Effect of Simulative Heartbeat Nest on Improving Physiological Parameters, Comfort and Pain of Preterm Neonates at Neonatal Intensive Care Unit

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Abstract

Background: It was estimated that 15 million preterm neonates were born worldwide each year, with over one million of those neonates dying as a result of prematurity. The aim of developmental supportive care is to create a womb out of womb which improve comfort of the preterm neonates in the Neonatal Intensive Care Unit. **Aim of this study** was to assess the effect of simulative heartbeat nest on improving physiological parameters, comfort and pain of preterm neonates at neonatal intensive care unit. **Research design:** A quasi experimental design was utilized in this study. **Setting:** This study was conducted at neonatal intensive care unit in Specialized Pediatric Hospital at Benha City. **Subjects:** Purposive sample of preterm neonates (60) at neonatal intensive care was involved. **Tools of data collection Tool (I): A structured interviewing questionnaire**: It included three parts: **Part (1):** Personal characteristics of the studied preterm neonates. **Part (2):** Physical parameters of preterm neonates. **Part (3):** Physiological measurements of the studied preterm neonates. **Tool (II):** Premature baby comfort scale. **Tool (III):** Premature baby pain profile (PIPP-R). **Results:** There were a highly statistically significant difference (P-value <0.001) between premature neonates in study/control group at the pre/post using of simulative heartbeat nest concerning their comfort, physiological parameters and pain score. **Conclusion:** It was concluded that using of simulative heartbeat nest was a highly effective method to improve physiological parameters, comfort and pain of preterm neonates. **Recommendations:** Implementing strategies of developmentally supportive care like nesting that mimic the intrauterine environment in the NICU that improves preterm neonate's state of alertness, posture, comfort and stable physiological parameters.

Keywords: Simulative Heartbeat Nest, Physiological Parameters, Comfort, Pain, Preterm Neonates.

Introduction

Preterm neonates need special care so they are admitted to neonatal intensive care units (NICU) in a variety of numbers. The time spent in the NICU is a crucial and delicate time for the neural structure and brain development of newborns. Worldwide, 15 million neonates are born prematurely each year, and the complications of preterm birth claim over 1 million lives. Preterm birth can result in neurodevelopmental, behavioral, and cognitive disorders. Preterm neonates' stress and pain cause lifelong behavioral morbidity. To improve the care of preterm newborns, it is crucial to recognize and eliminate stressful behaviors **(Morag & Ohlsson, 2020).**

It is crucial to implement the Neonates Individualized Developmental Care and Assessment Program (NIDCAP), it is a neonatal intensive care early intervention program that facilitate and provide the preterm neonates with early stabilization and neurodevelopmental control. Because of the numerous painful stimuli, strong light, and noise that preterm neonates are subjected to during this time. Preterm neonates frequently exhibit behavioral and physiological responses, such as increased oxygen saturation and heart rate, as a result of stressful situations, without the need of (NIDCAP). It's crucial to reduce the stress these stimuli create and

promote ideal neurological-behavioral development (**Valeri et al., 2019).**

Developmental supportive care is a method that aims to control the environment of preterm neonates to reduce external stressors. It may be simpler for preterm neonates to handle these stressful stimuli when a similar environment as intrauterine period is created. Low frequency maternal heartbeats in the uterus may help the fetus develop the neural bases for synchronous abilities as well as the auditory drift necessary for vocal and gestural communication. **(Morag & Ohlsson, 2020).**

Preterm neonates are cared for in a variety of ways to promote their neural development, including; nesting, swaddling, utilizing incubator covers, the mother's voice and listening to music. In order to help preterm neonates adjust to their extra uterine environment after birth, an application of a device which simulates maternal heartbeats is necessary. **(Alemdar, 2018).**

Maternal heartbeat simulation device was created by mechanical and computer engineers in conjunction with nursing researchers. The device is inserted into a nest for the application in an effort to give the preterm newborn the impression that they were close to their mother. When this device is placed in the nest, it produces beats that are rhythmic and imitate the mother's heartbeat (**Johnston et al., 2019).**

Antibacterial @ Eva sponge is used to reduce battery and noise insulation. The device has a closed circuit system and no elements that could be hazardous to preterm neonates. The Eva sponge covering the device prevented it from coming into direct contact with the preterm neonates. Therefore, it tries to decrease the sense of isolation in the incubator and improve handling stress-inducing stimuli in the NICU **(Chen et al., 2019)**.

Significance of the study:

Preterm birth is a global epidemic that is the second leading cause of death for children under five years, behind pneumonia. It also a major factor in long-term negative health outcomes. Prematurity increases the length of time newborn will need to stay in the neonatal intensive care unit and is a risk factor for the development of health problems. According to the Egyptian Ministry of Health, 70% of death in the first year of life are caused by neonatal prematurity. **(Braga & Sena, 2020).**

Managing the pain of preterm neonates during painful procedures is a significant challenge for neonatal nurses. As a result, they play an important role in pain assessment, prevention, and management to prevent its potentially negative effects. It is advised that neonatal nurses use the mothers' heartbeat nesting technique in a safe and effective manner to relieve neonatal pain, improve comfort, and physiological parameters. **(Hockenberry & Wilson, 2018).**

Aim of the study

The aim of this study was to assess the effect of simulative heartbeat nest on improving physiological parameters, comfort and pain of preterm neonates at neonatal intensive care unit.

