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Nesting Technique: it's Effect on Physiological Parameters and Neurobehavioral Organization in Preterm Infants

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Abstract: **Preterm infants are highly vulnerable group associated with the highest mortality rate. Applying developmental care is vital to support the behavioural organization, promoting physiological functioning, enable spontaneous motor activity and neuromuscular function. Aim: To examine the effect of the nesting technique on physiological parameters and neurobehavioral organization in preterm infants. Methods: A quasi-experimental design was used to accomplish this study (study group I and study group II). Setting: The present study was carried out in the Neonatal Intensive Care Unit at EL-Menoufia University Hospital, Shebin El-Kom City, Egypt. Sample: A purposive sample consisted of sixty preterm infants were chosen from the previously mentioned setting. Preterm infants classified randomly in either study group I and study group II through serial numbers of cases (30 in the study group I and 30 in the study group II). Tools: Three tools were used. Tool I: Neonatal Assessment Sheet. Tool II: Neonatal Behavioral Observation Sheet. Tool III: Neonatal Pain Scale. Results: There were highly statistical significant differences regarding the physiological parameter, behavioral and neurological outcomes of preterm infants' in the study group I compared to the study group II. Conclusion: the study concluded that preterm infants who received nesting technique had a better physiological adjustment and neurobehavioral organization than preterm infants in the study group II. Recommendations: Emphasize on the importance of applying the nesting technique for all preterm infants in the NICUs as a standard of care to improve their physiological parameters and neurobehavioral organization.**

Keywords: **Nesting technique, Physiological parameters, Neurobehavioral organization, preterm infants.**

Definitions of Variables:-

- **Nesting Technique**: is a developmental care for preterm infants to maintain normal vital signs and enables spontaneous motor activity for normal neuromuscular and skeletal joint function as well as neurobehavioral organization (Poulose et al, 2015).
- **Physiological Parameters**: it includes heart rate, blood pressure, body temperature, serum levels of various stress hormones (Kyle & Carman, 2013).
- **Neurobehavioral organization**: is the ability of preterm infants to organize themselves within their central nervous system maturation and environment (Kyle & Carman, 2013).
- **Preterm Infants**: neonates born alive before 37 weeks from the first day of the last menstrual period (Abd-Allah et al., 2017).

I. INTRODUCTION

Prematurity is a term used for all neonates born less than 37 week's or 259 days of their gestational age (El-Nagger & Bayoumi, 2016). It is considered the direct cause of 24% of neonatal deaths. Globally, 15 million preterm infants had born annually (World Health Organization, 2015). Prematurity is considered the main cause of 24% in neonatal deaths

(El-Nagger & Bayoumi, 2016). The rates of preterm birth ranged from 5-7% of the live births in some developed countries (World Health Organization, 2012). The incidence of preterm births in India is estimated between 11–14% (Beck et al., 2010). In Asia and Africa, 10.9 million births were preterm. In Egypt, the total number of preterm births at 32 weeks to <37 weeks was 123.131 and in the Kingdom of Saudi Arabia incidence was 41.728 (Waitzman, 2007).

Premature infants are more vulnerable to impaired sleep patterns, hypothermia, instability of heart rate, hypoxia Pain, and stressful events (Engle et al., 2013). Pain and stressor factors are activating the Hypothalamus-Pituitary- Adrenal (HPA) axis causing developmental trauma. Besides, various stimuli in Neonatal intensive care units such as exposure to light, loud noise and stressful interventions interfere with the cognitive and behavioral development of preterm infants (Westrup, 2015). Therefore, it is crucial to understand the age-specific needs and develop requisites of the critically ill premature infants based on advanced medical interventions, and extremely specialized nursing care to thrive and survive (Engle et al., 2013).

Preterm infants are at risk for developmental delays. Due to immaturity, they often lack adequate muscle tone and are at risk for developing abnormal movement patterns as well as skeletal deformation. Some delays related to improper body mechanics rather than neurological impairment e.g hypotonic or decreased muscle tone normally observed in the preterm infant born 28 to 30 weeks' of gestational age (Ahmed & Mohammed, 2019). Neonatal period is the first 28 days after birth, there is a sensitive and dynamic unfolding neurobehavioral organization (NBO) unique to the neonate. NBO is a mature multidimensional construct and includes an individual's ability to interact with the environment while maintaining internal stability. This internal stability is the foundation from which the neonate is able to socially interact and learn from the environment (Blackburn, 2005).

The Proper position of premature infants may promote normal motor development while minimizing the development of abnormal movement patterns. Positioning of preterm infants is a basic neonatal nursing care (Waitzman, 2007). It includes supine, prone, side lying and head up tilted position. Several studies demonstrated a variable outcome affected by the different body positioning of preterm infants (Hennesy et al., 2007). Positioning of preterm infants in prone, supine, side-lying and head elevated tilt positions had a greater effect on physiological outcomes, including respiratory function, hemodynamic, neuromotor development, gastric function and sleep states (Jeanson, 2016).

Nesting technique is a nursing skill that used commonly in the developmental care of preterm infants through using rolled-up sheets to form a 'nest' in order to provide physiological, behavioural and postural stability to the preterm infant (Eskandari et al., 2012). Nesting is one of the key factors that maintain a beneficial position for the preterm infant through position hands together near the face and feet together by using positioning aids to provide a safe snug and supportive nest (Mathews et al., 2013). The nesting technique provides a comfortable position for preterm infant, enable spontaneous motor activity for skeletal joint and neuromuscular function as well as facilitate the monitoring of stable vital signs (Mony et al., 2018).

