- **Basic Research**

Effect of Kangaroo Mother Care and Prone Position on Feeding Intolerance, Physiological Parameters, and Comfort among Preterm Neonates

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Abstract:

Background: Preterm neonates have an increased vulnerability to feeding intolerance problem and distress in Neonatal Intensive care unit, and they considered the most common significant donators to neonates' growth retardation. therefore, it is pivotal for neonatology nurses to detect this condition as early as possible and find effective intervention for confronting this problem to enhance neonates' outcomes. Kangaroo Mother Care and prone positions are therapeutic nursing modalities that may be effective for the protection from feeding intolerance and improve neonates' comfort in NICU. This study **aimed** to investigate the effect of kangaroo mother care and prone position on gastrointestinal intolerance, physiological parameters, and comfort in preterm neonates. A quasi-experimental research **design** was conducted to this study**. Setting:** This study was conducted in Neonatal Intensive Care Unit (NICU) at Alexandria University Children's Hospital (AUCH) at Smouha in Alexandria. **Sampling**: A convenience sample of 60 preterm neonates more than 130000 gm. hospitalized in NICU from March 2020 to March 2021.Four **tools** were used to collect the necessary data for this study: Tool1: Preterm Neonates' Characteristics and Their Mothers Assessment Record, Tool II: feeding intolerance and NEC risk–scoring tool, Tool III: feeding intolerance assessment sheet and Tool IV: COMFORT neo scale. **Results**: statistically significant differences were found between the 1st day and 3[rd] day concerning feeding intolerance parameters in the study group regarding the means of the abdominal circumference (P=0.000), the frequency of vomiting episodes (P=0.000), the frequency of defecation (P==<.001) and daily weight gain (P=.003). Additionally, improvement in the neonates' gastric residual volumes among both groups of study with no statistically significant differences were found. KMC and prone positions recorded more stability in physiological parameters than control group in the study. Fortunately, intervention group exhibited high significant comfort levels on three days of study in comparison with control group (P= 0.000). It is concluded that KMC and prone positions may reduce preterm neonates' gastric residual volume, frequency of vomiting episodes, and abdominal circumferences while increasing their daily weight gain and frequency of defecation. This study advised NICU nurses to emphasize the value of applying KMC and prone positions as a safe non-invasive intervention for preterm neonates.

Keywords: *preterm neonates, Kangaroo mother care, prone position, feeding intolerance, physiological parameters, comfort.*

1. Introduction

An estimated 15 million preterm deliveries occur each year throughout the world, necessitating admission to acute nursing care. Infant morbidity and death are significantly influenced by prematurity. It is quite challenging to manage these preterm neonates' dietary needs (Gomaa, Ahmed, & Aboelmagd, 2022). These newborns are more likely to experience feeding intolerance because of their immature digestive systems and high nutritional needs for catch-up growth. This could result in inadequate nutrition and subsequent negative effects like slowed brain development, cognitive delays, and necrotizing enterocolitis (NEC). Additionally, the chance of developing food intolerance may be increased by a caesarean delivery, a prolonged stay in a neonatal intensive care unit (NICU), or the use of antibiotics (Tume & Valla, 2018).

As one of the most prevalent nutritional issues in preterm infants, feeding resistance is often present. It describes the inability of preterm newborns to digest enteral feedings that manifested as gastric residual volumes (GRV) greater than 50%, abdominal distension, emesis, or both, and the disruption of the feeding schedule brought on by gastrointestinal symptoms. (Lin, Chu, Chen, Chen, & Huang, 2022; Özdel & Sarı, 2020). It is found in form of delayed gastric emptying. Increased gastric residual volume, emesis, abdominal distension is considered as criteria for feeding intolerance or precursors to NEC. For preterm neonates without NEC but with feeding intolerance, delayed enteral nutrition may lead to problems such as delayed intestinal tract development and caloric deficiencies (Safari, Saeed, Hasan, & Moghaddam-Banaem, 2018). Thus, preventing development of feeding intolerance in preterm neonates considered an enormous challenge in preterm neonatal care. Moreover, enteral feeding plays big role for the preterm infants in NICU and has a regulatory influence on development gastrointestinal system. Fortunately, Advancement of early enteral nutrition is delayed or discontinued for >24 h in nearly 75% of all extremely preterm infants. Despite of clinical evidence showing that early establishment of enteral nutrition is associated with reductions in severity of critical illness and long-lasting benefits on linear growth and neurodevelopmental outcomes (Kim & Bang, 2018; Naberhuis, Wetzel, & Tappenden, 2016).

On the other hand, NICU is a stressful environment for the neonates, stressful factors such as noise, nursing and medical interventions and harsh light. While the most important stressful factor is separation from mother, which is not the same as in the uterus life (Mirnia, Arshadi Bostanabad, Asadollahi, & Hamid Razzaghi, 2017). Distress and decrease in comfort negatively affect the evolutionary behavior of neonates and can will disturb the development of the infant immediately and may last for the rest of their life. These may alter the growth and development due to decrease of self-regulation of their autonomic nervous system (Mirnia et al., 2017; Özdel & Sarı, 2020). COMFORTneo scale is one of the tools for investigating the levels of comfort and distress among neonates. Fortunately, it seems that since skin-to-skin care can soothe the infant, it may decrease stress as well (Boerlage et al., 2015).

These problems may be improved via Kangaroo Mother Care (KMC) and prone positioning. When KMC is used as early as possible after stabilization of the neonates, it is found that mortality and morbidity of the preterm neonates decreased. So, KMC and prone position is considered to have influence on protection from feeding intolerance (Bera et al., 2014; Özdel & Sarı, 2020). It is one of developmental care that helps improving the regular function of the preterm systems and to maintain homeostasis, because it allows the bonding to occur between the mother or caregivers and the preterm neonates. There are many different feeding intolerance prevention techniques, and they differ greatly amongst institutions. Unfortunately, newborns may still develop significant levels of feeding resistance despite best efforts to incorporate these methods. It is essential that this condition be identified as soon as feasible and swiftly treated with therapy supported by evidence. A focused inquiry into feeding intolerance's treatment and prevention should significantly enhance preterm neonates' outcomes (Naberhuis et al., 2016).

