Effect of Using Kangaroo Mother Care on the Sleep State and Physiological Parameters among Preterm Neonates

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Abstract: Kangaroo Mother Care (KMC)refers to the care of the preterm neonates carried skin-to-skin with the mother. Early, prolonged and continuous mother-neonate contact provides exclusive breastfeedingand improves maternal–neonate bonding as well.It also guards against bradycardia and apneic episodes. In addition, it provides stability of transcutaneous oxygen level. Moreover, it improvesthe maturation of the prefrontal cortex and facilitates better organization of sleep pattern.**Aim** of the study was to determine the effect of using KMC on the sleep state and physiological parameters among preterm neonates. **ResearchDesign**:A quasi experimental research design was used.**Setting**: This study was conducted at the NICU ofMaternity University Hospital at El-Shatbyin Alexandria. **Subjects**:A convenient sample of 60 preterm neonates and their mothers attending the previously mentioned setting. The preterm neonates fulfilled the following criteria: Feeder and grower as well asgestational age ranged from 32-<37 weeks were equally divided into a study group (received KMC intervention plus routine NICU care) and a control group (received NICU routine care in conventional position inside the incubator).**Tools**: Two tools were used tocollect necessary data namely;Characteristics of the Mothers and the Preterm Neonates and Medical History of the Preterm Neonatesas well asPreterm Neonates'Sleep State Assessment Observational Checklist.**Results**: The mean heart rates after KMC of the preterm neonates in the study group were lower than the mean heart rates of those in the control group after the conventional position inside the incubator (144.39±13.98 and 159.93 ± 22.98 respectively) and the differences were statistically significant (P= 0.001). Additionally, the mean preterm neonates' respiratory rates were 45.92 ± 4.85 after KMC compared to 54.56 ± 6.07 of those in the control group with statistical significant differences, where P<0.001. Moreover, the mean oxygen saturations of preterm neonates in the study group after KMC were higher than the mean oxygen saturations of those in the control group (97.70 ± 0.93 and 94.93 ± 18.3 respectively) and the differences were statistically significant (P<0.001). Additionally, 80.0% of the preterm neonates in the study group were in deep sleep state compared to 33.3% of those in the control group. Highly aroused and agitated/crying state was found among 43.3% of the preterm neonates in the control group compared to none of those in the study group and the differences were statistically significant (P= 0.000).**Conclusion**:It can be concluded that KMC was effective in improving the sleep state and the physiological parameters of the preterm neonates. **Recommendation**: ApplyingKMC for all preterm neonates as a part of routine care within NICU.

Keywords: Preterm Neonates, Kangaroo Mother Care, Sleep State,Physiological Parameters**.**

Introduction

Globally, 15 million neonates were born prematurely according to the World Health Organization (2017) [(1)]. In the United States, the preterm birth affected one of every 10 born neonates in 2018[(2)].Prematurityis the leading cause of neonatal mortality and reducing this mortality is one of the goals of the United Nations' 2030 agenda [(3)].

It interrupts the neonates' intrauterine growth and development and interferes with their adaptation to the extra-uterine life.As such, they are hospitalized in a comparatively hostile environment of the Neonatal Intensive Care Units (NICUs) where they undergo numerous diagnostic and therapeutic procedures that are essential to guarantee their survival[(4)].

Continuous exposureto various environmental stimulations as excessive manipulations, bright lights, high noise levels and maternal separation leads to physiological, psychological and behavioral sequelae. Additionally, it results in impairment of sensory development,deep sleep and quiet awake as well[(5)]. Sleep deprivation may have negative impact on the health and development of the preterm neonates. It leads to increase sympathetic tonicity, the risk of obstructive apnea, pain perception and the risk of sleep disorders later in life.Internationally, it is estimated that over 2 million children today have some type of sleep disorder in 2015[(6)].

Preterm neonates in the NICUs are rarely reach the deep sleep and quietly awake states, which are required for healthy development. Accordingly, it is of great importance to develop intervention that aids in the improvement of deep sleep and quiet awake states for those neonates. Kangaroo Mother Care (KMC), first developed in Bogota, Columbia, is a safe and effective method to care for preterm neonates as an alternative to inadquate incubator

care[7].Studies have associated the use of KMC with reduced mortality, length of hospital stay, and hypothermia; increased weight gain; breastfeeding; and improved maternal–neonate bonding and mother satisfaction as well [7,8]. In addition, it improved maturation of the prefrontal cortex and better organization of sleep pattern[9].The KMC refers to the care of the preterm neonates carried skin-to-skin with the mother. It is a powerful, easy to use method to promote the health and well-being of those neonates[10].Early, prolonged and continuous mother-neonate contact provides exclusive breastfeeding. It can be initiated in hospital and continued at home.In the nursery, it should start gradually with smooth transition from conventional care to continuous KMC. The minimal time for carrying out this technique is one hour per session, while it may be increased up to 24 hours per day[11].

In relation to physiological parameters, KMC helps with thermal regulation where temperature regulation was found to be at least as good as that obtained inside an incubator or even better. It also guards against bradycardia, contributes to regular breathing patterns, and decreases apneic episodes. In addition, it provides stability of transcutaneous oxygen level. Generally, it improves infant's health, growth and development and contributes to better neonatal survival[12].