Research Hypotheses:

- The preterm neonates who listened to simulative mother’s heartbeat combined with the nest had improved the physiological parameters score than those who don’t.
- The preterm neonates who listened to simulative mother’s heartbeat combined with the nest had higher comfort level than those who don’t.
- The preterm neonates who listened to simulative mother’s heartbeat combined

with the nest had lower pain score than those who don't.

Subjects and method

Research Design:

A quasi–experimental research design was utilized to conduct the study.

Research Setting:

This study was conducted at neonatal intensive care unit in Specialized Pediatric Hospital at Benha City affiliated to Ministry of Health and Population. The NICU is located in the third floor from the right side, the unit is divided into NICU and PICU. The PICU includes 7 incubators, while the NICU has 24. The NICU provides services for critically ill neonates.

Subject:

The study subject was consisted of purposive sample of preterm neonates (60) at neonatal intensive care unit. A simple random sample was used to assign the preterm neonates into two equal/identical groups: study group (30) and control group (30). Preterm neonates in the control group received only nesting and the routine care of the department, while preterm neonates in the study group received simulative heartbeat nest and the routine department care. The neonates were included in the study based on inclusion and exclusion criteria namely.

Inclusion criteria:

- The preterm neonates between 1500 and 2500 g.
- The preterm neonates between 32 and 36 weeks of gestation.
- Preterm neonates with no congenital or chromosomal abnormalities.
- Preterm neonates exhibit spontaneous breathing.

Exclusion criteria:

- Preterm neonates' with intubation.
- Preterm neonates' who have hyperbilirubinemia.

Tools of the study:

Three tools were utilized to collect the required data. Those tools as the following:

Tool I:- A structured interviewing questionnaire: It was constructed by the researchers based on scientific literature and consisted of three parts:

Part (1): Personal characteristics of the studied preterm neonates & medical record such as; age, gender, type of delivery, ranking, medical diagnosis, gestational age & type of nutrition. (Seven questions).

Part (2): Physical parameters of preterm neonates:

It was consisted of six items such as; weight on admission, current weight, birth length, current length, birth head circumference and current head circumference. (Six questions)

Part (3): Physiological measurements of the studied preterm neonates:

It was consisted of vital signs measured just before and during application (preterm neonate's heart rate, respiration rate and (SaPO2) and compared with control group.

Tool II: Premature baby comfort scale:

The **COMFORT** scale is a standard valid and reliable tool adopted from **Caljouw et al., (2007)** to evaluate the calmness and distress of the preterm neonate. It is a five-point Likert scale involving seven items (alertness, calmness, respiratory response, heartbeat, body movement, facial tension and muscle tone). Each of these items is extending from (1–5). The comfort of the baby is evaluated on the total score. The COMFORT scale has a minimum sum score of 7 and a maximum sum score of 35. If the COMFORT scale score is less than 17, it indicates that preterm neonate is comfortable and is not probably in distress/ pain.

Total scoring system of premature baby comfort scale:

The total score of the comfort scale is the SUM of the points assigned to each of the seven indicators. It ranges from 7 to 35 degrees. A high score indicates that the preterm neonate is distressed (uncomfortable). The scale's important value is ≥17. It is the limit value for the baby's comfort level and indicates the necessity for a pain-relieving intervention. A score of 7 to 16 indicates totally comfortable. Scores between 17 and 26 indicates moderate uncomfortable, while, while those between 27 and 35 represents severely uncomfortable.

Tool III: Premature Infant pain profile (PIPP-R):

Premature Infant Pain Profile (PIPP) scale is a standard reliable and valid tool for assessment of pain among preterm and full term neonates less than two months of age. This scale was adopted from **Stevens et al., (1996)** to assess pain among preterm neonate while using simulative heartbeat nest. The PIPP is a pain measurement tool with seven indicators including behavioral, physiological and contextual indicators. As follow; gestational age, behavioral state, heart rate, oxygen saturation, brow bulges, eye squeeze and nasolabial furrow. Each of these items is evaluated on a Likert scale with four possible outcomes ranging from (0–3).

Total scoring system of premature baby pain profile (PIPP-R):

The total PIPP score is the SUM of the points for all seven indicators. It ranges from 0 to 21. The higher the score, the more pain. A score of 0-6 indicates no pain, a score of 7-12 indicates mild to moderate pain, and a score of >12 indicates severe pain.

Tools validity and reliability:

Validity:

Content validity of the study instruments, the researchers ensured that items of the tools were submitted to a jury of three experts (professors) in the field of Pediatric Nursing to test face and content validity. The tools were evaluated by the experts for clarity, relevance, comprehensiveness, simplicity, and applicability. The jury comments on the tools' format, layout, paraphrasing, consistency, accuracy, and relevancy were considered. The final form was then used in data collection.

Reliability:

The internal consistency of the study tools was checked for reliability using Cronbach's alpha coefficient. This turned to be ($r_= 0.94$) for comfort scale and ($r_= 0.85$) for Premature baby pain profile (PIPP-R). So, tools were founded to be highly reliable for data collection.

