

Does Kangaroo Mother Care Improve Preterm Infant's Temperature?

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Abstract: Kangaroo mother care is a method of care of preterm infants (before 37 completed weeks of gestation). The method involves infants being carried, usually by the mother, with skin-to-skin contact. This improves stability of preterm infant temperature. **The aim of the study:** To investigate the effect of kangaroo mother care on preterm infant's temperature in a neonatal intensive care unit at the Khartoum teaching hospital - Sudan.

Methodology: The study design was Nonequivalent Groups Design (a pretest-posttest randomized experiment), 120 moth-er-preterm infant pairs were selected through purposive sampling.

Subjects: The target population for this study was all medically stable preterm infants who were admitted to the neonatal intensive care unit at the time of the study. Preterm infants of gestational age 30–36 weeks (n=120), 60 intervention groups received KMC and an-other 60 were control group received conventional care. The researcher was available five days per week, five hours per day from 9 am to 2pm. The average number of cases that was taken per week ranged from 8 to 10 premature infants and their mothers. Setting: This study was conducted in neonatal intensive care unit (NICU) in Khartoum teaching hospital.

Tools: The tools of study divided into two tools; Tool I: Questionnaire was used to collect the demographic data related to preterm infants and their mothers in the intervention and control group, and auxiliary temperature before and after kangaroo mother care for intervention group and also done for control group in conventional care. Tool II: Mercury thermometer. The results: Independent-sample t test was calculated and showed that there is a significant difference regarding the mother's age, and preterm infant weight (P-value = .06 & .00) Respectively. And there is no significant difference regarding preterm infants gestational age, and preterm infants age since birth (P-value = .82 & .50) respectively. Mothers' educational level the majority were secondary school, (40.83%), and the lowest were intermediate school (11.67%). The majority of preterm gender were male (60%), and the other was female (40%). Regarding preterm infant's temperature, independent-sample t test showed that there is no significant difference between intervention and control group before KMC (P-value = .86). And there is a significant difference between intervention and control group after KMC (P-value = .01). Paired sample test investigate that, there is a significant difference regarding the level of temperature for intervention group before and after KMC (P-value: .000).

Conclusion: KMC was effective and positively promoted premature infant's temperature than those cared by the conventional care. Recommendation: Educational training program for all neonatal nurses in skills necessary to implement the KMC and further studies should be conducted to assess the neonatal nurses' knowledge, attitudes and practices regarding KMC.

Abbreviations: Skin to Skin Contact (SSC), World Health Organization (WHO), Kangaroo Care (KC), Neonatal Intensive Care Unit (NICU), Kangaroo Mother Care (KMC), Gestational Age (GA).

Keywords: Kangaroo mother care, Preterm infants, Temperature

1. Introduction

The preterm birth, known as birth before 37 weeks, is a common challenge of obstetrics. Globally, 13 million births occur prematurely each year, at a rate of 9%. In developed regions of the world the incidence rate ranges from 5-12%. May reach 40% in poorer, less developed regions.^[1] Globally, complications of prematurity are the leading direct cause of neonatal mortality (36%)^[2].

Approximately 64,000 premature babies are born in the United States each year, weighing 1,500 grams, this increased risk of medical and developmental complications and leading to major public health problems^[3].

The major national health problem is preterm care. March of the Dimes (2012) reported that children who born prematurely were nearly half a million^[4].

About 21% of infant deaths occur due to perinatal conditions in developing countries. Most causes of neonatal mortality can be prohibited or treated through simple, effective and low-cost interferences from the family or in the public^[5].

KC was introduced more than 25 years ago in Bogota, Colombia, as one component of an alternative approach to caring for the NICU for low birth weight infants in response to overcrowded incubation, scarce and expensive resources such as incubators, high rates of infection and neonatal deaths^[6].

A recent WHO strongly suggests that early SSC as a thermal service for preterm infants weighing less than 2,000 grams as guidance for interventions to improve consequences for preterm infants^[7].

WHO also identifies KMC with four components: persistent and extended SSC, exclusive breastfeeding, early discharge from the health facility and close follow-up at home^[8]. In addition to in the resource-rich countries, SSC is complementary to incubator care^[9].

