Effect of kangaroo Care on Pain Response in Premature Infants during Blood Sampling

Fatma Mohamed Amin[1], A.M Eita[2], Manal Mohamed Ahmed Ayed[3], Khadiga Zain Alabdeen Moustafa Mohammed[4]

(1) Assistant Professor of Pediatric Nursing Department, Faculty of Nursing, Mansoura University, Egypt
(2) Lecturer of Pediatric Medicine Department, Faculty of Medicine Mansoura University, Egypt
(3) Assistant Professor of Pediatric Nursing Department, Faculty of Nursing, Sohag University, Egypt
(4) Lecturer of pediatric nursing, Faculty of Nursing, Zagazig University Egypt

Abstract

Background: Kangaroo care helps reduce pain in newborns, especially those associated with a variety of procedures that are part of routine medical and nursing care for premature infants. **Aim:** This study aimed to evaluate the effect of kangaroo care on pain response in premature infants during blood sampling. **Research design:** A quasi-experimental study design was used to achieve the aim of this study. **Setting:** This study was conducted in a neonatal intensive care unit. **Sample:** The study included a purposive sample of premature infants, which were divided randomly into two groups (45 in each group).**Tool:** one tool was used; 1st **part**; Characteristics of premature infants and 2nd **part;** Premature Infant Pain Profile (PIPP). **Results:** Studied premature infants' total score of pain reflect significant differences compared to a control group. Kangaroo care was effective in reducing pain scores in premature infants before, during, and after blood sampling, with significantly reducing pain severity in premature infants compared to the control group. **Conclusion:** Premature infants who received Kangaroo care exhibited less pain scores during blood sampling compared to premature infants who did not receive it. **Recommendations:** Kangaroo care should be used as a part of the routine care to reduce pain during painful procedures in premature infants admitted in neonatal intensive care unit.

Keywords: Blood Sampling, Kangaroo care, Pain response, Premature infants.

Introduction

Premature infants are those whose gestational ages are fewer than 37 weeks (**Chawanpaiboon et al., 2019**). According to the World Health Organization, there are 15 million premature births each year **(Huang, Ural, & Zhu, 2022; Wang, Zhang, Ni, & Lv, 2022**), resulting in a global premature birth rate of around 11.1%, which is truly a concern increasing (**De Costa et al., 2021**) 38% of infant deaths in Egypt are caused by premature issues (**Hamad, Khamis, & Rashwan, 2022).**

Premature newborns in the neonatal intensive care unit (NICU) are often exposed to numerous painful but important medical diagnostic and therapeutic procedures (**Campbell-Yeo, Eriksson, & Benoit,2022; Ercelik, Yilmaz, & 2022; Özkan, Yüksel, & Akar, 2022).** Additionally, premature newborns are subjected to everyday handling and contact that might be stressful, such as positioning adjustments, diaper changes, oral care, and bottle feeding-all of which are not often seen as "hazardous" for infants. The majority of medical treatments are painful. A child that was born prematurely may need to stay in the NICU for several weeks or months **(Bucsea & Pillai Riddell, 2019; Espinosa Fernández et al., 2021; Sharma, & Ruikar, 2022; Zhao et al., 2022).**

Premature newborns require more intrusive procedures than full-term babies do because they have immature lungs, unstable blood flow, fragile blood vessels, and delayed neurological development. The two most frequent and routine procedures are blood sampling (BS) and venipuncture **(Sen, & Manav, 2020; Wang et al., 2022; Zer et al., 2021).** Pain is linked to physiological instability including tachycardia or bradycardia, tachypnea, increased blood pressure, and short-term hypoxia in addition to emotional, behavioral, and learning issues. Because of this, all newborn discomfort in the NICU should be avoided and well-controlled **(Yang, Fu, & Wang, 2022;**

Yıldızdaş, Karahan, OZLU, & Sertdemir, 2022).

Pharmacological pain reduction techniques, which are commonly used, are considered as efficient methods of analgesia. Nonpharmacologic approaches to pain management are also advised due to the negative consequences of medications, particularly in premature infants. Non-pharmacological techniques have a crucial role in the management of procedural pain in newborn. They enhance infants' ability to cope, lessen pain perception, and promote comfort **(Bucsea & Pillai Riddell, 2019; Efe, Erdem, Caner, & Güneş, 2022; Yilmaz, & Kurt, 2021).** Infants' procedural discomfort are frequently managed with positioning, massage, feedings of glucose or sucrose, white noise, nursing, kangaroo care (KC), reflexology, acupressure, vibration, music, pacifiers, and soothing human touch (**Erkut, Mutlu, & Çakici, 2021; Fitri, Nasution, Nurhidayah, & Maryam, 2021; Riadini, & Suwandono, 2019).**

Kangaroo Mother Care (KMC), as defined by the World Health Organization, as early, continuous, and prolonged skin-to-skin contact between the mother and her newborn as well as frequent exclusive breast feeding and early discharge from the hospital has been efficient in lowering the risk of mortality among preterm and low birth weight infants **(Chan, Valsangkar, Kajeepeta, Boundy, & Wall, 2016; Cristóbal Cañadas, et al., 2022).** Newborns who receive KC experience tactile stimulation from early skin-to-skin contact with their mothers, kinesthetic visual stimulation from near-skin contact, olfactory stimulation from sucking, and motor stimulation from breast sucking (**Suitor, 2022).**