Ethical considerations:

Before conducting the study, an ethical approval was obtained from the Scientific Research Ethical Committee at Benha University's Faculty of Nursing. The aim of the study and its expected outcomes were explained clearly and simply to mothers of preterm newborns, and participation in the study was voluntary. Oral consent was obtained from all mothers of the studied preterm neonates and they informed that they had the right to withdraw from the study at any time without explanation of their rational. The mothers were assured that all data collected would be kept confidential and anonymous, and would only be used for research purposes. Official permission was obtained from the Dean of Faculty Nursing for data collection, and the title, objectives and outcomes of the study as well as the main data items to be covered, were illustrated.

Pilot study:

A pilot study was conducted on 10% of the total sample size (6 preterm newborns) over a two-week period, from the middle of June to the end of June 2022, to test the validity and applicability of the study tools

and estimate the time required to complete the questionnaire. No radical modifications were made on the study tools so the pilot subjects were included in the study sample.

Field work:

Data for this study were collected over a four-month period, starting from the first of July to the end of October 2022. The researchers attended to the study setting two days weekly (Saturday & Tuesday) from 9A.M to 11 A.M, to collect data using the previously mentioned tools. The purpose and nature of the study were explained to the mothers of preterm neonates by the researchers. Oral consent was obtained from all mothers of the studied preterm neonates as a pre request of inclusion in the study.

Mathers's heart beats in the study group were measured using finger-type pulse oximetry for a full one minute (after five minutes resting in a calm and quiet environment). The mean values of the measurements were recorded and entered into the maternal heart beat simulator for use in the study.

Before the application, preterm neonates' information in both groups were filled and physical measurements (weight, length and head circumference) were evaluated and recorded, preterm neonates' heart rate, respiration and SaPO2 are also evaluated and recorded.

Preterm neonates in both groups were evaluated using the PIPP and Comfort scales prior to application. The application was performed for each preterm at the same time of the day (after care, feeding, treatment process and stressful procedures were completed) approximately 30 min after all procedures were finished) and for 15 minute the application performed only once daily.

Preterm neonates in the control group were placed only in the incubator. **For study group**, the nest containing a maternal heartbeat device was placed inside the incubator, where the neonates were already present. The device was placed on the nest's left side. Preterm neonates were then placed in the nest on their right side. The hands of the preterm neonates were on the left side of the nest, and their chests were directly in front of the left side of the nest. It allowed preterm neonates to feel the simulation device's heartbeats. Both groups' heart rates, respiration rates, and SaPO2 levels were measured during the application. The values were recorded at the end of each minute for 15 min, and the mean was calculated. Following the application, both groups were evaluated using the PIPP and COMFORT scales. The intervention was applied to the study group for 15 minutes and the control group for 15 minutes without interfering with the neonates' feeding, care, and treatment practices. The COMFORT and PIPP scales were rated before and after the application by the same investigator. The obtained values were recorded in the neonatal information and observation form.

Nesting is a technique that is currently being used in NICUs by using towels or sheets with a device which simulates maternal heartbeats to facilitate preterm neonates' adaptation to the extra uterine environment after birth. The nest used in the study was designed by the researchers using the preterm neonates' towels or sheets and anti-allergic cotton that are not dangerous to health. The interior of the nest was made of 100% pure antibacterial cotton and the nest's cover was made from the preterm neonates' towels or sheets. The researchers designed incubator nests that were appropriate for the size of the preterm neonates. The nesting procedure was carried out for two groups. Preterm neonates in the study group were placed in a nest with

a maternal heartbeat simulator device, while preterm neonates in the control group were placed in a nest without the device.

Maternal heartbeat simulation device:

The maternal heartbeat simulation device was created in collaboration with nursing researchers by mechanical and computer engineers. During the application, the device was located in the previous mentioned nest, and it attempted to make the sensation of being close to the mother. When this battery-powered device is placed in the nest, it produces regular beats that imitate the mother's heartbeat. Antibacterial Eva sponge is used for battery and noise insulation. The device is a locked-circuit system with no potentially dangerous features on the preterm. Because the device was covered with the Eva sponge, it did not come into direct contact with the preterm neonates. As a result, it aims to reduce the feeling of separation in the incubator and to make it easier to adapt to stress-inducing stimuli in the NICU. Because it is not always possible to remove preterm neonates from the incubator who are trying to adjust to external environment and whose vital signs are unstable and place them in the mother's arms in the NICU environment.

Statistical analysis:

The collected data was organized, tabulated and analyzed using an electronic computer and Statistical Package for Social Sciences (SPSS) version 20. Mean and standard deviation for quantitative data, and frequency and distribution for qualitative data, were calculated as descriptive statistics. Also in analytical statistics, chi square test ($\mathbf{X^2}$ value) was used in inter-group comparison of categorical data. In addition, the Pearson correlation coefficient test was used. In all analyses, P value< 0.05 was considered statistically significant (*), P value >0.05 was considered statistically insignificant, and P value< 0.001 was considered highly significant (**).

Results:

Table (1): Illustrates that, slightly more than one quarter (26.7%) of premature neonate's age is about 15 <22 days in both study/control groups with mean age of 20.300±9.432 & 20.500±10.019 days for both groups respectively. While, less than three quarters of premature neonates in study group (70%) are females. There are no statistical significance differences between premature neonates in both study and control groups regarding their personal characteristics.

