
THE EFFECTIVENESS OF APPLICATION OF KANGAROO MOTHER CARE ON PRETERM INFANTS IN INTENSIVE CARE UNITS AT KHARTOUM STATE HOSPITALS – SUDAN

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ABSTRACT

Background: Kangaroo Mother Care (KMC) is an effective, affordable, and acceptable intervention for preterm infants. Therefore, KMC can be actual in reducing potential complications in preterm infants. **Aim:** This study aimed to investigate the effectiveness of the application of kangaroo mother care on preterm infants in intensive care units at Khartoum state hospitals – Sudan. **Subjects and Methods design:** the quasi-experiment. **Setting** It was completed in 6 hospitals, for 5 months period. **Subjects:** the whole of the preterm infants in this research was medically stable divided up into two groups (intervention and control). **Tools** Data was gathered using a structured questionnaire, weighting scale, pulse oximeter, hand clock, and logbook. Preterm infant weight, oxygen saturation, respiratory rate, and heart rate were evaluated among the two groups. **Results:** Over the constitutive 5 days, weight gained significantly in the intervention group (1332.36±87.27 versus 1361.60±91.22) gained about 29 gram, while control group(1332.36±87.27 vs 1338.82±86.57) gained about 7 gram, the mean difference in weight gain was significant. Oxygen saturation increased significantly in the intervention group (92.28±1.81 versus 97.39±1.57) increased 5, while control group (95.13±2.11 versus 96.42±1.69) increased by 1. **Conclusion:** According to the outcomes of this study, a premature newborn who received kangaroo mother care improved significantly in weight, oxygen saturation, heart rate, and respiratory rate. **Recommendations:** KMC may be the most effective neonatal nursing intervention in ICU, therefore, to develop KMC implementation in Sudan will require a larger and better equipped KMC hospital ward, as well as consistent KMC training for nursing staff.

Keywords: Kangaroo mother care, preterm infants, neonatal care.

INTRODUCTION

Preterm birth (PTB) is defined by World Health Organization as “The fetus is born before the 37th week of pregnancy, or 259 days after the first day of the last menstrual cycle. PTB is a major health problem worldwide (Sharif, Mohamedain, Ahmed, Nasr, and Adam, 2017). The peak rate of neonatal mortality in the world is in Sub-Saharan Africa, 28 per 1,000 survives deliveries compared to the worldwide rate of 18 per 1,000 deliveries (Kinshella et al.,2021). 75% of neonatal deaths take place in the first 7 days of life, more than a third were premature infants (Lydon et al., 2018).

Therefore, lowering the death rate of these children who born in low- and middle-income nations in Asia and Sub-Saharan Africa, in particular, is critical to meeting the United Nations Sustainable Development Goal of lowering newborn mortality to 12 deaths per 1,000 live births in all countries by 2030 (‘Immediate “Kangaroo Mother Care” and Survival of Infants with Low Birth Weight’, 2021). Premature babies are known to have a variety of health issues, including poor body temperature regulation, cardiovascular, and respiratory issues (Cho et al., 2016). The initial days of a premature newborn's life are generally spent in critical care (Johnston, 2017).

More than three-quarters of preterm newborns can be preserved with relatively low-cost care, in prenatal care and postnatal care such as kangaroo mother care. When compared to typical neonatal care in resource-limited settings, there is evidence that kangaroo mother care (KMC) dramatically reduces the risk of mortality in clinically stable newborns weighing less than 2000g (Ramani et al., 2018). KMC reduces the severity of illness, nosocomial infections, length of hospital stay, enhances growth, breastfeeding, and improves mother-infant attachment, Also; using KMC is cost-effective and has abundant advantages for mothers and infants. For the mother, it increases milk production, feelings of trust, and satisfaction concerning the care of the baby. It is the breathing rate in preterm and LBW newborns. (Abrham Roba et al., 2017; Parsa, 2018).

KMC acts through multiple ways, many of which mediate skin-to-skin contact including thermoregulatory control, neuroendocrine mechanisms that include maternal and neonatal oxytocin release, reduced cortisol and stress response, and cardiac and respiratory stability, enhanced oxygen saturation, decrease apnea, and bradycardia(Brotherton et al., 2020; Thakur, Sarin and Kumar, 2020). Other stated benefits of KMC

include a better family atmosphere, faster healing for parents after childbirth, and stronger family bonds (Bilal, et al.,2021).

