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Effect of Nesting Position on Behavioral Organization among Preterm Neonates

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Abstract: **Nesting position considers one of the most essential developmental supportive interventions used within the Neonatal Intensive Care Unit (NICU) to maintain the intrauterine position for the preterm neonates. It helps to improve neuromuscular development and promotes behavioral organization. Whereas preterm neonates may spend months in the NICU, they are exposed to many factors that may interfere with the maturation and organization of preterm neonates' central nervous system. Aim of the study was to determine the effect of nesting position on behavioral organization among preterm neonates. Research Design: A quasi experimental research design was used. Setting: This study was conducted at the NICU of Damanhour National Medical Institute, Damanhour City, Al-Behira governorate, Egypt. Subjects: A convenient sample of 60 preterm neonates who fulfilled the inclusion criteria comprised the study subjects as: gestational age ranged from 32 - < 37 weeks and begin enteral feeding. Those neonates were equally divided into a study group (received nesting intervention) and a control group (received NICU routine care with traditional positions without nest). Tools: Two tools were used to collect necessary data namely; Characteristics and Medical History of Preterm Neonates and Preterm Neonate's Behavior Assessment Scale. Results: The total percent score of the preterm neonates' reactions on autonomic / visceral subsystem behavioral scale revealed that, in the first assessment 80% of the neonates in both groups exhibited suspected abnormal behavioral response, in the second assessment 63.3% of neonates in the study group had "normal behavioral response" in comparison with 26.7% of those in the control group. Moreover, in the third assessment 83.3% of the neonates in the study group compared to 60% of those in the control group had "normal behavioral response". Additionally, the total percent score of the preterm neonates' reactions on state regulation and attention- interaction subsystem behavioral scale reflected that, in the first assessment 73.3% of the neonates in both groups had definite abnormal behavioral response, in the second assessment 76.7% of neonates in the study group experienced "suspected abnormal behavioral response" compared to 56.7% of those in the control group. Amazingly, in the third assessment, 80% of neonates in the study group compared to 40% of those in the control group exhibited "normal behavioral response". The differences were statistically significant in both the second and third assessments. Conclusion: It can be concluded that nesting position was effective in improving behavioral organization of preterm neonates. Recommendation: applying nesting position for all preterm neonates as a part of routine care within NICUs and as standard of developmental supportive care.**

Keywords: **Nesting Position, Preterm Neonates, Behavioral Organization.**

1. INTRODUCTION

Prematurity is an increasing global perinatal challenge. Preterm neonates are vulnerable population who are born before completion of 37 weeks of gestation. Therefore, they require advanced medical interventions and special nursing approaches to survive. Internationally, the World Health Organization (WHO) (2017) [(1)] reported that 15 million neonates are born preterm. Prematurity is the leading cause of neonatal mortality and reducing this mortality is one of the goals of the United Nations' 2030 agenda [(1, 2)].

Currently, Neonatal Intensive Care Units (NICUs) have many technological resources for the care of neonates, as mechanical ventilators and cardiorespiratory monitors. Due to that, the preterm neonates who need intensive care must adapt to the reality of the NICUs, without the comfort of the womb [(3)]. During their stay at the NICUs, preterm neonates are always exposed to many painful procedures as well as numerous environmental stimulation which may lead to physiological, psychological and behavioral sequelae among those neonates [(4)]. Preterm neonates remain at risk for a wide spectrum of long-term morbidity including cerebral palsy, mental retardation, developmental delay, school problems, behavioral issues, and overall poor health status [(2)]. Hence, beside innovative interventions in medical field, there is a need for specialized nursing practices in NICUs to provide holistic care for preterm neonates particularly to support their neurodevelopmental processes [(5).]

Developmental supportive care (DSC) is an approach that attempts to manipulate the preterm neonates' environment to reduce external stressors. It helps preterm neonates to focus energy on growing and getting better. It also aims to use the unique physiological and behavioral cues of the preterm as a foundation for interactions and interventions. [(6-8)]. Positioning as nesting lies within the scope of DSC and it considers one of the most important and comfort position used in the NICUs to maintain the flexion posture that stimulates in-utero feeling [(4)]. Nesting technique involves the using of rolled-up sheets to form a ‘nest’. This ‘U’ shape provides boundaries for the preterm to push against and prevent extended positioning which can affect acquisition of developmental motor skills and hinder self-regulation [(9)]. This position also provides physiological, behavioral and postural stability to the preterm. Furthermore, it supports neuromuscular development, promotes self-soothing and behavioral organization [(10)].

Behavioral organization was discussed through the Als’s Synactive Development Theory. Through this theory Als H, revealed that, the behavior is the first way for preterm neonate to communicate. Additionally, the fetus from conception onward is thought to be organized in five distinct interrelated subsystems. These subsystems are autonomic, motor, state, attention /interaction and self-regulatory which guide the neonate’s interaction with the environment [(5, 7)]. Preterm neonates may spend months in the NICUs. They are exposed to an environment very different from that in utero. This environment may interfere with the maturation and organization of the preterm neonate’s Central Nervous System (CNS) [(3, 11)]. Organization reflects the neonate’s ability to integrate physiological and behavioral systems in response to the environment without disruption in state or physiological functions [(12)].