As a result, neonatal nurses are crucial to the care of preterm neonates. Therefore, neonatal nurses will continue to be crucial first line defenses in feeding intolerance identification and significant champions for their neonates. There is also a need to address nursing assessment for early detection of feeding intolerance symptoms. When a preterm neonate is suffering feeding intolerance, neonatal nurses must fully comprehend any potential physical changes they may found. (Tekgündüz, Gürol, Apay, & Caner, 2014; Valizadeh, Hosseini, Asghari Jafarabadi, & mohebbi, 2015). NICU administration must apply KMC and prone position approaches for all neonates. Studies have demonstrated the importance of adequate feeding, nutrition, and growth, especially in this preterm population. Early-life feeding problems may be associated with adverse growth and neurodevelopmental outcomes (Ameri, Rostami, Baniasadi, Aboli, & Ghorbani, 2018; Azeez & Azize, 2020). In addition to that a lack of evidence from clinical trials to support protective approaches from feeding intolerance and NEC. So, the researchers conducted this study to determine the effect of kangaroo mother care and prone position on feeding intolerance, physiological parameters, and comfort among preterm neonates

1.2.Aim of the study

This study aimed to investigate the effect of kangaroo mother care and prone position on feeding intolerance, physiological parameters, and comfort among preterm neonates

1.2. Research hypothesis

Preterm neonates who received KMC and prone position exhibit less feeding intolerance, stable physiological parameters, and more comfort than who don't.

2. Subjects and Method

2.1.Research Design: A Quasi-experimental research design was conducted to accomplish this study.

2.2.Setting: This study will be conducted at Neonatal Intensive Care Unit (NICU) of Alexandria University Children's Hospital (AUCH) at Smouha in Alexandria, Egypt.

2.3.Sampling: A convenience sample of 60 preterm neonates hospitalized from March 2020 to March 2021 and met the following criteria included the study:

- Preterm neonates: gestational age ranged from 30 to 36weeks.
- Birth weight over 1300 gm and had stable physiological parameters.
- Enteral feeding (gavage or oral feeding).
- Had spontaneous respiration and didn't require ventilatory support.
- Free from major congenital malformation as congenital heart disease, gastrointestinal (GIT) anomalies.
- Free from neurological disorders such as Hypoxic Ischemic Encephalopathy (HIE), Intraventricular Hemorrhage (IVH) and skull fracture.
- Didn't develop necrotizing enterocolitis (NEC).

Sample size estimation determined based on Open Epi Info Program, 60 preterm neonates. Participants were randomly assigned to two equal groups (Fig. 1):

- **Control group**: preterm neonates who received only standard routine hospital care (putted on semi setting position with head elevated 30ºC and their head on one side for 30 minutes after feeding inside incubator) (30 preterm neonates).
- **KMC and prone position group**; Preterm neonates received KMC for 30 minutes during and after feeding and then putted on prone position in incubator with close observation with researcher (30 preterm neonates).

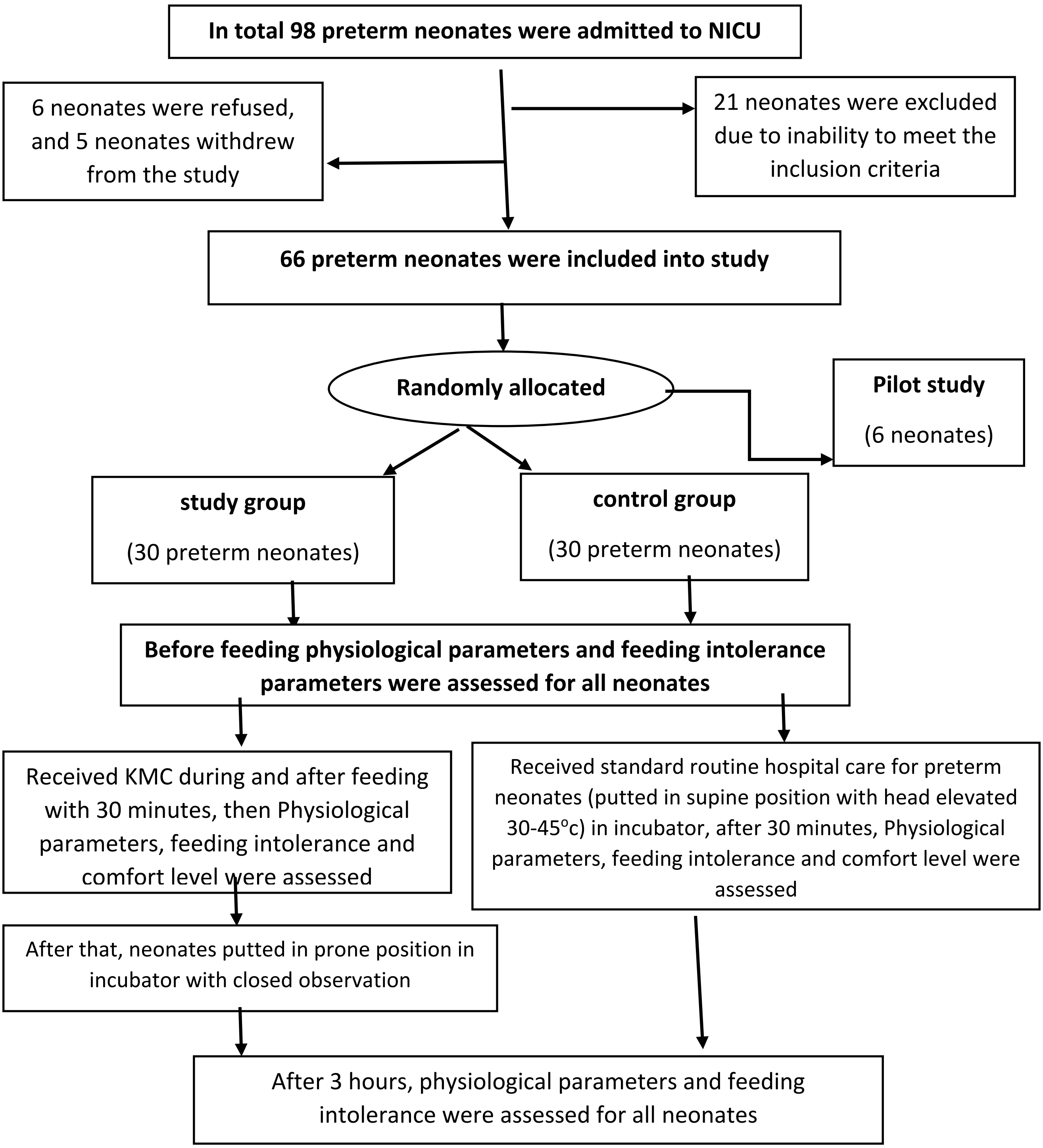

Figure (1): Flow chart of participants distribution in the study

2.4. Tools: Three tools were used to collect the necessary data for this study: -

Tool I: Preterm Neonates' Characteristics and Their Mothers Assessment Record.

This tool was developed by the researchers after reviewing of the recent relevant literatures (Mirnia et al., 2017; Özdel & Sarı, 2020) to identify the characteristics of preterm neonates and their mothers. it included two parts:

Part One: Preterm Neonates' Characteristics; as sex, gestational age (weeks), Postnatal age, Birth weight, and method of feeding.

Part Two: Preterm neonates' medical data; as Apgar scoring, blood transfusion, and diagnosis.