“Kangaroo mother care,” is defined as a constant skin-to-skin contact of the infant with the chest of the mother and feeding exclusively with breastfeeding (*Chan, 2016; Moore 2016*). In growing countries, due to limited advanced equipment, lack of trained personnel, and poorly equipped infrastructure, some task of the preterm infant is hard to achieve. To overcome these difficulties, KMC was first developed and scientifically evaluated in 1978 in Colombia. Many studies have suggested that KMC increases weight, improves breastfeeding, and reduces hospitalization duration. One of the non-pharmacological methods is the KMC procedures proposed by the Canadian Pediatric Society and the American Academy of Pediatrics (*Ahmed and Biswas, 2019*). If both the mother and the child are healthy, KMC is advised as soon as possible after birth once the umbilical cord has been cut and the infant has been dried and examined (*Changrani and Menahem, 2021*). WHO rules presently suggest induction of short sporadic Kangaroo Mother Care sessions when the infant’s condition begins to stabilize, and continuous Kangaroo Mother Care when fully stable. (*Immediate “Kangaroo Mother Care” and Survival of Infants with Low Birth Weight’, 2021*).

KMC is quite inexpensive and has less technological intrusion compared to many other treatments for young and sick newborns (*Bilal 2021*). Kangaroo Mother Care (KMC) position has been described as “frog-like.”, the newborn is kept nearly nude in a rigorous upright ventral position between the mother's breasts, in direct touch with her skin, under her garments, 24 hours a day. As a result, the infant's chest and abdominal skin are in direct touch with the mother's chest skin. To prevent airway blockage, the baby's limbs are flexed against the mother's torso and his head is put sideways, preventing flexion or hyperextension of his neck. The posture of the head is regularly changed (*Parsa et al., 2021*).

SIGNIFICANCE OF STUDY:

In Sudan, preterm births occur in 3.8% of all pregnancies (*Ramsis Hakem, 2015*) with a paucity of data regarding the effect of KMC on preterm infant's, so there is a need to conduct this study because Sudan is one of the developing countries, limited resources, and insufficient incubator care. Many evidence supported that KMC is an efficient

method of meeting a baby's demands such as improving body weight, oxygen saturation, heart rate, and respiratory rate.

AIM OF STUDY:

This study aims to investigate the effectiveness of the application of kangaroo mother care on preterm infants in neonatal intensive care units at Khartoum state hospitals – Sudan.

RESEARCH QUESTIONS:

1. Is there a difference in preterm infants' and mothers' sociodemographic characteristics between intervention and control groups?
2. Is there is a difference in preterm infants' weight, oxygen saturation, heart rate, and respiratory rate between intervention and control groups before KMC?
3. Does KMC improve preterm infants' weight, oxygen saturation, heart rate, and respiratory rate?

SUBJECTS AND METHOD:

A. Technical design:

The technical design includes; study design, setting, subjects, and tools for data collection.

Study design:

A quasi-experimental design was used to accomplish this study.

Study Setting:

The study was conducted in six hospitals (NICUs) in Khartoum state, three for the intervention group and the others for the control group. The study was conducted during 5 months period (from June – October 2021).

Study sample:

The sample of this research study consisted of all medically stable preterm infants who fulfilled the following criteria comprised the subjects:

- Weight is between 1200-1500 grams.
- The gestational age is between 33-36 weeks.
- Breastfed preterm infants

- Mothers of preterm infants are available in the hospital, healthy, and willing to be involved in the research study.

