

The effectiveness of kangaroo mother care in monitoring vital signs and preventing stunting risk in low-birth-weight infants

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Abstract

Low Birth Weight (LBW) infants have a greater risk of stunting and other non-communicable diseases. The highest causes of death were asphyxia and hypothermia. The Kangaroo Mother Care (KMC) method as a simple intervention is based on evidence-based, which can maintain stability and improve the physiological condition of the baby's body. This study was to determine the effectiveness of the KMC method in monitoring vital signs and preventing stunting in LBW. The study employed a quasi-experimental pre-posttest one group design, using a KMC carrier designed in the

shape of a backpack. The number of respondents was 38 infants, selected by consecutive sampling. Data analysis used the Wilcoxon test. Bivariate analysis with the application of the KMC method for 4 hours/day on average experienced an increase in body weight 15 gr/day ($p=0.011$), an average increase in body length ≥ 0.2 cm/day ($p=0.049$), infants received breast milk during the application of the KMC method ($p=0.013$) the three variables were $p\text{-value} < \alpha(0.05)$, based on the Wilcoxon test with the use of KMC backpacks on LBW showed a significant relationship to infant growth in risk prevention stunting with a value ($p=0.000 < 0.05$). The use of KMC backpacks for LBW is effective in maintaining the baby's vital signs and can prevent the risk of stunting. The KMC backpack is recommended as a safe, easy, inexpensive and effective non-pharmacological therapy to prevent hypothermia and the risk of stunting.

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Introduction

The birth of Low Birth Weight (LBW) babies, especially premature at <37 weeks of gestation, all organs in the body have not functioned optimally, and it is still difficult to maintain body temperature and is prone to hypothermia, which is one of the causes of LBW deaths and tends to experience instability of vital signs.^{1,2} Birth of LBW is also a dominant factor that has a risk of 5.87 times experiencing stunting. History of LBW birth is one of the factors causing stunting in children under two years old.^{3,4} Infant birth length <48 cm has a 4.5 times risk experiencing stunting growth in children compared to birth length 48 cm.⁵ Stunting is the result of several determinants including pre-pregnancy, gestational age and malnutrition after birth.⁶

Birth weight is an important and reliable indicator for the survival of neonates and infants, both in terms of physical growth and mental status development, as well as a general indicator for determining health, nutritional status, and socioeconomic status in developed and developing countries.⁷ The high and low infant mortality rate is an indicator of a country's health.⁸ Children face the highest risk of death in the first month of life and the first 28 days of life (neonatal period) with a global average of 17 deaths per 1,000 live births (KH) in 2022.⁹ In Indonesia, the Infant Mortality Rate (IMR) will be 16 per 1000 KH in 2024. The number of deaths occurring at the age of 0-28 days has increased slightly, where in 2021 there were 297 people, and in 2022 it increased to 308 people. Nationally, Central Sulawesi Province experienced an increase in the Infant Mortality Rate (IMR) from 52 to 60/1000 KH, and ranks third highest after West Sulawesi and NTB. The most common causes of neonatal death in Central Sulawesi Province in 2022 are LBW (27.92%), Asphyxia (19.16%), Congenital Abnormalities (12.34%), infection (5.19%) and other causes 35.39%.¹⁰ The high IMR is an indication of health and development problems which in general still require special efforts. Clinical trial study on 53 neonates admitted to the NICU, performed KMC on infants for 1 hour/day (3 consecutive days) by

monitoring vital signs: temperature, respiration and heart rate/minute, and arterial oxygen saturation rate was measured and recorded (before, during and after KMC). The results showed that the variation in mean body temperature and arterial oxygen saturation rate between the two groups had a significant difference, the kangaroo care method was effective in improving and stabilizing the vital signs of newborns.¹¹