Nurses are an integral part of neonates' care. They can help mothers develop mutual interaction with their preterm neonates through the application of KMC. To encourage mothers to provide such kind of care, its numerous benefits have to be explained to them. Nurses are in a key position that enables them to educate and motivate mothers to keep their stable preterm neonates warm by skin-to-skin contact inside their clothing. During KMC nurses can offer support, guidance, and counseling to the mothers regarding neonates' behavior cues and caring skills. If

nurses allow preterm neonates to be cared for by their mothers while they are still in the hospital, they will make sure that proper care from competent mothers will continue after discharge [13].

Unfortunately, KMC implementation in Egyptian NICUs is facing much resistance and is not being implemented routinely. So, few studies were conducted concerning the incorporation of KMC in Egypt [14,15]. Hopefully, the current study would implement a KMC approach that could enhance the preterm neonates' sleep state and physiological parameters in NICUs. Therefore, the current study was carried out to enhance the application of such approach in favor of the preterm neonates.

This study aimed to:

Determine the effect of using kangaroo mother care on the sleep state and physiological parameters among preterm neonates.

Research Hypotheses:

1. Preterm neonates who receiveKMC exhibit bettersleep state than those who do not.
2. Preterm neonates who receiveKMC exhibit more stable physiological parameters than those who do not.

Operational Definitions:

Kangaroo Mother Care: It refers to placingthe undressed and diapered preterm neonatein skin-to-skin contact in upright position upon the mother’s bare chestwith flexed arms and legs in a froglike position and the head turned sideways and upright. The mother and preterm neonate look like kangaroo.

Material and Methods

Material

Research Design

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

Setting

The study was conducted atthe NICU of Maternity University Hospital at El-Shatby in Alexandria.

Subjects:

- Epi-Info program was used to estimate the sample size using the following parameters:

- Population size =110 preterm neonates (the last three months prior to data collection)
- Expected frequency = 50%.
- Acceptable error =10%.
- Confidence coefficient =95%.
- Minimum sample size = 51 preterm neonates.

-A convenient sample of 60 preterm neonates and their mothers attending the previously mentioned settingcomprised the subjects. The preterm neonates fulfilled the following criteria:

- Feeder and grower i.e. being fed via oral feeding.
- Gestational age: Ranged from 34 - < 37 weeks (Late preterm).
- Not on oxygen therapy or respiratory support.
- Hemodynamic stable.
- Free from any congenital anomalies or neonatal sepsis.

- The preterm neonates were divided into two equal groups. Each group consisted of 30 preterm neonates as follows:

- **The kangaroo mother care group (the study group)**: where preterm neonates received KMCintervention in addition to routine care of the NICU.
- **The control group**: where preterm neonates received the NICU routine care in the conventional position inside the incubator.
- The preterm neonates were assigned randomly as follows: one neonate in the study group and one in the control group i.e. the preterm neonates of eachgroup were chosen alternatively.

Tools

Two tools were used to collect the necessary data.

Tool one: Characteristicsof the Mothers and the Preterm Neonates and Medical History of the Preterm Neonates

This tool was developed by the researchers after thorough review of related literature [1,9,11]. It was developed to assess thecharacteristics of the mothers and the preterm neonates. Additionally, it was also used to assess the medical history and physiological parameters of those neonates. It included four parts:

Part I: Characteristics of the Mothersas: age, educational level occupation and their residence.

Part II: Characteristics of the Preterm Neonates as: Postnatal age, gender and weight.

Part III: Medical Historyof the Preterm Neonatesas: gestational age, type of delivery, diagnosis on admission and method of feeding.

Part IV: Physiological Parameters of the Preterm Neonatesas: heart rate, respiratory rate and oxygen saturation.

Tool two: **Preterm Neonates'Sleep State Assessment Observational Checklist**:

It was developed by the researchersafter thorough review of related literature [1,9]guided by the definitions of the sleep and wake state of the Newborn Individualized Developmental Care and Assessment Program according toAls (1999) [16].The observational checklist was used to assess the preterm neonates' sleep state.It differentiates six states levels, including deep sleep, light sleep, drowsy, quietly awake and/or alert, actively awake and aroused, as well as highly aroused and agitated/crying. Each state level is defined by various behavioral cues such as breathing patterns, facial expressions, body/eye/mouth movements, various sounds, and skin color. The six states were ranked as follows:

a. State 1: Deep sleep with closed eyes, no eye movements, regular breathing and no spontaneous movements.
b. State 2: Light sleep with closed eyes, eye movements, irregular breathing, and slight spontaneous movements.
c. State 3: Drowsy with eyes opened or closed, eye movements, irregular breathing, and sporadicspontaneous movements.
d. State 4: Quietly awake/alert with eyes opened,and slight spontaneous movement.
e. State 5: Actively awake and aroused with brief periods of being crankyand active spontaneous movement.
f. State 6: Highly aroused and agitated/cryingwith violent intense crying and activespontaneous movement.