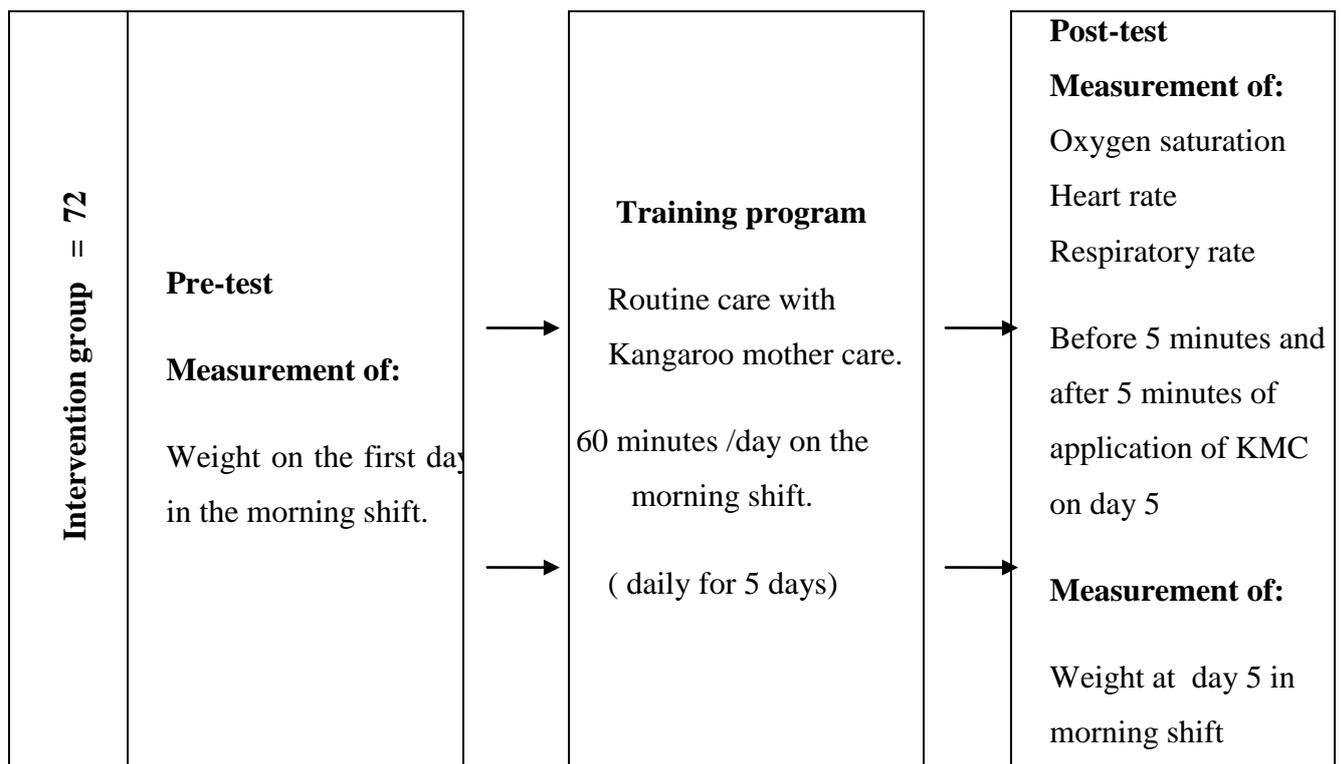
Exclusion criteria:

Preterm infants who have a medical disease would be excluded from the study. It was considered by expert neonatologists based on physical examination.

Sampling technique & Sample size:

The sample of preterm infants was calculated by (Raosoft®, sample size calculation) using the following parameters; Margin of error: 5%, Confidence level: 95%, Population size: 229, Response distribution: 50%.

The sample size was 144 preterm infants and was divided into 2 groups, 72 of them received routine care with kangaroo mother care (Intervention group) (WHO, 2003). While the other 72 preterm infants received routine hospital care without kangaroo mother care (Control group).