Kangaroo Care (KC) is one of the developmental care practices that offer several advantages, such as lower mortality, improved physiological parameters, pain alleviation, and better long-term developmental results. Additionally, it improves the production of breast milk, enhances the link between parents and children, and guards against intraventricular bleeding **(Blackett, James, Lok, & Reeder, 2022; Gross, Engel, & Trotter, 2021; Sharma, Farahbakhsh, Sharma, Sharma, & Sharma, 2019; Thomson, & Feeley, 2021; Yurdagül, & Esenay, 2022).**

Significance of the study:

For all of these reasons, KMC which is skin-to-skin contact between mother and neonates is regarded as one of the most crucial aspects of an infant's life. This approach enhances the mother-infant relationship while also reducing health-related consequences like infections. KMC improves the mother-child relationship while lowering the risk of hypothermia, nosocomial infections, severe illnesses, and infant mortality in infants weighing under 2000 pounds (**Hamad et al., 2022; Wang et al., 2022; WHO, 2019).** A cost-effective approach, KMC appears to help lower premature infants' distress, mortality, and morbidity have been discovered to have favorable impacts on maternal health **(Atnafu et al., 2022; Narciso, Beleza, & Imoto, 2022).** In order to determine how kangaroo care effect on pain response in premature infants during blood sampling, the current study was carried out.

Aim of the Study

The study aimed to assess the effect of kangaroo care on pain response in premature infants during blood sampling.

Research hypothesis:

Premature infants who receive Kangaroo care may exhibit less pain scores during blood sampling compared to premature infants who do not receive it.

Subjects & Methods

Research design:

Quasi-experimental research design was utilized to carry out this study.

Setting:

The study was carried out in the neonatal intensive care unit affiliated with Mansoura University Children's Hospital.

Subjects:

A purposive sample of premature infants (total 90) was allocated from the previously mentioned setting. The sample were divided randomly into two groups, the study group (45) who receive the KC and the control group (45) who receive only the routine care according to the unit policy after fulfilling the criteria of selection. A control group (45) only received normal care following unit recommendations and a study group (45) received KC after fulfilling eligibility requirements and after the control group infants were assigned. The following criteria were used to include newborns: 32<37 weeks gestation, 0 to 28 days after delivery, a body weight of under 2500 g, and stable hemodynamics. Infant were not included if they have a condition that would impact their physiological or pain responses, severe congenital defects, mechanical ventilator support, and sedative or analgesic medication that have occurred within the last 72 hours.

Tools for data collection:

Part I: Premature infants' characteristics as gestational age, gender, birth weight, type of labor, and Apgar score.

Part II: Premature Infant Pain Profile (PIPP)

This tool adopted from Stevens, Johnston, Petryshen, & Taddio, (1996), the PIPP used to assess premature infants' pain by seven indicators: three behavioral response (facial expressions: brow bulge, eye squeeze, nasolabial furrow), two physiologic response (heart rate and oxygen saturation) and two contextual (gestational age and sleep/wake state). Pain indicators were scored in this order: sleep/wake state, brow bulge, eye squeeze, nasolabial furrow "subtotal", gestational age, heart rate, and oxygen saturation. Each indicator is scored for pain on a 4-point scale (0–3); the total score can range from 0 to 21, depending on infant gestational age and sleep/wake state. Premature Infant Pain Profile scores ≥ 6 are suggested to indicate at least mild pain, and scores ≥ 12 are suggested to indicate moderate-to-severe pain.

Method

Validity and reliability of the tool:

Tools are standardized. Therefore, its validity was based on the studies and opinions of clinical experts, who rated the internal consistency reliability (Cronbach's α) for PIPP as 'excellent' with 0.901.

Pilot study

Pilot study was carried out on 10% of study sample (9 premature infants) participated to evaluate the instrument's clarity, viability, and applicability as well as to improve the study design. The study used samples from pilot studies and the corresponding adjustments were applied consistently.

Fieldwork

Between Augst 1, 2021, and March 30, 2022, data was gathered. For the study group, the researchers were assigned to each premature newborn. Mothers were urged to thoroughly wash their hands before KC. Premature infants only wore diapers and hats during KC. To maintain her privacy, Mothers sit back in her chair behind a privacy curtain. The premature was put between the mother's breasts with the head raised upright to allow as much surface area in touch with the skin as possible. The mother was dressed, but the chest area was left uncovered. To prevent heat loss, blankets were placed over infants. Both study and control groups' premature infants were received breast feeding an hour before their blood was drawn. Premature infants in the control group got just routine care without any assistance from the resaerchers. Both infants in the KC group

and the infants in control group when they were quiet in their incubator had blood drawn for standard laboratory examinations. KC starts 15 minutes before BS and lasts till blood sample is complete. The premature infants' pain response was then evaluated by the researchers using the premature infant pain profile (PIPP) 10 min before, 3 min during and 10 min after blood sample procedure. In both groups, scores were generated to classify the pain experienced by premature infants.

