intermittently (periodically), so during the period the baby is in care, additional interventions need to be given as a combination to optimize the increase in the baby's weight and improve the physiology of the baby's body, such as oxygen saturation. The application of prone positioning is an intervention that has never been implemented at Mangusada Hospital but has been widely recommended in neonatal care to help optimize the growth of premature and LBW babies. This intervention can especially be applied when the baby is resting in the incubator or crib ([Nakamura & Kihara, 2013](#)).

Based on this, testing the effectiveness of the combination of Kangaroo Mother Care (KMC) and prone positioning on oxygen saturation and increased weight of LBW babies needs to be carried out at Mangusada RSD, Badung Regency, Bali Province.

METHOD

Type of Research

This research uses quantitative methods with a quasi-experimental design approach. The aim of this design is to analyze the differences between the two interventions, namely the combination of Kangaroo Mother Care (KMC) and prone positioning compared to KMC alone (as standard care), on weight gain and oxygen saturation in low birth weight infants.

Place and Time of Research

This study was conducted from April to July 2023 in the NICU Ward. This research was carried out at RSD Mangusada and was declared to have passed ethical review by KEPK RSD Mangusada with number 070/4320/RSDM/2023.

Population and Sample

The respondents in this quasi-experimental pretest–posttest control group study consisted of 40 low-birth-weight infants recruited using a consecutive sampling technique over a four-month data collection period. Twenty infants were assigned to the intervention group and twenty to the control group. Consecutive sampling was selected because it enables the inclusion of all eligible participants who meet the predetermined criteria during the recruitment period, thereby reducing selection bias and improving the representativeness of the accessible population (Polit & Beck, 2021). The final sample size reflected the total number of eligible low-birth-weight infants admitted during the study period who met the inclusion criteria and whose parents provided informed consent to participate. This approach is commonly applied in hospital-based quasi-experimental studies when the target population is limited and participant recruitment depends on the availability of eligible clinical cases. The inclusion criteria comprised infants with a birth weight of less than 2,500 g, without congenital anomalies or severe medical complications, and whose parents were cooperative and willing to participate. Infants whose clinical condition deteriorated during the study were excluded. Before data collection, the researchers prepared Kangaroo Mother Care (KMC) garments made from soft, comfortable fabric with Balinese cultural motifs and developed standardized educational modules on Kangaroo Mother Care and prone positioning. These materials were used to train enumerators and ensure consistency in intervention delivery.

Data Collection

Infants' body weight was measured using a calibrated digital infant weighing scale. Baseline body weight was recorded for both the intervention and control groups before the intervention (pre-test). Infants in the intervention group received a combination of Kangaroo Mother Care (KMC) and prone positioning alternately for four consecutive days, whereas those in the control group received routine care consisting of KMC alone. At the end of the four-day intervention period, post-intervention body weight was measured using the same calibrated instrument. Throughout the data collection period, strict infection prevention and control protocols were implemented to minimize the risk of disease transmission. To ensure the consistency and reliability of data collection and intervention delivery, two trained enumerators were involved in the study. Prior to data collection, the researchers conducted standardized training sessions to ensure a uniform understanding of the study protocol and data collection procedures among all enumerators.

Data Analysis and Processing

After the data were collected, data recapitulation and univariate and bivariate data analyses were carried out using the SPSS computer program. Measurement of the difference before and after treatment was carried out using the paired t-test for normally distributed data ($p\text{-value} = 0.15$), such as body weight data on day 1 and day 4 in the two groups, while the difference in mean changes between the intervention and control groups was assessed using the independent t-test because the data were normally distributed in both groups.