Figure (1): Shows that more than one third of the studied premature neonates (40%) in the study group had hypoglycemia. While, less than half (46.7%) of premature neonates in control group had hypoglycemia.

Table (2): Shows that, there are no statistical significance difference between premature neonates in the study and control groups related to their physical parameters.

Table (3): Clarifies that, there are highly statistical significance differences (P<0.000) between preterm neonates according to their physiological parameters in the study group post intervention compared to control group.

Table (4): Shows that, there are highly statistical significance difference (P<0.000) between premature neonates according to their physiological parameters in the study group pre compared to post intervention.

Table (5): Clarifies that, there are highly statistical significance difference (P<0.000) between premature neonates in the study group pre compared to post intervention regarding premature baby comfort scale.

Table (6): Illustrates that, Therefore, there are highly statistical significance difference (P<0.001) between premature neonates in the study group post intervention compared to control group according to Premature baby comfort scale.

Figure (2): Demonstrates that, there are highly statistical significance difference between premature neonates according to their total score regarding Premature baby comfort scale in the study group pre compared to post intervention (P<0.000) .

Table (7): Total mean scores of the studied premature neonates according to premature baby pain profile (PIPP-R) scale in study group pre/ post intervention and showed that there are highly statistical significance difference (P<0.000) between premature neonates in the study group pre compared to post intervention.

Table (8): Shows that, there are highly statistical significance difference (P<0.000) between premature neonates according to premature baby pain profile (PIPP-R) scale in study group post intervention/ control group.

Figure (3): Shows that, there are highly statistical significance difference (P<0.000) between premature neonates according to their total score regarding premature baby pain profile (PIPP-R) scale in the study group pre compared to post intervention.

Table (1):- Distribution of the studied preterm neonates according to their personnel characteristics and medical history in the study/control group (n =60)

Items	Study group n=30		Control group n=30		X^2	P value
	N	%	N	%		
Age/ days						
1 < 7	3	10.0	3	10.0		
7 <15	8	26.7	7	23.3		
15 <22	8	26.7	8	**26.7**	0.158	0.997
22<30	6	20.0	6	20.0		
More than 30	5	16.6	6	20.0		
Mean ±SD	**20.300±9.432**		**20.500±10.019**			
Gender						
Male	9	30.0	12	40.0		
Female	21	**70.0**	18	60.0	0.659	0.217
Preterm neonate's ranking						
First	7	23.3	9	30.0		
Second	9	30.0	10	33.3		
Third	8	26.7	5	16.7	1.276	0.973
Fourth and more	6	20 .0	6	20.0		
Type of delivery						
Normal	13	43.3	12	40.0	0.069	0.793
Caesarean section	17	56.7	18	**60.0**		
Type of nutrition						
Breast feeding	13	43.3	7	23.3	2.700	0.158
Artificial feeding	17	56.7	23	**76.7**		
Gestational age/ weeks						
<28.	7	23.3	9	30.0		
28<32	11	36.7	10	33.3	0.389	0943
32<34	6	20.0	6	20.0		
34< 36	6	20.0	5	16.7		
Gestational weight						
SGA	8	26.7	9	30.0		
LGA	14	46.7	15	**50.0**	0.379	0.827
AGA	8	26.6	6	20.0		

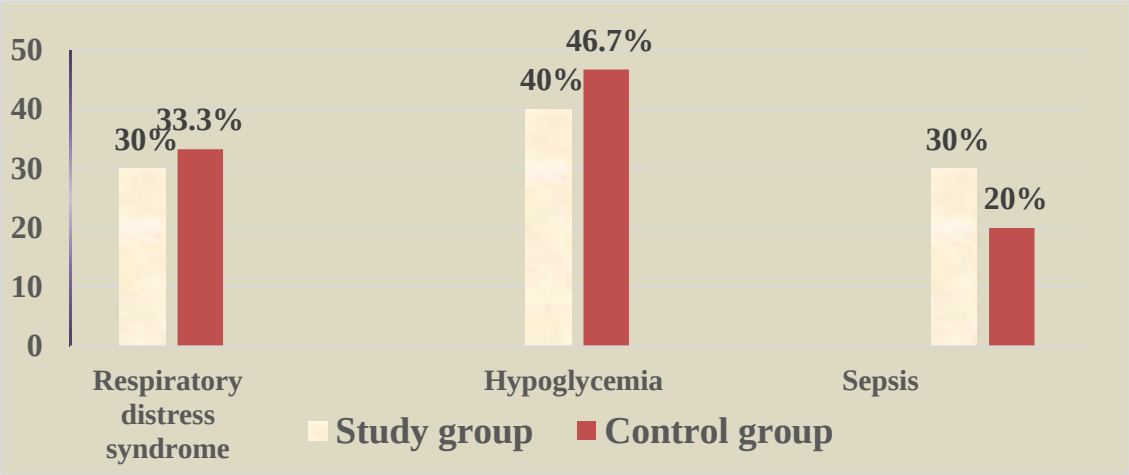

Figure (1): Distribution of the premature neonates according to their medical diagnosis in the study/control group (n=60)

Table (2):- Total mean scores of the studied premature neonates according to their physical parameters in the study / control group (n =60)

