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THE EFFECT OF DEVELOPMENTALLY SUPPORTIVE POSITIONING (DSP) ON THE STRESS LEVELS OF PRETERM INFANTS ADMITTED TO THE NEONATAL INTENSIVE CARE UNIT

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ABSTRACT

Background & Objective: Proper positioning is one of the earliest neuro developmental interventions in neonatal intensive care units. Due to the importance of preterm infant positioning and the limitation of studies regarding this matter, the present study was conducted, aiming at evaluating the effects of developmentally supportive positions on preterm infants' stress levels.
Method: In this clinical trial, 30 preterm infants admitted to the neonatal intensive care unit (NICU) were studied in two phases. There were no interventions in phase one; the infants were just put under observation for 30 minutes. In phase 2, the same infants were placed in developmentally supportive positions for 30 minutes. Infants were evaluated at the end of each phase based on the Brazelton sleep score and physiological indices (Heart rate, Respiratory rate, Blood oxygen saturation level). Data were analyzed through a paired t-test.
Findings: Based on our results, average heart and respiratory rates significantly decreased after placing the infants in developmentally supportive positions ($P<0.001$); also, the infants' average oxygen saturation levels and depth of sleep increased significantly ($P<0.001$).
Conclusion: Considering the decreasing effect of developmentally supportive positioning on stress levels of preterm infants which occurs through decreasing respiratory and heart rates and increasing blood oxygen saturation and depth of sleep, implementing this method in NICUs would be of great advantage.

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Introduction

Nowadays, preterm birth is the most important cause of admissions to NICUs [1]. During the past 20-30 years, the incidence of preterm birth has been 5-7% of all live births in most developed countries [2]. Around 12.9 million preterm infants are born worldwide on a yearly basis, from which 11 million (85%) are born in Asia and Africa [3] [4]. Experimental laboratory data

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show that environmental factors such as stress in the NICU play an important role in changing the course of an infant's brain development [5]. Preterm infants show visible signs in response to stress based on their specific behavioral characteristics [6]. The most important of infants' behavioral modes is sleep, especially in preterm infants; through observation via neonatal behavioral assessment tools, the most important sleep states, meaning quiet sleep and active sleep can be evaluated. The most important disturbing factors for infant sleep include noise, lights of the unit and painful treatment and care methods which don't support the infant; through disturbing sleep, these factors have negative effects on an infant's brain development [7]. Aiming to prevent adverse outcomes in preterm infants, numerous studies have been conducted with an emphasis on improving unit environments for mothers and newborns through implementing developmental care [8]. Developmental care aims to provide an organized care which can support the developmental structure of a preterm and ill infant during critical conditions.These interventions include reduction of external stimuli (sight, touch, hearing, etc.), classification of nursing care plans, positioning and swaddling of preterm infants [9]. The above-mentioned interventions reduce stress and prolong resting periods, therefore are beneficial to the preterm newborns [10]. As previously mentioned, developmentally supportive positioning is a part of these developmental care interventions.

Preterm infants have lost the third trimester of being in the uterus; therefore, they haven't reached the physiological state of flexion which is a developmental position indicative of an infant's brain growth [11]. Jorgensen believes that developmentally supportive positions are based on three principles: 1) Containing the infant's body 2) Fetal flexion patterns 3) Midline orientation [10]. Due to the very important fact that the body of a preterm infant doesn't have the strength and firmness of a full-term infant's body; when these babies are positioned on their backs, they prefer to sleep in an open position which leads to abnormal development [8]. Therefore, most newborns need help in order to get to a suitable physical position; an important task assigned to the nurses [12]. DSP allows us to position the infants in any of the prone, supine or side-lying positions and at the same time, keep them safe from the undesirable developmental outcomes of unsuitable positions; to this end, in any of the mentioned positions, the extremities are bent toward the body's midline in a supportive manner, so the infant gets into the fetal position as in the uterus [10]. The purpose of proper positioning is not just to get the infant to the fetal position, but also to prevent turning outwards and pressure on the baby's head, as well as improving midline orientation in order to prevent asymmetrical positions and movements [13]. Angie Hennessy states that when placed in developmentally supportive positions, preterm infants experience less stress and undesirable developmental effects [10]. During our study of texts related to developmental care in Iran, there was not a significant number of papers regarding the effects of developmentally supportive positioning on preterm infants' stress levels. Although, it should be mentioned that studies related to this issue are limited throughout the world. Therefore, it was decided to evaluate the effect of developmentally supportive positioning on stress levels of preterm infants in the neonatal intensive care unit.