RESULT**Table 1. Frequency Distribution of Respondent Characteristics of Control Group (n = 20)**

Research Variable	n	Percent (%)
Gender		
Female	7	35
Male	13	65
Type of labor		
Normal	13	65
SC	7	35
Birth History		
Mild asphyxia	0	0
Moderate asphyxia	9	45
Severe asphyxia	8	40
Vigorous baby	3	15

Table 1 explains several variables, including gender, type of delivery, and birth history of the baby. Respondents in the control group were dominated by male babies, namely 65%, while the most common type of delivery was normal delivery, which reached 65%. In addition, the birth history of babies in the control group showed that births with moderate asphyxia were more common among respondents in the control group (45%).

Table 2. Frequency Distribution of Respondent Characteristics of Intervention Group (n = 20)

Research Variable	n	Percent (%)
Gender		
Female	7	35
Male	13	65
Type of labor		
Normal	12	60
SC	8	40
Birth History		
Mild asphyxia	1	5
Moderate asphyxia	8	40
Severe asphyxia	7	35
Vigorous baby	4	20

Table 2 explains the characteristics of the intervention group. The respondents in the intervention group were dominated by male babies, namely 65%, while the most common type of delivery was normal delivery, which reached 60%. In addition, similar to Table 1, the birth history of babies in the intervention group showed that births with moderate asphyxia were more common among respondents in the intervention group (40%).

Apart from the characteristics described in Tables 1 and 2, Tables 3 and 4 also describe other characteristics of respondents from each group, which are presented in the form of numerical data. In the control group, the average age of the babies reached 4.95 days, while in the intervention group it reached 5.55 days. The average age of respondents' mothers from each group was not much different, namely 27.85 years in the control group and 26.80 years in the intervention group. Apart from that, the characteristics of the average body weight and body length of respondents from each group looked different, but they were included in the low birth weight category (< 2,500 grams), with body lengths that did not differ much, namely 46.70 cm in the control group and 46.45 cm in the intervention group.

Table 3. Characteristics of Control Group Respondents based on Age, Body Weight and Length (n = 20)

Variable	Mean	Dev. Std	Min-max
Babies age (days)	4.95	2.892	1-10
Mom's age (year)	27.85	7.073	19 – 43
Birth weight (gram)	2110.75	377.827	1300 – 2500
Birth length (cm)	46.70	2.515	40 – 50
Body Weight day 1 (gram)	2064.25	343.528	1315 – 2450
Body Weight day 4 (gram)	2111.25	349.883	1335 – 2490

Table 4. Characteristics of Intervention Group Respondents based on Age, Body Weight and Length (n = 20)

Variable	Mean	Dev. Std	Min-max
Babies age (days)	5.55	4.74	1 - 21
Mom's age (year)	26.80	6.872	17 – 40
Birth weight (gram)	1902	275.248	970 – 2230
Birth length (cm)	46.45	4.236	31 – 50
Body Weight day 1 (gram)	1906.5	252.452	1105 – 2230
Body Weight day 4 (gram)	2063	342.711	1170 – 3010

Table 5. The result of Paired Sample T-Test

Group	Mean±Std. Deviasi	Pretest (gram)	Posttest (gram)	P value
Intervention (n=20)	156.5 ± 192	1906.5	2063	0.002
Control (n=20)	47 ± 33.14	2064.25	2111.25	0.001

In Table 5, the results of the analysis using the paired sample t-test in both groups show p-values that are smaller than 0.05 (α). It means that there is an effect of these two interventions on increasing the weight of LBW babies in both groups, both the group that only received the KMC intervention and the group that received a combination of KMC and prone positioning.

Table 6. The result of Independent Sample T-test

Group	95% CI	t	P value
Intervention (n=20)	-246.3 - - 66.6	-3.64	0.016
Control (n=20)	-62.5 – -31.4	-6.34	

Based on Table 6, the results of the analysis using the independent sample t-test to compare the two intervention groups show a value of $p = 0.016$ ($< \alpha = 0.05$), meaning that there is a difference between the two intervention groups in increasing the weight of babies with LBW.