Preterm infant requires support to facilitate and maintain postures that enhance motor control, physiological functioning and reduce stress. Indeed, the nesting technique goals are to; provide flexion in the limbs and trunk and facilitate of nursing skills, also assist infant's self-regulation and maximize infant stability, preserve energy, growth and promote neurobehavioral organization (Grobman et al., 2018). Nurses are central in NICU efforts to improve quality of care. Comforting interventions in the field of nursing care of neonates are very important (Ahmed & Mohammed, 2019). The Neonatal intensive care nurse should be equipped with the recent evidences in newborn care and should be alert to provide developmental care in an NICU setting. Nurse administrators should provide and recommend the interventions like nesting in the setting like NICU of the hospital (Cheryl et al., 2016).

The role of NICU nurse is vital in applying the developmental care successfully and provision of an optimal NICU environment (Verklan & Walden, 2014). Nurses' should assess daily weight gain, numbered of bowel movement and medications measured in the morning shift on the preceding night shift by the nurses and calculated by two methods: one method was the average of preterm infant's daily weight gain and the second method was the average of preterm infant's weight gained in the NICU. Observation of sleep/awake states is useful for evaluating the development and neurobehavioral organization of preterm (Grenier, 2016).

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Significance of the Study:-

Nesting technique (Developmental positioning) is an intervention to improve musculoskeletal and postural outcomes, promote physiological functioning and sleep states of preterm infants. So, developmental positioning is an essential skill for NICU nurses. The benefits of developmental positioning are evident in the literature, but less known about how NICU nurses learn about it. There is a disconnect between what is practiced in some NICUs and what is known in the evidence; however developmental positioning is effective in improving preterm infant outcomes, less is known about how to improve the nurses' proficiency for providing developmental positioning in the care of preterm.

1- **Aim of the Study**

The aim of this study was to examine the effect of the nesting technique on physiological parameters and behavioural organization in preterm infants.

1.1-**Research Hypothesis:** This study hypothesized that:

1. Preterm infants who will receive nesting technique will have a better physiological adjustment than preterm infants in the non-nesting group.

2. Preterm infants who will receive nesting technique will exhibit better Neuro behavioral organization than preterm infants in the non-nesting group.

2. Subjects and Methods

2.1. Research Design: a quasi-experimental design was used to accomplish this study (study group I and study group II).

2.2. Research Setting

This study was carried out in the Neonatal Intensive Care Unit (NICU) at EL-Menoufia University Hospital, Shebin El-Kom City, Egypt.

2.3. Sample

A purposive sample consisted of sixty preterm infants were selected from the previously mentioned setting. Preterm infants classified randomly in either study group I and study group II through serial numbers of cases, the preterm infants who had single numbers were chosen in the study group I (Nesting technique) while, the preterm infants who had double numbers were chosen in the Study group II (Non -Nesting technique). Preterm infants in the study group I received nesting positioning through using simple linen to support preterm infants while preterm infants in the study group II put in the same position without nesting positioning and support as a routine care in the Neonatal Intensive Care Unit.

2.4. Inclusion criteria: 3 criteria were defined:

1) All preterm infants from both genders.
2) Gestational age 32-≤ 36 weeks.
3) Birth weight 1500 - ≤ 2500 grams.

2.5. Exclusion criteria: 3 criteria were defined:

1) Preterm infants suffering from severe respiratory distress syndrome and congenital anomalies or sepsis.
2) Preterm infants with brain abnormalities, bone fractures or injuries.
3) Preterm infants with Central Nervous System disorders such as brain haemorrhages, seizure and hypertonia.

2.6. Tools of Data Collection: three tools were used based on the study objectives to conduct the study:

Tool I. Neonatal Assessment Sheet (NAS): It was developed by the researchers to assess socio-demographic characteristics and Physiological Parameters of the studied sample. **It was divided into parts**

Part one: socio-demographic characteristics of preterm. It included gestational age, sex, diagnosis, type of delivery, birth weight, duration of hospital stay and preterm infants' weight.

Part two: Physiological Parameters of the Preterm Infant: such as temperature, respiratory rate (RR), heart rate (HR), Oxygen saturation (SaO2) through using the pulse Oximeters and cardiac monitor in addition to the tremors/startles and skin colour

Tool II. Neonatal Behavioral observation sheet: It was adapted from **Als et al., (2005)** and **Als, (2009)** and modified by the researchers to assess infants' behaviour through the following five subsystems:

1. Autonomic: expressed in the pattern of respiration, color changes and visceral signals.

2. Motor: Assess motor tone, movement activity and posture of preterm infants.

3. States: Classifying the preterm infants' Neurobehavioral or central nervous system arousal and the sleep/awake states of the preterm (i.e., deep sleep, light sleep, drowsiness, alert, hyper alert and cry).

4. Attention/Interaction: Evaluating continuum state (deep sleep to cry) as alertness to interaction.

5. Self-regulatory behavior: Assessing the preterm infants in maintaining a balanced, relatively stable and relaxed state of the subsystem of functioning or in returning to this a state of subsystem functioning, if imbalance or stress has occurred.

III. Neonatal Infant's Pain Scale: It was adopted by Waldemar et al., (2015). It was used to evaluate the quality and sensitivity of pain. It's comprised of four items (Face, Leg, Cry and Activity). Regarding severity of pain, it was classified into the following:

- **Score from 0-2** referred to no or mild pain.
- **Score from 3-4** referred to mild to moderate pain.
- **Score >4** referred to severe pain.

2.7.Validity and Reliability: before starting the data collection, the tools were translated into Arabic and tested for their content validity by a group of five panel experts from academic and clinical fields: one professor in the paediatric medicine, two associate professors in the paediatric nursing and neonatologist. In addition, content validity was assessed by both internal consistency and test-retest reliability. Internal consistency (Cronbach's alpha) coefficients for study tools were 0.83.