Neonatal intensive care nurses are key persons involved in the preterm neonates’ care. Those nurses should be equipped with the most recent evidences in the neonatal care. They have to be alert to apply the most optimum position for the preterm neonates as nesting position to enhance the preterm quality of care and maintain the best intermediate and long term outcomes [(5)]. Unfortunately, researches addressing the incorporation of nesting position in NICUs are limited. Hopefully, the current study would implement a developmental supportive position approach that could enhance the preterm neonates' behavioral organization in NICUs. So, this study was carried out to determine the effect of nesting position on behavioral organization among preterm neonates.

This study aimed to:

Determine the effect of nesting position on behavioral organization among preterm neonates.

Research Hypotheses:

1. Preterm neonates who receive nesting intervention exhibit higher autonomic/ visceral subsystem score on Preterm Neonate’s Behavior Assessment Scale than those who do not.

2. Preterm neonates who receive nesting intervention exhibit higher state regulation and attention- interaction subsystem score on Preterm Neonate’s Behavior Assessment Scale than those who do not.

Operational Definitions:

- **Behavioral Organization**: It refers to a set of behaviors that a preterm neonate possesses for regulating his internal state and his exchanges with the environment. It includes assessment of preterm neonate’s autonomic/visceral subsystem as well as state regulation and attention-interaction subsystem. Autonomic/visceral subsystem involves color, respiration, visceral and neurophysiological responses. While, state regulation and attention-interaction subsystem involves state regulation, orientation to auditory simulation and alertness.

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Nesting position: It refers to positioning the preterm neonate in a flexed fetal-type posture in three positions (supine-side-lying and prone position respectively and alternatively every two hours) inside a nest that was created by a towel to form boundaries around the preterm neonate.

2. MATERIAL AND METHODS

Material

Research Design

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

Setting

The study was conducted at Neonatal Intensive Care Unit of Damanhour National Medical Institute affiliated to Ministry of Health in Damanhour City, Al-Behira governorate, in Egypt.

Subjects:

- Epi-Info program was used to estimate the sample size using the following parameters:
- • Population size =110 preterm neonates (the last three months prior to data collection)
- • Expected frequency = 50%.
- • Acceptable error =10%.
- • Confidence coefficient =95%.
- • Minimum sample size = 51 preterm neonates.
- A convenient sample of 60 preterm neonates who fulfilled the following criteria comprised the study subjects:
- • Postnatal age: Ranged from 3-6 days.

(To allow for resolution of anesthesia received by their mothers during labor, allow for adaptation to the extra-uterine environment and avoid neurodevelopmental maturation before application of the study intervention)

- • Gestational age: Ranged from 32 - < 37 weeks.
- • Begin enteral feeding i.e. oral or Orogastric Tube (OGT).
- • Did not receive any sedatives or analgesics.
- • Free from any congenital anomalies or neonatal sepsis.
- The preterm neonates were divided into two equal groups. Each group consisted of 30 preterm neonates as follows:

• **The nesting position group (the study group)**: where preterm neonates received nesting intervention in addition to routine care of the NICU.

• **The control group**: where preterm neonates received the NICU routine care with traditional positions without nest.

Tools

Two tools were used to collect the necessary data.

Tool one: Characteristics and Medical History of the Preterm Neonates

This tool was developed by the researchers after thorough review of related literature [8, 11, 12]. It included two parts:

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

Part II: Medical History of the Preterm Neonates, such as: gestational age, the appropriateness of weight for gestational age, type of delivery, current diagnosis and method of feeding.

Tool two: **Preterm Neonate's Behavior Assessment Scale**:

This scale was developed by Souza et al (2014) [13] which was based on the Als's Synactive model of neonatal behavioral organization. The scale was used to assess behavior organization of the preterm neonates after provision of DSC in the NICUs.

The scale was adopted by the researchers to assess the behavioral organization of the preterm neonates after applying nesting position intervention. The scale has two subsystems: First one is the autonomic/visceral subsystem consisting of four domains namely; color, respiration, visceral and neurophysiological responses. The second is the state regulation and attention-interaction subsystem, consisting of three domains namely; state regulation, orientation to auditory stimulus and alertness. The content validity of the tool was 0.95 and test-retest reliability (r) revealed to be 0.96 for autonomic/visceral subsystem and 0.92 for state regulation and attention-interaction subsystem yielding a valid and reliable tool for assessing behavior of the preterm neonates.

Scoring system:

Each of these domains in the two subsystems was measured on a three-points likert scale ranged from (0–2) as follows:

A. Assessment of Preterm Neonate's Behavior : Autonomic/ Visceral Subsystem:

1. Color:

- Pale, cyanotic = 0
- Pink but changes rapidly with slow recovery, not returning to good color = 1
- Pink = 2

2. Respiration:

- Gasping, frequent apnea, unstable respiratory rate = 0
- Occasional apnea, unstable respiratory rate = 1
- Regular, stable respiratory rate = 2

3. Visceral:

- Vomits feed, feed intolerance = 0
- Bowel movement grunt and strain = 1
- Gastrooesophageal reflux Nil = 2

4. Neurophysiological Responses:

- Flaccid in stimulation = 0
- Abnormal jerks, Twitch = 1
- Stable = 2

B. Assessment of Preterm Neonate's Behavior: State Regulation and Attention-Interaction Subsystem

1. State Regulation:

- Intense crying which is rhythmic with irregular breathing = 0
- Active awake state with infant fussing but not crying but stressed and hyper alert = 1
- Awake, alert = 2

2. Orientation to auditory stimulation:

- Does not focus on or follow stimulus = 0
- Brightness with stimulus, may focus and follow briefly with jerky eye movement = 1
- Focuses on stimulus and follows with smooth continuous head movement = 2

3. Alertness:

- Rarely or never responsive to direct stimulation = 0
- When alert, responsivity brief and variable, may be delayed = 1
- Always alert in best periods, stimulation always elicits alerting and orientating = 2

The total score of **autonomic/ visceral subsystem** is the **SUM** of its four domains. It is ranged from 0-8. The higher the score the more stable behavioral response the neonate will exhibit. A score from 5-8 represents “normal behavioral response”, a score from 2-4 represents “suspected abnormal behavioral response”. While, a score ≤1 indicates “definite abnormal behavioral response”.