DISCUSSION

The Kangaroo Mother Care (KMC) intervention, as one of the standard interventions for babies with low birth weight (LBW), has been proven to significantly increase infant weight. In fact, research shows that the longer the KMC intervention is carried out, the faster the weight gain of babies with LBW can accelerate (Triana, Ani, & Dewi, 2022). WHO (2021) also stated that immediate Kangaroo Mother Care for newborns with low birth weight and prematurity can effectively reduce neonatal mortality (WHO Immediate KMC Study Group, 2021; Kumbhojkar et al., 2016). Besides that, the implementation of KMC not only influences the babies directly, but also has an impact on mothers by increasing breast milk production, thereby enabling babies to receive adequate breastfeeding (Cunningham et al., 2018). As a result of increased maternal breast milk production, babies gain weight more easily, which contributes to improving the condition of premature infants or those with low birth weight (Cunningham et al., 2018). Research conducted by Kumbhojkar et al. (2021), comparing KMC with conventional hospital management, demonstrated significant benefits in many aspects of neonatal health. KMC can effectively promote growth, reduce mortality rates, and shorten the length of hospital stay (Muliani & Lisnawati, 2018). In its implementation, KMC is also considered simple, acceptable, cost-effective, and easy for mothers to perform both in hospitals and at home after discharge (Kumbhojkar et al., 2016).

In Very Low Birth Weight (VLBW) babies, KMC can also reduce the duration of hospitalization and increase effective breastfeeding rates by up to 86% compared with conventional care (Mishra et al., 2017). Although KMC generally provides beneficial effects for neonates during hospitalization, no significant differences have been reported between infants with a history of KMC and those receiving conventional care after 6–12 months of corrected age in terms of long-term growth and feeding patterns (Gavhane et al., 2016). However, different findings have also been reported. A meta-analysis supported the implementation of KMC as an intervention with positive effects during the first 28 days of life. In addition to reducing mortality and shortening hospital stay, KMC also decreases the incidence of neonatal sepsis. Furthermore, exclusive breastfeeding can be sustained at home through continued KMC practice (Zhu et al., 2023). Another randomized controlled trial (RCT) demonstrated that KMC in intubated premature neonates effectively reduced mortality. In addition, comorbidities and the duration of intubation also tended to decrease (Baton et al., 2021). Random blood glucose levels were also found to be significantly higher, while remaining within the normal range, among intubated LBW neonates receiving KMC. This finding may be explained by several mechanisms. First, KMC improves thermoregulation and stabilizes brown adipose tissue metabolism, thereby preventing depletion of glycogen stores. Second, KMC reduces stress through decreased neurosteroid activity, resulting in better energy conservation and blood glucose stabilization. Finally, KMC is associated with increased maternal colostrum production, which has also been shown to stabilize glucose levels (Baton et al., 2021). KMC also benefits Extremely Low Birth Weight (ELBW) infants by shortening the duration of nIPPV/CPAP ventilation and supplemental oxygen therapy, while reducing the frequency of apnea (Xie et al., 2021).

Babies with low birth weight require more energy to support growth and development. One approach to conserving energy is maintaining stable physiological parameters. The application of KMC has been shown to significantly stabilize physiological parameters in LBW infants, particularly when performed for longer durations rather than only 10 minutes or 1 hour. Physiological parameters that improve significantly with KMC include oxygen saturation, blood pressure, heart rate, and respiratory rate (Ranjan & Malik, 2019). As physiological stability improves, energy expenditure decreases and babies become more relaxed, allowing them to rest and focus on growth. During KMC, babies remain in a position similar to that in the womb, increasing comfort and promoting longer sleep duration (Conde-Agudelo & Diaz-Rossello, 2016). Under these conditions, oxygen and calorie consumption are minimized, allowing more calories to be utilized for weight gain. In addition, maternal breast milk production increases because breastfeeding becomes more frequent during KMC. Other studies have also reported significantly greater weight gain among babies receiving KMC compared with conventional care. However, gestational age may also influence head circumference growth among premature infants receiving KMC (Lumbanraja, 2016).