Postpartum mother-infant separation after birth is common in Western culture. The onset of SSC begins ideally at birth and includes the nude child's position and the head is covered with a dry cover and a warm blanket on the back and prone to the bare breast of the mother^[10].

KMC is a prenatal care approach that empowers mothers and families as key providers of vital needs (warmth, food) and psychosocial (communication, care, cohesion and comfort) of newborns. KMC is designed for infants <2000 g with the aim of regulating the ther-

veloped regions^[1].

The increased risk of death in children weighing <2500 g because they are the most vulnerable newborns. In early 2010, it is estimated that 15 million of birth were premature. The highest rates of premature birth and death in the world in South and Southeast Asia regions.

mal achieved by the constant contact of the skin to the skin in the KMC position^[11].

The kangaroo method, introduced in Brazilian health units since the 1990s, has been incorporated into health policies and incorporated into the humanitarian context of neonatal care, which includes kangaroo status. This must be done in a targeted, safe and monitored manner by a well-trained health team. Among the benefits of the kangaroo method: reduced risk of death, physiological stability, shorter hospital stay, stronger mother-child interaction, improved maternal mood, and increased breastfeeding maintenance^[12-15].

Parent-infant bonding with their caretaker increases directly with increased touch and direct displayed toward an infant during their first years of life^[16].

KMC is one of the evidence-based life-saving interventions. In addition to providing thermal control, KMC is associated with a 36% lower risk of neonatal mortality among low birth weight newborns compared with traditional care, as well as low risk of sepsis, hypoglycemia and severe hypothermia^[17].

Low body temperature is a serious but preventable illness in preterm infants. The incidence of hypothermia is between 31% and 78% for those who have a birth weight of less than 1500 grams. The temperature of the preterm skin will drop by 0.5 °C to 1.0 °C per minute. Both physical properties and environmental factors predispose preterm infants to hypothermia. In 1997, the WHO provided the following definition of hypothermia of newborns:

- Potential cold stress: 36.0 °C to 36.5 °C; cause for concern
- Moderate hypothermia: 32.0 °C to 36.0 °C; danger, immediate warming of the baby needed
- Severe hypothermia: less than 32.0 °C; outlook grave, skilled care urgently needed^[18].

Preterm infants have an appropriate initial response to a reduction in environmental temperatures, the effect is limited, making preterm infants at risk of low body temperature with all associated complications^[19].

Low temperature can lead to tachypnea, apnea, hypoxia, metabolic acidosis, hypoglycemia, defects of clotting, acute renal failure, necrotizing enterocolitis, and eventually death^[20].

Non-shivering thermogenesis is the primary method of producing heat for the infant up to the age of one year^[21].

The purpose of this article is to investigate the effect of KMC on preterm infant's temperature

Significance of the study:

To the best knowledge of the researcher, there is no research studies about the effect of kangaroo mother care (KMC) on preterm infant's temperature in Sudan, despite neonatal intensive care units have specific protocols for discharge such as stability of preterm infant's temperature. There is minimal interaction between parents and preterm infants. Many researchers have shown significant benefits when KMC properly applied to preterm infants. It is found that preterm infants respond to KMC and increased temperature, parents of the preterm infant also have benefits because infant skin contact enhances bonding with their preterm infants, increases confidence in their parenting skills, and enhances the parent-child attachment relationship^[23].

Aim of the study:

To investigate the effect of kangaroo mother care on preterm infant's temperature in a Khartoum teaching hospital - Sudan.

Hypotheses of the study:

Hypothesis 1: There is no difference in preterm infants' temperature between intervention and control groups before KMC.

Hypothesis 2: Preterm infants who received KMC will have higher temperature gain than those who did not.

Hypothesis 3: Preterm infants who received KMC will have a higher temperature gain than before KMC.

2. Methods

Study design: The study design was Nonequivalent Groups Design (a pretest-posttest randomized experiment).

Setting: This study was conducted in neonatal intensive care unit (NICU) in Khartoum teaching hospital- Sudan.

Duration of study: Data were collected during the period from January – March (2018).