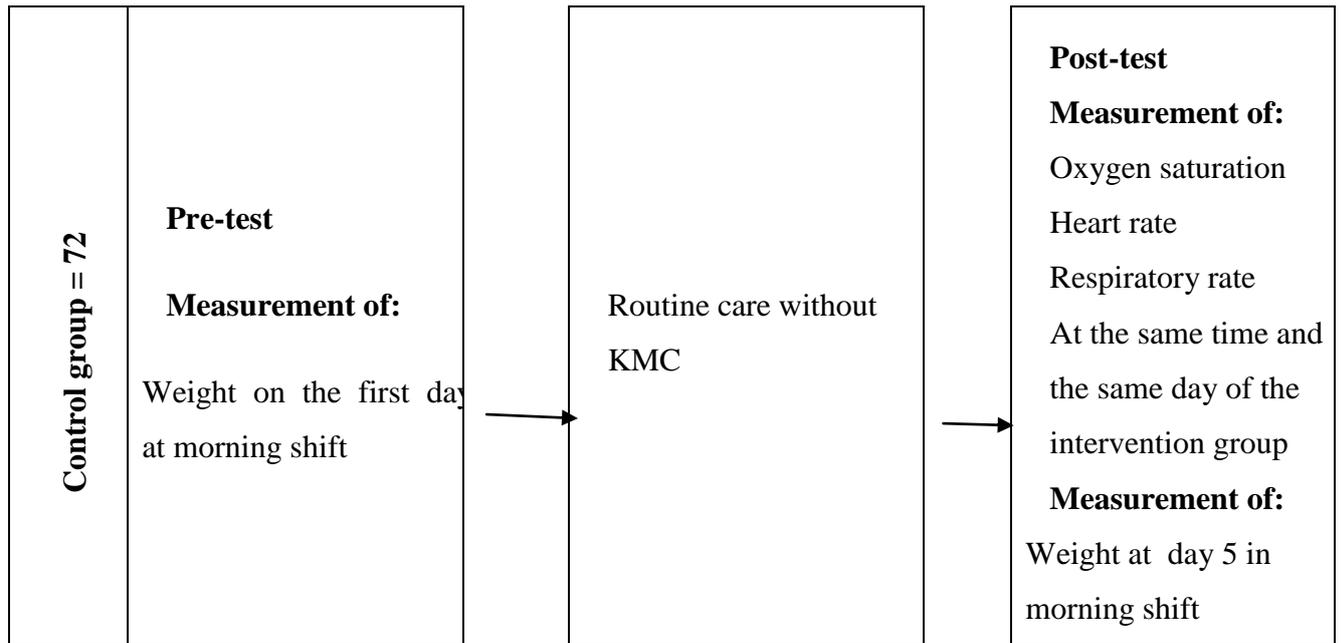


Figure 2.1: Research design used for the study

Tools:

- In the study, demographic data on preterm infants and their mothers were collected using a structured questionnaire. The researcher created the questionnaire based on KMC-related literature. The questionnaire, therefore, consists of two parts:

Part I: sociodemographic characteristics such as mother's age, mother's educational background, preterm infant's gender, preterm infant's age since birth, preterm infant gestational age, and preterm infants current weight.

Part II: the preterm infant parameters for measurement before and after an intervention such as weight, heart rate, oxygen saturation, and respiratory rate.

- Pulse oximeter. A sensor was positioned on the sole of the preterm infant's right foot (the right leg is standardized). Five minutes after putting the oximeter the oxygen saturation, and heart rate w checked.
- Digital weight scale for weighing preterm infants (in grams).
- The logbook contains basic information on all infants and types of care received and provides information for monitoring and periodic program evaluation.
- Hand clock for measuring respiratory rate.

B. Administrative design

- Official approval for conducting the study was obtained from the responsible administrative personnel after explaining the aim of the study .
- Tools were developed by the researchers.
- Subjects were assigned into two groups. The intervention group received routine care with Kangaroo mother care. The control group received routine hospital care.

Validity :

- Content validity of the tools was done by five experts in the pediatric nursing field and recommended changes were done.

Reliability:

- The reliability of the used tools was asserted through their internal consistency by using Cronbach's alpha test, it was $\alpha = 0.801$.

C. Intervention program

- Prospective participants were invited to individual and small group sessions, during which the researcher made it abundantly apparent to moms that their participation was entirely optional and that they may at any moment. Participants were given information sheets and consent forms, and they were requested to read and sign the consent form before returning it to the researcher.
- Following the receipt of informed consent, training on a doll for mothers in the intervention group was done for 2 days before starting the program, the intervention's potential participants NICUs and the control NICUs completed the pre-test measurement of the weight of the preterm infant and filled sociodemographic characteristics.
- For the intervention group, at all sessions (5 sessions during 5 days, 60 minutes for each session at morning shift) the preterm infants and their mothers were ready for KMC prepared by researcher and assistant team nurses (selected purposively) in the morning shift, who counseled the mother for the benefit of KMC, in a separate quite warm room near NICU in comfort chair, 5 minutes before starting nurses put pulse oximetry and measure pulse rate and oxygen saturation, respiratory rate counted

manually over 1 minute and repeat the measurement 5 minutes after KMC. Mothers wear in a front open hospital gown to hold baby between breasts, wash hand, and clean her chest the baby wear the diaper, cap, and binder over the baby back, baby head turned to the side to keep the airway open, and the hip in a frog-like position (WHO, 2003). The intervention groups are subjected to post-testing measurements for the weight (first day and fifth day), and also, oxygen saturation, respiratory rate, and heart rate were measured on day 5 before and after KMC.