The prone position is considered an energy-conserving position for infants because it reduces heat loss compared with the supine position. In the prone position, the baby's legs remain flexed, reducing metabolic demands and minimizing heat loss. In addition, the baby's face is positioned against the mattress or blanket, reducing exposure to ambient air and limiting heat loss through radiation. By

reducing heat loss, infants conserve energy, thereby facilitating weight gain. Prone positioning also contributes to the stability of oxygen saturation and heart rate (Babuyeh et al., 2018), as well as pulse rate and respiratory rate in LBW infants. Torabian et al. (2019) similarly demonstrated that prone positioning significantly improved oxygen saturation, heart rate, and respiratory rate compared with the supine position. Although both positions maintained physiological parameters within the normal range, greater stability was observed in the prone-position group. Nevertheless, prone positioning is recommended primarily in the NICU, where continuous monitoring is available, because its application at home without supervision may increase the risk of adverse events (Torabian et al., 2019). Therefore, prone positioning may be recommended as a nursing intervention and incorporated into standard operating procedures for the management of LBW infants (Sarli et al., 2021). In addition, Cândia et al. (2014) reported that prone positioning significantly reduced salivary cortisol levels, respiratory rate, and Brazelton sleep scores, indicating reduced stress among premature infants (Cândia et al., 2014). Other research by Deviana et al. (2020) also revealed that prone positioning not only stabilizes infants' vital signs but also reduces the duration of hospitalization and provides analgesic effects (Deviana et al., 2020). However, prone positioning does not always produce superior outcomes compared with the supine position. Prawesti et al. (2019) reported that both supine and prone positioning combined with nesting improved oxygen saturation and body weight, although no significant differences were observed between the two groups (Prawesti et al., 2019). Similarly, Badr et al. (2022) reported findings consistent with the present study, showing that KMC combined with prone positioning increased body weight and defecation frequency among LBW infants through reductions in residual gastric volume, vomiting frequency, and abdominal circumference. The authors also recommended that NICU nurses emphasize the implementation of KMC and prone positioning as safe, non-invasive interventions for premature infants (Badr et al., 2022).

Thus, the combination of KMC and prone positioning may be recommended for babies with low birth weight because the findings of this study demonstrated a greater improvement in weight gain compared with KMC alone. Considering the many benefits for both infants and mothers, it is expected that the implementation of Kangaroo Mother Care for LBW infants will become part of hospital policy, supported by healthcare professionals and adequate facilities to enable families to practice KMC effectively (Sukamti et al., 2020). A similar recommendation was emphasized in the RCT conducted by Mazumder et al. (2019), which highlighted the importance of adopting KMC as a strategy to reduce mortality among high-risk infants in low- and middle-income countries (Mazumder et al., 2019).

This study has several limitations that should be acknowledged. First, the sample size was relatively small, which may limit the generalizability of the findings. Second, the duration of the intervention and follow-up was relatively short (less than one week), which may not have been sufficient to fully evaluate changes in body weight among preterm infants. Therefore, future studies are encouraged to recruit larger sample sizes and incorporate longer intervention and follow-up periods to provide more robust evidence regarding the effects of the intervention on weight gain in preterm infants.

CONCLUSION AND SUGGESTION

This study has several limitations that should be considered when interpreting the findings. First, the intervention and follow-up period lasted only four days; therefore, the results reflect only the short-term effects of the combination of Kangaroo Mother Care (KMC) and prone positioning on weight gain among low birth weight infants. Consequently, the findings cannot be used to infer the long-term effectiveness of the intervention or the impact of a longer intervention period on neonatal outcomes. Second, this study employed a quasi-experimental design with a relatively small sample size and was conducted in a single hospital, which may limit the generalizability of the findings to other settings and populations. Future studies are recommended to include longer follow-up periods, larger sample sizes, and more rigorous study designs, such as randomized controlled trials, to further evaluate the effectiveness of combined KMC and prone positioning on clinical outcomes among low birth weight infants.

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