Participants: The targeted population for this study was

Preterm infants are unable to regulate the temperature of their bodies due to a higher body surface area, double thermal insulation due to subcutaneous hypoproteinemia, and loss of water across the skin is usually included in the causes of heat loss in preterm infants as well as their inefficiency in controlling body temperature^[22].

all medically stable preterm infants who were admitted to the neonatal intensive care unit at the time of the study. Preterm infants of gestational age 30–36 weeks (n=120), 60 intervention groups and another 60 were control group.

Inclusion criteria

To be eligible for the study the preterm infants had to meet the following criteria:

Current body weight is between 1000-2000 grams.

Gestational age of preterm infants is between 30-36 weeks.

Breast fed infants (direct or expressed breast milk).

In growing periods or medically stable.

Exclusion criteria

It was considered that the risks for preterm infants from this research study were minimal. However, there were certain conditions that would be excluded from the study as the following:

Congenital malformations, Cardiac abnormalities, Recent surgery, Serious infections, Central line and Umbilical line, Intravenous feedings, Use of supplemental oxygen, Skin rashes or lesions, Gastric or intestinal disorders, Micro-premies or very low birth weight infants, Use of a ventilator or CPAP machine, Frequent drug dosing, Apnea and bradycardia, Necrotizing enterocolitis, Phototherapy for hyperbilirubinemia, Hydrocephalous and Excessive regurgitation.

It was considered by expert neonatologists based on physical examination to minimize the risk of the preterm infants.

Procedure of data collection

A letter was sent to the head of the nursery expressing a formal request to conduct the research study at the NICU and seeking permission to do so. Signing of agreement from the NICU head nurse is provided before conducting the research study. Subsequent to, the eligible mothers were identified from head of NICU considering their preterm infants stable health and they were invited to participate in the research study through NICU staff. Prospective participants attended individual and small

group meeting where the researcher made it very clear to mothers that their participation was voluntary and they were free to withdraw at any time. Information sheets and consent forms were distributed to the participants and they were asked to read and sign the consent form and return their consent form to the researcher. After

Tools

- Questionnaire was used to collect the demographic data related to preterm infants and their mothers in the study. The questionnaire was developed by the researcher based on literature related to KMC. The questionnaire therefore included the following characteristics: mother's age, mothers educational background, preterm infant's gender; preterm infant's age since delivery, preterm infants gestational age, preterm infants' current weight, and preterm infant's temperature before and after KMC.

- Mercury thermometer.

Reliability of the tools:

Reliability was applied by the researcher for testing the internal consistency of the tool by administration of the tool in the same subjects before collecting the data to actually assess the clarity and simplicity of the questions. Reliability was estimated among 12 participants by using a test retest method. Then correlation coefficient was calculated between the two scores. The correlation coefficient was 0.83 which indicates that the questionnaire is reliable to detect the objectives of the study.

Validity of the tools:

The tool was tested for its content by a jury of five experts in the field of pediatric nursing to ascertain relevance and completeness. The validity of the questionnaire was assessed using content validity by an expert. The relevancy, clarity, fluency, and simplicity of each component in the questionnaire were examined by the expert and they found the questionnaire is useful and helpful.

Procedure:

- An official permission was obtained from NICU director. Upon receiving the formal approval through formal channel and a questionnaire was checked for its validity and reliability.

- The consent was obtained from every participant, after explaining the aim of the study.

- Training was done for the mother of preterm infants for 2 days on the doll.

- Arrangements were made to prepare an effective

informed consent was obtained, the prospective participants from the intervention and control completed the structured questionnaire which includes demographic data. Both the intervention and the control group were measured their temperature by researcher before KMC and after one hour of KMC.

environment before the intervention began. Include the following:

- Place: comfortable chair and infection control access.

- People: mother (rooming in).

- Equipment: ambubag if needed.

- Support system: warm, clean place, and breastfeeding support for all mothers

- The demographic data and temperature checked by the researcher before and after KMC.

- A record form of kangaroo position, with information about the day, frequency, and duration of the position.