Methods:

1) An official approval for conducting the study was obtained from the Faculty of Nursing, Alexandria University. Also, from the hospital administrative personnel after explaining the aim of the study to collect the necessary data.

2) Tool one was developed by the researchersafter thorough review of related literature [1, 9, 11].
3) Tool two was developed by the researchers after thorough review of related literature [1, 9] guided by the definitions of the sleep and wake state of the Newborn Individualized Developmental Care and Assessment Program according to Als(1999) [16].
4) Content validity of the tools was done by five experts in the pediatric nursing field and the recommended changes were done.
5) Reliability of Tool two was asserted using Cronbach's Coefficient Alpha test (r = 0.89).
6) A pilot study was carried out on 6 preterm neonates (10% of the total sample) to test the applicability and clarity of the tools and no modifications were done. Those neonates were excluded from the study subjects.
7) Subjects were assigned into two groups. The preterm neonates in the study group were received KMC intervention. Meanwhile, the preterm neonates in the control group were received routine NICU care in conventional position inside the incubator.
8) Initially, the characteristics ofmothers in both groups were assessed.The characteristics and medical history of the preterm neonateswere also assessed for both groups using Tool one.
9) Preterm neonates' physiological parameters were assessed and recordedbefore and after one hour of KMC intervention for the neonates in the studygroup and conventional positioninside the incubator for the neonates in the control group using Tool one for the both groups.
10) Preterm neonates' sleep states were assessedafter one hour of KMC intervention for the neonates in the study group[11,17]

andconventional position inside the incubator for those in the control group using Tool two for the both groups.

11) **The kangaroo mother careintervention was applied for one hour among the study group as follows:**

- Initially, the benefits of KMC intervention were explained to the mothers to gain their cooperation.
- The mothers were asked to:
  - Have a shower the day before KMC intervention.
  - Keep fingernails short and clean.

- Mothers' body temperature was assessed just before applying KMC intervention. Those whose body temperature is not within the normal range were not start KMC until they have stabilized body temperature.

- Before the onset of the KMC intervention, all mothers were instructed to take the following steps:
  -Empty their bladders and bowels.
  -Abstain from using perfume.
  - Pump breast milk in case of fullness.
  -Satisfy hunger and thirst.
  -Turn off mobile phones.
  -Dress a gown and a hospital insulation cap.

- The mothers were asked to remove their upper clothes and done an open-front gown.
- All mothers were assisted into a seated position in a comfortable chair with a 45° soft backrest to prevent fatigue.

- Kangaroo mother care intervention was explained to the mothers and initiated as follows:

    a) All neonates, clad in only a diaper and a hat was put on the head to prevent hypothermia

    b) Kangaroo mother care was applied by carefully putting the neonatesin skin-to-skin contact in theupright positionon the mothers'bare chest with flexed arms and flexed legs in froglike position. The neonates' arms and legs were tucked against their body.

    c) The head of the neonates was turned sideways and upright (not flexed or extended) near their mothers' heart, to ensure an open airway and facilitate direct eye to eye contact and transmission of the mother's heartbeat through her skin.

    d) Thermal insulation was achieved by placing the neonatesunder the mothers' clothes and by placing a blanket on the neonates'back and head.

    e) A simple device as an elastic cloth band placed around the mothers' chest to maintain the neonatesproperly positioned.

12) The preterm neonates in the control group were received routine NICU care in conventional position inside the incubator.

13) Comparison between two groups was done to determine the effect of KMCon sleep state and physiological parameters of thepreterm neonates.

14) Ethical considerations were considered all over the study phases as Following:

- Written informed consent was obtained from the preterm neonates' mothers after explaining the aim of the study.
- The preterm neonates' and their mothers' privacy, anonymity and confidentiality of the collected data were maintained.
- Mothers' right to refuse to participate in the study or to withdraw at any time was respected.

Statistical analysis:

Collected data was coded and transferred into specially designed formats to be suitable for computer feeding. The Statistical Package for Social Sciences (SPSS version 21) was utilized for both data presentation and statistical analysis of the results. Categorical data were expressed in the form of frequencies andpercentages. Numeric data were expressed in the form of minimum, maximum, mean and standard deviation (SD). Chi-square test and Fisher's Exact test were used to test the significance of results of qualitative variables. Moreover, Student t-test was used for comparing between the mean of two groups.

▪The 0.05 level was used as the cut off value for statistical significance**.**

Results:

Table 1: shows the characteristics of the mothers among the study and control groups. It was apparent that, more than half of the mothers in the study and control groups were in the age group 40 years and more (56.7% and 53.3% respectively). Around three quarters of them had secondary & diploma education (70.0% and 73.3% respectively). All the studied mothers were housewives. Additionally, 63.3% of the mothers in the study and 60.0% of those in the control group were from urban area.