Method

The present study is a clinical trial designed to evaluate the effect of developmentally supportive positioning on stress levels of preterm infants admitted to the NICU of Namazi teaching hospital in 2015. The research population consisted of all preterm infants admitted to the NICU of Shiraz Namazi hospital. Samples consisted of preterm infants who met the specified criteria. Inclusion criteria included parental consent, chronological age of 7-14 days, gestational age of 28-36 weeks, non-use of sedatives and short-term or long-term muscle relaxants, lack of obvious congenital, chromosomal and neurological anomalies, not requiring surgery, absence of extreme growth disorders since birth, absence of intraventricular hemorrhage grades 2 or higher, physiological stability confirmed by the unit's doctor, and lack of drug abuse or non-use of sedatives by the mother. Exclusion criteria were signs of physiological instability in the infant at the time of DSP, parents' unwillingness to continue cooperation and need for oxygen therapy through continuous positive airway pressure. The sample size was determined 30 preterm infants based on the formula for a comparison of means and a power of 95%. Through a convenient and accessible sampling method, all infants who met the criteria for inclusion were selected as samples.

This research was conducted between 7:30 to 9:00 A.M since during these hours, amounts of ongoing procedures, manipulations on infants, traffic of personnel and doctors, activities and consequently amounts of environmental brightness and noise were at a minimum in the NICU. This study took place in two phases; Phase 1: physiological indices and sleep score were measured without any interventions (developmentally supportive positioning); the infants were first placed in the supine position for 30 minutes, in other words, not in a developmentally supportive position; also, they were not manipulated during this 30- minute period. After this period, physiological indices including respiratory rate, heart rate, and oxygen saturation level were measured and sleep state was evaluated based on the Brazelton sleep score. Many studies have used this scale to evaluate sleep in infants [14-17]. Respiratory rate was measured through counting abdominal movements by observation for a full minute. In order to increase accuracy and assurance, a third party who was blind to the study's objective simultaneously counted the respirations. Then, the respiratory rates were recorded in the respective forms. Heart rate and oxygen saturation levels were measured by the standard portable pulse oximeter available in the unit. The six sleep/wake states introduced by Brazelton were evaluated as follows: 1- Quiet sleep 2- Active sleep 3- Drowsy 4- Alert 5- Open eyes 6- Crying. These variables were recorded in their respective informational forms after measurement. In the second phase, the same infants were placed in developmentally supportive positions (prone or side-lying) for 30 minutes, and as before, at the end of the 30 minutes, physiological indices and Brazelton's sleep states were measured. To ensure accuracy while measuring sleep states, the infants were filmed for 10 minutes after each phase. An expert with previous training on scoring infant sleep based on Brazelton's

scale evaluated each video in two-minute intervals and recorded the scores in the respective checklist. After giving a sleep score for each two minutes, the score most frequent during the ten minutes was selected for mean calculation.
The procedure of developmentally supportive positioning began by placing the infant in a side-lying or prone position while the fetal position was maintained, then the hands were bent and positioned close to the face and the legs were bent toward the abdomen; in both prone and side-lying positions, the infant's shoulders and pelvis were rounded, meaning they were oriented toward the body's midline. The paired t-test was used for data analysis.

Findings

Based on the results of the paired t-test, mean sleep scores decreased significantly after placing the infants in developmentally supportive positions (P<0.001). In other words, DSP increases quiet sleep (first sleep state) and active sleep (second sleep state). The mean for changes in heart rate after DSP indicates a significant reduction (P<0.001). According to the paired t-test, there was a statistically significant difference among the infants regarding mean oxygen saturation levels before and after DSP (P<0.001). Blood oxygen saturation levels of infants increased significantly after DSP. Also, the infants' mean respiratory rates had a significant decrease after being placed in developmentally supportive positions (P<0.001). All of the findings regarding physiological indices including the reduction of respiratory and heart rates and the increase in oxygen saturation levels, point to the reduction of infants' stress in developmentally supportive positions **[Table 1]**.