- According to the World Health Organization (WHO) guidelines for KMC. In the KMC group, usually the mother, held the infant for 1 hour daily at a time convenient to her in the morning shift. The mother sat at the side of the infant incubator in a rocking chair and received the infant who was placed skin-to-skin on the mother's chest between breast in prone and an upright position facing the mother (frog like position). The mothers were asked to use any front open light dressing. Infants wear diapers and caps, were covered over the back with blankets to maintain warmth, and were monitored for temperature stability by taking an auxiliary temperature at first and sixty minutes during holding^[24].

Data management

This study was conducted in the NICU. Data were collected by questionnaire and temperature checked and calculated pre and post intervention of KMC, by a researcher. Manual coding was used to check any error in coding. The coding manual and dummy tables were developed before entering the data. Double entry of data from researcher was done to prevent potential data entry error. The data were checked and cleaned by performing preliminary frequency distribution to enhance accuracy and reliability.

Data analysis

Data were analyzed by computerized method Statistical Package for the Social Sciences (SPSS) version 20.

The main dependent variables were preterm infant's temperature compared between intervention and control groups. Different test was done to test statistical significant differences such as independent- sample t test, and

paired sample t test. Data have been summarized by mean, standard deviation, and 95% confidence interval (CI) values have been quantified where deemed relevant.

Variables	Intervention group (Mean & SD)	Control group)Mean & SD(3. RE-SULTS P- value
Mother age	7.07± 27.95	8.29±27.73	.06
Preterm infants gestational age in weeks	33.08 ±1.93	32.98 ±1.93	.82
Preterm infant's weight in grams	1751.8 ± 152.33	1288.98 ± 347.79	.00
Preterm infants age since birth (per day)	10.80 ± 9.82	10.15 ± 10.61	.50

Table 1. Characteristics of mothers and preterm infants in intervention and control groups in NICU, Khartoum teaching hospital, Sudan.

Independent-sample t test was calculated and showed that there is a significant difference regarding the mother's age, and preterm infant weight (P-value = .06 & .00) Respectively. And there is no significant difference regarding preterm infants gestational age in weeks, and preterm infants age since birth (P-value = .82 & .50) respectively.

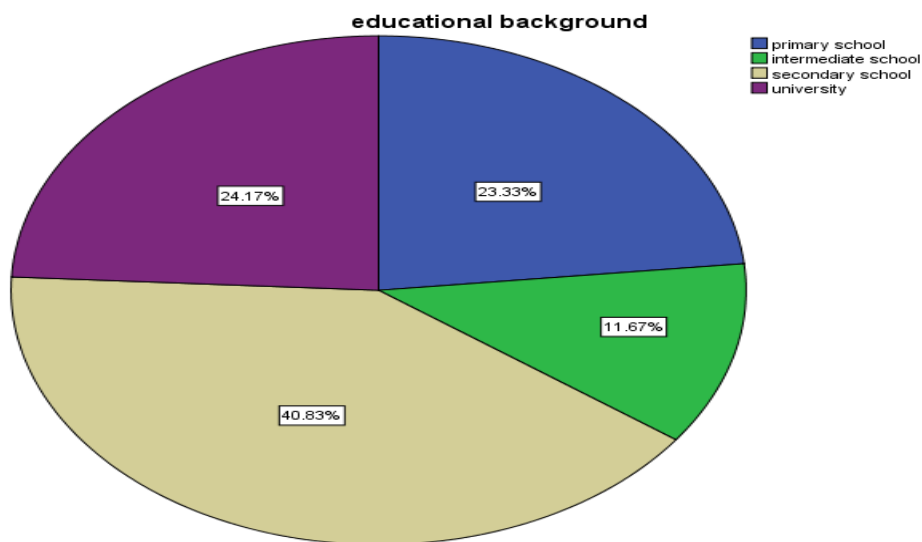


Figure 1. Mothers educational background (intervention and control groups) (N = 120)

This figure showed that, the majority of mothers' educational level was secondary school, (40.83%), followed by university level (24.17%), then primary school (23.33%), and the lowest were intermediate school (11.67%).