Ethical Considerations

Authorized ethically by the Mansoura University Faculty of Nursing Research Ethics Committee was obtained for conducting the study. Parents of premature infants who met the study's eligibility requirements were verbally told of the study's objectives and given consent. Additionally, moms who consent to infant participation are told that all data would be kept private.

Administrative design:

Following a description of the study's aim, methods, timeline, and utility, the NICU director provided the formal approval needed to carry out the study.

Statistical analysis:

The outcomes of the data sorting and categorization were shown in a table. On a suitable personal computer, data were assessed using the Statistical Package for Social Sciences (SPSS Inc; version 21; IBM Corp., Armonk, NY, USA). The data's normality was assessed using the one-sample Kolmogorov-Smirnov test. The quantitative data were described in terms of numbers and percentages. The two means were compared using a t-test. Percent of categorical variables were compared using the Chi-square test when appropriate. Results were deemed significant ($p < 0.05$) when the chance of error was less than 5%, and highly significant ($p < 0.001$) when it was less than 0.1%**.**

Results

Table 1 illustrates premature infants' characteristics. It was found that female premature infants constituted 55.6%, and 53.3%, of the study, and control groups respectively. Moreover, the mean gestational age of premature infants in the study and control groups are 32.17±1.20, and 31.99±1.10, respectively. The mean birth weight of premature infants in the study and control groups presented as 2.110±170.9, and 2.096±154.2, respectively. Vaginal labor constituted 51.1%, and 44.4%, of the study, and control groups respectively. Whereas C/S constituted 48.9%, and 55.6%, of the study, and control groups respectively. The mean Apgar score at 1st minute is 8.20±0.83, and 8.37±0.70, for the study, and control groups respectively. Moreover, it presented as 9.12±0.41 and 9.01±0.52 of the study, and control groups respectively at the 5th minute.

Table 2 reveals the mean score of premature infant pain profile of premature infants. The KC and control participants had a mean of 2.10±0.18 versus 3.13±0.16, 3.23±0.25 versus 9.34±3.33, and 2.35±0.22 versus 6.75±2.16 of HR before, during, and after blood sampling (BS), respectively. Regarding O2 saturation, premature infants of the KC group demonstrated more stabilized oxygen saturation before, during, and after BS at means of 1.65±0.40, 2.17±0.61, and 1.86±0.42 respectively. As regards, the Brow Bulge the KC and control participants had a mean of 1.67±0.45versus 4.20±1.36, 2.93±0.32 versus 5.36±1.56, and 2.74±0.29 versus 5.00±1.12 before, during, and after BS, respectively. Concerning eye squeeze, premature infants of the KC group demonstrated means of 1.63±0.64, 2.57±0.58, and 2.11±0.49 before, during, and after BS, respectively compared to 2.87±1.43, 5.98±1.31, and 5.03±1.42 for the control group. Moreover, for nasolabial furrow KC group demonstrated means of 2.00±0.26, 2.79±0.33, and 2.53±0.38 before, during, and after BS, respectively compared to 3.99 ± 0.35, 6.87 ± 0.41, and 6.32 ± 0.37for the control group, respectively. There is a significant difference between the study and control group at a *p*-value =<0.05 for all.

Table 3. Revealed that 77.8% of the KC group had mild pain, while 35.6% of the control group had moderate pain before BS. Also, 55.6% of the KC group had mild pain, while 51.1% of the control group had moderate pain during BS. Additionally, 64.4% of the KC group had mild pain, while 48.9% of the control group had moderate pain after BS. Finally, there was a statistically significant difference between the study and control group before, during, and after BS at a *p*-value <0.05 for all.

Figure 1. Revealed that 55.6% of the KC group had mild pain, while 33.3% of the control group had moderate pain before BS**.**

Figure 2. Revealed that 64.4% of the KC group had mild pain, while 48.9% of the control group had moderate pain before BS**.**

Table 1: *Distribution of studied premature infants regarding their characteristics (n=45)*

Items	**Study group 45**		**Control group 45**		**Test P value**
	N	**%**	**n**	**%**	
Gestational age: (weeks)					
30 <32	13	28.9	13	28.9	T-test
32 <34	20	44.4	22	48.9	0.987
34 - 36	12	26.7	10	22.2	>0.05
Mean SD					
	32.17 ± 1.20		31.99 ± 1.10		
Gender:					Chi-square
Male	20	44.4	21	46.7	1.204
Female	25	55.6	24	53.3	>0.05
Birth weight:					1.009
Mean SD	2.110 ± 170.9		2.096 ± 154.2		>0.05
Type of labor:					Chi-square
Vaginal	23	51.1	20	44.4	1.876
C/S	22	48.9	25	55.6	>0.05
Apgar score:					Chi-square
1st minute	8.20 ± 0.83		8.37 ± 0.70		0.661 >0.05
5th minute	9.12 ± 0.41		9.01 ± 0.52		0.734 >0.05

Table 2: *Comparison of the mean score of premature infant pain profile scale in the premature infants of the study and control groups (n=45).*