Part Three: Preterm Neonates' Mother's Characteristics; as age, type of pregnancy, number of gravidas, number of paras, type of pregnancy, and method of delivery.

Tool II: Feeding Intolerance and NEC Risk–Scoring Tool:

Naberhuis et al. (2016) developed and validated this tool to evaluate early parameters related to the detection of feeding intolerance in preterm infants and its severity. It comprises of five categories, including birth weight, gestational age at birth, the substance used to feed the infant, the newborn's postnatal circumstances, and perinatal mother circumstances. Numerous risk factors were used to fill out these categories, and each one was given a point value in the range of 1 to 3. the overall score, which ranges from 1 to 44 and is calculated by adding the points assigned to each risk factor. A score of 1 to 5 indicated minimal risk of feeding intolerance, 6 to 8 indicated moderate risk of feeding intolerance, and 9 or higher indicated severe risk of feeding intolerance.

Tool III: Feeding Intolerance Assessment Sheet:

This tool was developed by the researchers after reviewing relevant literatures (Gomaa et al., 2022; Zaky Mohamed & Saied Ahmed, 2018) to monitor feeding intolerance indicators and physiological parameters to studied preterm neonates. it included two parts: -

Part one: Physiological parameters of preterm neonates; Respiratory rate (RR), heart rate (HR), temperature and oxygen saturation (Spo_2).

Part two: Feeding intolerance parameters to preterm neonates.; gastric residual volume, number of vomiting episodes, abdominal circumference, frequency of defecation (diarrhea), and daily weight of newborn.

Tool IV: Newborn Comfort Behavior (COMFORT neo) Scale.

The Comfort Scale (CS) was developed by Ambuel, Hamlett, Marx, and Blumer (1992), to assess the distress levels of children on mechanical ventilator support in the pediatric intensive care unit. COMFORT neo scale was developed to assess sedation and comfort needs of newborns monitored in NICU and to assess their pain and distress levels. This scale was reliable and valid to measure only behaviors in neonates. Its reliability was 0.84 before the invasive procedure and 0.88 after the invasive procedure by using Cronbach's alpha test (van Dijk et al., 2009). It comprised of six behavioral categories namely, alertness, calmness–agitation, respiratory response (applies to ventilated neonates only) or crying (only spontaneously breathing neonates (including those requiring continuous positive airway pressure)), physical movement, muscle tone, and facial tension. Responses to each category in this scale were scored by using 5-point Likert scale ranged from 1 to 5 with distinct behavioral descriptions. The total possible score of this scale ranged from 6 to 30 and scores of ≥17 indicate distress and discomfort and requires an intervention (Boerlage et al., 2015). So, the total score was ranked as follows:

- 6 to 16 → Comfort
- 17 to 21→ Mild level of distress and discomfort.
- 22 to 26 →Moderate level of distress and discomfort.
- 27 to 30 → Severe level of distress and discomfort (the greatest possible pain).

2.5. Methods

- Approval from the Research Ethics Committee of the Faculty of Nursing, Alexandria University was obtained before conducting the study.
- Permission was obtained from the responsible authorities of the previously mentioned setting to conduct the study after explaining the aim of the study.
- Tools I and III were developed by the researchers based on the review of the relevant literature.
- Tools I and III were submitted to a jury of five experts in the pediatric nursing field to test the content validity. Based on their comments; necessary modifications were done. The tool's validity was 98.4%.
- The reliability of the tools I and III were assessed by using Cronbach's Coefficient Alpha Test (0.918).
- A pilot study was conducted on six preterm neonates (10% of the sample) to test the clarity and the applicability of the tools. There was no necessary modification was done. Those neonates were excluded from the study.
- Characteristics of preterm neonates and their mothers were obtained from neonates' medical records for each subject in the study by using tool I.

- Initially, the risk level of NEC and feeding intolerance was estimated for every preterm neonate in NICU by using tool II.
- Physiological parameters were measured and recorded before, 30minutes after and three hours after feeding for both groups of study by using tool III (part one), while axillary temperature was measured before feeding only.
- Feeding intolerance parameters for preterm neonates were monitored before, 30 minutes after and three hours after feeding for both groups of study by using tool III (part two).
- Neonates' comfort level was assessed for all neonates in this study during feeding for both groups of study feeding by using tool IV.
- **For KMC and prone position group:**
- First, mother and neonate settled in a quiet and private room (breast feeding room) after explaining aim of study and benefits of KMC.
- Then before feeding, pulse oximetry probe is attached to the neonate's right foot for evaluating physiological parameters (Spo2 saturation and heart rate). Body temperature was measured axillary by digital thermometer. Respiratory rate was counted for full one minute. Feeding intolerance was assessed by using tool III part two.
- Gastric residual volume was measured by using a manually aspirated 5 mL syringe.
- For mothers, changed clothes into a hospital gown and kept its opening in the front and then slept in bed with head elevated to a 45° angle to provide a comfortable reclining position. Then the neonate positioned on the mother's bare chest with wearing only a diaper to emphasize skin-to-skin contact. A soft blanket was wrapped around mother and neonate with ensure neonate's open airway and facilitate mother- neonate eye contact. Mother's hands placed over the blankets and applied a slight pressure on their neonate's back to stabilize the infant for ease KMC. After that, the neonatal nurse administered feeding to neonates in KMC that continued for 30 minutes.
- KMC was performed every day at 12:00 p.m. for consecutive three days.
- Finally, neonates' physiological parameters and feeding intolerance parameters were assessed at end of KMC.
- After KMC, neonates were placed in the prone position with head on one side and legs flexed, and the incubator was in the upright position. Prone position was applied for 15 minutes with close observation to neonates and attached to pulse oximeter.
- Physiological parameters and the feeding intolerance parameters to neonates were assessed after 3 hours from feeding.

- **For control Group:**

- Neonates in control group received only standard routine hospital care of feeding. Which are adjusting neonates' position after feeding by putting them in supine position with head elevated 30^{O} and their head on one side for 30 minutes inside incubator.

2.6. Data analysis: The Statistical Package for Social Sciences (SPSS) version 28 was used for data analysis. **Descriptive statistics** included number, percentage, mean and standard deviation, were used to describe neonates' characteristics, their maternal data, cardiopulmonary parameters, risk level of NEC and feeding intolerance, feeding intolerance parameters and comfort levels of neonates. Normality distribution of study variables were identified by Kolmogorov-Smirnov test. **In Analytical statistics**, comparison between the eligible neonates' data in two study groups were done within groups by using Paired sample t-test and between groups by using independent t sample t- test and Monto Carlo test. All the statistical analyses were considered significant at $P < 0.05$.

2.7. Ethical Considerations:

- Written Informed consent was obtained from every mother after explaining the aim of the study, benefits of intervention for mother and neonate and possible side effects, her voluntary participation, and the right to withdraw from the study at any time.
- Privacy for every mother and neonates was ascertained in a private room.
- Confidentiality of data considered.