The total score of **State regulation and attention-interaction subsystem** is the **SUM** of its three domains. It is ranged from 0-6. The higher the score the more stable behavioral response the neonate will exhibit. A score from 4-6 represents “normal behavioral response”, a score from 2-3 represents “suspected abnormal behavioral response”. While, a score ≤1 indicates “definite abnormal behavioral response”.

Methods:

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

2) Tool one was developed by the researchers after thorough review of related literature [8, 11, 12].

3) Content validity of tool one was done by five experts in the pediatric nursing field.

4) A pilot study was carried out on 6 preterm neonates (10% of the total sample) to test the applicability and clarity of the tools and no modifications were done. Those neonates were excluded from the study subjects.

5) Initially, data were collected from the preterm neonates in the control group who were left to the NICU routine care to prevent subjects’ contamination. Then, nesting position was carried out for the preterm neonates in the study group.

6) The researchers attended both morning and evening shifts for data collection. While, other three trained nurses attended the night shifts to maintain alternate nesting position for the preterm neonates in the study group.

7) Characteristics and medical history of each preterm neonate among both groups were assessed using tool one.

8) Preterm neonate’s behavior assessment scale was applied for the neonates in the control group as follows: first time as baseline data when a preterm neonate met the inclusion criteria. Then, the preterm neonates were left for the NICU routine care for 10 days after that, the assessment was done for the second time. Third assessment was applied after another 10 days.

9) Assessment of the preterm neonates' behavioral organization in the control group using tool two was applied as follows:

A: Assessment of Preterm Neonates’ Behavior: Autonomic/ Visceral Subsystem as follows:

- The researchers assessed, recorded and scored the color of each preterm neonate.
- The researchers counted the respiratory rate and recorded its characteristics for each preterm neonate.

- Visceral domain was assessed for all preterm neonates by observe the occurrence of vomiting or feeding intolerance through OGT aspiration (if present), observe Gastro-oesophageal reflux, and assess the bowel movement and scored the visceral domain.

- Neurophysiological responses were assessed by eliciting the preterm neonates' reflexes as palmar grasp reflex: The neonate's palm was stroked with a finger; this stimulated the neonate to grasp the finger. Then, the researchers scored the preterm neonates' reactions.

B. Assessment of Preterm Neonates' Behavior: State Regulation System and Attention-Interaction Subsystem as follows:

- The researchers assessed and scored the state regulation by observing each preterm neonate during the exposure to stressful situation, such as, diaper care or heel lance.

- **Orientation to auditory stimulation was assessed** as follows: A soft bell was used to test the preterm neonate's response to auditory stimuli which was presented to each side and out of neonate's sight. Then, the researchers scored the preterm neonate's reaction.

- **Finally, alertness was assessed** through visually stimulating the preterm neonate as follows: A red ball was used to test the neonate's ability to fix on a visual object and flow it horizontally. Then, the researchers scored the preterm neonate's alertness in response to visual stimulation.

10) The time spent to complete the assessment for each preterm neonate was about 20-30 minutes.

11) **The nesting position was applied for the study group as follows:**

Positioning the preterm neonate inside the nest was done alternatively in the three positions (supine- side-lying and prone position respectively). The preterm neonate's position was changed every two hours. This intervention will continue throughout the 24 hours for 10 consecutive days as follows:

- The required nesting equipment was prepared from the NICU such as blanket, linen and small pillow.

- A nest was created by a hand towel to support both sides of the preterm neonate and forming U shape under the buttocks.

- The suitable nest size was chosen to suit the preterm neonate's body, not too loose and not too tight during each position.

- Initially, the preterm neonate was placed in the supine position through wrapping him with hands to midline the nest through putting small pillow under the neonate's shoulder to support the head in the midline and to keep airway open as well as to attain a flexed position towards the chest. The elbow, shoulder and hip joints of the neonate were kept in flexion position.

- After that, the preterm neonate's position was changed after two hours to side- lying position (left or right) through supporting the preterm neonate's back by the nest or small pillow. Additionally, the preterm neonate's both hands were placed together near to his face.

- Then, the preterm neonate's position was changed after two hours to prone position through supporting the preterm neonate by small pillow under the chest to keep the airway open.

12) Neonatal behavior using preterm neonate's behavior assessment scale was assessed with the same manner and at the same time sequences like mentioned previously for the control group.

13) Neonatal behavior using preterm neonate's behavior assessment scale was assessed for the second time after the discontinuation of nesting intervention - which continue for 10 consecutive days- and the third time 10 days later to check for its prolonged effect on the preterm neonates' behavioral organization.