Items	Study Mean SD	Control Mean SD	T-test	P value
Heart Rate ((/min))				
Before blood sampling	2.10 ± 0.18	3.13 ± 0.16	5.602	<0.05*
During blood sampling	3.23 ± 0.25	9.34 ± 3.33	4.001	<0.05*
After blood sampling	2.35 ± 0.22	6.75 ± 2.16	4.013	<0.05*
O2 saturation (%)				
Before blood sampling	1.65 ± 0.40	3.70 ± 1.10	3.602	<0.05*
During blood sampling	2.17 ± 0.61	4.29 ± 1.89	4.102	<0.05*
After blood sampling	1.86 ± 0.42	3.61 ± 1.27	3.750	<0.05*
Brow Bulge (sec)				
Before blood sampling	1.67 ± 0.45	4.20 ± 1.36	3.244	<0.05*
During blood sampling	2.93 ± 0.32	5.36 ± 1.56	2.998	<0.05*
After blood sampling	2.74 ± 0.29	5.00 ± 1.12	4.110	<0.05*
Eye squeeze (sec)				
Before blood sampling	1.63 ± 0.64	2.87 ± 1.43	4.102	<0.05*
During blood sampling	2.57 ± 0.58	5.98 ± 1.31	3.851	<0.05*
After blood sampling	2.11 ± 0.49	5.03 ± 1.42	4.200	<0.05*
Nasolabial Furrow(sec)				
Before blood sampling	2.00 ± 0.26	3.99 ± 0.35	4.660	<0.05*
During blood sampling	2.79 ± 0.33	6.87 ± 0.41	5.013	<0.05*
After blood sampling	2.53 ± 0.38	6.32 ± 0.37	4.056	<0.05*

Table 3: *Distribution of premature infants among study and control groups related to total pain scale (n=45).*

Items	Study 45		Control 45		Chi-square	P value
	n	%	N	%		
Before blood sampling						
Mild	35	77.8	29	64.4		
Moderate	10	22.2	16	35.6	4.506	<0.05*
Severe	0	0	0	0		
During blood sampling						
Mild	25	55.6	15	33.3		
Moderate	18	40	23	51.1	5.228	<0.05*
Severe	2	4.4	7	15.6		
After blood sampling						
Mild	29	64.4	19	42.2		
Moderate	16	35.6	22	48.9	4.173	<0.05*
Severe	0	0	4	8.9		

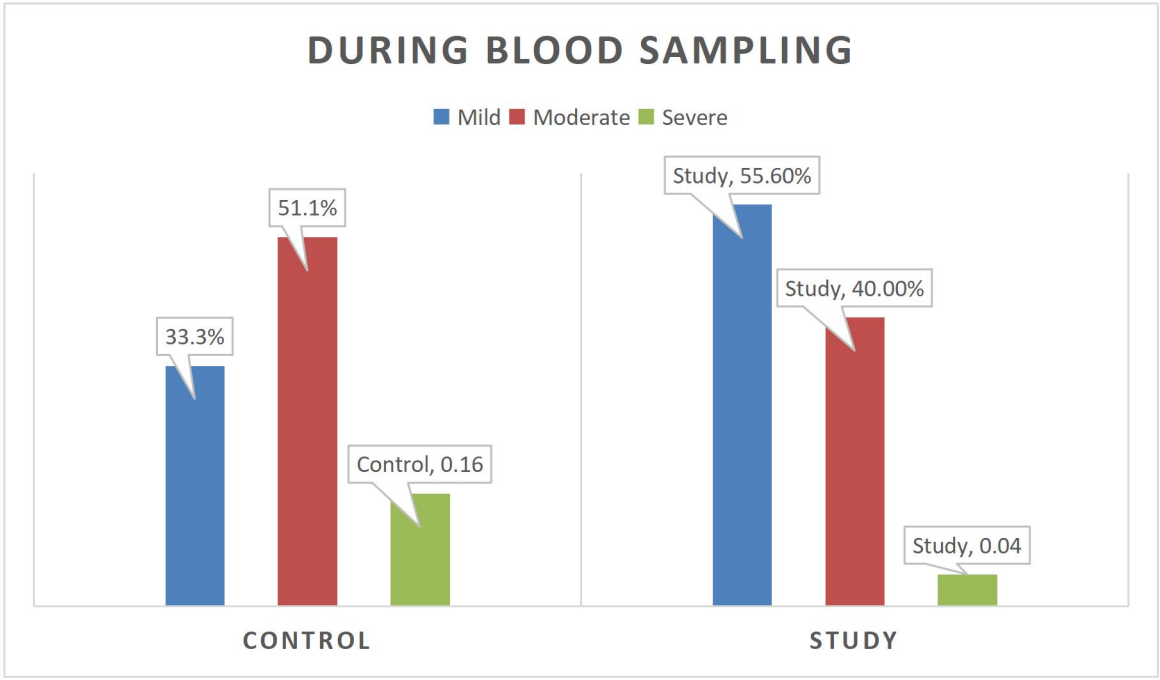

Figure 1. *Distribution of premature infants among control and study groups related total pain scale during blood sample (n=45).*