The characteristics and medical history of the preterm neonates among the study and control groupswere portrayed in **Table 2**. In relation to their characteristics it was found that, male preterm neonates constituted 53.3% and 56.7% among the study group and the control group respectively. The preterm neonates who weighted 2000 to less than 3000 grams constituted 66.7% in the study group and 76.7% in the control group. Their mean weights were 2.177±435.38 and 2.138±428.66 grams respectively. Regarding to medical history, all neonates in both groups were late preterm (100.0%).Their mean gestational ages were 35.8±4.51 and 35.9±4.54 weeks for the study and control groups respectively.Themost common diagnosis on admission encountered by preterm neonates in the study group and control group was hyperbilirubinemia (63.3% and 60.0% respectively). The mode of delivery was cesarean section for 93.3% of the preterm neonates in the study group and for all of those in the control group. All preterm neonates in both groups received their feeding via oral method. No statistical significant differences were detected between the study and control groups in relation to their characteristics and medical history which means that both groups are matched.

Table 3clarifies the effect of KMC on preterm neonates' physiological parameters.The mean heart rates after KMC were decreased than before for the preterm neonates in the study group (144.39 ± 13.98 and 150.0 ± 14.90 respectively). Meanwhile,the mean heart rates of the preterm neonates in the control group increased (159.93 ± 22.98 after and 149.66 ± 17.89 before). Moreover, the mean heart rates after KMC of the preterm neonates in the study group were lower than the mean heart rates of those in the control group (144.39±13.98 and 159.93 ± 22.98 respectively) and the differences were statistically significant (**P= 0.001**).

Additionally, the mean preterm neonates' respiratory rates were 45.92 ± 4.85 after one hour of KMC intervention compared to 54.56 ± 6.07 for those in the control group after one hour of the conventional position inside the incubator with a statistical significant differences, where **P<0.001**.Furthermore, the mean respiratory rates after KMC intervention were lower than before for the preterm neonates in the study group (45.92 ± 4.85 and 52.70 ± 6.81 respectively). The mean oxygen saturations of preterm neonates in the study group after KMC intervention were higher than the mean oxygen saturations of those in the control group after conventional position (97.70 ± 0.93 and 94.93 ± 18.3 respectively) and the differences were statistically significant (**P<0.001)**. Also, the mean oxygen saturations after one hour of KMC intervention were higher than before for preterm neonates in the study group (97.70 ± 0.93 and 95.30 ± 1.60 respectively).

Table 4illustrates the effect of KMC on preterm neonates' sleep state. It was revealed that the majority of the preterm neonates (80.0%) in the study group were in deep sleep state compared to 33.3% of those in the control group and the difference was statistically significant (P= 0.000). Moreover, light sleep state was observed among almost three quarters of the preterm neonates (73.3%) in the study group compared to 40.0% of those in the control group with statistically significant difference, where P= 0.009. Furthermore, both drowsy state and quiet awake/ alert state were noticed among 23.3% of the preterm neonates in the study group in comparison with among 30.0% of those in the control group with no statistically significant differences. Also, actively awake and aroused state was detected among 20.0% of the neonates from both groups.

Meanwhile, highly aroused and agitated/crying state was found among 43.3% of the preterm neonates in the control group compared to none of those in the study group and the difference was statistically significant (P= 0.000).

Table 1: Characteristics of the Mothers among the Study and Control Groups

Characteristics of Mothers	Mothers in the study group (n=30)		Mothers in the control group (n=30)		Test of Significance
	No.	%	No.	%	
Age (years)					
• 20 -	9	30.0	9	30.0	
• 30 -	4	13.3	5	16.7	
• 40 and more	17	56.7	16	53.3	X^2 =0.638 P=0.809
Min-Max	20-45		20-45		
Mean ±SD	35.0±6.8		35.0±7.9		
Level of Education					
• Illiterate / read and write.	0	0.0	2	6.7	
• Primary& preparatory education.	9	30.0	6	20.0	X^2 =0.638 P=0.809
• Secondary& diploma education.	21	70.0	22	73.3	
Occupation					
• Housewives	100	100.0	100	100.0	FET= 0.0 P= 1.000
Residence					
• Urban.	19	63.3	18	60.0	X^2 = 5.710 P= 0.222
• Rural.	11	36.7	12	40.0	

X^2 = Chi Square test FET = Fisher's Exact Test *Significant at P < 0.05.

Table 2: Characteristics and Medical Historyof the Preterm Neonates among the Study and Control Groups

Characteristics and Medical History	Study group (n=30)		Control group (n=30)		Test of Significance
	No.	%	No.	%	
Characteristics					
Gender					
• Male.	16	53.3	17	56.7	X^2 =0.638
• Female.	14	46.7	13	43.3	P=0.809
Weight / grams					
• 2000 –	20	66.7	23	76.7	X^2 = 0.739
• ≥3000	10	33.3	7	23.3	P= 0.390
Mean ± SD	2.177± 435.38		2.138±428.66		
Medical History					
Gestational age					
• Late preterm (34 -< 37 weeks)	30	100.0	30	100.0	FET= 0.0 P= 1.000
Mean ± SD	35.8± 4.51		35.9± 4.54		
Diagnosis on admission					
• Hyperbilirubinemia.	19	63.3	18	60.0	X^2 = 5.710
• Congenital Pneumonia.	2	6.7	6	20.0	P= 0.222
• Respiratory Distress Syndrome.	9	30.0	6	20.0	
Type of Delivery					
• Normal Vaginal Delivery.	2	6.7	0	0.0	FET=0.246
• Cesarean Section.	28	93.3	30	100.0	P = 0.492
Method of Feeding					
• Oral	30	100.0	30	100.0	FET= 0.0 P= 1.000

