Effectiveness of Nesting Positioning on Physiological Parameters and Behavioral State, among Preterm Neonates in Neonatal Intensive Care Unit (NICU)

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Abstract

Background: Preterm neonates who are admitted to the neonatal intensive care unit (NICU) undergo several unpleasant treatments as part of their routine care throughout their hospital stay. Nesting positions are supporting techniques that help preterm neonates in the NICU to correct their posture, which may have an impact on their general health. **Aim of the study**: The current study aimed to determine the effectiveness of nesting positioning on physiological parameters and behavioral state, among preterm neonates in neonatal intensive care unit. **Research design**: A cross-over experimental research design was used in this study. **Setting**: The study was carried out in the neonatal intensive care unit at Kafr Eldwar General Hospital, located in El Beheira Governorate, Egypt. **Subjects:** A convenience sample of 65 preterm neonates was selected for the current study. **Tools:** Two tools were used for data collection, Tool I: Characteristics and physiological parameters of preterm neonates' assessment tool. Tool II: Assessment of Preterm Neonate's Behavior Assessment Scale. **Results:** it was obvious that the highest percentages (56.9 % & 78.5 % respectively) of preterm neonates demonstrated normal behavioral response in both supine and prone positions respectively compared to only 9.2% of them in pre-nesting positions. In addition, the preterm Neonatal Behavioral Assessment Scale (NBAS) in the post-prone position positively correlates with physiological parameters observed in premature neonates' post-supine and post-prone assessments. The results indicate statistical significance, with p-values of less than 0.039, 0.018, and 0.033, respectively. **Conclusion:** The study concluded that neonatal nesting in prone and supine positions is a simple, noninvasive, and free-of-charge method. It led to improved physiological parameters and neonatal behavioral state. **Recommendations**: Nesting should be integrated into the routine nursing care of preterm neonates as it is a safe, simple, and noninvasive technique that can enhance their physiological stability and behavioral state. Neonatal intensive care unit nurses should engage in training sessions that emphasize the importance and benefits of using nesting for preterm infants.

Keywords: Nesting, Physiological Parameters, Behavioral State, Preterm Neonates

Introduction:

Preterm neonates are defined as those born before 37 weeks of pregnancy; in North Africa, the rate of preterm births varies from 13.4% to 8.7% in Europe**,** whereas in Egypt preterm births account for 39.4% of neonatal deaths, as well as prematurity is thought to be the primary cause of 24% of newborn deaths as reported by **El-Ganainy et al. (2019)**. Preterm newborns are often exposed to uncomfortable treatments as part of their care throughout their stay in the NICU. Babies born prematurely are more susceptible to sleep disturbances, hypothermia, irregular heartbeat, hypoxia, pain, and stressful situations. Preterm neonates may eventually have physiological, psychological, and behavioral consequences from traumatic and distressing procedures. During invasive operations, minimizing pain positively impacts neuromuscular and motor development, oxygen saturation as well as heartbeat. Positioning is used during traumatic and agonizing treatments within the framework of care that is developmentally supporting care efforts **(Kahraman et al., 2018; Yazdanpanahi et al., 2020).** Stress for preterm neonates have faster metabolisms, which raise stress hormones, heart rates, and oxygen saturation levels as a result, they require more oxygen to sustain their

physiological functions. Premature newborns during their hospital stay and their hospitalization to the neonatal intensive care unit (NICU) endure some uncomfortable procedures. Preterm neonates' stress can also result in increased energy consumption, which can hinder the conservation of energy efforts and make it harder for them to gain weight **(Barutçu et al., 2021; Kapoor et al., 2021)**. Nesting has often been employed when caring for the needs of preterm neonates. It is putting rolled-up sheets in an "O" or "U" configuration to form a nest that encourages behavioral and physiological stability. This helpful position promotes relaxation by keeping the newborn's hands near their face and feet together, which imitates the mother's uterus. So, it should be effective interventions are inexpensive, noninvasive, and rapidly applied to improve premature pain control, behavior, and physiological parameters like nesting positioning must be used **(Charafeddine et al., 2018; Yazdanpanahi et al., 2020).**

Proper positioning can support healthy posture, steady physiological parameters, and muscular regulation among newborns. When nesting is used, the premature physiological parameters will remain consistent, and they will feel safe as mentioned by **Das et al. (2020).** They can suck their fingers and clutch their hands together to provide extra comfort when they are nesting. It always takes assistance for preterm neonates to find a comfortable position. Nesting positions are supporting techniques that help preterm neonates in the NICU to correct their posture, which may have an impact on their general health. Nesting positioning can accelerate the growth of preterm neonates and profoundly impact physiological parameters, and comfort behavior among preterm neonates **(Guo et al., 2020)**

Significance of the study

Prematurity is a significant public health concern, linked to both short- and long-term health complications, including disabilities that may arise later in life and an increased risk of premature mortality.