14) Comparison between two groups was done to evaluate the effect of nesting position on preterm neonates' behavioral organization.

15) Ethical considerations were considered all over the study phases as

Following:

- Written consent of the preterm neonates' parents was obtained after explaining the aim of the study.
- Parents were ascertained about confidentiality of their neonates' data.

Statistical analysis:

Collected data was coded and transferred into specially designed formats to be suitable for computer feeding. The Statistical Package for Social Sciences (SPSS version 21) was utilized for both data presentation and statistical analysis of the results. Categorical data were expressed in the form of frequencies and percentages. Numeric data were expressed in the form of mean and standard deviation (SD). Chi-square test and Fisher's Exact test were used to test the significance of results of qualitative variables.

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

3. RESULTS

Table 1: illustrates the characteristics and medical history of the preterm neonates among the study and control groups. Regarding their characteristics it was revealed from the table that, 66.7% of the preterm neonates were females in each group. The same table shows that preterm neonates who weighted 2000 to less than 3000 grams constituted 76.7% in the study group and 66.7% in the control group. Their mean weights were 1966±435.95 and 1983 ± 428.57 grams respectively. In relation to medical history, the majority of neonates (86.7%) in both groups were late preterm. Their mean gestational ages were 34.5±4.55 and 34.7±4.51 weeks for the study and control groups respectively. In addition, the weight of more than three quarters of participant neonates (76.7%) was appropriate for their gestational age using intraunterine growth chart in both groups. The same table presents that, the most common diagnosis encountered by preterm neonates in the study group and control group was respiratory distress syndrome (60% and 46.7% respectively). The mode of delivery was cesarean section for all preterm neonates in the study group and for the vast majority of them (93.3%) in the control group. The table also illustrates that slightly more than two thirds of neonates (66.7%) in the study group and 53.3% of those in the control group received their feeding via OGT. No statistical significant differences detected among the preterm neonates in the two groups.

The effect of nesting position on preterm neonates' reactions on autonomic / visceral subsystem behavioral scale among the study and control groups was clarified in **table 2**. Regarding neonates' color, the first assessment revealed that 50% of the preterm neonates in the study group were pale /cyanotic. While, more than half of those (53.3%) in the control group were pink but changes rapidly with slow recovery. At the second assessment, approximately three quarters of the neonates in the study and control groups were pink but changes rapidly with slow recovery (73.4% and 76.7% respectively). Fortunately, in the third assessment the color for almost two thirds of the neonates (66.7%) in the study group was pink in contrast with only 26.7% of those in the control group. There was statistical significant difference between the study and control groups at third assessment, where P = 0.002.

Concerning respiration, the first assessment on autonomic / visceral subsystem behavioral scale revealed that, 76.7% of the neonates in the study group had occasional apnea and unstable respiratory rate. Also, the same reaction was seen among 70.0 % of those in the control group. In the second assessment, 70% of the neonates in the study group had occasional apnea and unstable respiratory rate compared to 56.7% of those in the control group. It was luckily that the third assessment showed that, 56.7% of the neonates in the study group had regular, stable respiratory rate compared to 36.7% of the neonates in the control group. However, the differences were not statistically significant among both groups.

In relation to their visceral reactions, the first assessment portrayed that half of the neonates in study group vomited their feeds, so they had feeding intolerance and the other half had bowel movement grunt and strain. On the other hand, one third of the neonates in the control group vomited their feeds and two thirds of them had bowel movement grunt and strain. At the second assessment, nearly three quarters of the neonates (73.3%) in the study group had bowel movement grunt and strain compared to 86.6% of the neonates in the control group. Also, more than one quarter of the neonates (26.7%) in the study group had nil gastro-oesophageal reflux compared to 6.7% of those in the control group. It was

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amazing that, at the third assessment 83.3% of the neonates in the study group had nil gastro-oesophageal reflux compared to only one third of the neonates in the control group. The differences were statistically significant between the study and control groups at the second and third assessments (P= 0.045 and P = 0.000 respectively).

The same table also points out the neurophysiological responses for the study and control groups. At first assessment, more than half of the neonates (53.3%) in the study group were flaccid in stimulation and 46.7% of them had abnormal jerks and twitch. While the first assessment of the control group revealed that, 43.3% of the neonates were flaccid in stimulation and 56.7% of them had abnormal jerks and twitch. At second assessment, around three quarters of the neonates (76.7%) in the study group exhibited abnormal jerks and twitch compared to 86.6% of those in the control group. Additionally, almost one quarter of the neonates (23.3%) in the study group was stable compared to only 6.7% of the neonates in the control group. Amazingly, the third assessment reflected that 80% of the neonates in the study group were stable compared to one third of those in the control group. The difference was statistically significant between the study and control groups at the third assessment, where P = 0.000.

Table 3: Portrays the effect of nesting position on preterm neonates' reactions on state regulation and attention-interaction subsystem behavioral scale among the study and control groups. Concerning state regulation, at first assessment more than half of the neonates in the study and control groups were active awake with infant fussing but not crying (53.3%, 56.7 % respectively). At second assessment, the same behavioral state was noticed among 83.3% of the neonates in the study group compared to 73.3% of those in the control group. While it was interesting that, in the third assessment about two thirds of the neonates (66.7%) in the study group were awake alert in their reactions compared to less than one quarter of the neonates (23.3%) in the control group. The difference was statistically significant between two groups at third assessment (P =0.001).