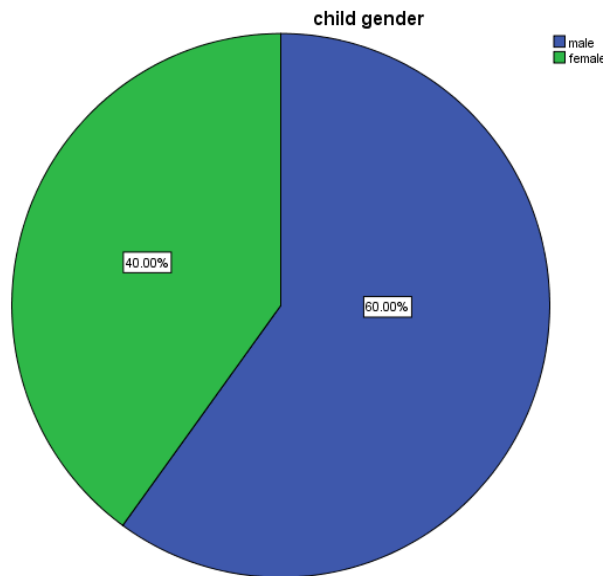


Figure 2. Preterm infant gender (intervention and control groups) (N = 120)
This figure illustrates that, the majority of preterm gender were male (60%), and the other was female (40%).

Variables	Intervention group (Mean ±SD)	Control group (Mean ±SD)	P – value
Preterm infant temperature before KMC	36.19 ± .29	36.20 ± .28	.86
Preterm infant temperature after KMC	36.79 ± .15	36.16 ± .23	.01

Table 2. The mean difference in preterm infant's temperature between the intervention and control groups in NICU, Khartoum teaching hospital, Sudan.

Independent–sample t test was calculated and showed that, there is no significant difference in preterm infant's temperature between intervention and control group before KMC (P-value = .86). And there is a significant difference in preterm infant's temperature between intervention and control group after KMC (P-value = .01).

Variables	Before KMC (Mean ±SD)	After KMC (Mean ±SD)	P – value
Intervention group temperature	36.20 ± .28	36.47 ± .37	.000

Table 3. The mean difference in temperature regarding preterm infants intervention group in NICU, Khartoum teaching hospital, Sudan.

Paired sample test investigated that, there is a significant difference regarding the level of temperature for intervention group before and after KMC (P-value: .000).

4. Discussion

Getting a new idea adopted, even when it has obvious advantages, is often very difficult. Many innovations require a lengthy of the period, often for many years, from the time they became available at the time they are widely adopted. Therefore, a common problem for many individuals and organizations is how to speed up the rate of diffusion of an innovation. Rogers (1994, p. 1). Pre-term birth still represents a major cause of mortality, morbidity and poor long-term outcome^[25].

Kangaroo care may be one way of caring that can

positively affect the results of preterm infants. Preterm infants are unable to regulate their body temperature, this is mainly due to lack of sweat, defective heat production resulting from less movement, immaturity in their nerve centers^[26].

The current study aimed to investigate the effect on KMC on preterm infant's temperature.

Regarding the characteristics of mothers and pre-term infants in the intervention and control groups.

According to the characteristics of mothers in the intervention and control groups, the present study re-

vealed that there was a significant difference regarding the mother's age in intervention group 27.95 ± 7.07 , and a control group is 27.73 ± 8.29 , p-value = .06. Compared to the study, which was done by Bera *et al* (2014)^[27] in India; the mean age of the mothers was 25.7 ± 5.19 years. Also in comparison to Nahed Saied *et al* (2013)^[28]; discussed that more than three fourths (76%) of mothers' age of the study group is 20 - <30 years, Florent Fuchs *et al* (2018)^[29] mentioned that maternal age at pregnancy is increasing worldwide as well as preterm birth, however, the association between prematurity and advanced maternal age remains controversial. Nahed mentioned that concerning the mother's level of education, more than half (52%) of them are moderately and highly educated in the study group, compared to my study the majority of mothers' educational level were secondary school, (40.83%), followed by university level (24.17%), then primary school (23.33%), and the lowest were intermediate school (11.67%). Ruiz *et al* (2015)^[30] reported that; poor health at birth is greater among babies of mothers with low education across all cohorts combined from 12 European countries.