Premature birth rates are anticipated to be significa ntly higher in underdeveloped nations and have bee n observed to range from 5 to 7% of live births in s ome wealthy countries.**(World Health Organization [WHO], 2015; Ahmed & Mohammed, 2019).** Premature neonates who are hospitalized undergo invasive and painful treatments 93 times more regularly. Furthermore, many preterm neonates have these operations in the absence of pain control techniques or analgesic medications **(Kahraman et al., 2018)**. Therefore, it is crucial to practice various developmental supportive care strategies tailored to preterm neonates' unique requirements and physiological traits. Moreover, these kinds of treatments are easy to use, effective, and inexpensive tools like nesting position, one type of intervention used to help preterm neonates with their musculoskeletal and postural problems and their physiological and behavioral states. Nesting positioning is so crucial for supporting preterm neonates ' growth.

Aim of the study

The study aimed to determine the Effectiveness of Nesting Positioning on Physiological Parameters and Behavioral State, Among Preterm Neonates in Neonatal Intensive Care Unit.

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Research hypothesis:

-Preterm neonates who received nesting positioning are expected to exhibit more stability in physiological parameters compared to those who don't

-Preterm neonates who received nesting positioning are expected to improve their behavioral state than those who do not.

Operational Definition:

Physiological Parameters:

Physiological parameters are heart rate, respiratory rate, and oxygen saturation.

Subjects and Methods:

Research design:

A cross-over experimental research design was used to accomplish this study.

Settings:

The current study was conducted in the neonatal intensive care unit at Kafr Eldwar General Hospital, El Beheira Governorate, Egypt. The researcher visited the setting three consecutive days a week, from 8 a.m. to 2 p.m. each day.

Subject

The study included a convenience sample of 65 preterm neonates who met specific **eligibility criteria:**

- Neonates gestational age 32 ≤ 36 weeks.
- Birth weight 1300 to 2000 grams.
  - Absent of congenital anomalies.
  - Not connected to an artificial ventilator.
  - Using a heated incubator and spontaneous breathing of surrounding air

Two tools were used for data collection:

Tool I: Characteristics and physiological parameters of preterm neonates' assessment tool

The researchers created this measure after reading relevant studies on the characteristics and cardiorespiratory parameters of premature babies **(Harika et al., 2015; Sharma et al., 2016).** This tool involves two parts:

Part 1: Preterm Neonate's Characteristics; gender, gestational age (weeks), Postnatal age, weight at birth, and feeding methods.

Part 2: Physiological parameters of preterm neonates, such as respiratory rate (RR), heart rate (HR), and oxygen saturation (Spo2); Pulse oximetry was used to measure oxygen saturation, and a new pulse oximetry.

Tool II: Assessment of Preterm Neonate's Behavior Assessment Scale NBAS**:** adopted from **(Brazelton, 1995),** this tool was utilized to assess preterm neonates' behavior. Through assessment of their ability to maintain equilibrium among the following subsystems.

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, responsive brief, and variable, may be delayed = 1
   - Always alert in best periods, stimulation always elicits alerting and orientating = 2

The Neonatal Behavioral Assessment Scale (NBAS) is a vital instrument for evaluating the neurobehavior of preterm neonates. This comprehensive scale plays an important role in the formulation of suitable therapeutic interventions, ensuring that care is tailored to the specific needs of these vulnerable infants.

Scoring system: The sum of the three domains in the State regulation and attention-interaction subsystem determines its overall score. It falls between 0 and 6. The newborn's behavioral response will be more stable the higher the score. "Normal behavioral response" is denoted by a score between 4-6, whereas "suspected abnormal behavioral response" is represented by a number between 2-3. A score of less than one denotes a "definitely abnormal behavioral response."