Considering orientation to auditory stimulation, the first assessment revealed that all neonates in both groups did not focus on or follow stimulus. Changes occurred in the second assessment where, nearly three quarters of the neonates (73.3%) in the study group showed brightness with stimulus, might focus and followed briefly with jerky eye movements in comparison with 40.0% of those in the control group. Fortunately, the reactions of the neonates in the study group to auditory stimulation were changed again in the third assessment as more than half of the neonates (56.7%) in the study group focused on stimulus and followed it with smooth continuous head movement in contrast with only 13.3% of the neonates in the control group. There were statistical significant differences evident between the study and control groups at second assessment as well as the third assessment (P= 0.009 and P = 0.000 respectively).

Regarding to their alertness, it was obvious that 56.7 % of the neonates in both groups in their first assessment were rarely or never responsive to direct stimulation. While, in the second assessment 80.0% of the neonates in the study group when alert their responsivity were brief and variable compared to 63.3% of the neonates in the control group. In the third assessment the alertness of the neonates in the study group was dramatically improved as more than half of them (60.0%) were always alert in best periods and their stimulation always elicited alerting and orientating compared to 23.3% of the neonates in the control group. There were statistical significant differences in the second and third assessments between the two groups (P = 0.002 and P= 0.004 respectively).

Table 4: reveals the total percent score of the preterm neonates' reactions on autonomic / visceral subsystem behavioral scale among the study and control groups. It is clear from the table that in the first assessment 80% of the neonates in both groups exhibited "suspected abnormal behavioral response". Substantially, in the second assessment approximately two thirds of the neonates (63.3%) in the study group experienced "normal behavioral response" in comparison with 26.7% of those in the control group. Moreover, in the third assessment 83.3% of the neonates in the study group compared to 60% of those in the control group experienced "normal behavioral response". The differences were statistically significant between both groups in the second assessment and the third assessment as well, where P= 0.006 and P= 0.045 respectively. The mean autonomic /visceral subsystem score for the neonates in the study group at first assessment, second assessment and at third were 2.4 ± 0.44, 4.6 ± 0.817 and 6.8 ± 0.63 respectively. While, the mean autonomic /visceral subsystem score for the neonates in the control group were 2.5 ± 0.74, 3.8 ± 0.93 and 5.2 ± 1.43 respectively.

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The total percent score of the preterm neonates' reactions on state regulation and attention- interaction subsystem behavioral scale among the study and control groups are presented in **table 5**. It was apparent that, in the first assessment 73.3% of the neonates in both groups had "definite abnormal behavioral response". Dramatically, in the second assessment more than three quarters of the neonates (76.7%) in the study group demonstrated "suspected abnormal behavioral response" compared to 56.7% of those in the control group. Amazingly, in the third assessment 80% of the neonates in the study group compared to 40% of those in the control group exhibited "normal behavioral response". The differences were statistically significant between both groups in the second and the third assessments, (P= 0.001 and P= 0.002 respectively). The mean score of state regulation and attention- interaction subsystem for the neonates in the study group at first assessment, second assessment and at third assessment were 1.0±1.10, 2.7 ± 0.817 and 4.7 ± 1.45 respectively. While, the mean score for those in the control group were 1.0 ± 3.45, 1.7 ± 0.93 and 3.6 ± 1.10 respectively.

Table 1: Characteristics and Medical History of the Preterm Neonates in the Study and Control Groups

Characteristics and Medical History	Study group (n=30)		Control group (n=30)		Test of Significance
	No.	%	No.	%	
Characteristics					
Gender					
• Male.	10	33.3	10	33.3	-----------
• Female	20	66.7	20	66.7	
Weight / grams					
• 1000 –	7	23.3	10	33.3	X = 0.739
• 2000 -<3000	23	76.7	20	66.7	P= 0.390
Mean ± SD	1966 ± 435.95		1983 ± 428.57		
Medical History					
Gestational age					
• Moderately preterm (32 - < 34 weeks)	4	13.3	4	13.3	-----------
• Late preterm (34 -< 37 weeks)	26	86.7	26	86.7	
Mean ± SD	34.5 ± 4.55		34.7 ± 4.51		
Appropriateness of weight to gestational age					
• Small for gestational age.	7	23.3	7	23.3	-----------
• Appropriate for gestational age.	23	76.7	23	76.7	
Mean ± SD	1966 ± 435.95		1983 ± 428.57		
Current Diagnosis					
• Hyperbilirubinemia.	7	23.3	9	30.0	X = 1.083
• Congenital Pneumonia.	5	16.7	7	23.3	P= 0.651
• Respiratory Distress Syndrome.	18	60.0	14	46.7	
Type of Delivery					
• Normal Vaginal Delivery.	0	0.0	2	6.7	FET:0.246
• Cesarean Section.	30	100	28	93.3	P = 0.492
Method of Feeding					
• Oral	10	33.3	14	46.7	X = 1.111
• Orogastric Tube.	20	66.7	16	53.3	P= 0.292

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

Table 2: Effect of Nesting Position on Preterm Neonates' Reactions on Autonomic / Visceral Subsystem Behavioral Scale among the Study and Control Groups