Physical parameters	Study group n=30	Control group n=30	Independent T- test	P value
	Mean ± SD	Mean ± SD		
Birth weight	1870 ±320	1850±315	10.532	0.741
Current weight	1900 ±340	1930±321	10.687	0.342
Birth length	**43±3.21**	**44±3.34**	6.524	0.472
Current length	**43.6±3.3**	**44.5±3.42**	6.352	0.536
Birth head circumference	30±2.34	31±2.21	4.631	0.364
Current head circumference	31±2.51	31.5±2.63	4.513	0.562

Table (3):- Total mean scores of the studied premature neonates according to their physiological parameters in the study group post intervention/control group (n =60)

Physiological Rates	Study group post-intervention n=30	Control group n=30	Independent T- test	P value
	Mean ± SD	Mean ± SD		
Heart rate(b/m)	**140.7±11.03**	**150.33±8.16**	10.161	0.000**
Respiratory rate(c/m)	40.29±6.68	43.53±4.465	6.072	0.000**
SaPO2	97.45±0.636	95.466±0.5713	8.253	0.000**

Highly significant P< 0.000** **Significant P <0.05***

Table (4):- Total mean scores of the studied premature neonates according to their physiological parameters in the study group pre/post intervention (n =30)

Physiological Rates	Study group pre-intervention	Study group post-intervention	Independent T- test	P value
	Mean ± SD	Mean ± SD		
Heart rate (b/m)	152.32±8.16	140.7±11.03	10.214	0.000**
Respiratory rate(c/m)	42.33±4.465	40.29±6.68	6.521	0.000**
SaPO2	95.538±0.5713	97.45±0.636	8.156	0.000**

Highly Statistical significant P< 0.000**

Table (5):- Total mean scores of the studied premature neonates according to Premature baby comfort scale in study group pre/ post intervention (n =30).

Parameters	Study group		t- test	P value
	pre intervention n=30	Post intervention n=30		
	Mean ± SD	Mean ± SD		
Calmness and agitation	**3.900 ±0.819**	**4.133 ±0.922**	1.428	0.000**
Alertness	3.600 ±0.751	4.220 ±0.812	1.500	0.000**
Crying	1.733±0.739	1.433±0.504	4.253	0.000**
Physical movement	1.933±0.827	1.633±0.718	3.245	0.000**
Muscle tone	1.400±0.498	1.566±0.504	2.547	0.000**
Facial tension	**4.300±0.651**	**4.556±0.504**	1.546	0.000**
Heart rate	4.000±0.830	4.166±0.791	1.475	0.000**
Total	**16.32±2.65**	**18.78±2.45**	2.856	0.000**

Highly statistical significant at P value <0.000**

Table (6):- Mean scores of the studied premature neonates according to Premature baby comfort scale in study group post intervention / control group (n =60).

Parameters	Study group	Control group n=30	t	P value
	Post intervention n=30			
	Mean ± SD	Mean ± SD		
Calmness and agitation	4.133 ±0.922	2.800 ±0.716	1.357	0.000**
Alertness	**4.220 ±0.812**	**2.600 ±0.720**	**1.247**	**0.000****
Crying	1.433±0.504	1.533±0.839	4.547	0.001**
Physical movement	1.633±0.718	1.952±0.937	3.524	0.000**
Muscle tone	1.566±0.504	1.450±0.478	2.741	0.001**
Facial tension	**4.556±0.504**	**4.245±0.561**	**1.346**	**0.000****
Heart rate	4.166±0.791	3.500±0.840	1.214	0.000**
Total	**18.78±2.45**	**16.470±2.65**	**2.713**	**0.000****

Highly statistical significant at P value <0.000**

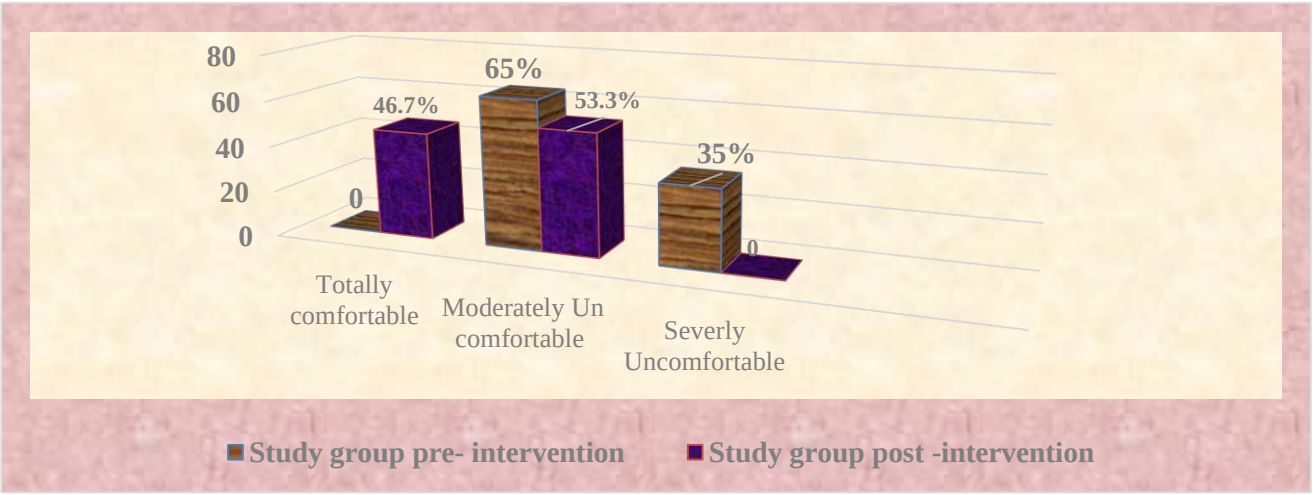

Figure (2): Distribution of the premature neonates according to their total score regarding Premature baby comfort scale in study group pre/ post intervention (n =30)

Table (7):- Total mean scores of the studied premature neonates according to premature baby pain profile (PIPP-R) scale in study group pre/ post intervention (n =30).