Fieldwork:

The formal approval to conduct the study has been obtained from the relevant authorities of the Neonatal Intensive Care Unit (NICU) at Kafr Eldwar General Hospital, El Beheira Governorate, after explaining the study's purpose. Data collections were done in four months, starting from the beginning of July 2021 to the end of October 2021. Preterm neonates were studied in nesting positions (supine and prone positions). Nesting positions were applied to the same neonates cross-overly.

Tool Validity:

The content validity of Tools I and II was evaluated by five pediatric nursing experts, and necessary changes were made in response to their comments

Tool Reliability:

The reliability of Tools I and II was confirmed through appropriate statistical testing, with reliability coefficients of r=0.89 and r=0.84, respectively.

Pilot study:

A pilot study was carried out on 7 preterm neonates (10% of the sample) to test the clarity and feasibility of the tools and necessary modifications were done. These preterm neonates were excluded from the study sample.

Intervention phase:

Pretest (Baseline):

Before placing the preterm neonates in nesting positions (supine and prone positions), it is essential to first gather baseline data. This data

encompasses the neonatal assessment and their sociodemographic data and physiological parameters: including respiratory rate (RR), heart rate (HR), and oxygen saturation (SpO2). All these metrics should be meticulously documented by a researcher using tool I on the observational sheet. Furthermore, researchers conducted assessments of the neonates' behavior scale use tool II.

Neonatal Behavior Assessment Scale:

- The state regulation was assessed by observing each preterm neonate during exposure to any developmental care procedures like; diaper care, feeding, and bed bath or others.
- The assessment of orientation to auditory stimulation is as follows: An audio stimulus, in the form of a soft bell, was employed to assess the preterm neonate's reaction provided for each ear and outside the baby's visual field.
- Lastly, alertness was evaluated by assessing the preterm neonate's capacity to focus on and follow a visual object horizontally using a red ball. Next, the researchers estimated the degree to which the preterm neonates were in response to visual cues.
- The time needed for assessing neonates was 30 minutes.

Nesting Positions:

- The preterm newborn was positioned inside the nest in each of the two locations alternately (supine- and prone position respectively) adopted **by Babaei et al. (2019)** and **Healthcare Northern Devon (2018)**. This intervention will continue for 3 consecutive days as follows:

- The necessary nesting equipment was gathered from the NICU, including a blanket, linen, and a small pillow.
- A hand towel was utilized to construct a supportive nest for the preterm neonate, forming a U or O shape beneath the buttocks to provide stability and comfort on both sides.
- Researchers cradled neonates in a high-sided nest, aligning their chin with the sternum. They supported their shoulders, drawing them towards the chest for a secure posture. Hand-mouth coordination was enhanced by bringing hands forward with a head positioner. A supportive nest was constructed, and hips were flexed towards the abdomen. The feet-maintained contact with the sheet or towel in a neutral stance; for both supine and prone positions.
- The preterm neonates were first positioned in the supine position for 2 hours. After that, they were placed in the prone position for another 2 hours respectively. The two positions were operated to the same neonates cross-overly.
- The preterm neonates were left free in routine unit position (supine position) for 15 minutes (i.e., washout period) after each position change, to avoid the effect of the previous body position.
- Ensure the nest size is appropriate for the neonate's body, neither too loose nor too tight, during each position.
- Physiological parameters including respiratory rate, heart rate, and oxygen saturation (SPO2) were measured and recorded at the baseline (zero minute) before positioning, and then every 15 minutes using Tool I. The average of these measurements was calculated after one hour and again after two hours
- If the neonate's oxygen saturation dropped below 85%, heart rate rose above 200 or fell below 100 beats per minute, or respiratory rate exceeded 60 breaths per minute during any position, the neonate would be returned to the previous position, and the doctor would be immediately notified.

Post-test (post-Nesting Positions):

The preterm neonates were evaluated immediately after intervention (nesting positions) for the following:

Preterm neonates were evaluated for their physiological parameters, and behavioral state, following a period of stabilization, to minimize the impact of positional changes, waiting for 15 minutes after assuming the position then continuing to apply the next position for 3 consecutive days and take the average score.

Ethical considerations

Written informed consent was obtained from each preterm neonate's caregiver after explaining the aim of the study and their right to participate voluntarily and withdraw from the study at any time. The privacy of preterm neonates was carefully considered, and the confidentiality of the data was assured to uphold

the highest ethical standards.