- The control group infants were measured at the same time (oxygen saturation, heart rate, and respiratory rate). Weight measured on day one and day five.
- To minimize the risk of preterm infants, basic resuscitation equipment and some emergency drugs were available during KMC. And to minimize nosocomial infection, hand washing was applied and trained the mothers to do it.

Ethical considerations

The following ethical issues were considered throughout the study phases:

- Upon getting the formal endorsement and permission from the head of neonatal intensive care units.
- The study aim was discussed to the mothers of the preterm infants and a written consent form was got.
- Mothers were ascertained about the confidentiality of their preterm infant's data and privacy was guaranteed.
- Mothers have the right to withdraw at any time.

D. Statistical analysis:

Data is analyzed by computer system Statistical Package for the Social Sciences (SPSS) version 20. The different test was done to test statistically significant differences such as a chi-square test, independent-sample *t*-test, and paired-sample *t*-test.

RESULTS

Table (1): present the distribution of sociodemographic characteristics of mothers and preterm infants between intervention and control group, there was no statistically significant difference for all variables, the percentage of women who had secondary school were similar in both groups (50%) with a p-value 0.563. The mean mother's age

between the intervention and control group (28.50 ± 8.12 VS 30.21 ± 7.45) respectively, p-value 0.213. Regard preterm infant gender, 90 of the sample were male with a p-value of 0.863. The mean of preterm infant gestational age between intervention and control group (34.40 ± 1.17 VS 34.40 ± 1.17) respectively with p-value 1.000. The mean of preterm infant age between intervention and control group (2.65 ± 1.27 VS 2.57 ± 1.30) respectively with a p-value of 0.822.

Table (2): shows there is no statistically significant difference in preterm infant's weight, oxygen saturation, respiratory rate, and heart rate between the intervention and control groups **before** KMC, preterm infant weight in the intervention group and control group is similar in mean&SD 1332.36 ± 87.27 (p-value = 1.000). Oxygen saturation, in the intervention group and control group, Mean&SD (92.28 ± 1.81 VS 95.13 ± 2.11) respectively, p value=0.376. Heart rate, in intervention group and control group, Mean&SD (146.75 ± 6.51 VS 145.32 ± 8.05) respectively, p value=0.091. Respiratory rate in intervention group and control group, Mean&SD (51.81 ± 6.27 VS 51.44 ± 6.39) respectively, p value=0.813.

Table (3): revealed that there is a significant difference between the intervention and control group **after** KMC, preterm infant weight gained significantly in the intervention group (1332.36 ± 87.27 versus 1361.60 ± 91.22) gained about 29 gram, while the control group (1332.36 ± 87.27 versus 1338.82 ± 86.57) gained about 7 gram, the mean difference in weight gain was significant (p=.000). Oxygen saturation increased significantly in the intervention group (92.28 ± 1.81 versus 97.39 ± 1.57) increased 5, while the control group (95.13 ± 2.11 versus 96.42 ± 1.69) increased by 1, the mean difference in oxygen saturation was significant (p=.000). Heart rate decreased significantly in the intervention group (146.75 ± 6.51 versus 134.53 ± 7.87) decreased about 11b/m, while in the control group (145.32 ± 8.05 versus 142.85 ± 7.88) decreased 3 b/m, the mean difference in heart rate was significant (p=.000). the respiratory rate decreased significantly in the intervention group (51.81 ± 6.27 versus 39.93 ± 6.32) decrease 12 t/m, while in the control group (51.44 ± 6.39 versus 49.92 ± 6.22) decreased 2 t/m, the mean difference in respiratory rate was significant (p=.000).

Table (1): Sociodemographic characteristics of mothers and preterm infants in intervention and control groups in Khartoum state hospitals, Sudan.