After three days of KMC treatment, the average weight gain increased by 12.19 grams/day, the KMC method is an appropriate technology for LBW treatment, with skin-to-skin contact.¹² The duration of 2 hours of KMC, as measured by vital signs before and after 1 hour and 2 hours, had a greater effect on the baby's temperature, heart rate, respiratory rate, and oxygen saturation than the duration of 1 hour, while blood pressure did not change.^{13,14} Kangaroo care as a simple intervention based on evidence-based practice, can save the life of newborns. The effect of kangaroo care can improve physiological conditions such as breathing, heart rate, temperature and sleep patterns of the baby and make a positive contribution to the psychological condition of the mother after giving birth.^{15,16} Another study showed that infants experienced an average weight gain of 188.75±166.6 grams with a KMC duration of 4 hours/day, statistically significant and potentially increasing weight in LBW.¹⁷ Kangaroo care is considered a fundamental component of therapeutic developments for the care of premature infants as a non-pharmacological treatment strategy.¹⁸ The KMC sling model, which is specially designed in a simpler form while taking into account the element of safety for mothers and babies, is easy to use or apply by mothers independently without the need for help from others, equipped with a support strap and a lock that is quite safe. The selection of soft and smooth materials is also an important element in providing comfort for mother and baby, coated with sponge pads to give a softer impression when used, making mother and baby not stifling but maintaining a stable body temperature.¹⁹⁻²¹ This sling is designed to be simpler in the form of a «KMC Backpack» which is very possible to be used at any time without hindering or limiting the mother's daily physical activities such as: cooking, ironing, drying clothes, reading, even eating and drinking or mothers doing other activities both at home or outside the home by keeping the baby attached to the mother's chest, while breastfeeding the baby. Mother easily walks, stands, sits or lies in a supine position with her head slightly elevated when resting. The results of this design are effective in maintaining the stability of the baby's vital signs, with skin-to-skin contact increasing the emotional relationship between mother and baby and preventing hypothermia, the baby's heart rate and breathing also become more regular, this tool as a natural incubator is much cheaper and easier to use throughout time. KMC backpacks that are used regularly and continuously can shorten the hospitalization period of the baby thereby reducing the cost of care.²²⁻²⁴

The position of the baby in the KMC backpack is placed between the mother's two breasts, in addition to preventing hypothermia, the baby's position is always upright, making the baby's heart rate and breathing pattern more regular, making it easier for the baby to suckle longer and more often, stimulating the release of the mother's hormones for milk production and expenditure. More so that the baby's nutritional intake is adequate. This can support optimal baby growth and reduce the risk of stunting in infants.^{25,26} The purpose of the study was to determine the effectiveness of the application of the KMC method in monitoring vital signs as an effort to prevent the risk of stunting in LBW. The application of the KMC method consistently can help stabilize the baby's condition, improve growth patterns as an early effort to prevent stunting, is a form of basic research that is superior to higher

education as a center for stunting studies.

Materials and Methods

Study design and setting

This research uses a quasi-experimental research design with a pre-posttest one group design. This research was carried out in the Perinatology Room at Anuntaloko Parimo Hospital, Central Sulawesi Province, Indonesia.

Sample size

This study consisted of all mother-baby pairs with LBW births, both Mature and Premature who were treated in the Perinatology Room at Anuntaloko Parimo Hospital, Central Sulawesi. A total of 38 babies participated in the study who were selected by consecutive sampling with babies with BBL <2.500 gr.

Survey instrument

This study looked at the differences before and after the intervention by measuring the baby's weight, body length, temperature, pulse, and breathing. The intervention was given treatment using the KMC method which had been modified to be simpler and easier to apply by mothers, which was named «KMC Backpack». The position of the baby in the KMC backpack between the mother's breasts, apart from being able to prevent hypothermia, also by keeping the baby in an upright position, makes the baby's heart rate and breathing patterns more regular, making it easier for the baby to breastfeed longer and more often, which can stimulate the production and release of more breast milk so that baby's nutritional intake is adequate. This can support optimal baby growth and reduce the risk of stunting in babies. KMC was given 4 hours/day in 4 days.

Data analysis

Data were analyzed using IBM SPSS Statistics 20 software, with a significance level set at 0.05. Demographic data were examined using frequency distribution tables and percentages. Presentation of bivariate data by conducting data analysis first to test the normality of the data using the Shapiro Wilk test. It is said that the data is normally distributed if the p value is >0.05 and vice versa. In this research, the normality test results are p-value <0.05, which means the data is not normally distributed. So, the test used is the Wilcoxon Test (match pair test) to analyze the results of observations of paired data that are different or not, and at the same time analyze the level of effectiveness of the KMC method.