X^2 = Chi Square test FET = Fisher's Exact Test *Significant at P < 0.05

Table 3: Effect of Kangaroo Mother Care on Preterm Neonates' Physiological Parameters

Physiological Parameters	Before**		After***	
	Study group (n=30)	Control group (n=30)	Study group (n=30)	Control group (n=30)
Heart Rate				
• $\overline{X}$ ± SD	150.0 ± 14.90	149.66 ± 17.89	144.39 ± 13.98	159.93 ± 22.98
Test of significance: t (P)	t = 0.409, P= 0.683		**t = 3.488, P= 0.001***	
Respiratory Rate				
• $\overline{X}$ ± SD	52.70 ± 6.81	51.80 ± 8.09	45.92 ± 4.85	54.56 ± 6.07
Test of significance	t = 1.657, P= 0.103		**t = 5.452, P <0.001***	
Oxygen Saturation95.30 ± 1.60				
• $\overline{X}$ ± SD	95.30 ± 1.60	94.95 ± 2.74	97.70 ± 0.93	94.93 ± 18.3
Test of significance	t = 1.714, P= 0.190		**t = 6.052, P<0.001***	

****Before**: before KMC for the study group and conventional position inside incubator for the control group

*****After**: One hour after KMC for study group and one hour after conventional position inside incubator for the control group

t, p: t and p values for Student t-test for comparing between the two groups*Significant at P < 0.05

Table 4: Effect of Kangaroo Mother Care on Preterm Neonates' SleepState

Sleep State	Study group (n=30)	Control group (n=30)
	NO. %	NO. %
State 1: Deep Sleep • Yes • No	2480.0 620.0	10 33.3 2066.7
Test of significance	**X^2= 13.303, P= 0.000***	
State 2: Light Sleep • Yes • No	22 73.3 8 26.7	12 40.0 1860.0
Test of significance	**X^2= 6.787, P= 0.009***	
State 3: Drowsy • Yes • No	723.3 2376.7	9 30.0 2170.0
Test of significance	X^2= 0.341, P= 0.559	
State 4: Quiet Awake/ Alert • Yes • No	7 23.3 23 76.7	9 30.0 21 70.0
Test of significance	X^2= 0.341, P= 0.559	
State 5: Actively Awake and aroused • Yes • No	6 20.0 24 80.0	6 20.0 24 80.0
Test of significance	FET= 0.0, P= 1.000	
State 6: Highly aroused and agitated/Crying • Yes • No	00.0 30100.0	13 43.3 1756.7
Test of significance	**X^2= 12.381, P= 0.000***	

X^2 = Chi Square test FET: Fisher's Exact Test *Significant at P < 0.05

Discussion

Internationally, prematurity accounts for 35% of neonatal mortalities and it considers a major cause to child's morbidity later on.Such category of neonates are particularly a vulnerablegroup. Asthey require advanced medical interventions and highly specialized nursing care in order to survive that necessiate their exposure to superfluous environmental stimulants in NICUs. When the environmental demands exceed coping regulatory capabilities of the preterm neonates, neurobiological dysfunction may occur.So, it is resonable to change neonatal care practices in the NICUs to support the neuro-developmental processes. In this context, a variety of approaches are used in order to improve optimal behavioral development of the preterm neonates as the organization of sleep and wake states [(18)].The organization of sleep and wake states relates closely to brain maturation and reflects the central well-being of the nervous system [(19)].

A significant progress has been made in care of the preterm neonates. The practice of KMC has evolved worldwide to be an intervention strategy in NICUs for those neonates and their mothers. The early, intimate and physiologically stabilizing KMC provide a new conceptualization of the optimal environmentfor those neonates in NICUs.The past two decades of implementation and research have made it clear that KMC may be an alternative to incubator care for hemodynamically stable preterm neonates[(10)].

Kangaroo mother care is a non-expensive, cost effective, and comprehensive method of care that can be provided safely for preterm neonates. Its application is beneficial for both mothers and their neonates as it enhances breastfeeding, mother-neonate attachment andmaternal

satisfaction as well [20]. Additionally, it regulates neonates' behavioral state by decreasing motor activity and purposeless movements and increasing frequency and duration of quiet regular sleep. In addition, it improves weight gain by enhancing digestion and energy conservation through relaxation. Concerning physiological parameters, it helps with thermal regulation. Moreover, it regulates heart rate, respiratory rate, and oxygen saturation[8].