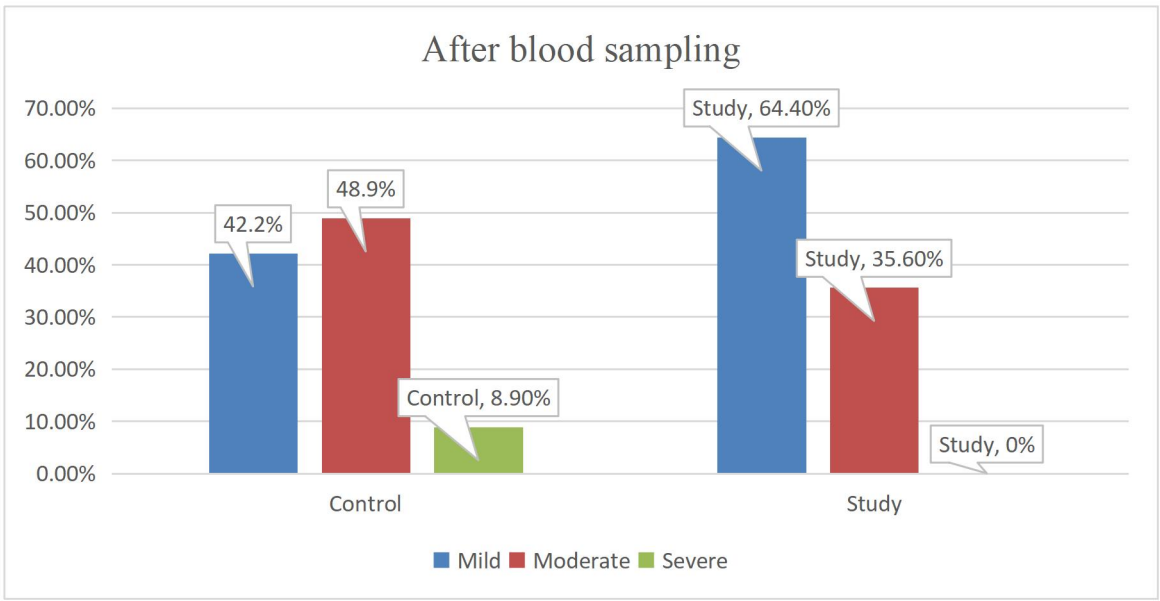

Figure 2. *Distribution of premature infants among control and study groups related total pain scale after blood sample (n=45).*

Discussion

Kangaroo Care (KC), a humanitarian intervention, was founded in Bogota, Colombia, in the late 1970s in order to keep premature infants' temperatures stable in the neonatal intensive care unit

(NICU) when incubators were insufficient method **(Davy, Bergh, & Van Rooyen, 2011; Grayson, & Claire, 2018; Kostandy, & Ludington-Hoe, 2019**). The distinctiveness of KC is acknowledged on a global scale for its immense advantages in restoring physiological indices to balance and enhancing psychological circumstances. According to studies, KC can shorten newborns' hospital stays by promoting weight growth, extending sleep, improving oxygen saturation, reducing apnea, and regulating body temperature. Consequently the total newborn morbidity and death rate significantly decreased **(Cristóbal Cañadas et al., 2022; Cunningham et al., 2021; Samsudin, Chui, Kamar, & Abdullah, 2022).** Therefore, this study aimed to assess the effect of kangaroo care on pain response in premature infants during blood sampling.

Regarding the characteristics of premature infants, the current study found that the mean gestational age of premature infants in the study and control groups was 32.17 ± 1.20 and 31.99 ± 1.10, respectively. This finding is contradicted with **Sen& Manav, (2020**) who found that the mean gestational age was 34.38± 1.59 in the experimental group and 34.95± 1.43 in the control group. Regarding birth weight this result revealed that the control group's mean birth weight was 2.096± 154.2 while the study group's mean birth weight was 2.110±170.9 for premature infants. This result is in contrast to their findings by **Sen & Manav (2020)** who discovered that the mean birth weight of premature infants was 2102.97 ±346.21 in the study group and 2244.69± 344.89 in the control group.

Concerning the comparison of the mean score of premature infant pain profile scale in the premature infant of the study and control groups The current study discovered that there were statistically significant differences between the study and control groups before, during, and after BS p-value < 0.05. In the current study, KC was linked to pain alleviation before, during, and following invasive BS procedures in premature infants when started 15 minutes before and continued for another 15 minutes after demonstrated to be efficient at pain alleviation. This outcome is in line with **Seo, Lee, and Ahn's (2016)** study, which discovered that between the two groups, differences identified. Heart rate and oxygen saturation varied significantly. They also observed that KC had a beneficial impact on heart rate decrease, supporting the usefulness of PIPP as a therapeutic intervention to lessen newborn pain both during and after neonatal heel sticks.

These findings are also in line with study done by **Sen & Manav (2020**), which compared the effects of KC and oral sucrose on pain alleviation after the use of heel lances in premature newborns and demonstrated that there is a statistically significant between them. KC is more effective than oral sucrose in reducing pain in premature infants. This finding was supported by **Boundy et al., 2016**, who shows a similar outcome. The KMC is unquestionably supported as a standard of therapy for pain reduction by a pooled analysis of several RCTs. Similarly, Sharma and **Ruikar's (2022**) that included the results of six researches suggested that KMC may have a statistically significant advantage for future pain reduction. Technique for stimulating (p=0.01, mean difference=-2.04, 95% Chi2 = 69.86, I2 = 93%, CI: 3.65, -0.43.