Results

Analysis of 38 Low Birth Weight (LBW) Babies as shown in Table 1, shows that the majority of LBW babies were born from a history of parity of multigravida mothers 24 people (63.2%), with a mature gestational age of 29 people (76.3%) and most types of birth with surgery (cesarean section) as many as 25 people (65.8%), and the average type of baby drinking during KMC was breast milk for 23 people (60.5%).

Table 2 shows that with the application of the KMC method for 4 hours/day the average weight gain was 15 g/day as many as 16 infants (76.19%), X²hit value=6.446 and p=0.011, the number of infants experiencing the average increase in body length 0.2

cm/day there are 14 babies (73.68%) X^2_{hit} value=3.886 and $p=0.049$, as well as infants who received breast milk during the application of the KMC method of 17 infants (73.91%) X^2_{hit} value =6.133 and $p=0.013$. In the results of this test, the values of the three variables were obtained at 95% CI $X^2_{hit}>X^2_{tab}$ (3.84) and $p<\alpha(0.05)$, indicating a significant relationship with the application of the KMC method to LBW to prevent the risk of stunting.

Based on Table 3, it shows the average ranking (mean rank) of the results of weight monitoring before and after KMC where the highest results were in the positive rank value, namely the number of measurements after KMC increased compared to before KMC 34 babies (89.4%), the negative ranking value was showed that there were babies whose measurements after KMC were lower than before being given KMC 3 babies (7.9%), Ties value or constant value where there was no change in value after KMC and before KMC 1 Baby (2.7%) with $p=0.000<0.05$, while the baby's overall body length increases by an average of 0.2 cm/day ($p=0.000$). Thus, the effectiveness of using the KMC method for LBW shows a significant relationship with growth in preventing the risk of stunting with a value ($p=0.000<0.05$).

Based on Table 4, it shows that in monitoring the baby's vital signs while using the KMC method, of the 38 babies who had measurements taken to measure body temperature, there were 37 babies (97.3%) whose measurement results increased after KMC compared to before KMC, for overall pulse measurement 38 The measurement results for babies (100%) increased after KMC compared to before KMC, while the respiratory measurement results for 34 babies (89.4%) increased after being given KMC compared

to before KMC. With a value ($p=0.000<0.05$) which shows that the use of the KMC method is significantly effective in monitoring the baby's vital signs.

Discussion

Differences in average weight growth and length of LBW with KMC method treatment

The results of the analysis showed that the KMC method treatment 4 hours/day was effective in increasing the baby's weight 15gr/day, from the Chi-Quadrat test there was a significant significance with the value of $X^2_{hit}=6.446>X^2_{tab}=3.84$ and $p=0.011<0.05$. The Wilcoxon test showed a negative rank value = 3, meaning that from 38 babies there were 3 babies who experienced a decrease in weight while using the KMC method ($p=0.000$), this shows that the weight gain in weeks I-II is still not stable because there is a tendency for weight gain. Babies experience a decline after birth until day 14 as a process of adjustment from intra-uterine to extra-uterine life. Similarly, the baby's overall body length increased by an average of 0.2 cm/day ($p=0.000$). Thus the effectiveness of the use of the KMC method on LBW shows a significant relationship to growth in preventing stunting risk with a value ($p=0.000<0.05$).

In line with this study, infants using the KMC method achieved physical growth parameters up to the age of 40 weeks of correction, although they were smaller at birth indicating better growth

Table 1. Characteristics of LBW with the application of the KMC method.

Baby characteristics		f (n=38)	%
Maternal parity history	- Primigravida	10	26.3
	- Multigravida	24	63.2
	- Grandemultigravida	4	10.5
Gestational age at birth	- Matur (≥ 37 weeks)	29	76.3
	- Premature (< 37 weeks)	9	23.7
Baby's gender	- Male	17	44.7
	- Female	21	55.3
Type of birth	- Spontaneous	13	34.2
	- Cesarean section (SC)	25	65.8
Type of feeding	- Breast milk	23	60.5
	- Breast milk + Formula milk	15	39.5

Table 2. Distribution of respondent characteristics based on the duration of KMC in LBW.