2.8. Pilot Study: It was carried out on 10% of the study sample (6 preterm infants) before starting data collection to check the clarity, applicability and relevancy of the tools. The necessary modification was done so the pilot study subjects were excluded from the sample of the study.

2.9. Ethical Considerations: A necessary approval from El- Menoufia University Hospital was taken after delivering an official letter from the dean of the Faculty of Nursing, Menoufia University. A formal consent to participate in the current study was taken after clarifying the purpose of the study to the parents of preterm infants. Confidentiality of their data was totally ensured.

Procedure for data collection

Implementation of nesting technique passed into four phases (assessment, planning, implementation and Evaluation).

1-Assessment phase

- A formal consent was obtained from the parents of preterm infants before inclusion in the study.
- Selecting the preterm infants in relation to inclusion and exclusion criteria and through using Neonatal Assessment Sheet.

- Preterm infants classified randomly in either study group I and study group II through serial numbers of cases, the preterm infants who had single numbers were chosen in the study group I (Nesting technique) while, the preterm infants who had double numbers were chosen in the Study group II (Non –Nesting technique).
- The researchers introduced themselves to the parents, nurses and explained the significance of the study as well as obtained the verbal agreement before applying the nesting and non-nesting technique.
- Preterm infants in both groups assessed at the beginning of the study for the following**:**
- Socio-demographic characteristics of the preterm infants. It was filled for both groups by the researchers from the patient's file (pretest).
- Physiological parameters such as vital signs (Temp., HR, and RR) and SaO2 (pre-test).
- Neonatal behavioral response such as sleep/awake states and deep sleep to crying (Pre-test).
- Infant's motor activity and primitive reflexes (pre-test).
- Infant's pain level during invasive procedures such as nasogastric tube insertion or blood sampling and Cannulation technique (pre-test).

2-Planning phase:

- The fieldwork started at the beginning of July to the end of August 2019. The researchers were available four days weekly in the NICUs from 8am –2 pm. The number of preterm infants who were assessed daily was 3- 4. The researchers filled out the study tools by themselves and the times required for filling out each tool was around 5-10 minutes.
- All required nesting equipment's were Prepared and arranged from the NICU such as linen, blanket, small pillow….etc.

3- **Implementation phase**:-

A- Nesting Technique:

*** Study group I:**

- The researchers prepared and arranged all the requisite nesting equipment from the NICU (linen, blanket, small pillow) and make the nest by folding the blanket form one corner, then placing it upright and putting the linen over the blanket.
- The researchers put the preterm infants inside the nest in a three positions (supine- side-lying and prone position respectively) and make sure that the nest size is appropriate for the neonate's body (not too free or too skin-tight) during each position.

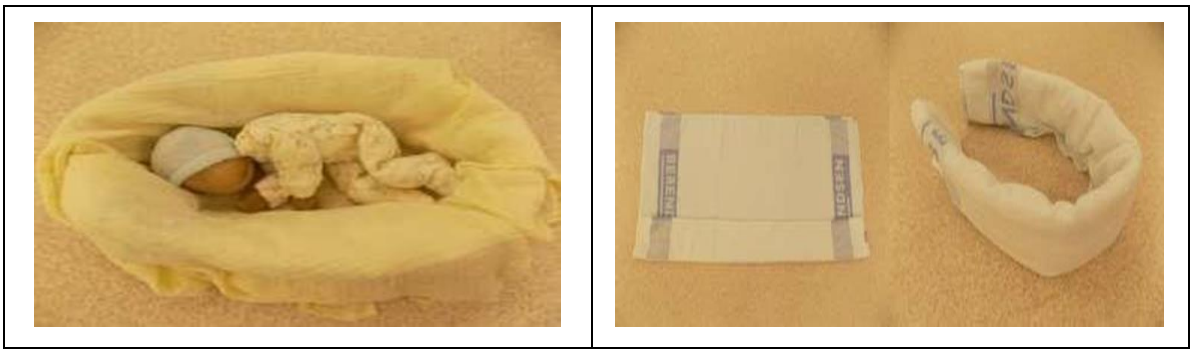

Figure (1): Technique for creating a nest from bedding . Positioning and Handling on the Neonatal Unit. 2019.at Neonatal Website: http://www.networks.nhs.uk/nhs-networks/thames-valley-wessex-neonatal-network

- **First position**: The researchers put the preterm infant in the supine position through enfolding infant with hand to midline the nest through putting a small pillow under the preterm shoulder to keep airway open.

- **Second position**: The researchers changed the preterm infant's position after two hours to side- lying (left or right) position through supporting the infant's back in the nest by small pillow and make certain to put both preterm infant's hands together close to the face.

- **Third position**: The researchers changed the preterm infant's position to prone position by putting a small pillow under the preterm infant's chest, to keep the airway open.

- Preterm infant's was assessed daily for both physiological parameters and neurobehavioral organization 3 times in each position every 20 minutes until discharge through using Neonatal Behavioral observation sheet.

- To eliminate the effect of position change, the preterm infants were assessed after a stabilization period approximately, 15 minutes in each position.

- **All findings documented in the Neonatal Behavioural observation sheet and Neonatal Infant's Pain Scale as follows :**

i. **Preterm Infant's** physiological parameters such as vital signs (Temp., HR, RR), occurrence of apnea and SaO2.

ii. **Preterm Infant's** behavioral response such as sleep/awake states and deep sleep to crying.

iii. **Pre term Infant's** motor activity and primitive reflexes.

iv. **Preterm Infant's** pain level during invasive procedures such as; nasogastric tube insertion or blood sampling and Cannulation Technique.