Regarding distribution of premature infant among study and control groups related total pain scale the present study showed that, there was significantly decreased in the severity of pain compared to control group before, during, and after BS at a *p*-value <0.05. The current results mentioned that, more than three quarters of KC group had mild pain, while more than one third of control group had moderate pain before BS. Also, more than half of KC group had mild pain, while more than half of control group had moderate pain during BS. Additionally, about two thirds of KC group had mild pain, while about half of control group had moderate pain after BS. According to the researchers' point of view, the results may be connected to how well KC treatments reduce pain in premature infants. This finding in harmony with **Wang et al., (2022)**

that, KC was fairly beneficial in reducing pain during painful procedures, but not between 28 and 31+6 weeks. Additionally, 15 or 30 minutes of KC was only marginally beneficial and may only greatly reduce pain at that very instant and 30 or 60 seconds afterward, with minimal impact at 90 or 120 seconds after the treatment has no impact.

Additionally, This outcome matched with **El-Farrash et al., (2020**) who showed in their study about how KC enhanced premature newborns' neurobehavioral performance and feeding who observed a significant difference between the kangaroo care groups (36.90 10.06 and 38.07 13.10) and the control group (57.47 10.86 and 50.10 9.19). similarly, **Gholami et al., (2021)** revealed that the KC group experienced significantly less newborn pain (2.00 1.02) than the control group (4.17 1.21) ($p<0.001$). Similarly to this, **Bastani, Rajai, Farsi, & Als, (2017)** who reported that KC improves the quality of premature infants' sleep. **Seo et al., (2016)** also mentioned that KC could be a useful strategy in in a full-term nursery for neonatal pain management. Also, the study carried out by **Zeng et al., (2022)** who revealed that the experience of fathers involved in KC of premature infants included creating the feeling of being a father, improving the correlation between the father and the child and reducing stress of premature infants. Moreover, **Parsa, Karimi, Basiri, & Roshanaei, (2018)** indicate the effect of KMC on improvement of physiological indices. Therefore, it is recommended that KMC is taken as one of the routine care of premature infants.

Conclusion

Based on study findings, premature infants who received Kangaroo care exhibited less pain scores during blood sampling compared to premature infants who did not receive it

Recommendations

Based on current study results, it can be recommended that KC should be part of the routine care of premature infants admitted in the NICU. An illustrated booklet explaining the KC technique step by step should be available in NICU. An ongoing training program should be conducted regularly for neonatal nurses to improve their knowledge and practice regarding KC.

References:

Atnafu, N., Gelaw, K. A., Azeze, G. A., Admass, B. A., Lake, E. A., & Adela, G. A. (2022). Knowledge, attitude and practice towards kangaroo mother care among postnatal women in Ethiopia: systematic review and meta-analysis. https://doi.org/10.1371/journal.pone.0265411

Bastani, F., Rajai, N., Farsi, Z., & Als, H. (2017). The effects of kangaroo care on the sleep and wake states of premature infants. *Journal of Nursing Research*, *25*(3), 231-239.

Blackett, K., James, C., Lok, A., & Reeder, C. (2022). 900 Side-lying Kangaroo care: all the benefits whilst still maintaining midline head positioning. Archives of Disease in Childhood.107:A172-A173.http://dx.doi.org/10.1136/archdischild-2022-rcpch.277

Boundy, E. O., Dastjerdi, R., Spiegelman, D., Fawzi, W. W., Missmer, S. A., Lieberman, E., ... & Chan, G. J. (2016). Kangaroo mother care and neonatal outcomes: a meta-analysis. *Pediatrics, 137*(1). http://dx.doi.org/10.1542/peds.2015-2238

Bucsea, O., & Pillai Riddell, R. P. (2019). Non-pharmacological pain management in the neonatal intensive care unit: Managing neonatal pain without drugs. *Seminars in fetal & neonatal medicine, 24*(4), 101017. https://doi.org/10.1016/j.siny.2019.05.009

Campbell-Yeo, M., Eriksson, M., & Benoit, B. (2022). Assessment and Management of Pain in Premature

infants: A Practice Update. *Children, 9*(2), 244. https://doi.org/10.3390/children9020244

Chan, G. J., Valsangkar, B., Kajeepeta, S., Boundy, E. O., & Wall, S. (2016). What is kangaroo mother care? Systematic review of the literature. *Journal of global health*, *6*(1). http://dx.doi.org/10.7189/jogh.06.010701

Chawanpaiboon, S., Vogel, J. P., Moller, A. B., Lumbiganon, P., Petzold, M., Hogan, D., ... & Gülmezoglu, A. M. (2019). Global, regional, and national estimates of levels of preterm birth in 2014: a systematic review and modelling analysis. *The Lancet Global Health*, *7*(1), e37-e46. http://dx.doi.org/ 10.1016/S2214-109X(18)30451-0**Cristóbal Cañadas, D., Bonillo Perales, A., Galera Martínez, R., Casado-Belmonte, M. D. P., & Parrón Carreño, T. (2022).** Effects of Kangaroo mother care in the NICU on the physiological stress parameters of premature infants: a meta-analysis of RCTs. *International journal of environmental research and public health*, *19*(1), 583. https://doi.org/10.3390/ijerph19010583