Variable	KMC < 4 hour/day f (n=16) (%)	KMC ≥ 4 hour/day f (n=22) (%)	Total	X^2_{tab}	CI 95%	p
Weight Gain						
Not increased or < 15 gr/day	11 (64.71)	6 (35.29)	17 (100.00)	6.446	1.43-24.11	0.011
Increased ≥ 15 gr/day	5 (23.81)	16 (76.19)	21 (100.00)			
Increase in Body Length						
Body length increases (< 0.2 cm/day)	11 (57.89)	8 (42.11)	19 (100.00)	3.886	0.98-15.12	0.049
Body length increases (≥ 0.2 cm/day)	5 (26.32)	14 (73.68)	19 (100.00)			
Type of drink						
Breast milk/formula milk	10 (66.67)	5 (33.33)	15 (100.00)	6.133	1.37-23.46	0.013
Breast milk	6 (26.09)	17 (73.91)	23 (100.00)			

and physical development of infants than the control group with conventional treatment methods.²⁷ The KMC method can also increase the size of the head circumference with an average difference of: 0.2 cm/week; (95%CI: 0.09-0.31) and body length: 0.23 cm/week; (95%CI: 0.10-0.35 cm/week) with RR: 0.74; (95%CI:0.36-1.44) compared to standard/conventional care, and reduces the risk of stunting.²⁸ The results of the study that are not in line with this study are that KMC has no effect on infant weight gain, but the KMC method is still declared effective, efficient and has the potential to shorten the period of LBW hospitalization in hospitals. The longer you do KMC, the shorter the length of stay in the hospital, which means that reducing the length of stay has an impact on decreasing treatment costs.¹⁷ In another study also found a significant relationship between protein and calorie intake with stunted growth related to child health in rural communities. There are differences in the prevalence of infection, child morbidity, and frequency of hospitalization between stunted and non-stunted children.²⁹

Indonesia has the highest prevalence of stunting in early childhood among ASEAN countries. Exclusively breastfed children grow faster than other children who are not breastfed.³⁰ This study examines the protective effect of exclusive breastfeeding on stunting in children under the age of two, as well as its interaction with monthly household expenses.³¹ A number of premature infants with hypothermia, hypoglycemia, and sepsis had a significantly higher prevalence in the CMC group than in the KMC group. Likewise, it was positively significant with an average weight gain of 19.28±2.9g/day, body length: 0.99±0.56cm/week, head circumference: 0.72±0.07 cm/week ($p < 0.001$), with KMC treatment can increase growth and reduce morbidity in LBW. This method is simple and effective and can be continued at home.³²

Another study found that birth length (OR=4,500; $p=0.003$) and maternal parity (OR=0.850; $p=0.026$) were risk factors that affected the incidence of stunting in infants aged 6-23 months, indicating a relationship between birth length and stunting incident.⁵ Infants who did not receive exclusive breastfeeding in the first 6 months, low household socioeconomic status, premature birth, short birth length, and 140 cm mother's height, as well as households that did not have latrines and inadequate drinking water, were some determinants of child stunting in Indonesia and the gap.³³

The difference in the mean of monitoring LBW vital signs with treatment based on the duration of KMC

During the KMC method treatment 4 hours/day the baby's body temperature remained in a stable condition and there was only 1 baby who experienced a decrease in body temperature ($p=0.000$), pulse ($p=0.000$), there were 2 babies who experienced a decrease respiration rate but remained within normal limits, and 2 infants who did not experience changes before and after KMC ($p=0.000$). In this study, the KMC method was effective on the stability of LBW vital signs. Body temperature increased above the average of 36.3oC, with a value of Z-3.114 ($p=0.002$ 0.05), in line with other studies that showed the results of observations of changes in body temperature in LBW through intervention with the KMC method. This method can be used as an alternative treatment to an incubator to prevent hypothermia.³⁴

During KMC, the infant's vital signs remain stable and appropriate for the infant receiving oxygenated respiratory support. The KMC method was declared effective and could be used for a long time because the respiratory rate and saturation tended to be stable slightly higher during KMC than before or after KMC ($p=0.04$) and FIO_2 ($p=0.034$).³⁵ Evaluation of newborns started 30 minutes after birth using the KMC method for three consecutive days, and the results showed a significant increase in axillary temperature, peripheral oxygen saturation, and a decrease in respiration rate with a p-value of 0.05, but not significant. Changes in heart rate or mean arterial pressure with $p>0.05$. KMC treatment for LBW causes beneficial changes in the baby's vital signs by increasing body temperature and peripheral oxygen saturation to increase tissue oxygenation, and decreasing respiratory rate, which can provide greater respiratory comfort for the newborn.³⁶