Figure (2): One technique for creating a nest from bedding. Such a nest may be used for positioning a baby prone, supine or laterally. Positioning and Handling on the Neonatal Unit. 2019.at *Neonatal Website:* http://www.networks.nhs.uk/nhs-networks/thames-valley-wessex-neonatal-network

Non-Nesting technique:

***Study group II:**

- The preterm infant lies in the three positions (supine- side-lying and prone positions respectively), without nesting, two hours for each position and assessed for applying different positions without nesting technique.

- Preterm infant health outcomes during each position was assessed through using the study tools daily until discharge.

- Physiological parameter and neurobehavioral organization were assessed three times in each position every 20 minutes daily until discharge from through using NBAT.

- Preterm infant's was assessed after a stabilization period to eliminate the effect of changing position. The assessment was approximately 15 minutes in each position.

- All findings documented in the NBAT and NIPS including: Infant's physiological functioning, Infant's behavioral response such as sleep/awake states and deep sleep to crying, infant's motor activity, primitive reflexes and Infant's pain level during invasive procedures such as blood sampling and drug administration.

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4-Evaluation phase:-

Preterm infants in both groups reassessed immediately after intervention for the following**:**

- Physiological parameters such as vital signs (Temp., HR, and RR) and SaO2 (post-test).
- Neonatal behavioral response such as sleep/awake states and deep sleep to crying (Post-test).
- Preterm Infant's motor activity and primitive reflexes (post-test).
- Preterm Infant's pain level during invasive procedures such as nasogastric tube insertion or blood sampling and Cannulation technique (post-test).
- Weigh and duration of hospital stay was documented in the discharge from the NICU for both groups to evaluate the weight gain and length of hospital stay (post-test).

Data processing and analysis: Data were analyzed using the IBM Statistical Package of Social Science (SPSS) version 20. Quantitative data were clarified by mean (X) and standard deviation (SD). Qualitative data were presented in the form of frequency distribution tables, number and percentage. Statistical significance was considered at p-value ≤ 0.05 and P<.001.

II. RESULTS

Table 1:-Socio- demographic characteristic of the studied sample (No=60).

Preterm infant's Characteristics	Total number(n=60)				X^2	P. value
	Study group I (n=30)		Study group II (n=30)			
	No	%	No	%		
1. Gestational age /weeks.						
<32	8	26.6	6	20.0	**2.46**	**0.292 > 0.05**
32-<34	11	36.7	7	23.3		
34-≤36	11	36.7	17	56.7		
2. Birth weight /grams.						
1500-< 2000	11	36.7	12	40	**1.56**	**0.321 > 0.05**
2000-< 2500	10	33.3	9	30		
≥ 2500	9	30.0	9	30		
Mean ±SD	1735±375.6		1725±286.3			
3. Duration of Hospital Stay/ days.						
<3	6	20.00	3	10.00	**16.3**	**0.002 <0.01***
3-<6	8	26.67	5	16.67		
6-<10	12	40.00	9	30.00		
≥10	4	13.33	13	43.33		
4. Weight gain at discharge/grams.					**15.01**	**0.002 <0.01***
<50	10	33.3	8	26.7		
50-<100	12	40.0	3	10.0		
≥100	5	16.7	3	10.0		
No weight gain	3	10.0	16	53.3		

(*) statistically significant at p <0.05.

Table 1: showed socio- demographic characteristic of the studied sample, it was showed that 36.7% of preterm infants were between 34 - ≤36 weeks of gestational age in the study group I compared to 56.7% in the study group II. Regarding birth weight, 33.3% of preterm infants weighed 2000-< 2500 grams in the study group I compared to 30% in the study group II. The mean and standard deviation of birth weight in the study group I was 1735±375.6 grams compared to 1725±286.3 in the study group II. Regarding duration of hospital stay, it was revealed that 13.33% of preterm infants

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stayed more than 10 days (≥10 days) in the study group I compared to 43.33% in the study group II. Also, this table clarified that 33.3% and 26.7% of preterm infants gain weight <50 grams at discharge in the study group I and Study group II respectively.

Figure (3): Distribution of preterm infants According to their mode of delivery.

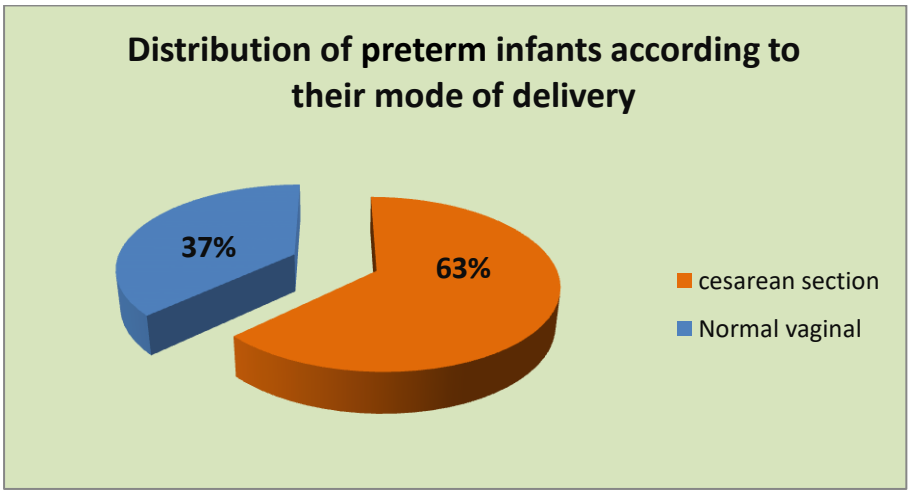

Figure 3: showed the distribution of preterm infants according to their mode of delivery, it was illustrated that 63% of the preterm infants delivered through caesarean section (CS) and the rest (37%) of them by normal vaginal delivery (NVD).

Figure (4): Distribution of preterm infants according to their gender.