As a matter of fact, repeated exposure to stressful procedures in early life is associated with many hazards as: intracranial pressure and increased demands on cardio-pulmonary system that manifested in physiological instability asbradycardia, apnea and drop in the oxygensaturation [21]. The present study findings reflected that, the mean heart rates after KMC decreased than before for the preterm neonates in the study group. In addition,the differences between heartrate among neonates in the study groupand control group were statisticallysignificant.These findings could be interpreted in the light of the fact that,skin–to-skin contact in KMC can improve the autonomic nervous system response and decrease hormonal markers for, stress such as, cortisol and epinephrine. So, it improves thebehavioral response of preterm neonates by producing positive changes in the motor behavior and heart rate.Consequently, it can decrease energy expenditure, stimulates quiet state and keep a stable heartrate[22]. These results are in concordance withtheresultsofParsa et al (2018) [23] who conducted a study about the effect of KMC on physiological parameters of premature infants in Hamadan City, Iran. They found that preterm neonates in KMCgroup exhibit stable physiological parameters in terms of heart rate, respiratory rate and oxygen saturation during theirstay in NICU compared to those in the control group with statistical significant

differences.Additionally, Nourian et al (2009)[24] conducted a randomized controlled trail study about the effect of KMC on cardiopulmonary and thermal response of healthy preterm and low birth weight infantsand found that KMC has positive and significant effect on body temperature, heart rate, respiratory rate, oxygen saturation, and urine cortisol as well.

The current study findings revealed that the mean respiratory rates of neonates in study group were lower than for those in the control group and the differences were statistically significant. Moreover, the mean respiratory rates of the neonates inthe study group decreased after KMC than before. Meanwhile,the mean respiratory rates of neonates in control groupincreased.These findings could be justified by the fact that upright position during KMC can enhance the efficiency of the diaphragm and cardio-pulmonary functions. Hence, it can improve the oxygenation, ventilation and respiratory status of the preterm neonates[7]. These findings are consistent with the findings of Sarparast et al (2015) [25] who have done a study about the effect of KMC on neonatal outcomes in Iranian hospital after reviewing42 Persian and English language papers. They reported that KMC had various effect on different factors such as analgesia; breastfeeding, length of hospitalization, infection, psychologic effects,weight gain and physiological effects in term of body temperature, heart rate, respiratory rate and oxygen saturation.Similar findings were reported by Ranjan and Malik (2019)[17].Conversley, a study done by Seyedrasooli et al (2010) [26] showed no statistically significant differences between KMC group and control group in relation to respiratory rate.

In fact, the normal range of oxygen saturation falls between 90-94% for preterm neonates whose gestational age is <36 weeks.While, it is 95-99% for others whose gestational age is ≥36 weeks. Desaturation refers to

oxygen saturation between 85-88%[27]. The current study results illustrated thatthe mean oxygen saturation after one hour of KMC was higher than before for preterm neonates in the study group. Moreover, the mean oxygen saturation of the preterm neonates in study group was higher than the mean oxygen saturation of those in the control group with statisticallysignificant difference. These results could be interpreted in the light of different reasons as the unique feature of KMC that involves direct skin-to-skin contact between the mother and her neonate. This feature acts as a sensory stimulation measure that can increase the blood flow to the body tissues and the brain; thus improving oxygen saturation[28].Furthermore, oxygen saturation could also be enhanced due to the particular relationship between KMC and motor regulation. This also diminishes agitation and, consequently, oxygen is saved and is not used up in excessive movements.The current study results are in line with the results of Beheshtipooret al (2013) [29]who found a significant difference between the KMC condition and control condition (incubator care condition) regarding the infants' oxygen saturation. So, they concluded that during KMC, oxygen demand may decrease or just become stable.While,the present study results are not in congruent with the results ofBasiri et al (2014) [30]who found that in using the KMC more than 4 hours, the mean oxygen saturation was significantly higher than a group with less than 4 hours KMC duration. Moreover, El-Farrash et al (2019) [31] reported that after the first KMC session, a significant improvement in oxygen saturation was observed in KMC 120-minutes group compared with the KMC 60-minutes group.

Certainly, optimal sleep is essential to normal growth and development. Studies show that sleep has a pivotal role in the development and function of the brain[9, 32]. Preterm neonates require more than 18 hours sleep per

day for normal growth and development. Hence, deep sleep state aids the preterm neonates to cope with and to resist environmental stimulants.On assessing thesleep state of preterm neonates, the current study findings revealed thatthe percentage of preterm neonates noticed in deep sleep state among KMCgroup were more than thoseamong control group with statistically significant difference.Furthermore, highly aroused and agitated/cryingstate was evident among almost half of the preterm neonates in the control group compared to none of those in the study group and the difference was alsostatistically significant.

The findings of the present study couldbe attributedto that KMChas major components[13]. The first one is theKMC position which consists of skin-to-skin contact during which the release of oxytocin increases in both neonates and their mothers. Oxytocin increases the calmness and relaxation of the neonates[33].The second component is KMCnutrition which is based on exclusive breastfeedingby direct sucking, whenever possiblethat induces neonatal satisfaction[13].A final mechanism may be the maternal attendance which is related to the presence of maternal odor that makes the neonates feel more secure. Therefore, the neonates fall deeply asleep and are less prone to excitement due to the environment happenings. The neonates were placed vertically between the breasts of their mothers, which appear to create a more confined, containing, and cradling space that may be analogous to the internal space of the uterus and may protect neonates from contact with excessive peripheral sensory stimulation, increase neonates'sense of security and comfort, and help them move into deep sleep[33].