Table 1: Comparison of infants' mean sleep, respiration, heart rate and oxygen saturation scores before and after intervention

Dependent Variable	Before DSP	After DSP	P value
	Mean ± Standard Deviation	Mean ± Standard Deviation	
Sleep Score	93.0 ± 13.3	66.0 ± 36.1	p<0.001
Respiration	76.5± 73.56	59.4 ± 49	p<0.001
Heart rate	89.9 ± 31.154	36.8 ± 99.142	p<0.001
Blood oxygen saturation level	32.3 ± 39.91	17.2± 42.94	p<0.001

Discussion

Since preterm infants are in a physiologically sensitive condition, there was no choice but to prepare the setting for infant positioning through controlling five areas of developmental care. These areas include: Sleep care, Management and evaluation of pain and stress, daily routine care (feeding, skin care and position of sleep), family-oriented care and providing a healthy environment in the NICU [18). Therefore, proper positioning is a fundamental part of infant care in NICUs [19]. The results of the study showed that DSP leads to increased sleep, increased blood oxygen saturation level and a significant decrease in respiratory and heart rates. It can be said that placing infants in developmentally supportive positions reduces their stress. In other words, placing infants in the fetal position causes them to be more relaxed and as the results indicated, breathe slower, have a slower heart rate and higher oxygen saturation levels; all this helps an infant experience a better sleep.
Bertelle et al. compared sleep between preterm infants who received developmental care and infants under routine care in 2005. According to their results, the infants under developmental care had longer sleeping periods (averages 156.2 min against 139.2 min), longer periods of quiet sleep (averages 47.1 min against 36.1 min) and longer periods of active sleep (averages 86.6 min against 77 min). These results showed that developmental care, of which DSP is a fundamental part, leads to prolonged sleeping periods [20]. The results of the study done by Liaw et al. (2012) revealed that placing infants in a side-lying position increases their quiet sleep [21].
In their study relating developmentally supportive care in the NICU, Coughlin et al., stated that placing infants in the fetal position and creating a flexion pattern improves their sleep [18]. Colombo and De Bon also studied the strategies to protect the infants' sleep in a systematic review and emphasized the importance of implementing developmental care for this issue [22]. Hennessy did a study in 2007 in Africa relating the effects of DSP on preterm infants' stress levels. Results from this study showed the mean stress scores of infants to be 29.07% and 16.8% before and after DSP, respectively, which indicates a significant reduction of stress while placed in developmentally supportive positions (P<0.0001) [10]. Also, following their study in 2005 in the United States, Hill et al. stated that preterm infants' stress responses decrease in the facilitated tucking position during routine care (P<0.013) [23]. All the above-mentioned studies have results consistent with ours, and they all indicate that when infants are placed in developmentally supportive positions, they have less stress and this consequently

increases their depth of sleep. Results from the present study revealed that the mean for changes in heart rate significantly decreases after DSP (P<0.001). Adrenal medullary cells and fibers of the sympathetic nervous system are activated in response to stress and catecholamines (adrenaline and noradrenaline) are discharged from the adrenal medulla; this causes increased heart and respiratory rates as well as oxygen consumption [24]. Therefore, it seems that the slower heart rate after DSP is caused by the reduction of stress. Although according to our search, there hasn't yet been an official and documented study revealing the effects of DSP on heart rate. The results of the study done by Coff et al. showed that heart rate generally increases in infants undergoing the heel-stick test, but for the infants in the facilitated tucking position, this increased heart rate returns to baseline significantly faster [25]. These results are consistent with ours.

The present study's results showed a significant decrease in blood oxygen saturation levels following DSP (P<0.001). Numerous studies have previously shown the effects of infant positioning on blood oxygen saturation levels. Our results are consistent with results of Huang et al., study in 2004. This study compared preterm infants' pain responses to the heel-stick between the two positions of containment and swaddling; their results indicated that both of these positions accelerated the return of oxygen saturation level to the baseline [26]. Placing infants in the prone position, which is a developmentally supportive position, improves the mechanical activity of the lungs and tidal volume, as well as improving respiratory control and sleep apnea; this explains the ability of DSP to increase blood oxygen saturation [27].

This study also revealed that the number of respirations significantly decreases after placing an infant in a developmentally supportive position (P<0.001). In this regard, Kucukoglu et al. investigated the effect of the facilitated tucking position in reducing vaccination-induced pain in newborns and showed that this position causes the significant reduction of respiration rate in infants (P<0.05) [28]. Technically, a developmentally supportive position, in this case, the facilitated tucking position, makes an infant feel safe; oxygen consumption decreases as a result and following that number of respirations decrease; consequently, this causes a decrease in the respiratory system's activity which helps save energy [28]. The effects of unavoidable noise in the unit which interfered with the infants' sleep can be regarded as one of the limitations of this study. It is suggested that future studies evaluate the effects of developmentally supportive positioning and reduction of noise and light on the development of preterm and full-term infants.

Conclusion

Considering the significant and positive effect of DSP on lowering stress levels in this study, this method can be used in NICUs in order to improve preterm infant care as well as the short-term and long-term developmental outcomes.

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