

Effect of Nesting and Swaddling On Sleep and Physiological Parameters of Preterm Infants- A Scoping Review

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Abstract

The infants born before 37 weeks of gestation are known as preterm infants. Sleep is essential for brain development as well as plays a fundamental role in the new-born's growth. The main challenge of preterm infants after their birth is development of their circadian rhythm due to environmental factors of NICU.

Objective: to find the existing scientific evidence regarding the effect of nesting and swaddling on preterm infant's sleep and physiological parameters.

Methodology: The scoping review was carried out in March 2022 using search engine such as PubMed, Google Scholar, Academia, CINHAL Plus and Science Direct. The search was limited from year 2013-2021. The selection process of the studies was based primarily on analysis of the titles and abstract, followed by the analysis of full text of selected articles, based on inclusion criteria.

Results: A total 30 studies were found out of which 3 met the inclusion criteria. It was found that the swaddling and nesting were showing improvement in quiet sleep as well as in total sleep. The infants were able to maintain their heart rate, respiratory rate, SPO₂ levels, as the preterm infants were in relaxed state, their energy expenditure was also found to be less.

Conclusion: Adequate sleep patterns and maintenance of physiological parameters should be given importance as it has strong impact on development of the infants. With the nesting and swaddling, the infants were able to maintain sleep patterns and physiological parameters.

Keyword: sleep, heart rate, respiratory rate, nesting, swaddling, preterm infants, neonatal intensive care units.

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I. Introduction

According to WHO, prematurity is defined as the birth of an infant before 37 weeks after the first day of the last menstrual period.¹ Premature infants are a vulnerable group who require advanced medical intervention and highly specialised nursing care. Their early birth interrupts with the maturation of internal organs, they lack self-regulatory behavior, inability to make purposeful movements.² As medical technology is developing, the survival rate of premature infants has been markedly improving.³

Sleep is essential for brain development as well as plays a fundamental role in the new-born's growth. Specifically adequate sleep and rest plays a great role for development of the central nervous system such as cerebral structures, sensory and behavioral systems.^{4,5,6} The main challenge of preterm infants after their birth is, development of their circadian rhythm due to several environmental factors.⁶ In neonates sleep cycle is divided into three stages active, quiet and indetermined sleep. Active sleep (AS) is characterised by presence of rapid eye movement (REM, irregular breathing, facial and body movements, and continuous EEG patterns and is essential for maturation and development of CNS. Quiet sleep (QS) is marked by absence of REM and body movements, presence of regular respiration, and discontinuous EEG patterns. It promotes energy recovery and cell repair with an increase in protein synthesis and growth hormone production contributing to learning and memory process. Indetermined sleep (IS) state is not clearly classifiable as QS or AS, it is beginning of sleep and between QS and AS.^{4,5} Quiet sleep is essential for proper growth of preterm infants.

Developmental Supportive Care (DSC) model uses positioning, swaddling, KMC, massage, NNS, breastfeeding. It aims at minimizing energy expenditure using various techniques such as positioning, containment. DSC program have shown positive results for the infants and their families. These strategies have indicated better neurodevelopmental function and helps in maturation of brain fibers.⁷

Nesting is commonly used in developmental care, as it provides physiological, behavioral, and postural stability to preterm infants. The nest is formed using rolled-up sheets and helps to maintain the infant in comfortable position.²

Another technique used in developmental care is swaddling, which involves wrapping infants in blankets promoting flexed position and limited extension. It helps in self-regulation, calming the infant and promoting the sleep.⁸

Some NICU units use Nesting with swaddling, where as some use only nesting as their care program. Recently the combined effect of nesting & swaddling is being approved & practiced by very few NICU units. Research studies have been undertaken for analysing the effect of Nesting, swaddling on preterm and Low birth weight infants. This study attempts to review the effect of Nesting with swaddling on the sleep pattern of neonates with low birth weight.

II. Methodology

Inclusion criteria

- 1) Preterm infants
- 2) Low Birth Weight/LBW
- 3) Infants provided with Nesting & swaddling
- 4) Strategies to promote sleep patterns
- 5) Admitted in NICU
- 6) Maintenance of physiological pattern

The question of revision formulated was “What will be the combined effect of nesting and swaddling on sleep patterns and physiological patterns of new born infants?”

Regarding the type of studies, all existing literature of primary or secondary origin (literature reviews, observational, qualitative, quantitative or mixed studies and experimental studies) was included. (Free articles)

Search strategy

The research was carried out in March 2022. The research was carried out using PubMed, Google Scholar Academia, CINHAL Plus and Science Direct in order to identify the articles followed by the words contained in the titles, abstracts and descriptors of said articles.

Further MeSH descriptors were used for formulation of research equation. Keywords such as NICU, sleep, physiological parameters, low birth weight, neurobehavioral status, were found. The research of the articles was confined for last 10 years i.e., between 2013 to 2021.