The findings of the present study are in agreement with the findings of Bastani et al (2017) [34]who concluded that KMC appears to significantly increase the length of time that preterm infants spend in deep sleep and quiet awake/alert states and significantly decreases the states of light

sleep, drowsiness, and actively awake states as compared with simply being held in their mothers' arms. Additionally, the findings of the current study are in consistent with the findings of Cong et al (2012) [35]who examined the effect of KMC during heel-stick blood sampling on the responses of twin preterm infants. They found that both infants during KMC spent 80%–100% of their time in deep sleep. Similar findings were reported byArnon et al (2014) [36] who mentioned that the potential underlying reasons for increased deep sleep during KMC include the mother's body warmth, which may promote increased infant tranquility and deep sleep as well as the odor of the mothers' body and breasts and the soothing sound of the mothers' heartbeat in combination with the rhythmic movements of her chest.

Conclusion: Based on the findings of the current study, it can be concluded that applying KMC for preterm neonates enhances theirsleep state, improves deep sleeping as well as decrease the highly aroused and agitated/crying among preterm neonates in comparison with those in the control group (conventional position in incubator care condition). Additionally, it improves physiological parameters in term of heart rate, respiratory rate and oxygen saturation as well.

Recommendations:

1- Nurses should use KMC for all preterm neonates as a part of routine care within NICUs.

2- The curricula of undergraduate program should include KMC and its benefits.

3- Training program should be conducted for all NICUs nurses to increase their awareness regarding benefits of KMC and to enhance their skills in its application.

4- The KMCshould be incorporated in NICUs policies.

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References

1- Lan H,Yang L,Hsieh K,Yin T,Chang Y&Liaw G. Effects of a supportive care bundle on sleep variables ofpreterm infants during hospitalization.Res Nurs Health.2018;41:281–91.

2- Centers for Disease Control and Prevention: Reproductive Health. 2019; Available form: https://www.cdc.gov/reproductivehealth/maternalinfanthealth/pretermbirth.htm. Retrieved on 2 January 2020.

3- Liu L, MSc S, Hogan D, MSPH Y, Perin J, Cousens S, Mathers C, E Black R. Global, regional, and national causes of under-5 mortality in 2000–15: an updated systematic analysis with implications for the Sustainable Development Goals. Lancet. 2016 Dec 17; 388(10063): 3027–35.doi: 10.1016/S0140-6736(16)31593-8

4- Johnston CC, Fernandes AM, Campbell-Yeo M. Pain in neonates is different. Pain 2011; 152(3):S65-S73.

5- Ahmed AA. Effect of Facilitated Tucking Versus Swaddling Positions on Orogastric Tube Insertion Pain among Preterm Neonates.IOSR Journal of Nursing and Health Science 2018; 7(5):75-86.e- ISSN: 2320–1959.p- ISSN: 2320–1940. DOI: 10.9790/1959-0705017586.

6- Indra V, Mony SR. Effect of Nesting versus Non Nesting on Sleep Pattern and Physiological Parameters among Premature Infants. International Journal of Advances in Nursing Management 2018; 6(2): 149-51.

7- Abd El-Naby BA. Effect of Kangaroo Care on Heel Stick Pain of Neonates. [Unpublished Master Thesis]. Faculty of Nursing, Alexandria University. 2016.1, 58, 62.

8- Conde-Agudelo A, Belizán J M, Díaz-Rossello J. Kangaroo mother care to reduce morbidity and mortality in low birthweight infants. The Cochrane Database of Systematic Reviews 2011:3, CD002771. doi:10.1002/14651858.CD002771.

9- Feldman R, Rosenthal Z, Eidelman AI. Maternal-preterm skin-to-skin contact enhances child physiologic organization and cognitive control across the first 10 years of life. Biological Psychiatry2014: 75(1):56–64. doi:10.1016/j.biopsych.2013.08.012.

10- Akhtar K, Haque M, Khatoon S. Kangaroo mother care: A simple method to care for low- birth-weight infants in developing countries. J ShaheedSuhrawardy Med Coll 2013; 5(1): 49-54.

11- Website of KMC India Network. Guidelines for Parents and Health Providers. KMC India Network; 2012. Available from: www.kmcindia.org. Retrieved on 10 December 2019.

12- Conde-Agudelo A, Diaz-Rossello J. Kangaroo mother care to reduce morbidity and mortality in low birth weight infants. Cochrane Database Syst Rev. 2016; (8): CD002771.

13- Shrivastava S. Utility of kangaroo mother care in preterm and low birthweight infants. S AfrFamPract. 2013; 55(4): 340-4.

14- Samra N, El Taweel A, Cadwell K. Effect of intermittent kangaroo mother care on weight gain of low birth weight neonates with delayed weight gain. The Journal of Perinatal Education 2013; 22(4): 194–200.

15- Saad N. Monitoring low birth weight infants on kangaroo mother care and conventional care. Thesis. Pediatrics Department, Faculty of Medicine: Benha University, 2012.

16- Als H. Manual for the Naturalistic Observation of Newborn Behavior (NIDCAP). Behavioral Definition. In Goldson E. (Ed.), Developmental Interventions in the Neonatal Intensive Care Nursery (pp. 18–85). New York, NY: Oxford University Press;1999.