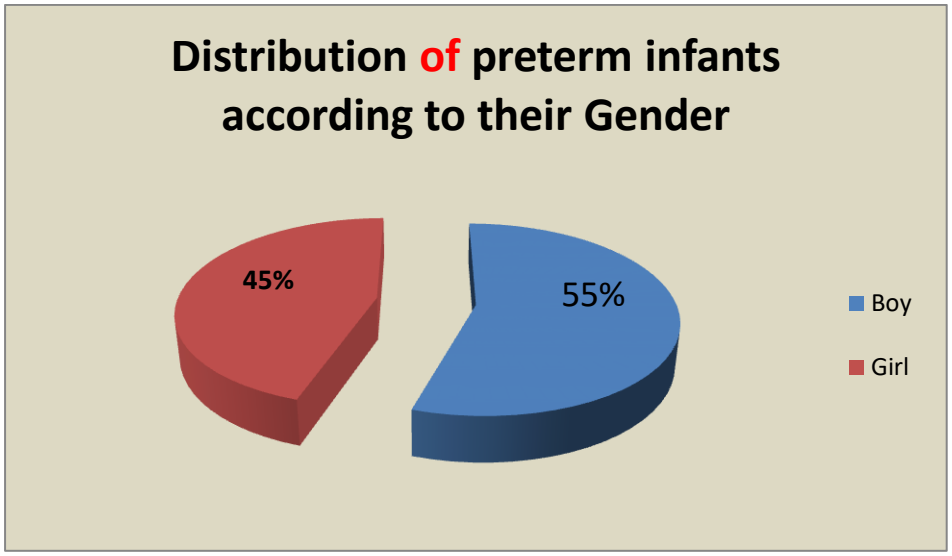

Figure 4: revealed distribution of preterm infants according to their gender, it was clarified that 55% of preterm infants' were boys and the rest (45%) were girls.

Table (2): Distribution of Preterm Infants according to their Physiological parameters in the study group I and study group II.

1.Temperature														
Positions	**Study group I (n=30)**						**Study group II (n=30)**						**X^2**	**p-value**
	Hypothermia		**Normal**		**Hyperthermia**		**Hypothermia**		**Normal**		**Hyperthermia**			
	No	**%**	**No**	**%**	**No**	**%**	**No**	**%**	**No**	**%**	**No**	**%**		
Supine	**1**	**10**	**8**	**80**	**1**	**10**	**5**	**33.3**	**6**	**40**	**4**	**26.7**	**13.3**	**0.001**
Side-lying	**0**	**0**	**5**	**83.3**	**1**	**16.7**	**4**	**26.7**	**6**	**40**	**5**	**33.3**	**9.6**	**0.002**

Prone	**0**	**0**	**12**	**85.7**	**2**	**14.3**	**0**	**0**	**0**	**0**	**0**	**0**	**8.3**	**0.003**
X^2	**10.9**													
p-value	**0.001**													
2.Heart rate														
Positions	**Normal**		**Tachycardia**		**Normal**				**Tachycardia**				**X^2**	**p.value**
	No	**%**	**No**	**%**	**No**		**%**		**No**		**%**			
Supine	**8**	**80**	**2**	**10**	**5**		**50**		**5**		**50**		**8.4**	**0.001**
Side-lying	**12**	**85.7**	**2**	**14.3**	**7**		**70**		**3**		**30**		**1.3**	**0.26**
Prone	**5**	**83.3**	**1**	**16.7**	**7**		**70**		**3**		**30**		**1.3**	**0.28**
X^2	**4.66**													
p-value	**0.321**													
3.Respiratory rate														
Positions	**Bradypnea**		**Normal**		**Tachypnea**		**Bradypnea**		**Normal**		**Tachypnea**		**X^2**	**p.value**
	No	%	No	%	No	%	No	%	No	%	No	%		
Supine	**1**	**10**	**7**	**70**	**2**	**20**	**1**	**10**	**6**	**60**	**3**	**30**	**4.32**	**0.061**
Side-lying	**1**	**16.7**	**4**	**66.6**	**1**	**16.7**	**1**	**10**	**7**	**70**	**2**	**20**	**3.65**	**0.059**
Prone	**3**	**21.4**	**7**	**50**	**4**	**28.6**	**1**	**10**	**7**	**70**	**2**	**20**	**3.42**	**0.081**
X^2	**2.49**													
p-value	**0.32**													
4.Oxygen saturation														
Position	**>95**		**<95**		**>95**				**<95**				**X^2**	**p.value**
	No	%	No	%	No		%		No		%			
Supine	**8**	**80**	**2**	**20**	**6**		**60**		**4**		**40**		**4.82**	**0.021**
Side-lying	**5**	**83.3**	**1**	**16.7**	**7**		**70**		**3**		**30**		**9.76**	**0.001****
Prone	**14**	**100**	**0**	**0**	**9**		**90**		**1**		**10**		**4.21**	**0.04***
X^2	**13.17**													
p-value	**0.001****													

*p-value < 0.05 statistically significant differences;

Table 2: showed distribution of Preterm Infants according to their Physiological parameters in both groups. It was noted that 80%, 83.3% & 85.7% in the study group I their temperature was normal in supine, side lying and prone positions compared to 40%, 40 & 0% in the study group II respectively. Therefore, there was a statistical significance difference at < 0.05 level of statistical significance. As regards heart rate, it was revealed that 80% of preterm infants in the study group I had a normal heart rate during supine position compared to 50% in the study group II. According to respiratory rate, it was revealed that 70% of preterm infants had normal respiratory rate during supine position in study group I compared to 60% in the study group II. Concerning SaO2 during prone position, it was found that 100% of preterm infants had SaO2 level at ≥ 95% in study group I compared to 90% in the study group II. So, there were highly statistical significant differences at 0.001 level of statistical significance.