3. Results

Table (1) shows characteristics of neonates and their mothers among control and study groups. It was found more than two third of neonates were male in study and control groups (63.3%, 70%, respectively). 56.7% and 50.0% of neonates were feed orally among study and control groups respectively. Unfortunately, all preterm neonates (100%) in both groups of study were delivered caesarean section. The mean gestational ages of neonates in this study were 32.97 ± 2.141 and 32.80± 2.172 for study and control groups respectively. Additionally, 13.20± 3.736 and 14.00± 4.386 are postnatal age means of neonates among both groups (study and control respectively). Neonates mean of birth weight in study and control groups were 2181.17± 549.134 and 2164.50± 568.826 respectively. As regard diagnosis, prematurity and RDS are the most common causes of NICU admission prevalent neonates in this study. Mean of neonates' mothers age were 27.77± 3.775 and 28.10 ± 3.818 for study and study groups respectively. luckily, neonates' mothers in study group nearly have the same number of gravidae as in control group (4.17± 2.183, 4.10± 2.006, respectively). Moreover, neonates' mothers in study group nearly have the same number of parities as in control group (2.70 ±1.022 and 2.60± 1.037, respectively). 83.3% and 90.0% of neonates were single in study and control groups respectively.

Figure (2) illustrates neonates' risk levels of feeding intolerance development and NEC among control and study groups in this study. It was found fifty percent of neonates in study group had high risk level of NEC and feeding intolerance development compared to 53.3% of neonates in control group. Additionally, nearly half of neonates in study group (46.7%) had moderate risk level of NEC and feeding intolerance compared to 40.0% of neonates in control group.

Table (2) presents a comparison of neonates' feeding intolerance parameters between control and study groups. It was observed that neonates of study group had lower gastric residual volume than those in control group on second and third days of study with no statistically significant differences were found within group or between groups. Concerning the vomiting frequencies per day, there are significant differences in control group between first and third day of study (P=.000). While it was observed decline in number of vomiting frequencies in study group in second and third days with statically significant differences were found (P=.000 for each). Statistically significant differences were found between neonates in control and study groups on second and third days of study (P=.000 for each). Moreover, neonates in study group had improvement in defecation frequencies every day more than control group with statistically significant difference in third day (P=<.001). Regarding the abdominal circumferences of neonates, it was recorded improvement in abdominal circumferences in neonates of control and study group on second and third days of study. Statistically significant differences were found between first and second day within control and study group (0.033, 0.035 respectively). Additionally, statistically significant differences were found between first and third day within control and study group (P=0.000 for each). Furthermore, KMC and prone position increased neonates' weight gain on third day with statistically significant difference (P=0.003). On the other hand, it is obvious that no statistically significant differences between neonates in control and study groups regarding the neonate's weight gain/day on three days of study. Fortunately, the same table illustrates an improvement in amount of feeding /day for neonates in both groups with statistically significant differences on second and third days of study (P=0.000 for each group). In addition to that, there are statistically significant differences between neonates in control and study groups on third day of study (P=0.000).

Comparison of neonates' physiological parameters between control and study groups is illustrated in table (3). It was found decreases in O_2 saturation among neonates of control group on three days of study after feeding with 30 minutes with statistically significant differences (P=0.000 for each day). While after 3 hours of feeding, O2 saturation of these neonates nearly try to return as before feeding on three days of study. Statistically significant difference was found between before and after 3 hours of feeding on first day of control group (P=0.048). On the other hand, neonates in study group experienced changes in O2 saturation after feeding with 30 minutes on first and third days with statistically significant differences (P=0.019 and 0.000, respectively). In addition to that, there is a statistically significant difference between control and study groups after feeding with 30 minutes on first and third days (P=0.018 and 0.038, respectively). The same table shows statistically significant differences between before and after feeding with 30 minutes among neonates' heart rate of control group on three days of study (P=0.000 for each day). Moreover, there are statistically significant differences between before and after three hours of feeding concerning heart rate of neonates in control group on second and third days (P=0.001 and 0.002, respectively). While neonates in study group recorded statistically significant differences on second and third days after feeding with 30 minutes as well as three hours after (P1=0.000, P1=0.001, P2=0.015, and P2=0.003, respectively). Concerning comparison between control and study groups regarding heart rate, it was a statically significant difference after feeding with 30 minutes on third day (P=0.041).

Neonates in control group exhibited increase in respiratory rate after feeding with 30 minutes on three days of study with statistically significant differences (P=0.000 for each day as presented in table (3). Additionally, those neonates recorded statistically significant differences between before and after feeding with three hours on second day only (P=0.004). For study group, neonates experienced changes in respiratory rate after feeding with 30 minutes of feeding with statistically significant differences were found on three days of study (P=0.002 for first day, 0.000 for second and third days). There are statistically significant differences between control and study groups concerning respiratory rate on first day of study before, 30 minutes after and three hours after neonates' feeding (P=0.046, 0.008 and 0.046, respectively). Furthermore, there are statistically significant differences between control and study groups regarding neonates' respiratory rate after feeding with 30 minutes on second and third days of study (P=0.007 and 0.001, respectively). As regard neonates' body temperature, no statistically significant differences were found between groups of this study.

Comparison of Neonates' comfort levels between control and study group is displayed in table (4). It was noticed that neonates in study group who experienced KMC, and prone position had achieved comfort through first, second and third day of study (93.3%, 86.7% and 83.3%, respectively). On the contrary, 56.7%, 50.0% and 53.3% of neonates in control group exhibited mild distress level through first, second and third day of study. In addition to that 26.7% and 23.3% of neonates in control group showed moderate distress during second and third days of study and only 16.7 % of those neonates had moderate distress on the first day of the study. There are statistically significant differences between comfort levels of neonates in the control and study groups throughout three days of this study (P=.000).

Table 1: Characteristics of Neonates and Their Mothers Among Control and Study Groups.