Statistical Design:

Version 29.0). Descriptive statistics, including means and standard deviations for quantitative variables, and frequencies and percentages for qualitative variables, were used to evaluate the characteristics of preterm neonates. Statistical methods such as Chi-square analysis and repeated measures t-tests were applied for significance testing, with results considered statistically significant if $p < 0.05$

Results:

The data displayed in **Table 1** indicates that 56.9% of the neonates were female, while the remaining were male. The mean age of the neonates was 7.56 days, and the average birth weight was 1565.78 ± 193.02 grams. Additionally, 30.8% of the neonates were classified as having an appropriate weight for their gestational age, whereas 69.2% were categorized as small for gestational age. Among the preterm neonates, the highest percentage of the preterm neonates (44.6%) were admitted with hyperbilirubinemia. Furthermore, 63.1% of the premature neonates were delivered via cesarean section, and more than half (53.8%) were fed through an orogastric tube.

In Table 2; Regarding state regulation, it was observed that 53.8% of preterm neonates exhibited intense crying with irregular breathing during baseline measurements. In comparison, 58.3% of these neonates were awake and alert after nesting in the prone position. Regarding auditory stimulation, 40 % of the preterm neonates focus on the stimulus and follow with smooth continuous head movement in post-nesting in the supine position, while 47.7% did the same in the prone position compared to 9.2% during baseline measurements. For alertness, 52.3% of preterm neonates in the post-nesting prone position showed always alert in best periods, stimulation always elicits alerting and orientating, which may have been delayed during both baseline and post-nesting in the supine position (21.5% and 52.3%, respectively). Notably, none of the preterm neonates were responsive to direct stimulation after nesting in the prone position.

It was observed from **Figure 1** that 66.2% of preterm neonates were suspected of abnormal behavioral response pre-nesting positioning compared to only 21.5 % of them post-nesting in prone positioning, in addition to the highest percentages (56.9 % & 78.5 %) of premature neonates demonstrating normal behavioral response in both supine and prone positions respectively compared to only 9.2% of them in pre-nesting position.

Regarding physiological parameters, it was evident from **Figure 2** that the mean heart rate was 130.69 per minute in pre-nesting (baseline) compared to 125.64 and 120.9 beats per minute after nesting in the supine position and post-nesting prone position respectively. The mean oxygen saturation levels were 88.0% during baseline compared to 92.93% post-nesting in the supine position, and 93.66% post-nesting in the prone position. Additionally, the respiratory rate of the neonates decreased from 49.63 breaths per minute before nesting to 41.29 breaths per minute after nesting in the supine position, further declining to 35.61 breaths per minute post-nesting in the prone position.

The data presented in **Table 3** demonstrates a negative correlation between the NBAS scores obtained post-nesting in the supine position and the physiological parameters measured at baseline, with a p-value =0.352. However, it is noteworthy that the NBAS scores following the supine position exhibit a significant positive correlation with the physiological parameters, evidenced by a p-value =0.002. The analysis reveals that the preterm Neonatal Behavioral Assessment Scale (NBAS) in the post-prone position is positively statistically correlated with physiological parameters observed in preterm neonates' post-supine and post-prone assessments. The results indicate statistical significance, with p-values of less than 0.018, and 0.033, respectively.

Table: (1): Frequency and distribution of the neonates according to their gender, age, birth weight, weight for gestational age, gestational age, admitted diagnosis, type of delivery, and method of feeding, n=65.

Characteristics of Preterm Neonates	Frequency (No)	Percentage (%)
Gender		
• Male.	28	43.1
• Female	37	56.9
Neonatal Age (days): Mean ± SD	7.56 ± 1.06	
Weight/grams (Grams): Mean ± SD	1565.78 ± 193.02	
Weight to gestational age:		
• Small for gestational age.	45	69.2
• Appropriate for gestational age.	20	30.8
Gestational Age (Weeks): Mean ± SD	33.76 ± 1.23	
Current Diagnosis		
• Hyperbilirubinemia.	29	44.6
• RDS	14	21.5
• Hypoglycemia	20	30.8
• Multiple Pregnancy	2	3.1
Type of Delivery		
• Normal Vaginal Delivery.	24	36.9
• Cesarean Section	41	63.1
Method of Feeding	30	46.2
• Oral	35	53.8
• Orogastric Tube		

Table 2: percentages and distribution of preterm neonates` Neonatal Behavior and their physiological parameters during; baseline, and post-nesting in supine and prone positionings. N=65