Another study found no significant difference in infant physiological parameters, including heart rate, respiratory rate, arterial blood oxygen saturation, and temperature, between the two groups (intervention and control) before KMC, but there was a significant difference in physiological index between the two groups after KMC intervention. This study shows that the KMC method increases the physiological index and can be recommended as a routine care method for premature infants.³⁷ Globally, approximately 15% of newborns are born with low LBW due to preterm birth, intrauterine growth restriction, or both; 70% of neonatal deaths occur in this group in the first three days of life. The KMC

Table 3. Wilcoxon rank-sum test results on LBW growth assessment on the effectiveness of using the KMC method.

Variable	Mean ranks	Negatif ranks	Positif ranks	Ties	p
Weight After KMC	10.17	3	34	1	0.000
Weight before KMC	19.78				
Body Length after KMC	0.00	0	38	0	0.000
Body Length before KMC	19.50				

Table 4. . Wilcoxon rank-sum test results on monitoring LBW vital signs against the effectiveness of using the KMC method.

Variable	Mean ranks	Negatif ranks	Positif ranks	Ties	p
Temperature after KMC	1.00	1	37	0	0.000
Temperature before KMC	20.00				
Pulse after KMC	0.00	0	38	0	0.000
Pulse before KMC	19.50				
Respiration after KMC	4.00	2	34	2	0.000
Respiration before KMC	19.35				

method, which was applied after hospitalization of infants weighing 2.0 kg at birth, was shown to reduce mortality by up to 40%.³⁸ In this situation, in India, it becomes a pragmatic choice to implement KMC at home for LBW, but it is necessary to educate and promote the use of the baby's mother through qualitative methods with in-depth interviews and FGDs in increasing knowledge and understanding of KMC acceptance.³⁹

Globally, an estimated 15 million children are born prematurely each year, resulting in a high burden of under-five mortality and neurodevelopmental disability. The KMC method is a key intervention in supporting the development of premature babies both physically and cognitively.⁴⁰ With the kangaroo method of care, it contributes to a faster discharge time from the hospital and care can be continued at home on an ongoing basis to maintain the stability of the baby.⁴¹ KMC treatment had a significant positive effect on infant physiological functions, such as different respiratory rates between the two groups ($p=0.020$), higher maternal-infant attachment ($p=0.001$), and lower maternal stress scores ($p=0.001$). Skin-to-skin contact can strengthen the bond and emotional support between mother and baby, making it one of the most effective nursing interventions in the neonatal intensive care unit.⁴²

Kangaroo Mother Care (KMC), one of the most effective and efficient treatments for premature babies, can improve the baby's vital signs. There was a significant difference in the mean temperature ($p\ 0.001$ vs $p\ 0.001$), heart rate ($p\ 0.054$ vs $p\ 0.001$), respiratory rate ($p\ 0.058$ vs $p\ 0.001$), and oxygen saturation ($p\ 0.004$ vs $p\ 0.001$) in LBW and LBW women aged 0-28 days, with significant differences in the mean temperature ($p\ 0.001$ vs $p\ 0.001$). The duration of KMC was 1 hour and 2 hours, but there was no significant difference in median systolic ($p=0.159$) or diastolic ($p=0.727$) pressure.¹⁴ When comparing KMC transportation to incubator transportation, average changes decreased heart rate 1.6 times/minute, respiration 0.18 times/minute, O₂ saturation 0.07%, and blood glucose 5.07 mg/dL, but temperature increased 0.01°C. KMC transportation has been shown to reduce hypothermia, hypoglycemia, tachypnea, and tachycardia, allowing it to be recommended as a safe and effective mode of transportation for neonates.⁴³

Conclusions

The use of the KMC backpack showed its effectiveness in monitoring vital signs to reduce the risk of stunting in LBW. Infants experienced stable vital signs in the form of temperature, pulse, and respiration rate, increased within normal limits, and showed an increase in body weight and growth in preventing the risk of stunting in LBW with the KMC method 4 hours/day. KMC backpacks are recommended as a non-pharmacological therapy that is safe and cheaper than incubators, effective and can meet the basic needs of LBW by maintaining warmth and preventing hypothermia, providing exclusive breastfeeding opportunities, increasing growth, and reducing the risk of stunting.

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