Neonates' Characteristics and their mothers' data	Groups				Sig. (2-tailed)	
	Study (n=30)		Control (n=30)		T	P
	No	%	No	%		
Gender					0.540	0.591
▪ Female	11	36.7%	9	30.0%		
▪ Male	19	63.3%	21	70.0%		
Method of feeding					0.510	0.612
• Oral feeding	17	56.7%	15	50.0%		
• Gavage feeding	13	43.3%	15	50.0%		
Type of delivery					-------	-------
• Normal Vaginal Delivery	0	0.0%	0	0.0%		
• Caesarean section	30	100.0 %	30	100.0 %		
Gestational age (wks.)					- 0.299	0.766
• Mean ± SD	32.97 ± 2.141		32.80± 2.172			
• Minimum-Maximum	30-36					
Neonate's postnatal age (day)					0.760	0.450
• Mean ± SD	13.20± 3.736		14.00± 4.386			

Neonate's birth weight (grams)	2181.17± 549.134		2164.50± 568.826		-0.115	0.908
• Mean ± SD						
Diagnosis**					0.409	0.684
• Prematurity	27	90%	25	83%		
• RDS	21	70%	21	70%		
• NHB	12	40%	13	43%		
• IDM	7	23%	6	20%		
• Others	4	13%	5	17%		
Mother's age (year)	27.77± 3.775		28.10 ± 3.818		0.340	0.735
• Mean ± SD						
Mother's Gravidity	4.17± 2.183		4.10± 2.006		-0.123	0.902
• Mean ± SD						
Mother's Parity	2.70 ±1.022		2.60± 1.037		-0.376	0.708
• Mean ± SD						
Type of pregnancy:					-0.957	0.343
• Single	25	83.3%	27	90.0%		
• Twins	4	13.3%	3	10.0%		
• Triples	1	3.3%	0	0.0%		
Blood transfusion					-0.3083	0.3794
• Mean ± SD	1.800± 0.406		1.766± 0.430			
APGAR score					0.000	0.5000
• Mean ± SD	7.700±1.055		7.700±0.749			

****Multiple response item** **t: independent samples t-test** *** P < 0.05 (significant)**

Figure (2): Neonates' Risk levels of Feeding Intolerance Development and NEC among Control and Study Groups.

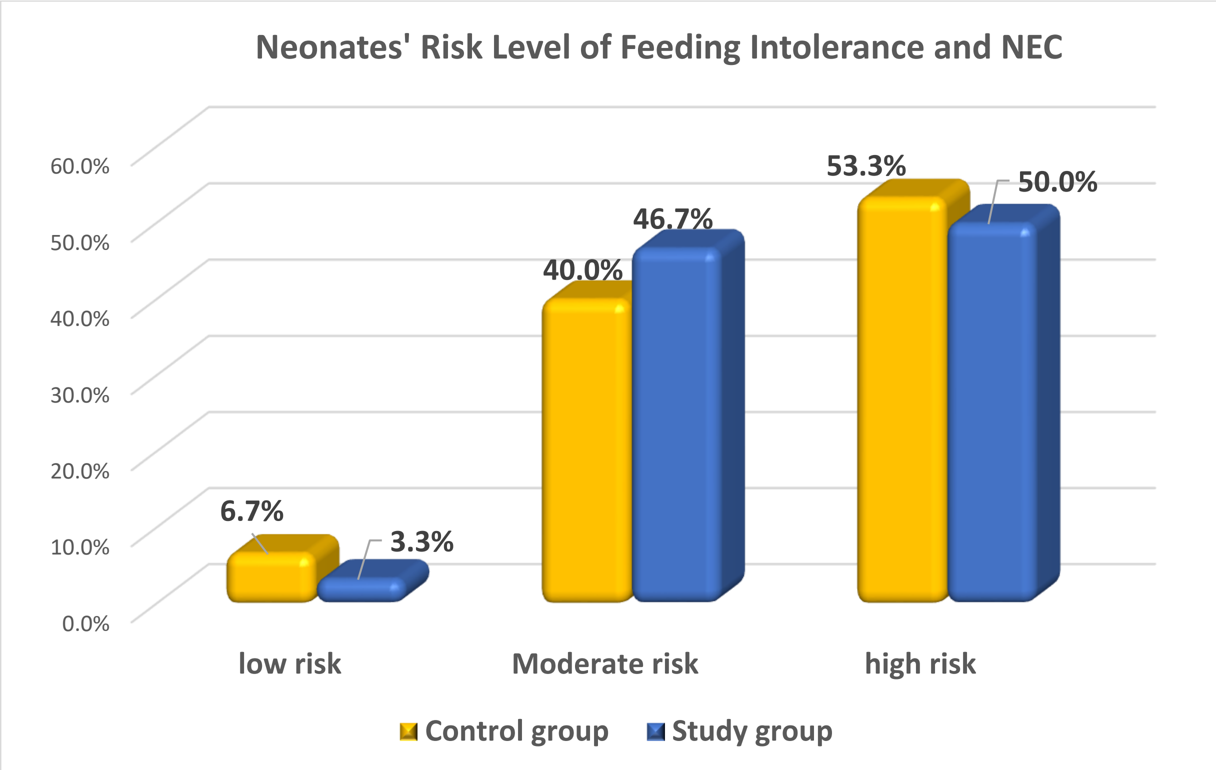

Table (2): Comparisons of Neonates' Feeding Intolerance Parameters Between Control and Study Groups.

Feeding Intolerance Parameters		Control group(n=30)		Study group (n=30)		Sig. (2-tailed)	
		Mean	Std. Deviation	Mean	Std. Deviation	t	P
Gastric Residual Volume	Day 1	0.5000	1.52564	0.5000	1.52564	0.000	1.000
	Day 2	0.3000	0.91539	0.2333	0.72793	0.312	0.756
	Day 3	0.2000	0.61026	0.0000	0.00000	1.795	0.078
		tp1=1.795 P1=0.083 tp2= 1.795 P2=0.083		tp1= 1.765 P1=0.088 tp2= 1.795 P2=0.083			
Vomiting frequency/ day	Day 1	1.90	0.712	1.70	0.702	1.095	0.278
	Day 2	1.70	0.651	1.07	0.640	3.800	0.000*

	Day 3	1.30	0.466	0.40	0.563	6.743	0.000*
		tp1=1.439 P1=0.161 tp2=6.595 P2=0.000*		tp1=5.188 P1=0.000* tp2=8.963 P2=0.000*			
Defecation frequency/ day	Day 1	2.00	0.643	1.90	0.759	0.551	0.584
	Day 2	1.90	0.548	2.13	0.434	-1.829	0.073
	Day 3	1.70	0.794	3.26	0.907	- 7.116	<.001*
		tp1=0.769 P1=0.448 tp2=1.608 P2=0.119		tp1=-1.651 P1=0.109 tp2= -6.457 P2=<.001*			
Abdominal circumferences	Day 1	27.60	2.699	27.57	2.596	0.049	0.961
	Day 2	28.10	2.339	28.00	2.289	0.167	0.868
	Day 3	28.35	2.297	28.27	2.269	0.141	0.888
		tp1=-2.236 P1=0.033* tp2=-5.939 P2=0.000*		tp1=-2.213 P1=0.035* tp2=-5.558 P2=0.000*			
Neonate's weight gain/day	**Day 1**	1922.50	796.020	2130.50	523.612	-1.196	0.237
	Day 2	2096.50	556.045	2126.00	518.610	-0.213	0.832
	Day 3	1967.50	793.615	2151.66	516.266	-1.065	0.145
		tp1=-1.569 P1=0.128 tp2=-0.319 P2=0.751		tp1=0.809 P1=0.425 tp2= -2.963 P2=0.003*			
Amount of feeding/day	**Day 1**	9.3000	3.55402	9.7667	3.59773	-0.505	0.615
	Day 2	11.7000	4.72813	13.8333	4.50351	-1.789	0.079
	Day 3	13.8000	5.18220	20.5000	6.34497	-4.479	0.000*
		tp1=-4.347 P1=0.000* tp2=-6.868 P2=0.000*		tp1=-8.846 P1=0.000* tp2=-11.016 P2=0.000*			

tp: paired samples t-test t: independent samples t-test * P < 0.05 (significant)

P1= Significance between day one and day two within group

P2= Significance between day one and day three within group

Table (3): Comparison of neonates' physiological parameters between control and study groups.