Variables	Intervention group N (%)	Control group n(%)	P-value
Mothers educational level			
Primary school	16 (53.3)	14 (46.7)	.563
Intermediate school	5 (33.3)	10 (66.7)	
Secondary school	31 (50.0)	31 (50.0)	
University level	20 (54.1)	17 (45.9)	
Preterm infants gender			
Male	44 (48.9)	46 (51.1)	.863
Female	28 (51.9)	26 (48.1)	
Mean & SD			
Mean mothers age	30.21±7.45	28.50±8.12	.213
Mean preterm infants gestational age (weeks)	34.40±1.17	34.40±1.17	1.000
Mean preterm infants age when starting KMC (days)	2.57±1.30	2.65±1.27	.822

Table 2: Difference in preterm infants' weight, oxygen saturation, heart rate, and respiratory rate between intervention and control groups before KMC

Variables	Before KMC (Mean ± SD)	
	Intervention group	Control group
Preterm infant's weight	1332.36±87.27	1332.36±87.27
P.value	1.000	
Preterm infant's oxygen saturation	92.28±1.81	95.13±2.11
P.value	.376	
Preterm infant's heart rate	146.75±6.51	145.32±8.05
P.value	.091	
Preterm infant's respiratory rate	51.81±6.27	51.44±6.39
P.value	.813	

Table(3): The mean difference in preterm infant's weight, oxygen saturation, heart rate, and respiratory rate between intervention and control groups in Khartoum states hospitals, Sudan

Variables	Before KMC (Mean \pm SD)	After KMC (Mean \pm SD)	<i>P.value</i>
Preterm infant's weight			
Intervention group	1332.36 \pm 87.27	1361.60 \pm 91.22	.000
Control group	1332.36 \pm 87.27	1338.82 \pm 86.57	
Preterm infant oxygen saturation			
Intervention group	92.28 \pm 1.81	97.39 \pm 1.57	.000
Control group	95.13 \pm 2.11	96.42 \pm 1.69	
Preterm infant heart rate			
Intervention group	146.75 \pm 6.51	134.53 \pm 7.87	.000
Control group	145.32 \pm 8.05	142.85 \pm 7.88	
Preterm infant respiratory rate			
Intervention group	51.81 \pm 6.27	39.93 \pm 6.32	.000
Control group	51.44 \pm 6.39	49.92 \pm 6.22	

DISCUSSION:

Kangaroo mother care is “a type of preterm infants care that includes skin-to-skin contact with the mother or other caregiver, and it decreases mortality in a newborn with low birth weight (<2.0 kg) upon initiation after stabilization. The current study tottt tt examines the effectiveness of applying maternal kangaroo care to premature infants in intensive care units in Khartoum State Hospitals - Sudan.

The results of this study revealed that there is no significant difference between the intervention and control groups concerning sociodemographic characteristics. This was agreed with (*Cho et al; 2016*) who reported that there is no statistically significant difference regarding sociodemographic characteristics. Also (*Ahmed and Biswas, 2019*) mentioned that there were no significant differences in birth weight and gestational age, in addition, (*Parsa, Karimi, Basiri and Roshanaei 2018*) pointed that there is no significant difference in mother's age, and mothers education level between intervention and control group.

Results of the present study showed that there is no statistically significant difference before KMC between the intervention and control group concerning weight, oxygen saturation, heart rate, and respiratory rate. These results agreed with those of (*Jafari et al; 2019 and Parsa, Karimi, Basiri, and Roshanaei 2018*) where they reported that there is no significant difference before KMC between the intervention and control group.

On the contrary, (*Cho et al; 2016*) mentioned that there is a significant difference between intervention and control group regarding weight, oxygen saturation, respiratory rate, and heart rate, these similarities may be due to study design used for both studies is a nonequivalent comparison group design.

the present study is agreed with the study done by (*Phirke, 2017*) who observed that there is a significant difference between the intervention group before and after KMC regard heart rate decreased by about 7 beats/minute, while in this study decreased by about 11b/m. Also, our study showed that the respiratory rate of preterm infants is decreased about 12 times/minute, while S.Phirke study respiratory rate decreased about 5 times/minute. In the present study, oxygen saturation is increased by about 5, while S.Phirke study oxygen saturation is increased by about 4. These similarities may be due to, both studies done on the stable infants, the duration of KMC in our study 60 minutes versus S.Phirke 90 minutes.