According to the characteristics of preterm infants, there is a significant difference in preterm infant weight in the intervention and control group, 1751.8 ± 152.33 ; 1288.98 ± 347.79 ; respectively, p-value = 0.00. There is no significant difference regarding preterm infants gestational age in weeks in intervention and control group, 33.08 ± 1.93 ; 32.98 ± 1.93 ; respectively, p-value = .82. Compared to the study, which was done by Bera *et al* (2014)^[26] in India; The gestational age of the preterm infant at birth was 33.2 ± 3.30 weeks and birth weight was 1450.9 ± 311.19 g. Also, compared to study, which was done by Almeida CM, *et al* (2007)^[25], mentioned that gestational age of 28 to 33 weeks (M= 30.6; SD= 1.8) and weighing between 1050 and 1500 grams (M= 1330; SD= 0.182). In addition to Nahed Saied *et al* (2013)^[27], pointed out that approximately half (52% and 48%) of premature infants' gestational age is $34 \leq 36$ weeks and < 32 weeks in both study and control groups respectively. Meanwhile, the birth weight in 76 % of the study group is 2000 - < 2500 grams compared with 36% of the control group, also stated that the relation between the neonate's gestational age and birth weight reflects the adequacy of his intrauterine growth, whereas the organ system maturity depends largely on gestational age. The findings are consistent with the results of Dehghaniet *al*

(2015)^[31], the mean GA age in the case group has been as $34.48 \pm 2/42$ weeks and in the control group as 35.07 ± 2.4 weeks. The average birth weight in the two groups has been, respectively, as 2268.84 ± 490.03 and 2192.22 ± 619.85 g. Nahed pointed that; 60% of the premature infant's gender in both groups are males and the rest of them (40 %) are females, these results of premature gender is same like my study, P. Astolfi L.A. Zonta (1999)^[32] pointed that the male fetal gender, hormonally involved in the control of labour onset, might be responsible for the shortened duration of pregnancy.

The mean difference in preterm infant's temperature between the intervention and control groups.

Our study revealed that there is no significant difference between intervention and control group before KMC (P-value = .86). And there is a significant difference between intervention and control group after KMC (P-value = .01). There is a significant difference regarding the level of temperature for intervention group before and after KMC 36.47 ± 37 ; 36.20 ± 28 , respectively (P-value: .000); Mean temperature rose by about 0.3 °C. These results are in agreement with a study which was done by Bera *et al* (2014)^[26], the study showed that there was a significant increase in the preterm body temperature after applying KMC, mean temperature rose by about 0.4 °C. These differences may be due to my study, KMC assessed for one day, Bera study; KMC assessed during 3 consecutive days, and despite in Bera study the preterm infant weight is lower than our study (1450.9 ± 311.19 g; 1751.8 ± 152.33) respectively, and both studies having near gestational age. Bera mentioned that, a meta-analysis of 23 studies of 190 term and 326 preterm infants (gestational age 26 to 36 weeks) concluded that there was an increase in body temperature of 0.22 °C. Also, compared to a study which was done by Almeida CM, *et al* (2007)^[25], mentioned that, there were significant increases in axillary temperature (p< 0.05), despite sample size 30 preterm infant, they were healthy, clinically stable and did not have any respiratory, cardiac and/or neurological dysfunctions, their body temperature was measured using the Gold Flash clinical thermometer. The evaluations were done once a day, for three consecutive days, one hour after the preterm infant had been fed in the afternoon, because of the calmer hospital routine at this period. Verma P, Verma V. (2014)^[33] pointed that, it is evident that before KMC 82.5% of babies were hypothermic but after KMC 96.2% babies became normo-

thermic within half an hour which was found highly significant (p-value <0.0001).

5. Conclusion

In general, the results of this study showed that the KMC can contribute in increasing the temperature, the intervention program significantly improved temperature of preterm infants in the intervention group compared to the control group.

Acknowledgements

Author is grateful to all participating hospital staff, and appreciate the efforts of all our colleagues, and the preterm infants' mothers.

Ethical consideration

For ethical reasons, the official permission was taken from the directors of the NICU. Also, they were assured that the information would remain confidential and used for the research purpose only. Agreement to measures temperature of the subjects were taken from their mothers.

Conflict of interest

The authors declare no conflict of interest in this study.

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