17- Ranjan A, Malik S. Effect of Kangaroo mother care on physiological parameters in low birth weight neonates. International Journal of Contemporary Pediatrics 2019; 6(2): doi: http://dx.doi.org/10.18203/2349-3291.ijcp20190731.

18- Sathish Y, Lewis LE, Noronha JA, George A, Snayak B, Pai MS, Bhat R, Purkayastha J. Clinical outcomes of snuggle up

position using positioning aids for preterm (27-32 weeks) infants. Iranian Journal of Neonatology 2017;8 (1):1-6.

19- Holditch-Davis D, and Blackburn ST. Neurobehavioral Development in Comprehensive Neonatal Nursing Care. 5th ed. Kenner C, and Lott JW, Eds. New York: Springer Publishing, 2010; 689–721.

20- Flacking R, Ewald U, Wallin L. Positive effect of kangaroo mother care on longterm breastfeeding in very preterm infants. J ObstetGynecol Neonatal Nurs. 2011; 40(2): 190-7.

21- Ghorbani F, Asadollahi M, Valizadeh S.Comparison the effect of sleep positioning on cardiorespiratory rate of noninvasive ventilated premature infants. Kahsan University Medical Sciences. Nursing and Midwifery Studies 2013;2 (2): 182-7.

22- Grunau R, Linhares M. Effect of multisensory stimulation on analgesia in preterm neonates. Pediatrics. 2014; 13(8): 460-3.

23- Parsa P, Karimi S, Basiri B, RoshanaeiG. The effect of kangaroo mother care on physiological parameters of premature infants in Hamadan City, Iran.Pan Afr Med J. 2018; 30: 89.doi: 10.11604/pamj.2018.30.89.14428

24- Nourian M, Yalgha M, Yaghmaei F, Akbarzadehbaghbani AR, Heydarzadeh H. Compare the effect of KMC and traditional care on Physiological measures of LBW. Journal of Nursing & MidwiferyFaculty 2009;19(65):19–24.

25- Sarparast L, Farhadi R, Sarparast M, Shafai S. The Effect of Kangaroo Mother Care on Neonatal Outcomes in Iranian Hospitals: A review. J Pediatr Rev. 2015;3(1):e195.

26- Seyedrasooli A, Jabreili M, Valizade S. The Physiological Parameters in Preterm Infant in Kangaroo and Traditional Methods. IJNR. 2010;4(14):67–75.

27- Brannagan M. Normal oxygen saturation for neonates; 2015. Available from: http://www. Livestrong.com. Retrieved on 22 November 2019.

28- Nordqvist C. Factors affecting massage therapy. Journal of Obstetric and Neonatal Nursing 2013; 5(1): 34-7.

29- BeheshtipoorN, MemarizadehA, Hashem F, PorarianSh, RambodM.The Effect of Kangaroo Care on Pain and Physiological Parameters in Preterm Infants on Heelstick Procedure: A Randomiz ed Controlled, Cross-over Study. Galen Medical Journal 2013;2(4):ISSN Print:2588-2767, ISSN Online:2322-2379.

30- Basiri B, Shokouhi M, Heydari Farah S. The Effect of Kangaroo Mother Care (KMC) Duration on Physical Growth of Low Birth Weight Infants. Sci J Hamadan Univ Med Sci. 2014;21(1):8–15.

31- El-Farrash RA, Shinkar DM, Ragab DA, Salem RM, Saad WE, Farag AS, Salama DH, Sakr NF. Longer duration of kangaroo care improves neurobehavioral performance and feeding in preterm infants: A randomized controlled trial. Pediatric Research 2019; https://doi.org/10.1038/s41390-019-0558-6.

32- Tarullo AR, Balsam PD, Fifer WP. Sleep and infant learning. Infant Child Dev.2011Jan 1; 20 (1): 35-46.

33- Mosayebi Z, Javidpour M, Rahmati M, Hagani H, Movahedian AH. The Effect of kangaroo mother care on pain from heel lance in preterm newborns admitted to Neonatal Intensive Care Unit: A Crossover Randomized Clinical Trial. Journal of Comprehensive Pediatrics 2014; 5(4): e22214. doi : 10.17795/compreped-22214.

34- Bastani F, Farsi Z, Rajai N, Als H. The Effects of kangaroo care on the sleep and wake states of preterm infants. Journal of Nursing Research 2017; 25(3):231–9. doi: 10.1097/jnr.0000000000000194

35- Cong X, Cusson RM, Hussain N, Zhang D, Kelly S P. Kangaroo care and behavioral and physiologic pain responses in very-low-birth-weight twins: A case study. Pain Management Nursing 2012; 13(3): 127–38. doi:10.1016/j.pmn.2010.10.035.

36- Arnon S, Diamant C, Bauer S, Regev R, Sirota G, Litmanovitz I. Maternal singing during kangaroo care led to autonomic stability in preterm infants and reduced maternal anxiety. Acta Paediatrica. 2014; 103(10): 1039–44. doi:10.1111/apa.12744.