Parameters	Study group		t- test	P value
	pre intervention n=30	post intervention n=30		
	Mean ± SD	Mean ± SD		
Behavioral state	2.500 ±0.508	2.621 ±0.478	1.428	0.000**
Increase in heart rate	**2.633±0.490**	**1.687±0.479**	1.633	0.000**
Oxygen saturation	2.133±0.678	1.354±0.730	1.244	0.000**
Facial changes	0.566±0.504	0.633±0.490	0.377	0.000**
Total	**5.125±1.87**	**4.789±1.35**	1.834	0.000**

Highly statistical significant at P value <0.000**

Table (8):- Total mean scores of the studied preterm neonates according to premature baby pain profile (PIPP-R) scale in study group post intervention/ control group (n =60).

Parameters	Study group Post intervention n=30	Control group n=30	ndependen T- test	P - value
	Mean ± SD	Mean ± SD		
Behavioral state	2.621 ±0.478	2.465 ±0.548	1.851	0.000**
Increase in heart rate	**1.687±0.479**	2.730±0.485	1.745	0.000**
Oxygen saturation	1.354±0.730	3.253±0.775	1.254	0.000**
Facial changes	0.633±0.490	0.456±0.652	0.486	0.000**
Total	**4.789±1.35**	6.531±1.981	1.953	0.000**

Highly Statistical significant at P value <0.000**

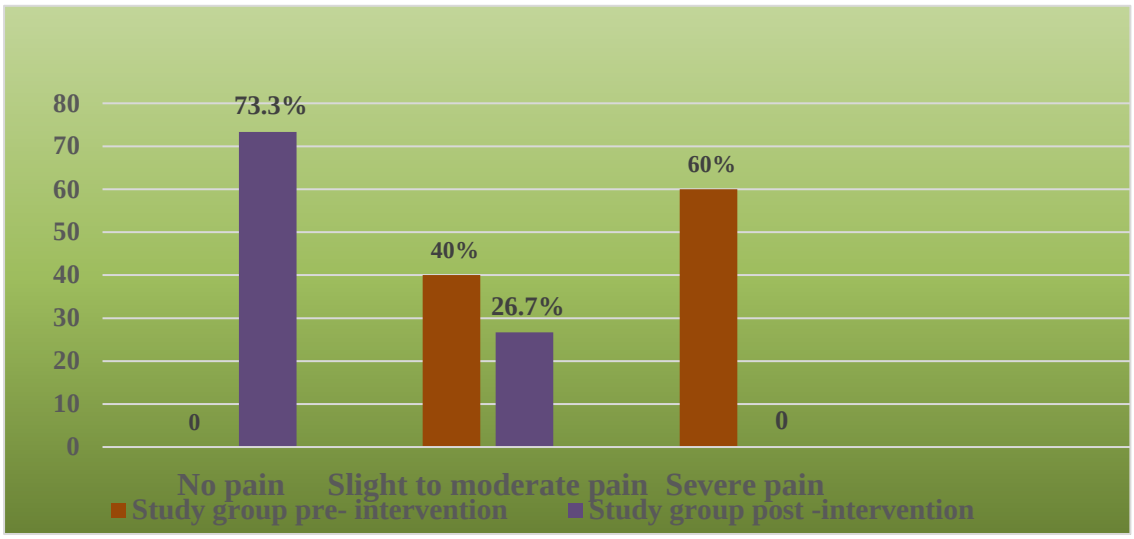

Figure (3): Distribution of the premature neonates according to their total score regarding premature baby pain profile (PIPP-R) scale in study group pre/ post intervention (n =30).

Discussion

Separation of preterm neonates from the mother's voice represent a great problem, because it is an important source for the development of the fetus's sound sensation, which is exposed to intense sound stimuli in Neonatal Intensive Care Units (NICU). The fetus is normally familiar with bowel movements, blood flow sounds, the mother's voice, the mother's heartbeat sound, uterine movements, and synchronized sounds (**Krueger.2016).**

The environment of NICU has very human-made sounds. Unwanted noise in the NICU causes fatigue, stress, and fear, as well as physiological changes such as changes in heart rate, oxygen saturation level, respiratory rate, and blood pressure, also an increase in intracranial pressure, and changes in corticosteroid hormone. An effective auditory stimulus, on the other hand, keeps the infant occupied while also providing a cognitive effect for pain control, physiological stability, and pain suppression. (**Chen et al., 2019).**

According to characteristics of the studied premature neonates, the current study indicated that, one quarter of premature neonates age was about 15 <22 days in both study/control groups and the mean age was 20.300±9.432 & 20.500±10.019 days for both groups. These findings were in contrast with **Karadag et al.(2022),** who conduct study about "The effect of a simulative heartbeat nest on vital signs, pain, and comfort in preterm neonates in Turkey: a randomized controlled trial" who found that the age of premature neonates were 7.9 ± 7.7 days in the experimental group and 8.2 ± 6.9 days in the control group. The preterm neonates ' birth weight was 1918 ± 395 g in control group (appropriate for gestational age). But similar as regard type of nutrition, as they illustrated that more than half of the preterm neonates in the control group were fed with formula milk.