Cristóbal Cañadas, D., Parrón Carreño, T., Sánchez Borja, C., & Bonillo Perales, A. (2022). Benefits of Kangaroo Mother Care on the Physiological Stress Parameters of Premature infants and Mothers in Neonatal Intensive Care. *International Journal of Environmental Research and Public Health*, *19*(12), 7183. https://doi.org/10.3390/ijerph19127183

Cunningham, C., Patton, D., Moore, Z., O'Connor, T., Bux, D., & Nugent, L. (2021). Neonatal kangaroo care-What we know and how we can improve its practice: An evidence review. *Journal of Neonatal Nursing*, 28(6), 383-387. https://doi.org/10.1016/j.jnn.2021.10.004

Davy, K., Bergh, A., & Van Rooyen, E. (2011). The neonatal nurse's role in kangaroo mother care: mother and child health. Professional Nursing Today, 15(3), 32-37. https://hdl.handle.net/10520/EJC79433

De Costa, A., Moller, A. B., Blencowe, H., Johansson, E. W., Hussain-Alkhateeb, L., Ohuma, E. O., ... & Moran, A. C. (2021). Study protocol for WHO and UNICEF estimates of global, regional, and national preterm birth rates for 2010 to 2019. *PloS one*, *16*(10), e0258751. https://doi.org/10.1371/journal.pone.0258751

Efe, Y. S., Erdem, E., Caner, N., & Güneş, T. (2022). The effect of gentle human touch on pain, comfort and physiological parameters in premature infants during heel lancing. *Complementary Therapies in Clinical Practice, 48*, 101622. https://doi.org/10.1016/j.ctcp.2022.101622

El-Farrash, R. A., Shinkar, D. M., Ragab, D. A., Salem, R. M., Saad, W. E., Farag, A. S., ... & Sakr, M. F. (2020). Longer duration of kangaroo care improves neurobehavioral performance and feeding in premature infants: a randomized controlled trial. *Pediatric Research*, *87*(4), 683-688. https://doi.org/10.1038/s41390-019-0558-6

Erçelik, Z. E., & Yilmaz, D. (2022). Nonpharmacological Applications During the Retinopathy of Prematurity Examination and Their

Effects on Pain Control: A Systematic Review and Meta-analysis. *The Journal of Perinatal & Neonatal Nursing, 36*(3), 297-304. https://doi.org/10.1097/JPN.0000000000000673

Erkut, Z., Mutlu, B., & Çakici, M. (2021). The effect of 3 positions given to premature infants during heelstick procedure on pain and durations of crying and procedure. *The Journal of Perinatal & Neonatal Nursing, 35*(2), 188-195. https://doi.org/10.1097/JPN.0000000000000547

Espinosa Fernandez, M. G., González-Pacheco, N., Sánchez-Redondo, M. D., Cernada, M., Martín-Ancel, A., Perez-Munuzuri, A., ... & Couce, M. L. (2021). Sedoanalgesia in neonatal units *59*, 102735.

Fitri, S. Y. R., Nasution, S. K., Nurhidayah, I., & Maryam, N. N. A. (2021). Massage therapy as a non-pharmacological analgesia for procedural pain in neonates: A scoping review. *Complementary Therapies in Medicine*, *59*, 102735. https://doi.org/10.1016/j.ctim.2021.102735

Grayson & Claire E., "Kangaroo Mother Care". Embryo Project Encyclopedia (2018-04-11). ISSN: 1940-5030 http://embryo.asu.edu/handle/10776/13060.

Gross, M., Engel, C., & Trotter, A. (2021). Evaluating the effect of a neonatal care bundle for the prevention of intraventricular hemorrhage in premature infants. *Children*, *8*(4), 257.

Hamad, N. I., Khamis, G. M., & Rashwan, Z. I. (2022). Effect of Kangaroo Mother Care versus Hammock Positioning on Physiological Indices and Behavioral Organization among Premature Neonates: A Humanized Nursing Approach. *Tanta Scientific Nursing Journal*, *25*(22), 37-48.

Huang, W., Ural, S., & Zhu, Y. (2022). Premature labor tests: Current status and future directions. Critical Reviews in Clinical Laboratory Sciences, 59(4), 278– 296. https://doi.org/10.1080/10408363.2022.2027864

Kostandy, R. R., & Ludington-Hoe, S. M. (2019). The evolution of the science of kangaroo (mother) care (skin-to-skin contact). *Birth defects research, 111*(15), 1032-1043.

Narciso, L. M., Beleza, L. O., & Imoto, A. M. (2022). The effectiveness of Kangaroo Mother Care in hospitalization period of premature and low birth weight infants: systematic review and meta-analysis. *Jornal de Pediatria, 98*, 117-125.

Özkan, T. K., Yüksel, E. D., & Akar, S. (2022). Effect of non-nutritive sucking on pain during the examination of retinopathy of prematurity. *Journal of Neonatal Nursing, 28*(3), 155-158. https://doi.org/10.1016/j.jnn.2021.12.002

Parsa, P., Karimi, S., Basiri, B., & Roshanaei, G. (2018). The effect of kangaroo mother care on physiological parameters of premature infants in Hamadan City, Iran. *The Pan African medical journal*, *30*.