Table (3): Distribution of Preterm infants according to their behavioral responses in the study group I and study group II.

1.Infant sleep state														
Positions	**Study group I (n=30)**						**Study group II (n=30)**						**X^2**	**p-value**
	Deep sleep		**Light sleep**		**Drowsy**		**Deep sleep**		**Light sleep**		**Drowsy**			
	No	**%**	**No**	**%**	**No**	**%**	**No**	**%**	**No**	**%**	**No**	**%**		
Supine	7	70	2	20	1	10	2	20	3	30	5	50	8.82	0.003
Side-lying	4	66.7	1	16.7	1	16.7	1	10	3	30	6	60	11.52	0.001
Prone	14	100	0	0	0	0	1	10	1	10	8	80	11.86	0.001
X^2	**16.54**													
p-value	**0.001**													
2.Infants awake state														

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Positions	Study group I (n=30)						Study group II (n=30)						X^2	p-value
	Alert		Hyper Alert		Cry		Alert		Hyper Alert		Cry			
	No	%	No	%	No	%	No	%	No	%	No	%		
Supine	7	70	2	20	1	10	7	70	1	10	2	20	18.9	0.001*
Side-lying	4	66.7	1	16.7	1	16.7	6	60	1	10	3	30	22.3	0.001*
Prone	12	85.8	1	7.1	1	7.1	3	30	1	10	6	60	12.3	0.005*
X^2	23.8													
p-value	0.001													

*p-value < 0.05 = statistical significant differences.

Table 3: revealed distribution of Preterm infants according to their behavioural responses in the form of sleep/awake states in both groups, it was noted that 82.5% , 87.5% & 100% having deep sleep during supine, side-lying and prone positions in the study group I compared to 20%, 20% & 10% in the study group II respectively. The majority of preterm infants (80% and 90%) in the study group I was awake and alert compared to 62.5% and 30% in the study group II. These referred to highly statistically significant difference at 0.001 levels of statistical significance.

Table (4): Distribution of Preterm infants according to their Attention/ Interaction and Self –Regulatory behaviour in study group I and study group II.

1.Primitive reflexes										
Positions	Positive		Negative		Positive		Negative		X^2	p.value
	No	%	No	%	No	%	No	%		
Supine	9	90	1	10	4	40	6	60	21.33	0.001
Side-lying	4	66.7	2	33.3	5	50	5	50	9.98	0.006
Prone	12	85.7	2	14.3	7	70	3	30	10.65	0.002
X^2	16.32									
p-value	0.001									
2.Attention interaction										
Positions	Positive		Negative		Positive		Negative		X^2	p.value
	No	%	No	%	No	%	No	%		
Supine	7	70	3	30	5	50	5	50	11.86	0.001*
Side-lying	4	66.7	2	33.3	6	60	4	40	6.9	0.042*
Prone	14	100	0	0	7	70	3	30	10.8	0.002*
X^2	16.33									
p-value	0.001									
Self-regulatory behavior										
Positions	Balance		Imbalance		Balance		Imbalance		X^2	p.value
	No	%	No	%			No	%		
Supine	7	70	3	30	5	50	5	50	11.86	0.001*
Side-lying	5	83.3	1	6.7	6	60	4	40	14.87	0.001*
Prone	13	92.8	1	7.2	7	70	3	30	9.3	0.003*
X^2	13.82									
p-value	0.001									

(*) statistically significant at p <0.05.

Table 4: illustrated distribution of preterm infants according to their Motor Activity, Attention/ Interaction and Self-regulatory Behavior in study group I and study group II. Regarding preterm infant primitive reflexes, it was noted that 90%, 66.7% & 85.7% of them have positive primitive reflexes in the study group I compared to 40%, 50% &70 % in the study group II during supine, side-lying and prone positions. Concerning attention/interaction, this result clarified that 70%, 66.7%, &100% of them had a positive attention/interaction responses in study group I compared to 50%, 60%, and 70% in the study group II during supine, side-lying and prone positions respectively. Also, there was a statistical significant difference (X2=13.82 at 0.001 level of statistical significance) between the two groups regarding preterm infants' self- regulatory behaviour.

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Figure (5): Distribution of Preterm infants according to their motor Activity in the study group I and study group II.