	Pre-Nesting Positioning (baseline)		Pos-Nesting Supine Position		Pos-Nesting Prone Position	
Neonatal Behavior:	**No**	**%**	**No**	**%**	**No**	**%**
State Regulation:						
• Intense crying which is rhythmic with irregular breathing	35	53.8%	10	15.4%	8	12.3%
• Active awake state with infant fussing but not crying but stressed and hyper-alert	22	33.8%	32	49.2%	19	29.2%
• Awake & alert	8	12.3%	23	35.4%	38	58.5%
Auditory Stimulation:						
• Does not focus on or follow a stimulus	16	24.6%	4	6.2%	0	0.0%
• Brightness with stimulus may focus and follow briefly with jerky eye movement	43	66.2%	35	53.8%	34	52.3%
• Focuses on stimulus and follows with smooth continuous head movement	6	9.2%	26	40.0%	31	47.7%
Alertness:						
• Rarely or never responsive to direct stimulation	22	33.8%	9	13.8%	0	0.0%
• When alert, responsivity brief, and variable, may be delayed	29	44.6%	32	49.2%	31	47.7%
• Always alert in best periods, stimulation always elicits alerting and orientating	14	21.5%	24	36.9%	34	52.3%

Figure 1: Distribution of preterm neonates according to their total behavior pre-post nesting in both supine and prone positions n=65.

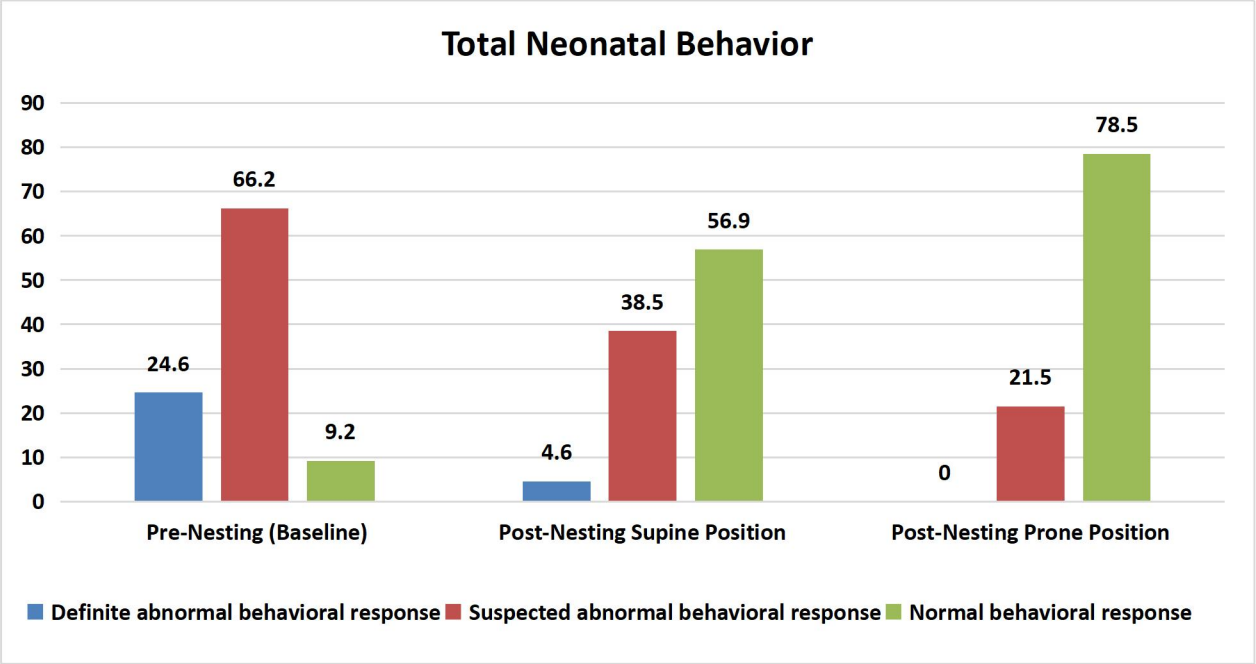

Figure 2: Distribution of preterm neonates according to their total mean of physiological parameters pre-nesting and post-in both supine and prone nesting positions. n=65