Physiological parameters of neonates		Control group (n=30)			Study group (n=30)			t	Sig.
		Before Feeding	After 30 minutes of feeding	After 3 hours of feeding	Before Feeding	After 30 minutes of feeding	After 3 hours of feeding		
O2 saturation	Day 1	97.20±1.423	95.400±1.940	97.800±0.996	97.300±1.317	96.500±1.525	97.800±0.996	t1=-0.282 t2=-2.441 t3=0.000	Sig.1=0.779 Sig.2=0.018* Sig.3=1.000
		tp1=4.443 P1=0.000*	tp2=-2.068 P2=0.048*		tp1=2.476 P1=0.019*	tp2=-1.795 P2=0.083			
	Day 2	97.00±1.508	95.10±2.669	96.80±1.349	97.033±1.449	96.333±2.138	96.800±1.349	t1=-0.087 t2=-1.975 t3=0.000	Sig.1=0.931 Sig.2=0.053 Sig.3=1.000
		tp1=4.289 P1=0.000*	tp2=0.701 P2=0.489		tp1=1.809 P1=0.081	tp2=0.826 P2=0.415			
	Day 3	98.00±0.787	95.100±2.202	97.900±1.470	98.000±0.787	96.233±1.924	98.033±1.272	t1=0.000 t2=-2.122 t3=-0.376	Sig.1=1.000 Sig.2=0.038* Sig.3=0.709
		tp1=5.784 P1=0.000*	tp2=0.280 P2=0.781		tp1=4.235 P1=0.000*	tp2=--0.105 P2=0.917			
Heart rate	Day 1	141.300±19.977	151.200±19.140	141.800±17.958	141.266±19.994	143.433±18.561	141.633±17.660	t1=0.006 t2=1.595 t3=0.036	Sig.1=0.995 Sig.2=0.116 Sig.3=0.971
		tp1=-9.501 P1=0.000*	tp2=-0.584 P2=0.564		tp1=-1.999 P1=0.055	tp2=-0.395 P2=0.696			
	Day 2	150.200±14.2015	157.500±13.177	144.500±14.457	148.466±15.244	152.366±14.471	144.433±14.840	t1=0.456 t2=1.437 t3=0.018	Sig.1=0.650 Sig.2=0.156 Sig.3=0.986
		tp1=-12.954 P1=0.000*	tp2=3.627 P2=0.001*		tp1=-5.070 P1=0.000*	tp2=2.594 P2=0.015*			
	Day 3	134.900±12.852	146.400±13.050	141.000±8.982	134.566±13.137	139.466±12.626	139.833±8.902	t1=0.099 t2=2.091 t3=0.505	Sig.1=0.921 Sig.2=0.041* Sig.3=0.615
		tp1=--8.972 P1=0.000*	tp2=--3.484 P2=0.002*		tp1=-3.668 P1=0.001*	tp2=-3.225 P2=0.003*			
Respiratory rate	Day 1	63.400±35.004	71.100±35.558	63.000±31.634	48.733±18.093	51.866±14.383	49.966±15.185	t1=2.039 t2=2.746 t3=2.034	Sig.1=0.046* Sig.2=0.008* Sig.3=0.046*
		tp1=-10.775 P1=0.000*	tp2=0.355 P2=0.725		tp1=-3.460 P1=0.002*	tp2=-1.245 P2=0.223			

	Day 2	53.100±22.589	63.000±22.380	54.600±21.848	46.266±3.542	51.266±5.023	47.966±4.398	t1=1.637 t2=2.802 t3=1.630	Sig.1=0.107 Sig.2=0.007* Sig.3=0.108
		tp1=-16.620 P1=0.000*	tp2=-3.132 P2=0.004*		tp1=-5.512 P1=0.000*	tp2=-3.714 P2=0.001*			
	Day 3	44.000±3.373	52.500±3.559	44.100±3.198	43.800±3.397	48.933±4.540	44.366±3.357	t1=0.229 t2=3.386 t3=-0.315	Sig.1=0.820 Sig.2=0.001* Sig.3=0.754
		tp1=-10.599 P1=0.000*	tp2=-0.288 P2=0.775		tp1=-6.507 P1=0.000*	tp2=-1.437 P2=0.162			
Body temperature (Axillary)	Day 1	36.700±0.269			36.736±0.255			-0.541	0.590
	Day 2	36.630±0.312			36.733±0.250			-1.413	0.163
	Day 3	36.590±0.278			36.713±0.2417			-1.832	0.072

tp: paired samples t-test **t: independent samples t-test** *** P < 0.05 (significant)**

P1= Significance between before and after 30 minutes of feeding within group

P2= Significance between before feeding and after 3 hours of feeding within group

Table (4): Comparison of Neonates' Comfort Levels Between Control and Study Groups.

Neonates' Comfort Levels	Study days											
	Day 1				Day 2				Day 3			
	Control group		Study group		Control group		Study group		Control group		Study group	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
• Comfort	8	26.7%	28	93.3%	7	23.3%	26	86.7%	7	23.3%	25	83.3%
• Mild distress	17	56.7%	2	6.7%	15	50.0%	4	13.3%	16	53.3%	5	16.7%
• Moderate distress	5	16.7%	0	0.0%	8	26.7%	0	0.0%	7	23.3%	0	0.0%
• Severe distress	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Total	30	100.0%	30	100.0%	30	100.0%	30	100.0%	30	100.0%	30	100.0%
^{MC}P	0.000*				0.000*				0.000*			

^{MC}P Mont Carlo test *** P < 0.05 (significant)**

Sig.1=Significance between control and study groups before feeding of preterm neonates

Sig.2= Significance between control and study groups after 30 minutes of feeding

Sig.3= Significance between control and study groups after 3 hours of feeding

4. Discussion:

Preterm neonates are more vulnerable for developing feeding intolerance and NEC due to the digestive-absorptive immaturities of premature infants (Lin et al., 2022). So, neonatal nurse has a crucial role in prevention and early detection, rather than development, will be essential in reducing neonates' morbidities and mortalities. Furthermore, as NEC is hard to diagnose, nursing assessments offer help in identifying early signs of a suspected feeding intolerance such as vomiting, abdominal distention, and increased GRV. Otherwise, proper nutrition can arm this population from developing other co- morbidities Therefore, it is important to know and assess correctly, the warning signs of the possible complications of enteral feeding (Naberhuis et al., 2016).