Riadini, A. Y., & Suwandono, A. (2019). A modified gentle human touch (GHT) to increase oxygen saturation levels on low birth weight infants: A study at a Private and Public Hospital in Central Java, Indonesia. *GHMJ (Global Health Management Journal)*, *3*(1), 4-7. https://doi.org/10.35898/ghmj-31549

Samsudin, S., Chui, P. L., Kamar, A. B. A., & Abdullah, K. L. (2022). Maternal Kangaroo care education program in the neonatal intensive care unit improved mothers' perceptions, knowledge, perceived barriers and stress relates to premature infant. *Nursing Open*.

Sen, E., & Manav, G. (2020). Effect of Kangaroo care and oral sucrose on premature infants' pain: a randomized controlled trial. *Pain management nursing*, *21*(6), 556-564. https://doi.org/10.1016/j.pmn.2020.05.003

Seo, Y. S., Lee, J., & Ahn, H. Y. (2016). Effects of kangaroo care on neonatal pain in South Korea. *Journal of Tropical Pediatrics*, *62*(3), 246-249.

Sharma, D., Farahbakhsh, N., Sharma, S., Sharma, P., & Sharma, A. (2019). Role of kangaroo mother care in growth and breast feeding rates in very low birth weight (VLBW) neonates: a systematic review. *The Journal of Maternal-Fetal & Neonatal Medicine*, *32*(1), 129-142. https://doi.org/10.1080/14767058.2017.1304535

Sharma, H., & Ruikar, M. (2022). Kangaroo mother care (KMC) for procedural pain in infants: A meta-analysis from the current evidence of randomized control trials and cross-over trials. *Journal of Family Medicine and Primary Care*, *11*(4), 1250. https://doi.org/10.4103/jfmpc.jfmpc_1383_21

Stevens, B., Johnston, C., Petryshen, P., & Taddio, A. (1996). Premature infant pain profile: development and initial validation. *The Clinical journal of pain*, *12*(1), 13-22.

Suitor, C. (2022). Kangaroo mother care: A literature review of barriers and facilitators to implementation in the neonatal intensive care unit. *Journal of Neonatal Nursing*. Available online 12 July 2022. https://doi.org/10.1016/j.jnn.2022.07.003

Thomson, G., & Feeley, C. (2021). Types, evidence, and resources of interventions focused on improving the psychosocial wellbeing of parents of premature/sick infants: A scoping review. *Advances in Neonatal Care*. https://doi.org/10.1097/ANC.0000000000000913

Wang, F., Zhang, Q., Ni, Z. H., & Lv, H. T. (2022). Effects of kangaroo care on pain relief in premature infants during painful procedures: A meta-analysis. *Journal for Specialists in Pediatric Nursing*, e12390. https://doi.org/10.1111/jspn.12390

World Health Organization (2019, February 8). Kangaroo mother care Available from: https://www.who.int/reproductivehealth/publications/maternal_perinatal_health/9241590351/en/ Last accessed 2021 Nov 10

Yang, Z., Fu, Y., & Wang, Y. (2022). Summary and Analysis of Relevant Evidence for Nondrug Nursing Programs in Neonatal Operational Pain Management. *Emergency Medicine International*, *2022*. https://doi.org/10.1155/2022/7074500

Yilmaz, D., & Kurt, F. Y. (2021). The effect of foot reflexology on procedural pain before heel lancing in neonates. *Archives de Pédiatrie*, *28*(4), 278-284.

Yıldızdaş, H. Y., Karahan, D. Y., OZLU, F., & Sertdemir, Y. (2022). The Effect of Whole Body Massage on Pain Scores of Neonates During

Venous Puncture and Comparison With Oral Dextrose and Kangaroo Care, a Randomized Controlled Evaluator-blind Clinical Study. PREPRINT (Version 1) available at Research Square. https://doi.org/10.21203/rs.3.rs-1925790/v1

Yurdagül, N. İ., & Esenay, F. I. (2022). Effect of kangaroo care applied by mothers and fathers in premature infants: A crossover study. *Journal of Neonatal Nursing.* Available online 26 August 2022. https://doi.org/10.1016/j.jnn.2022.08.008

Zeng, X., Li, L. L., Wu, X., Tian, Y. H., Gao, D. D., & Hu, X. J. (2022). Qualitative study on the experience of fathers involved in kangaroo care of premature infants. *Journal of Neonatal Nursing*.

Zer, S., Wainstock, T., Sheiner, E., Miodownik, S., & Pariente, G. (2021). Identifying the critical threshold for long-term pediatric neurological hospitalizations of the offspring in premature delivery. *Journal of Clinical Medicine, 10*(13), 2919. https://doi.org/10.3390/jcm10132919

Zhao, T., Griffith, T., Zhang, Y., Li, H., Hussain, N., Lester, B., & Cong, X. (2022). Early-life factors associated with neurobehavioral outcomes in premature infants during NICU hospitalization. *Pediatric Research*, 1-10. https://doi.org/10.1038/s41390-022-02021-y