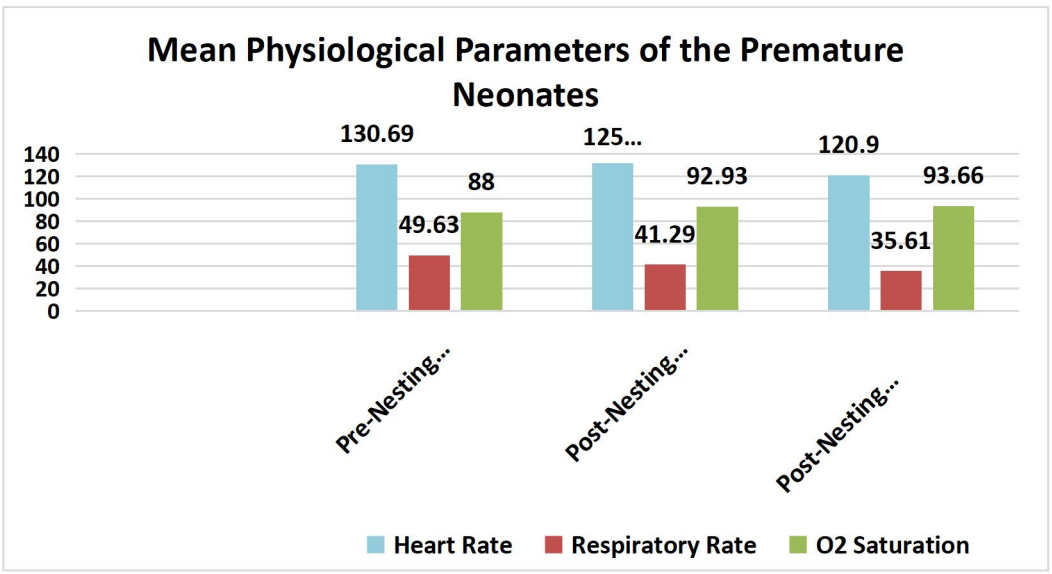

Table (3): Correlation coefficient between Preterm Neonates Physiological Parameters and Total Neonatal Behavior, Pre- and Post-Nesting Through Both Supine and Prone Positions n=65

Behavioral Assessment Scale / Physiological Parameters	Preterm Neonatal Behavior (NBAS) Pre-Nesting (Baseline)		Preterm Neonatal Behavior (NBAS) Post-Nesting in Supine Position		Preterm Neonatal Behavior (NBAS) Post-Nesting in Prone Position	
	r	P	r	P	r	P
• Preterm Neonatal Physiological Parameters Baseline **(pre-nesting)**	0.031	0.135	-0.796	- 0.352	0. 982	0.322
• Preterm Neonatal Physiological Parameters **Post-Nesting in Supine Position**	0.165	0.190	0.167	0.184	0.292	0.018*
• Preterm Neonatal Physiological Parameters **Post-Nesting in Prone Position**	0.396	0.048*	0.978	0.002**	0.780	0.033*

Discussion:

Establishing a nesting position is crucial for ensuring the proper alignment of preterm neonates. Due to their familiarity with the confined womb space, creating boundaries (nesting) around these preterm neonates promotes a sense of security and physiological stability. Furthermore, preterm neonates derive comfort from the ability to grasp bedding, suck their fingers, or clench both hands **(Charafeddine et al., 2018; Özdel & Sarı, 2020).** Therefore, the current study was carried out to assess the effectiveness of nesting positioning on physiological parameters and behavioral states, among preterm neonates in neonatal intensive care units

The current study's findings regarding the characteristics of preterm neonates showed that birth weight and gestational age are clues to the premature neonate's wellness. The study sample's mean birth weight and gestational age were 33.76 weeks and 1565.78 grams, respectively, positively affecting premature weight gain and the absence of complications or recurrent hypoxia when using nesting positioning. Within this framework, **El-Nagger and Bayoumi (2016)** noted that birth weight was a clear indicator of health for their Egyptian neonates in research. Similarly, **Barutçu et al. (2021)** corroborated findings from Tuirkiye, Çukurova University in Adana, Turkey, showing that the gestational ages of the premature in the supported and control groups were 32.9±2.5 and 32.7±2.8 weeks, respectively. The researchers concentrated on the fact that birth weight was a health indicator for the supported group with a nesting intervention.