Autonomic /Visceral Subsystem Domains	Baseline data (first assessment)				Second assessment				Third assessment			
	Study group (n=30)		Control group (n=30)		Study group (n=30)		Control group (n=30)		Study group (n=30)		Control group (n=30)	
	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%
Color												
Pale/cyanotic.	15	50.0	12	40.0	1	3.3	3	10.0	0	0.0	0	0.0
Pink but changes rapidly with slow recovery, not returning to good color	14	46.7	16	53.3	22	73.4	23	76.7	10	33.3	22	73.3
Pink.	1	3.3	2	6.7	7	23.3	4	13.3	20	66.7	8	26.7
Test of significance	FET = 0.889, P= 0.695				FET = 1.761, P= 0.435				**X = 9.643, P= 0.002***			
Respiration												
Gasping, frequent apnea, unstable respiratory rate	7	23.3	9	30.0	6	20.0	10	33.3	0	0.0	0	0.0
Occasional apnea, unstable respiratory rate	23	76.7	21	70.0	21	70. 0	17	56.7	13	43.3	19	63.3
Regular, stable respiratory rate.	0	0.0	0	0.0	3	10.0	3	10.0	17	56.7	11	36.7
Test of significance	X = 0.341, P= 0.559				FET = 2.032, P= 0.630				X = 2.411, P= 0.121			
Visceral												
Vomits feed, feed intolerance.	15	50.0	10	33.3	0	0.0	2	6.7	0	0.0	1	3.4
Bowel movement grunt and strain	15	50.0	20	66.7	22	73.3	26	86.6	5	16.7	19	63.3
Gastro-oesophageal reflux Nil	0	0.0	0	0.0	8	26.7	2	6.7	25	83.3	10	33.3
Test of significance	X = 1.714, P= 0.190				**FET = 5.452, P= 0.045***				**FET = 15.710, P= 0.000***			
Neurophysiological responses												
Flaccid in stimulation	16	53.3	13	43.3	0	0.0	2	6.7	0	0.0	0	0.0
Abnormal jerks, Twitch	14	46.7	17	56.7	23	76.7	26	86.6	6	20.0	20	66.7
Stable	0	0.0	0	0.0	7	23.3	2	6.7	24	80.0	10	33.3
Test of significance	X = 0.601, P= 0.438				FET = 4.471, P= 0.081				**X = 13.303, P= 0.000***			

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

Table 3: Effect of Nesting Position on Preterm Neonates' Reactions on State Regulation and Attention- Interaction Subsystem Behavioral Scale among the Study and Control Groups

State Regulation and Attention-Interaction Subsystem Domains	Baseline data (first assessment)				Second assessment				Third assessment			
	Study group (n=30)		Control group (n=30)		Study group (n=30)		Control group (n=30)		Study group (n=30)		Control group (n=30)	
	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%
State Regulation												
Intense crying which is rhythmic with irregular breathing.	14	46.7	13	43.3	3	10.0	8	26.7	0	0.0	0	0.0
Active awake state with infant fussing but not crying but stressed and hyper alert.	16	53.3	17	56.7	25	83.3	22	73.3	10	33.3	23	76.7
Awake alert.	0	0.0	0	0.0	2	6.7	0	0.0	20	66.7	7	23.3
Test of significance	X = 0.067, P= 0.795				FET = 4.006, P= 0.107				**X = 11.380, P= 0.001***			

Orientation to Auditory Stimulation												
Does not focus on or follow stimulus.	30	100	30	100	8	26.7	18	60.0	0	0.0	0	0.0
Brightness with stimulus, may focus and follow briefly with jerky eye movements	0	0.0	0	0.0	22	73.3	12	40.0	13	43.3	26	86.7
Focuses on stimulus and follows with smooth continuous head movement	0	0.0	0	0.0	0	0.0	0	0.0	17	56.7	4	13.3
Test of significance	--------------				**X = 6.787, P= 0.009***				**X = 12.381, P= 0.000***			
Alertness												
Rarely or never responsive to direct stimulation	17	56.7	17	56.7	2	6.7	11	36.7	0	0.0	0	0.0
When alert, responsivity brief and variable, may be delayed	13	43.3	13	43.3	24	80.0	19	63.3	12	40.0	23	76.7
Always alert in best periods, stimulation always elicits alerting and orientating	0	0.0	0	0.0	4	13.3	0	0.0	18	60.0	7	23.3
Test of significance	--------------				FET = 10.572, **P= 0.002***				**X = 8.297, P= 0.004***			

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

Table 4: The Total Percent Score of the Preterm Neonates' Reactions on Autonomic / Visceral Subsystem Behavioral Scale among the Study and Control Groups

Total Percent Score of Autonomic /Visceral Subsystem	**Baseline data (first assessment)**				**Second assessment**				**Third assessment**			
	Study group (n=30)		**Control group (n=30)**		**Study group (n=30)**		**Control group (n=30)**		**Study group (n=30)**		**Control group (n=30)**	
	NO.	**%**	**NO.**	**%**	**NO.**	**%**	**NO.**	**%**	**NO.**	**%**	**NO.**	**%**
Normal behavioral response **(5-8)**.	0	0.0	2	6.7	19	63.3	8	26.7	25	83.3	18	60.0
Suspected abnormal behavioral response **(2-4)**.	24	80.0	24	80.0	11	36.7	20	66.6	5	16.7	12	40.0
Definite abnormal behavioral response **(≤1)**.	6	20.0	4	13.3	0	0.0	2	6.7	0	0.0	0	0.0
Mean ± S.D	2.4 ± 0.44		2.5 ± 0.74		4.6 ± 0.817		3.8 ± 0.93		6.8 ± 0.63		5.2±1.43	
Test of significance	FET = 2.045, P= 0.517				FET = 8.67, **P= 0.006***				**X = 4.022, P= 0.045***			