As regards gender of the studied premature neonates, the present study showed that, less than three quarters of premature neonates in study group were females. This finding was in disagreement with (**Radwan et al., 2022)** who conduct study about "Effect of Mothers' Heartbeats and Swaddling Technique on Orogastric Tube Insertion Pain between Preterm Neonates" and reported that more than two thirds (66%) of Preterm Neonates in the study groups were males.

The finding of the present study indicated that less than two thirds of premature neonates in the control group were born by caesarean section. This finding was in the same line with **Karadag et al. (2022),** who reported that more than half (59.3%) of Preterm Neonates in the control groups were born by caesarean section.

The finding of the present study showed that more than one third of the studied premature neonates in the study group had hypoglycemia. While, less than half of premature neonates in control group had hypoglycemia. It also shows that, one third of the studied premature neonates in the control group had respiratory distress syndrome. This finding was in contrast with **Radwan et al., (2022)** who found that the most common diagnosis encountered among preterm neonates in the study group and the control group was hyperbilirubinemia.

As well as, this study finding contraindicated with **Alemdar and Tüfekci, (2017)** who conduct study about "Effect of maternal heart sounds on physiological parameters in preterm infants throughout aspiration" who found that the most common diagnosis encountered among preterm neonates in the study group and the control group was respiratory distress syndrome.

Regarding physical parameters (Birth weight, birth length and head circumference) of the studied premature neonates, the current study showed that, there were no statistical significance difference between premature neonates in the study and control groups**.** This finding was in the same line with **Küçük Alemdar & Güdücü Tüfekci, (2018)** who conduct study about "Effects of maternal heart sounds on pain and comfort throughout aspiration in preterm infants" and found that there were no statistical significance difference between the control and intervention groups in terms of gestational age, birthweight, birth height and head circumference averages (P > 0.05).

Regarding physiological parameters for preterm neonates**,** the finding of the present study reflected that there were highly statistical significance difference between preterm neonates regarding their physiological parameters in the study group post/ intervention compared to control group(P<0.000). From the researchers' point of view, these results could be related that the preterm neonates in the study group had a relaxation response to mothers' heartbeats, which made the neonates calmer and breathed better, consequently. Leading to increasing oxygenation.

These findings were in agreement with **Kihara & Nakamura (2017),** who conduct study about "Nested and swaddled positioning support in the prone position simplifies sleep and heart rate stability in very low birth weight newborns" and found that there was a significant difference in HR between the experiment and control groups (p > .003).

These findings also were in agreement with **Rand & Lahav (2014),** who conduct study about "Maternal sounds cause lower heart rate in preterm newborns in the first month of life" who reported that preterm neonates who listened to the recorded mother's voice and heartbeat had significantly lower heart rate compared to those in the control group.

Similarly with. **Radwan et al., (2022),** who found that the oxygen desaturation was not detected among the majority of the preterm neonates in study group in comparison with half among those in the control group with a statistically significant difference between the study and control group.

On the other hand, this finding was in disagreement with **Alipour et al., (2013),** who conduct study about "Effects of music on physiological and behavior responses of premature newborns: A randomized controlled trial" who played a lullaby to a group of newborns for 20 minutes while keeping the environment quiet for the other group. And found that there was no significant change in the mean of oxygen saturation, respiratory rate, or heart rate during or 10 min after the application.

The finding of the present study showed that, there were highly statistical significance difference between premature neonates regarding physiological parameters in the study group pre compared to post intervention (P<0.000). From the point of view of the researchers', this result could be thought that the nesting technique controlled the movements of preterm neonates and relaxation response of preterm neonates to mothers' heartbeats so, prevented excessive use of oxygen, leading to more storage of oxygen and enhance oxygen saturation.

This study finding was supported by **Alemdar and Tüfekci, (2017),** who found a statistically significant difference in terms of heart rate, respiration and oxygen saturation SaPO2 in the experimental group before, during, and after the procedure ($p < 0.05$).

According to premature baby comfort scale the finding of the present study revealed that there were highly statistical significance difference in study group pre/ post intervention (P<0.000). This finding was consistent with **Karadag et al., (2022),** who found a significant difference in the groups before and after the application based on the comfort scale in the EG, particularly in calmness ($z = 2.121$, p.05, $n = 25$), movement ($z = 2.646$, p.01, $n = 25$), muscle tone ($z = 2810$, $p = .005$, $n = 25$), and facial tension ($z = 2.714$, p.01, $n = 25$).