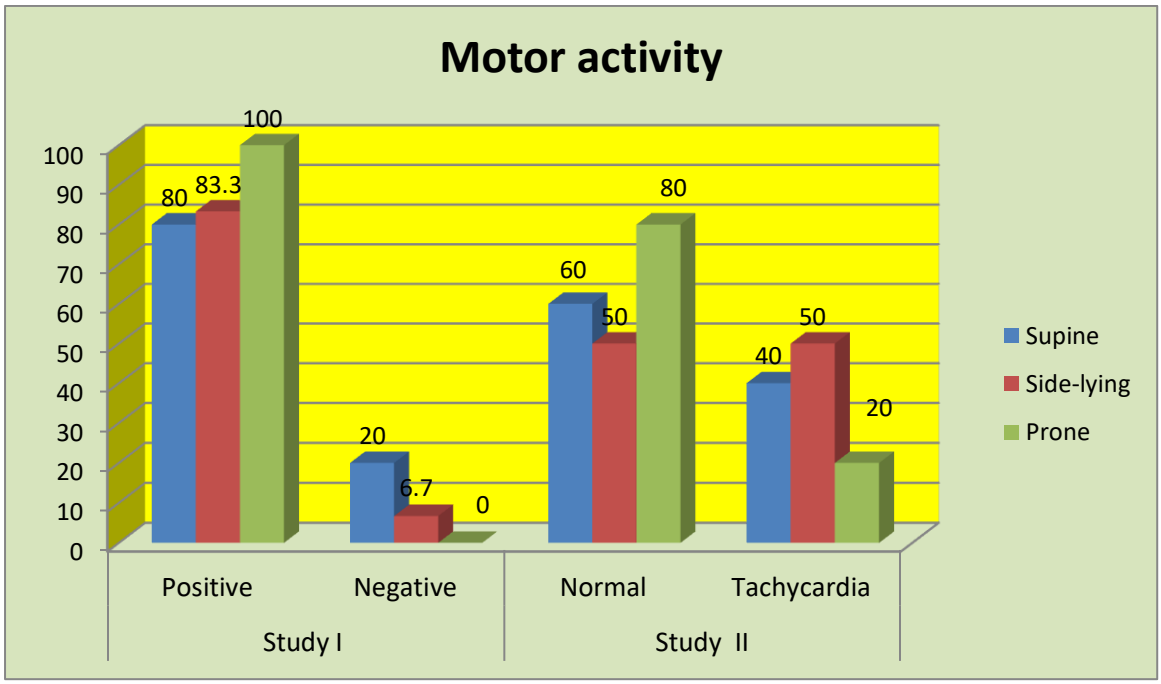

Figure 5: showed that distribution of preterm infants according to their motor activity in the study group I and study group II. The majority of preterm infants (80 %, 83.3% & 100%) had positive motor activity in the study group I compared to 60%, 50% and 80% in the study group II during supine, side lying and prone positions respectively.

Table (5): Distribution of Pain level among preterm infants during positioning in the study group I and study group II.

Infants pain level														
Positions	**Study group I (n=30)**						**Study group II (n=30)**						**X^2**	**p-value**
	No/mild pain		**Mild/ moderate pain**		**Severe pain**		**No/mild pain**		**Mild/ moderate pain**		**Severe pain**			
	No	%	No	%	No	%	No	%	No	%	No	%		
Supine	8	80	2	20	0	0	5	50	4	40	1	10	14.9	0.001*
Side-lying	4	66.7	1	16.7	1	16.7	2	20	5	50	3	30	23.3	0.001*
Prone	12	85.8	2	14.2	0	0	2	20	6	60	2	20	29.3	0.005
X^2	31.22													
p-value	0.001													

*P-value < 0.05 statistically significant differences. P-value >0 .05 No statistical significant differences.

Table (5): illustrates the distribution of pain level among preterm infants during positioning in the study group I and study group II, it was revealed that 80%, 66.7 % & 85.8% of preterm infants having no or mild pain in study group I compared to 50%, 20 % and 20% in study group II during supine, side-lying and prone positions respectively. Therefore, there were statistical significance differences at the 0.001 level of statistical significance.

III. DISCUSSION

The result of the present study showed that, the nesting technique was effective in improving physiological parameters and neurobehavioral organization of preterm infants in the early neonatal period. Regarding socio-demographic characteristic of the studied sample, it was revealed that 36.7% of preterm infants were between 34 - ≤36 weeks of gestational age in the study group I compared to 56.7% in the study group II. On the same subject, Reyhani et al., (2016)

inferred that 84% of preterm infants in the experimental group were between 34 – 36 weeks of gestation. Therefore, implementing of appropriate nursing interventions is crucial for conserving and promoting wholeness of preterm infants.

Regarding birth weight, it was noted that 33.3% of preterm infants weighed 2000-< 2500 grams in the study group I compared to 30% in the study group II. This was in line with Poulose et al., (2015) who revealed that the birth weight infants under study were more in the group of 2-2.5kg. In addition, the mean and standard deviation of birth weight in the study group I was 1735±375.6 grams compared to 1725±286.3 in study group II. Our findings were compatible with the study of Reyhani et al., (2016) who reported that infants in the experimental group weighed 2002.2±395.9 grams and in the control group weighed 1958.7±415.2 grams. Regarding the duration of hospital stay, it was clear that 13.33% of preterm infants stayed more than 10 days (≥10 days) in the study group I compared to 43.33% in the study group II. Also, this table clarified that 33.3% and 26.7% of the preterm infants gain weight <50 grams at discharge in the study group I and study group II respectively. This demonstrates that preterm infants require support to facilitate and maximize infant stability, preserve energy, growth, and promote neurobehavioral organization.

Regarding distribution of Preterm Infants according to their Physiological parameters in the study group I and study group II, it was revealed that temperature was normal in supine, side-lying and prone positions in the study group I (80%, 83.3% & 85.7%) compared to 40%, 40 & 0% in the study group II. It is noteworthy that in the study by El-Nagger and Bayoumi (2016) mentioned that 90%, 97.5% & 85% compared to 40%, 60% & 0% of preterm infants, their temperature was normal in supine, side-lying and prone positions in the study group and control group respectively. This was confirmed with Kavimani (2016) who inferred that there was a significant difference in maintaining the physiological parameters in the experimental group than in the control group. Therefore, there were statistical significant differences between the two groups. These findings of the current study was contradicted with El-Nagger and Bayoumi (2016) who illustrated that, there was no statistical significant difference regarding the heart rate between nesting and un-nesting positioning in the three different positions (supine, side-lying and prone). This clarified proper supported position is providing functional support of all parts of the body as well as ensuring physical safety.

As regards heart rate, it was revealed that 80% of preterm infants compared to 50% of them had a normal heart rate during supine position in the study group I and study group II respectively. Therefore, there was a statistical significant difference. This was confirmed by Reyhani et al., (2016) who reported that nest posture is a completely safe and non-medicinal nursing procedure that accelerate brain maturity and development. Nevertheless, the findings of the current study disagreed with El-Nagger and Bayoumi (2006) who reported that, there was no statistical significant difference regarding the heart rate between the study group and control group in the three different positions (supine, side-lying and prone). According to the results nest posture is safe and non-medicinal nursing procedure, which accelerate brain maturity and development.