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

Table 5: The Total Percent Score of the Preterm Neonates' Reactions on State Regulation and Attention-Interaction Subsystem Behavioral Scale among the Study and Control Groups

Total Percent Score of State regulation and Attention- Interaction Subsystem	**Baseline data (first assessment)**				**Second assessment**				**Third assessment**			
	Study group (n=30)		**Control group (n=30)**		**Study group (n=30)**		**Control group (n=30)**		**Study group (n=30)**		**Control group (n=30)**	
	NO.	**%**	**NO.**	**%**	**NO.**	**%**	**NO.**	**%**	**NO.**	**%**	**NO.**	**%**
Normal behavioral response **(4-6)**.	0	0.0	0	0.0	5	16.6	0	0.0	24	80.0	12	40.0
Suspected abnormal behavioral response **(2-3)**.	8	26.7	8	26.7	23	76.7	17	56.7	6	20.0	18	60.0

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Definite abnormal behavioral response (≤1).	22 73.3	22 73.3	2 6.7	13 43.3	0 0.0	0 0.0
Mean ± S.D	1.0 ± 1.10	1.0 ± 3.45	2.7±0.817	1.7 ±0.93	4.7 ± 1.45	3.6 ± 1.10
Test of significance	--------------		FET = 14.083, **P= 0.001***		**X = 10.000, P=0.002***	

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

4. DISCUSSION

Worldwide, prematurity accounts for 35% of neonatal mortalities in 2017 and it considers a major cause of child's morbidity later on. Those who survive without receiving adequate interventions have long-term disabilities. According to the WHO, neurodevelopmental outcomes are one of the major issues of concern [(14)].Prematurity interrupts the neonates' intrauterine growth and development and interferes with their adaptation to the extra-uterine life. Their hospitalization at NICUs exposed them to comparatively unfamiliar environment from that in utero [(15)].

When the environmental demands exceed coping regulatory capabilities of the preterm neonates, neurobiological dysfunction may occur. Therefore, there is a need to change neonatal care practices in the NICUs to support the neuro-developmental processes in extra uterine environment. In this context, a variety of approaches are used in order to improve optimal behavioral development and organization of the preterm neonates as maintaining their posture [(16)]. Maintaining posture helps to improve physiological function, decrease stress and sudden elevation in blood pressure with subsequent intra-ventricular hemorrhage. In this respect, nesting position is one of the most common developmental supportive positions used in the NICUs to achieve optimal position. Additionally, it assists neonates' self-regulation, maximizes neonates' stability and promotes behavioral organization. Moreover, it preserves neonates' energy and improves growth [(17, 18)].

As a matter of fact, repeated exposure to painful procedures and stressful environment in early life is associated with hazards as: increased intracranial pressure and demands on cardio-pulmonary system that manifested in physiological instability as bradycardia, apnea, drop in the oxygen saturation (SaO2) and cyanosis [(19)]. As illustrated in the current study results, improvement in the color was found among preterm neonates in the study and control groups with no significant difference at the second assessment. Meanwhile, the differences between their colors after applying nesting intervention for the study group and traditional positions without nest for the control group were statistically significant at the third assessment. Additionally, another change was detected in both the second and third assessments regarding preterm neonates' respiration between the neonates in the study group compared to those in the control group with no significant difference. These results could be justified by the fact that lying within a nest resembles the fetus position in the womb, could induce neonate's quiet state, decrease energy expenditure and keep more stable heart rate [(20)]. Consequently, it enhances the physiological stability, oxygenation, ventilation and color of the preterm neonates. These results are in harmony with the results of Gill et al (2015) [(11)] who reported that nesting is effective in lowering and stabilizing the mean respiratory rate of preterm neonates. Moreover, Halder et al. (2015) [(5)] emphasized that the trials of different developmentally supportive care program including nesting position have shown an improvement in pulmonary and neuro-physiological functions.

It is well known that the digestive ability of the preterm neonates is limited due to anatomical and functional immaturity. Forward movement of the food to the stomach is developing only near term. So, they are at risk for vomiting, abdominal distension, feeding intolerance and gastro-esophageal reflux [(21)]. The current study findings reflected that nesting position was effective in the improvement of visceral organization and the differences between the preterm neonates in the study group and those in the control group were statistically significant at the second and the third assessments. These findings could be attributed to the unique design of nesting position that mimic the elasticity and resistance of the uterine wall in providing a feedback mechanism by allowing flexion and extension within the dynamic circumferential boundaries. Consequently, touching these boundaries could act as a stimulus that improves preterm neonatal circulation and keeps them more alert and calm. Additionally, the nest facilitates sucking their fingers these help in regular digestion and better absorption of the nutrients. The current study findings are in line with Cole and Gavey (2011) [(22)] who mentioned that nesting position promotes comfort and calmness of the preterm neonates, so it could facilitate the absorption of nutrients and maintain weight gain.