(Thakur, Sarin, and Kumar, 2020) ascertained that there is a significant difference before 10 minutes and after 1 hour of KMC with minimal improvement, while our study is higher in improvement, there is a difference in the level of improvement despite the similarity in many areas and both studies were quasi-experimental design. Also, (Van den Berg, Jakobsson, Selander, and Lundqvist 2021) described lower results compared to ours, the difference may be due to Van's study, which KMC did during transportation in Sweden. Also, (Ahmed and Biswas, 2019) described that KMC for preterm infants revealed significantly higher daily weight increase than control care group. Ahmed's study is RCT, in low birth weight, in Bangladesh, birth weight 1250 to 1800 gm, gestational age >30weeks to <37 weeks, and the hemodynamically stable after birth.

The current study is in line with (Parsa, Karimi, Basiri and Roshanaei, 2018) pointed that there is a significant difference in heart rate, respiratory rate, oxygen saturation at day five before and after KMC. Parsa study was a quasi-experimental study in stable premature neonates, birth weight less than 2500 grams, gestational age is between 34-36

weeks, selected by convenience sampling method.

CONCLUSION:

According to the findings of this study, a premature newborn who received kangaroo mother care improved significantly in weight, oxygen saturation, heart rate, and respiratory rate.

RECOMMENDATIONS:

Kangaroo mother care is crucial and effective neonatal nursing intervention in the intensive care unit, therefore, Further study is needed to determine the long-term outcomes of KMC in low birth weight and premature infants. In addition, developing training programs regarding KMC for premature infants depending on evidence-based guideline protocol for the nurses is important to improve their knowledge.

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فاعلية تطبيق رعاية الأم بالكنغر على الاطفال الخدج في وحدات العناية المركزة بمستشفيات ولاية

الخرطوم – السودان

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الخلاصة

الخلفية: تعتبر طريقة " طريقة الكنغر لرعاية الوليد " مؤثرة وفعاله للأطفال الخدج ويمكن ان تساهم فعليًا في تقليل المضاعفات المحتملة عند هؤلاء الأطفال. أهداف البحث: يهدف البحث الى معرفة مدى فاعلية تطبيق نموذج طريقة الكنغر لرعاية الوليد على الاطفال المولودين مبكرا عن ميعاد ولادتهم. مكان البحث: تم إجراؤها في وحدات العناية المركزة بمستشفيات ولاية الخرطوم – السودان في 6 مستشفيات، خلال خمسه أشهر من يونيو - أكتوبر 2021. عينة وطرق البحث: كان هذا البحث شبه تجريبي (الاختبار القبلي والبعدي) أجريت على 144 من الاطفال الخدج بشكل عشوائي في مجموعتين متساويتان. تمت مقارنة وزن الرضع المولودين مبكرا، وتشبع الأكسجين، ومعدل التنفس، ومعدل ضربات القلب بين المجموعتين. النتائج: زاد متوسط اكتساب الوزن بشكل ملحوظ في مجموعة الاولى (87.27 ± 1332.36 مقابل 91.22 ± 1361.60) حوالي 29 جرامًا، بينما اكتسبت المجموعة الثانية (1332.36 ± 87.27 مقابل 1338.82 ± 86.57) حوالي 7 جرام، وهو متوسط الفرق في زيادة الوزن كان كبيرا. زاد تشبع الأكسجين بشكل ملحوظ في مجموعة الاولى (92.28 ± 1.81 مقابل 97.39 ± 1.57) زاد 5، بينما زادت المجموعة الثانية (95.13 ± 2.11 مقابل 96.42 ± 1.69) بمقدار 1، وايضا وجود اختلاف ذي دلالة إحصائية في تشبع الأكسجين كبيرًا. الخلاصة والتوصيات: خلصت الدراسة الى أن استخدام نموذج " طريقة الكنغر لرعاية الوليد " على الاطفال الخدج له تأثير على زيادة الوزن، وتشبع الأكسجين ، ومعدل ضربات القلب ، ومعدل التنفس ، وفقاً لنتائج هذه الدراسة ، تحسن حديثي الولادة الخدج الذين تلقوا " طريقة الكنغر لرعاية الوليد " بشكل ملحوظ في الوزن وتشبع الأكسجين ومعدل ضربات القلب ومعدل التنفس. ولذا قد يكون هذا النموذج هو التدخل التمريضي الأكثر فعالية لحديثي الولادة في وحدة العناية المركزة ، . ولذلك يجب تدريب ممرضات الأطفال على هذا التطبيق.

الكلمات المرشدة: طريقة الكنغر لرعاية الوليد ، الخدج ، رعاية الأطفال حديثي الولادة.