As regard to risk levels of feeding intolerance among control and KMC and prone position groups of studied preterm neonates. It was found half of neonates in control group and slightly more than half of neonates in study group had high risk level of NEC and feeding intolerance. Additionally, fifty percent of neonates in control group and slightly more than half of those in study group had moderate risk level of NEC and feeding intolerance development. These findings may be related to neonates' prematurity, low birth weight, feeding practices, prolonged NICU stay, postnatal factors, antibiotic administration, or perinatal maternal factors (Naberhuis et al., 2016; Zaky Mohamed & Saied Ahmed, 2018). These findings are apparently agreed with Zaky Mohamed and Ahmed Saied (2018), their findings reported that just 5% of the control group had moderate levels of feeding intolerance, compared to 100% of the massage group and the vast majority of the control group had high levels of feeding intolerance. However, neither the control group nor the massage group's preterm neonates had any of them exhibit mild level of feeding intolerance. These findings appear to be consistent with Kim and Bang's (2018) claim that feeding intolerance is one of the symptoms frequently observed in the NICU due to premature infants' digestive-absorptive immaturities, as well as with other studies (Lucchini, Bizzarri, Giampietro, & De Curtis, 2011), who reported that feeding intolerance is commonly observed among premature infants. Additionally, Naberhuis et al. (2016) findings illustrated that 7.8% infant classified as low risk, 15.1% as moderate risk, and 77.1% as high risk. While Ameri et al. (2018), who found that the percentage of feeding intolerance in Port Said, Egypt is 2.6% of the preterm neonates.

Therefore, protection of preterm neonates from feeding intolerance is necessary and needs an effort to prevent its destructive sequela. Providing early effective protective interventions could reduce the potential progression of feeding intolerance to NEC and lead to better neonates' clinical outcomes for these high-risk neonates. Curtailing the development of feeding intolerance has the power to decline the average premature neonates' length of hospital stay a and overall healthcare costs (T. A. Moore & Pickler, 2013). KMC and prone positions are non- pharmacological and non-invasive interventions for tackling the problem of feeding intolerance and comfort enhancement in premature neonates. Interestingly, findings of the current study revealed that, highly statistically significant differences were found between the first day, second day and third day related to feeding intolerance parameters of the KMC and prone position group compared to control group. As differences were observed in the means of the neonates' abdominal circumference and the frequency of vomiting episodes in the study group had decreased significantly in the third day of the intervention of KMC and prone position group, as compared with those in the first day. Additionally, mean of GRV of those neonates had registered daily decline when measured 3 hours after feeding, but no significant difference was determined between the prone position and KMC group and control group. That these findings were probably due to the fact that in the KMC and prone positions, the infant is laid face down (the front side of the infant's body is in contact with mother's chest or bed) and is fed only with prepared special formula and these positions facilitating gastric emptying. Valizadeh et al. (2015) who conducted a study to compare the KC and supine position, it was determined that the gastric residual volume was lower in those fed via KC than those fed in the supine position. This finding is accordance with findings of Özdel and Sarı (2020), Ameri et al. (2018) and Valizadeh et al. (2015).

The introduction and advancement of enteral feeds for preterm infants may be delayed as concerns that early full enteral feeding will not be well tolerated or may raise the risk of NEC. Although, early enteral feeding after birth is essential, and breast milk is the best food which has regulatory influence on the development of the gastrointestinal system (Özdel & Sarı, 2020). This study findings registered a significant daily increase in defecation frequency, amount of feeding and neonates' weight gain for both groups of study with statistically significant difference for study group on third day of study. These findings may be due to improvement in bowel movement as observed in defecation frequency elevation for those neonates. Safari et al. (2018) findings illustrated that neonates who received skin-skin contact initiated breastfeeding in 2.41 ± 1.38 (M ± SD) minutes after birth, however, neonates who received routine hospital care started breastfeeding within 5.48 ± 5.7 (M ± SD) minutes.

In the present study, nearly two thirds of both groups were males, and more than half of study group and half of the control group was being fed orally with artificial prepared special formula. Unfortunately, all neonates in this study were delivered CS. Additionally, the majority of neonates in both groups of study were hospitalized with diagnosis of prematurity. This result is in accordance with Özdel and Sarı (2020) and Tekgündüz et al. (2014) characteristics of neonates in their studies.

Neonatal hypothermia is an important contributing factor to neonatal mortality and morbidity in both developed and developing countries; especially in developing countries (Safari et al., 2018). Fortunately, A Cochrane study reported that KMC improves breastfeeding outcomes and cardiopulmonary balanced in neonates without adverse effects (E. R. Moore, Anderson, Bergman, & Dowswell, 2012). Regarding axillary temperature of this study, there was no change in response to Kangaroo care and prone positions neonates' temperature and temperature of neonates who received standard care in this study. The most substantial data base on KMC effects relates to temperature. Preterm infants >28 weeks, neonates are warmer in KC than anywhere else as shown in different randomized controlled trials and meta-analyses (Azeez & Azize, 2020; Özdel & Sarı, 2020; Safari et al., 2018). Neonates are warmer in KMC and prone positions because heat transfer from mother to neonate is obvious. As KMC implies placing the neonate in intimate skin-to-skin contact with the mother's chest and abdomen coupled with frequent and preferably breastfeeding. This is like marsupial caregiving, where the premature neonate is kept warm in the maternal pouch and close to the breasts. The breasts conduct heat to the infant When neonates become sufficiently warmed (37.4°C), breast temperatures drop to prevent hyperthermia, thermoregulating the neonates' body temperature (Azeez & Azize, 2020). Bera et al. (2014) illustrated that KMC did not elevate the risk of hypothermia. The current student researchers noticed no changes in body temperature were observed in the present study because the temperature of the neutral environment was ensured.

Interestingly, this study findings show that KMC and prone positions neonates had a stabilizing effect on cardiopulmonary parameters (RR, HR and Spo2) after feeding with 30 minutes. While, after 3 hours of feeding physiological parameters seems Increased are due in part to being prone. Nonetheless, RR, HR and Spo2 remains within clinically acceptable range for each neonate and shows greater stability than seen in an incubator. which might be since the preterm infants were calm and sleepy and were fed in the upright position during KMC position. So, the causes of the influential effects of KMC are yet to be fully identified. The intimate and early skin-to-skin contact between mother and neonate, with repeated suckling, possibly also stimulates neuropsychological responses that include physiology and behavior. Further, during KMC, the neonate exhibits maternal heart beats, rhythmic maternal breathing movement, warmth, and prone positioning, all of which offer gentle stimulation across tactile, auditory, vestibular, and thermal sensory systems, which may in sum total have a tranquilizing effect on the neonate, allowing physiological parameters to be stable (Bera et al., 2014)

Concerning physiological parameters findings of this study is in line with findings of Özdel and Sarı (2020). Other study findings by Cho et al. (2016) on KC given to preterm infants did not find a significant difference in SpO2 values while, a significant difference in the respiratory rates in the group undergoing KC was noticed. Moreover, Bera et al. (2014) was stated that the application of KMC had positive effects on physiological parameters among neonates. On the other hand, a study on the effect of the lying position on oxygen saturation in preterm neonates, it was noted that there was no difference between the supine and prone positions regarding oxygen saturation values (Ludington, 2011).