Many researchers have reported that the NICU environment involves sensory overload which is mismatched to the nervous system development of the preterm neonates. So, these neonates respond to the surrounding stressors with many neurophysiological reactions and behavioral stress cues. They may express certain signs of stress as: jerking, grimacing, staring and irritability that could be assessed via eliciting neonates' reflexes [23, 24]. The results of the current study revealed that nesting position was effective in improving the neurophysiological responses of the preterm neonates in the study group compared to those in the control group with statistical significant difference in the third assessment. This could be attributed to that nesting position helps to decrease neonates' stress and promotes calmness that manifested by more stable neurophysiological responses during stimulation. The results of the current study are consistent with the results of El-Nagger and Bayoumi (2016) [8] which revealed that there was a high statistical significant difference related to primitive reflexes between nesting and un-nesting groups. The results of the present study also, were supported by Halder et al.(2015) [5] who pointed out that regular changes in a preterm neonate's posture may have a beneficial effect on their neurodevelopment and organization.

The calming cycle theory proposes that visceral/autonomic co-regulation occurs in the emotionally connected mother and her neonate. Through such cycling, the neonate is able to adapt to the environment. So, it is beneficial to make the extra uterine environment nearly similar to that in the womb [25]. The findings of the present study indicated that there were statistical significant differences in the total percent score of autonomic/ visceral subsystem between the study and control groups in both the second and the third assessments. In addition, the mean autonomic/ visceral subsystem score was dramatically improved in the second and third assessments among preterm neonates in the study group compared to those in the control group. These findings could be justified by the preterm neonates feel more secure and are more physiologically stable, if they have boundaries (nesting) placed around them; as they were used to be within an enclosed womb. Also, they gain comfort from being able to grasp their hands together and suck their fingers which may improve gastric motility and visceral organization. Conversely, Zeiner et al (2016) [26] found significant increase in both biological and behavioral stress responses during the care of preterm neonates in terms of increasing heart rate and respiration. However, visceral stress signals did not show significant increases with developmental care.

The results of the current study showed that nesting position was effective in improving the state-regulation of the preterm neonates in the study group compared to those in the control group with statistical significant difference at the third assessment. These results could be explained in the light of that, nesting position facilitates neonates' regulatory behaviors as sucking hands which help to deal with stress and regain preterm neonates' self-control. So, preterm neonates could adapt better in various stressful situations. These results are not in accordance with Grenier et al (2015) [27] who reported that the highest number of self-regulatory behaviors occurred among preterm neonates with the side-lying un-nesting position.

In fact sleep is crucial during fetal and neonatal life for the development of neurosensory function. Neurosensory development depends upon appropriate stimuli from both internal and external sources. Endogenous stimulation occurs only during deep sleep. Once these sensory systems are formed using endogenous input from the neonate's own CNS, they are ready for exogenous stimuli from the external environment [28]. The current study findings revealed that there were statistical significant differences between the study and control groups in relation to the orientation to auditory stimulation and alertness during visual stimulation in both the second and third assessments. These findings could be explained in the light of the fact that nesting position facilitates the transformation of sleep pattern from erratic disturbed spells to deep sleep which is fundamental for neurosensory development. Consequently, this allows caregivers to provide stimulation, so improved the preterm neonates' overall outcomes [17]. The findings of the present study are congruent with another national study which conducted at Ain Shams University Hospitals (2016) [8]. The study indicated that the majority of preterm neonates were alert in the study group (nesting position group) compared to slightly more than one fourth of those in the control group. In this respect, Reyhani et. al.(2016) [29] emphasized the importance of sleep for CNS improvement as they conducted a study about the effect of nest posture on sleep/awake state of premature infants and found that nest posture increased the sleeping hours of preterm neonates.

As a matter of fact, the state organization is governing consciousness from sleep to wakefulness, ability to sustain the state and smooth state transitions. Additionally, state regulation and attention/interaction subsystem of behavior development is governing the ability of the preterm neonates to interact with the care givers. Both are guided by the maturation of CNS and neurosensory development that increase preterm neonates' attention and improve their interaction with the surrounding environment inside NICUs (5). As clarified in the current study results, there were statistical significant differences in the total percent score of state regulation and attention- interaction subsystem between the study and the control groups in both the second and third assessments. Moreover, the mean state regulation and attention-interaction subsystem score was substantially improved in the second and third assessments among preterm neonates in the study group compared to those in the control group. These findings could be justified by that nesting position maximizes the preterm neonates' stability, prevents fluctuations in cerebral blood flow and prevents rupture of the fragile blood vessels in the brain. Furthermore, it better regulates neonates' sleep cycles; the stability in the sleep cycle increased the neonates' alertness and level of activity. These abilities may help to improve interaction with the surrounding environment. These findings are in accordance with Zeiner et al (2016) (26) who found that nesting position was associated with significant increases in attention cues and the ability to self-console. In addition, the present study findings are in agreement with the findings of El-Nagger and Bayoumi (2016) (8) which highlighted that there were high statistical significant differences between the nesting and un-nesting groups regarding the preterm neonates' attention/ interaction and their self – regulatory behavior.

5. CONCLUSION

Based on the findings of the current study, it can be concluded that applying nesting position for preterm neonates helps to improve their behavioral organization. As they had higher score on Preterm Neonate's Behavior Assessment Scale regarding autonomic/ visceral subsystem and state regulation and attention- interaction subsystem.

6. RECOMMENDATIONS

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

2- Nesting position as an essential part of DSC should be incorporated in the NICUs' policies.

3- Nurses should use nesting position as a part of DSC for all preterm neonates within the NICUs.

4- The nursing curricula of undergraduate should include DSC and its benefits.

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