According to premature baby comfort scale in study group post intervention and control group, the finding of the present study Illustrated that there were highly statistical significance difference (P<0.001) between premature neonates in the study group post intervention compared to control group specially alertness. From the researchers' point of view, these results could be related to the positive effect of hearing mothers' heartbeats which led to neonatal calmness and helped to reduce the stress.

Similarly with **Abdeyazdan et al. (2016),** who conduct study about " Effects of nesting and swaddling on the sleep period of premature infants hospitalized in neonatal intensive care units" who found that mean values of total sleep time and quiet sleep time during nesting and also swaddling periods were significantly higher than in the control period in both groups ($P < 0.001$). This mean that both swaddling and nesting could significantly increase the duration of total sleep time and quiet sleep time.

The findings of the present study showed that, there were highly statistical significance difference between premature neonates according to their total score regarding premature baby comfort scale in the study group pre compared to post intervention (P<0.000).

These findings was consistent with **Doheny et al., (2012),** entitled "Exposure to biological maternal sounds increases cardiorespiratory regulation in very preterm infants". According to the study. Apnea and bradycardia were found to be lower in the group that listened to the maternal heartbeat sounds. These study findings were also consistent with **Karadag et al., (2022),** who found that the neonates were significantly calmer after the application of simulative heartbeat nest in the experimental group.

The finding of the present study revealed that there were highly statistical significance difference between premature neonates related to premature baby pain profile (PIPP-R) scale in the study group pre compared to post intervention (P<0.000). From the researchers point of view these results could be related to the effect of using nesting technique which limits movement of preterm neonates or respond freely to pain, which consequently diminishes the number of afferent stimuli. So, reducing pain and providing relaxation and comfort.

The same results were reported by **Inal et al., (2022)** who has conducted a study entitled "The efficiency of swaddling and maternal holding applied throughout heel blood collection on pain level of healthy term infants; randomized controlled trial" and concluded that there was a statistically significant difference among preterm neonates of the study group regarding pain scale in the study group pre / post intervention.

The finding of the present study revealed that there were highly statistical significance difference between premature neonates related to premature baby pain profile (PIPP-R) scale in study group post intervention/ control group.This study finding was supported by**, Küçük Alemdar & Güdücü Tüfekci, (2018),** who made preterm neonates listen prerecorded maternal heartbeat sounds during the endotracheal aspiration procedure. They discovered that the preterm neonates who listened to their mother's heartbeat sounds during endotracheal aspiration scored lower on the pain scale and higher on the comfort scale than the control group.

The findings of the present study showed that, there are highly statistical significance difference between premature neonates according to their total score regarding premature baby pain profile (PIPP-R) scale in the study group pre compared to post intervention (P<0.000).

This reflect that the application of maternal heart sounds intervention effectively reduced pain. This finding was consistent with **Radwan et al., (2022)** who found that there was a statistically significant difference among preterm neonates of the study and control groups regarding mean total pain percent score during and immediately after orogastric tube insertion.

Conclusion

Based on the results of the present study, it can be concluded that, using of simulative heartbeat nest is a highly effective method to improve physiological parameters, comfort and pain of preterm neonates.

Recommendations:

- Implementing strategies of developmentally supportive care like nesting that mimic the intrauterine environment in the NICU that provides more appropriate preterm neonate's state of alertness, posture, comfort and stable physiological parameters.
- Suggest non- pharmacological interventions namely simulative heartbeat nest to reduce preterm neonates' pain and discomfort.
- Further studies are highly suggested including a larger sample size.
- In-service nursing educational training programs about simulative heartbeat nest are necessary for preterm neonates.

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تأثير عش محاكاة نبضات القلب علي تحسين العلامات الفسيولوجية ,الراحة والالم للأطفال المبتسرين داخل وحدة العناية المركزة

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يولد اكثر من 15 مليون من الاطفال المبتسرين في جميع أنحاء العالم كل عام ، ويتوفي أكثر من مليون منهم نتيجة نقص النمو.تهدف الرعاية الداعمة للنمو الي خلق رحم خارج الرحم مماثلا لرحم الام مما يحسن راحة الأطفال المبتسرين داخل وحدة العناية المركزة . لذا هدفت هذة الدراسة الى تقييم تاثير عش محاكاة نبضات القلب علي تحسين العلامات الفسيولوجية ,الراحة والألم للأطفال المبتسرين داخل وحدة العناية المركزة. تم استخدام تصميم شبه تجريبي لإجراء هذة الدراسة. أجريت هذة الدراسة فى وحده العناية المركزة للأطفال بمستشفى الأطفال التخصصى بمدينة بنها التابعة لوزارة الصحة والسكان المصرية . تم تطبيق هذة الدراسة على عينة غرضيه (60) من الاطفال المبتسرين داخل وحدة العناية المركزة. وأوضحت الدراسة ان هناك فروق ذو دلالة احصائيه بين الاطفال المبتسرين في المجموعة الضابطة والمجموعه التجريبية قبل وبعد استخدام عش محاكاة نبضات القلب علي تحسين العلامات الفسيولوجية ,الراحة والألم لديهم ، كما أوصت الدراسة بضرورة تطبيق استراتيجيات الرعاية الداعمة للنمو التي تحاكي البيئة الداخلية لرحم الام وتحسن من وعي ، الراحه وكذلك العلامات الحيوية للاطفال المبتسرين داخل وحدة العناية المركزة.