Regarding the respiratory rate, it was revealed that 70% of preterm infants had normal respiratory rate during supine position in study group I compared to 60% in the study group II. This was agreed with Poulose et al., (2015) who revealed that infants in the experimental group experienced stable physiological parameters in respiration during the stay in the Neonatal Intensive Care Unit (NICU). However, such findings are contradicted with El-Nagger and Bayoumi (2016) who reported that, there was no statistical significant difference between study and control group regarding respiratory rate. This demonstrated that the positioning of infants inside the nest may capacitate them to maintain their state due to the curved fetal position of the body and closeness of body parts, which may improve their physiological parameters.

Concerning SaO2 during prone position, it was found that 100% of preterm infants had SaO2 level at ≥ 95% in study group I compared to 90% in the study group II that referred to highly statistically significant difference (P =0.001). This was corresponding with Maher and Elarousy (2018) who pointed out the mean Oxygen saturations after nesting were higher than before nesting for neonates in the study group (97.43 ± 1.473 and 94.37 ± 2.34 respectively). These results are in accordance with King (2009) who reported that prone position could improve lungs and cardio-respiratory development. This demonstrates that nesting position resembles a fetus in the uterus, which stimulates an intrauterine environment to enhance the physiological stability and oxygenation of the neonates.

Concerning the distribution of Preterm infants regarding behavioral responses in the form of sleep/awake states, it was revealed that 82.5% , 87.5% & 100% having deep sleep during supine, side-lying and prone positions in the study group I compared to 20%,20% &10% in the study group II. Our findings were compatible with the study by Baley (2015) who

mentioned that developmental positioning was associated with longer quiet sleep duration and better sleep organization. Also, the majority of the preterm infants (80% and 90%) in the study group I was awake and alert compared to 62.5% and 30% in study group II. This referred to highly statistically significant difference (P =0.001). The findings were in line with Reyhani et al., (2016) who mentioned that during the intervention the mean of positioning time in the deep sleep state was significantly higher in the experimental group compared to control group (P<0.01). Also, Kihara and Nakamura (2013) reported that infants who placed with nested support experienced longer deep sleep hours compared to those without support. In this context, Prasanna and Radhika (2015) justified that nesting with swaddling position facilitates transformation of sleep pattern from erratic disturbed spells to deep sleep rather than prone position only. This could be justified that nesting techniques facilitates deep sleep that plays a critical role in the early neurosensory development, impacts memory and subsequent learning, and preserves brain plasticity.

The present study illustrated that the majority of preterm infants (80 %, 83.3% & 100%) had positive motor activity in the study group I compared to 60%, 50% and 80% in the study group II during supine, side lying and prone positions. This was clarified by Ferrari et al., (2007) who mentioned that nest promotes a flexed posture of the limbs with adduction of shoulders, facilitates well-designed wrist movements and movements towards and across the midline and minimize abrupt movements and frozen postures of the arms and legs. Preterm infants seem to benefit most from intervention that aims at mimicking the intrauterine environment Also, there was a high statistical significance difference at P-values 0.001. Therefore, because of the advantages of nesting techniques regarding the maintenance of therapeutic posture, it is believed that the use of this intervention in preterm infants may result in promoting comfort, increases muscle tone, reflexes and motor agility.

Regarding preterm infant primitive reflexes, it was represented that 90% , 66.7% & 85.7% of them having positive primitive reflexes in the study group I compared to 40%, 50% & 70 % during supine, side-lying and prone positions in study group II. In this context, Keller et al., (2003) mentioned that nesting position increases muscle tone, reflexes, motor agility, prevents external rotation contractures of the neonates extremities and abnormally shaped heads as well as consequences of brain growth. Concerning preterm infants' attention/interaction, this result also clarified that 70%, 66.7%, &100% of them had positive attention/interaction responses in study group I compared to 50%, 60%, and 70% in the study group II during supine, side-lying and prone positions respectively. Also, there was a statistical significant difference at the 0.001 level of statistical significance between the study group I and the study group II regards preterm infants' self – regulatory behavior. El Nagar and Bayomi et al., (2016) mentioned that the use of the nesting technique in the NICUs is recommended to ensure more humanized and harmless care to the preterm infants. This clarified that the nesting technique is effective in improving the preterm infant's posture and provide comfort during their stay in NICU

Regarding the pain level among preterm infants during positioning in the study group I and study group II. It was revealed that 80%, 66.7 % & 85.8% of preterm infants having no or mild pain in study group I compared to 50%, 20 % and 20% in study group II during supine, side-lying and prone positions respectively. This explained that there is a statistical significance at the 0.001 level of statistical significance. This finding was consistent with Comaru (2008) who mentioned that nesting intervention in the preterm infants result in minimizing pain, stress and promotes comfort. Therefore, the present study revealed that Nesting was effective in reducing the discomfort of preterm infants during their stay in NICU.

IV. CONCLUSION

Based on the findings of the current study, it can be concluded that the nesting technique enhanced and stabilize the physiological parameters of preterm babies mainly heart rate, respiratory rate and oxygen saturation as well as facilitate deep sleeping, increased comfort and improved neurobehavioral organization.

V. RECOMMENDATION

Based on the previous findings, the following recommendations are advocated:

1) Accentuate the importance of applying the nesting technique for all preterm infants in the NICUs as standard of developmental supportive care to improve physiological parameters and neurobehavioral organization.

2**)** Further research: Implementing a training program for all nurses in NICU about the application of a nesting technique for preterm infants to enhance their growth and development.

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