Upon analyzing the reasons for NICU admissions, our study revealed that hyperbilirubinemia is the foremost cause, primarily stemming from physiological jaundice. Additionally, hypoglycemia emerged as the secondary cause for admission, potentially contributing to prolonged hospital stays for neonates. In a study conducted in a general

hospital in Jakarta, **Tane et al. (2019)** found that about two-thirds of premature neonatal hospitalizations were due to hyperbilirubinemia. Physiological jaundice was identified as the main cause of hyperbilirubinemia.

Frequent early-life exposure to stressful situations may increase intracranial pressure and place additional strain on the heart and lungs, along with other concerns. Physiological instability, such as bradycardia, apnea, and decreased oxygen saturation, may result from these factors **(Paul & Bagga, 2019).** The present findings demonstrated that maintaining physiological parameters after nesting positions was more successful when done in the supine and prone posture as opposed to the pre-nesting position as the mean SpO2 values, heart, and respiratory rates were significantly different from those measured in the pre-nesting position. Preterm infants' heart rates might explain this, mean SpO2 values, and respiratory rates, which significantly improved compared to those of the pre-nesting position, as the neonates felt more secure than in the routine position. In addition, this difference could be explained by the fact that nesting positioning serves as a sensory stimulation measure that can improve oxygen saturation by increasing blood flow to the brain and body tissues **(Helaly & Mohammed, 2020; Elewa et al., 2021)**. Furthermore, oxygen saturation could also be enhanced due to the relationship between Kangaroo Mother Care (KMC) and motor regulation. This also diminishes agitation and, consequently, oxygen is saved and is not used up in excessive movements. The current study reports similar findings to a study by **Das et al. (2020)** and **Tharashree et al. (2018)** carried out in India to examine how nesting affected the physiological markers of preterm newborns. Nesting was found to be an impactful and successful intervention that stabilizes the physiological parameters and general activity of preterm infants admitted to the NICU. Additionally**, Borenstein, 2020** pointed out in the study conducted in a general hospital in Haifa that the level of SaO2 in premature babies placed in the prone position was considerably greater than that in premature neonates placed in the supine position, which corresponds with the current research findings.

The current study demonstrated that, following the application of nesting positions for preterm neonates, there was a significant decrease in the frequency of behaviors resulting from systems instability when compared to the preterm neonates before nesting positions, as the preterm neonates' state regulation, auditory stimulation, and alertness improved, with the prone position showing the greatest improvement than the supine position. The current study's findings are consistent with the research revealing that position support approaches improve the motor system functions of preterm infants and their developmental outcomes as well as the researchers highlight the need for nesting as a technique to be practiced as it has a profound impact on comfort behavior among preterm infants, as mentioned by **Eskandari et al. (2020)** in Iran, also the results for the current research were congruent with **Costa et al. (2019)** in their study in Brasilia as the researchers consider nesting positions and hammock as the gold standard for promoting the comfort of hospitalized preterm infants. On the same line, **Menger et al. (2020)** cleared that the prone position is documented as being more beneficial compared to the supine position. This occurs due to greater stability of the rib cage and more space for the diaphragmatic muscle fiber, which enhances its action and makes premature newborns feel more comfortable.

The prone position showed the most consistent and statistically significant results across all measured parameters. Significant positive correlations were observed. These findings suggest that the prone position provides a more supportive environment for both physiological stability and behavioral regulation. The prone position is known to enhance chest wall stability, promote self-regulation, and reduce stress responses in neonates, which may explain the higher levels of statistical significance observed in this condition. These findings align with previous research by **Mohamed et al. (2020)** suggesting that prone positioning can enhance oxygenation, improve thermoregulation, and support behavioral state organization in premature neonates. Neonatal nurses have a crucial role in improving the quality of care of preterm neonates and providing them with comfort measures to improve physiological parameters and behavioral States. Therefore, this study was carried out.

Limitations of the study:

The present study had some limitations. Several preterm neonates who were initially included in the study sample had to be excluded later because some required intubation and others passed away. As a result, the researchers had to select other

preterm neonates who met the study's inclusion criteria.

Conclusion

Based on the results above, neonatal nesting positioning in prone and supine positions is a simple, noninvasive, and free-of-charge method. It led to improved physiological parameters and neonatal behavioral state.

Recommendations

The following are recommendations based on the results of the current study:

- Nesting should be integrated into the routine nursing care of preterm neonates as it is a safe, simple, and noninvasive technique that can enhance their physiological stability and behavioral state.
- Neonatal intensive care unit nurses should engage in training sessions that emphasize the importance and benefits of using nesting for premature neonates.

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