Neonatal Intensive Care Units is an environment that is stressful for a preterm neonate, due to parent–infant separation, bright lights, noise, iatrogenic interventions and other unnatural stimuli may lead to prolonged hospitalization and interrupted growth and development (Mirnia et al., 2017). So, is important for preterm neonates to survive in the process of growth and development in a comfortable way. For preterm infants, the best lying position is the prone position. It was recommended that preterm infants should be laid in the prone position as long as they stay in NICU, Kangaroo Mother Care has been found to either reduce neonates' distress. Twenty minutes of KMC reduced circulating cortisol levels by 67% and more (Ludington, 2011), Also, other studies show KMC is known to reduce infant agitation and restlessness. Because of the calming effect of it. Another physiologic effect of KMC is noticed in records of sleep/wake states taken in an incubator and in KMC. During KMC and prone positions sleep organization is greatly improved. Even in quiet sleep in the incubator, neonates frequently arouse that move from quiet sleep to being awake and active or crying instead of returning to quiet sleep. In KMC, infants maintain a healthy duration of quiet sleep followed by short durations of high-quality active sleep. The other state in which KMC effects are compelling is crying. Crying rarely occurs during KMC, so its times are significantly less for preterm infants during KMC than when in incubators (Ludington, 2011).

For the following reasons, this study noticed a staring finding concerning the mean of estimated comfort and distress levels of preterm neonates which measured daily during feeding on three days of study, were highly varied significantly in the KMC and in the prone position group compared to control group. Additional reason from point of view of researcher Because feeding procedure is not one of induced procedural pain or needle interventions were performed during feeding in the present study. These findings are agreed with findings of Özdel and Sarı (2020). Another study conducted by Mirnia et al. (2017), reported that neonate’s reduction in cortisol levels of the skin-to-skin care neonates’ group was more than in the control group, but with no significant difference.

5. CONCLUSION

Kangaroo Mother Care and prone positions as a protective measure against a variety of adverse effects on preterm neonates. This intervention significantly improves feeding intolerance criteria and physiological parameters and thus it may positively influence on the newborns' comfort.

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الملخص العربى

تأثير رعاية الام الكنغر ووضع النوم المنبطح على عدم تحمل التغذية ، والعلامات الفسيولوجية ، والراحة لحديثى الولادة الخدج

المقدمة :يعاني حديثى الولادة الخدج من قابلية متزايدة لمشكلة عدم تحمل التغذية والتوتر بداخل وحدة العناية المركزة لحديثي الولادة ، ويعتبرون أيضا الأكثر تعرضا لتأخر نمو الأطفال حديثي الولادة. لذلك ، من المحوري لممرضات حديثى الولادة الاكتشاف المبكر لهذة المشاكل في أقرب وقت مع ايجاد الحل الفعال لمواجهة هذه المشكلة لتعزيز نمو حديثي الولادة. تعتبر رعاية الأم الكنغر والوضعيات المنبطحة من طرائق التمريض العلاجية التي قد تكون فعالة للحماية من عدم تحمل التغذية وتحسين راحة الأطفال حديثي الولادة في وحدة العناية المركزة لحديثي الولادة. **هدفت** هذه الدراسة إلى تحديد مدى تأثير رعاية أمهات الكنغر ووضع الانبطاح على عدم تحمل للتغذية، والعلامات الفسيولوجية ، والراحة عند الخدج. تم إجراء **تصميم** بحث شبه تجريبي لهذه الدراسة. **الإعداد**: أجريت هذه الدراسة في وحدة العناية المركزة لحديثي الولادة في مستشفى الأطفال بجامعة الإسكندرية التخصصى بسموحة بالإسكندرية**. العينات**: عينة ملائمة من 60 من الخدج أكثر من 130000 جم. تم حجزهم بالمستشفى في وحدة العناية المركزة لحديثي الولادة من مارس 2020 إلى مارس 2021. تم استخدام أربع **أدوات** لجمع البيانات اللازمة لهذه الدراسة: الأداة الاولى: خصائص حديثي الولادة المبكرة وسجل بيانات أمهاتهم ، الأداة الثانية: عدم تحمل التغذية ومعدل تسجيل مخاطر حدوث التهاب الامعاء ، الأداة الثالثة: ورقة تقييم عدم تحمل التغذية والأداة الرابعة: مقياس الراحة الجديد. **النتائج**: وُجدت فروق ذات دلالة إحصائية بين اليوم الأول واليوم الثالث مرتبطة بمؤشرات عدم تحمل التغذية في مجموعة الدراسة فيما يتعلق بمتوسط محيط البطن ، وتكرار نوبات القيء ، وتكرار نوبات التقيؤ ، وزيادة الوزن اليومية ، بالإضافة إلى ذلك ، تم ملاحظة تحسن في كمية الاكل المتبقية بالمعدة لحديثي الولادة بين مجموعتي الدراسة مع عدم وجود فروق ذات دلالة إحصائية. سجلت مجموعه خدج رعاية ام الكنغر والنوم منبطحا ثباتًا أكبر في الدلائل الفسيولوجية من المجموعة الضابطة في الدراسة. لحسن الحظ ، أظهرت مجموعة التدخل مستويات عالية من الراحة في ثلاثة أيام من الدراسة مقارنة مع مجموعة التحكم .**الخالصة** :أكدت الدراسة أن رعاية الام الكنغر والنوم منبطحا لها تأثير محتمل على تقليل الحجم الطعام المتبقي بالمعدة لحديثى الولادة الخدج ، وتكرار نوبات القيء ، ومحيط البطن ، وزيادة الوزن اليومي وتكرار التغوط عند الخدج وايضا تحسن مستوى الراحه لديهم. **أوصت** هذه الدراسة بتغيير ممارسة التمريض لممرضات وحدة العناية المركزة لحديثي الولادة من خلال التأكيد على أهمية تطبيق رعاية الام الكنغروالنوم منبطحا كتدخل آمن غير جراحي كمعيار للرعاية عند الخدج الذين يتغذون معوياً.

الكلمات المفتاحية: الخدج ، رعاية الأم الكنغر ، وضعية الانبطاح ، عدم تحمل التغذية ، المعايير الفسيولوجية ، الراحة.