Since the focus of present study was on strategies promoting sleep as well as on physiological parameters, there were excluded studies that included infants after first 28 days of life, as well as studies referring studies other than NICU setting, studies on promotion of newborn’s mother and studies which did not address sleep promotion.

The selection process of the studies was based primarily on analysis of the titles and abstract, followed by the analysis of full text of selected articles, based on inclusion criteria.

III. Results

	Study 1	Study 2	Study 3
Aim/purpose	The effect of nested and swaddled positioning support in the prone position on heart rate, sleep distribution, and behavior state in VLBW infants. ⁹	the effect of nesting and swaddled position on sleep duration of premature infants. ⁴	The effect of nesting and swaddled prone position on sleep and physiological parameters in LBW infants. ³
Author	Hideki et al.	Zahra et al	Gehan et al.
Year of the study	2013	2015	2018
Country	Japan	Iran	Egypt
Type of study	Prospective and crossover design	Prospective clinical trial	Quasi experimental
Sample size	20	42	60
Gestational age	26.5-30.5	31-34 weeks	Preterm as well as term infants.
Birth weight	709-715gm	1200-2300gm	1300-2400gm
Tools used	Heart rate and electroencephalography Brazelton & Nugent’s index	Pretchl’s index,	Brazelton & Nugent’s index, Observation of physiological parameters.
procedure	First the infants were kept only prone position for 1 hr and then the infants held the hand towel and were nested	19 were given nesting- swaddling and 20 swaddling- nesting for a period of 2 hours. Parameters were checked 1 min after starting and 1min before ending	30 were given prone nesting position for 1 hour and swaddling and other 30 were given only prone position as a

	and swaddled with a special mat (Baby Positioning Mat, Akatyan No Shiro Corporation, Kurume, Japan) to keep the elbow, shoulder, hip, and knee joint in flexion for 1 hour.	the intervention	routine procedure.
Results	The parasympathetic activities of premature infants are higher than term infants and has intense relationship with HR. it was seen in the study that, prone position along with swaddling in VLBWI, enhanced HR stability leading to relaxation. As the infants were relaxed, less expenditure of energy was seen enhancing growth and brain development.	Repeated measure analysis of covariance (ANCOVA), showed no significant difference in mean of TST between swaddling and nesting period (P= 0.245), but there was significant difference in the means of TST between both swaddling and nesting period and control period in both groups (P<0,001). The effect of period was not significant (P=0.414). this shows that sequence of applying nesting and swaddling was not affecting the TST. As independent t-test, showed no significance (p=0.133), in wash out period indicating that the the length of wash out period was adequate for deletion of pervious effect of intervention. Repeated ANCOVA showed no significant difference (p=0.450), in QST in periods of swaddling and nesting in two groups, but QST between both periods of swaddling and nesting and the control period was significantly different (p<0.001). ANCOVA also showed that the effect of period was not significant (p=0.693) and independent t-test showed that the effect of wash out period was not significant (P=0.312).	Mean HR decreased in study group as compared with control group. Means oxygen saturation level were higher in study group than in control group. Mean RR of study group decreased than before whereas in control group it increased (difference was statistically significant). The percentage of neonates in deep sleep among study group were more than neonates among control group and the difference between both groups was statistically significant. crying was not observed among the neonates of study group compared with one third of neonates among control group and the difference between both groups was statistically significant.

The study done, by Hideki et al., which is an experimental study, the infants were studied in both in prone position using nesting and swaddled positioning support and in prone position without support. First infants were placed in prone position without any support for 1 hour, then the babies held the hand towel and were nested and swaddled using special mat (Baby Positioning Mat, Akatyan No Shiro Corporation, Kurume, Japan) to keep the elbow, shoulder, hip, and knee joint flexed for 1 hour and then the infants were taken off the special mat in prone position. This study was done during 3-hour interfeeding epoch. The Brazelton and Nugent's index was used to evaluate the states of the infants. HR was recorded, EEG data was recorded from an electroencephalograph with eight-channel method. Sleep data from EEG were evaluated as QS (high voltage, slow wave pattern and trace alternant) or as (low voltage irregularity pattern and wave mixing). The states were evaluated using Brazelton and Nugent's index was lower in infants with positioning support than without positioning support. The percent of QS in prone position with positioning support was high compared to those without positioning support. Most the preterm infants who were positioned with nest and swaddling, were seen to be in state 1 and stage 2 of Brazelton & Nugent's index.⁹

Zahra et al., performed a prospective clinical trial on 39 neonates. These neonates were evaluated for 2 sleep cycles where in first control period of 2 hours no intervention was given and in next 2 hours after feed they were in swaddling or nesting. in later 2 hours 39 infants were divided into 2 groups of nesting-swaddling (N-S) or swaddling-nesting (S-N). Prechtl's scale was used for evaluation of sleep. It was seen that there was a significant difference in the means of total sleep time and quiet sleep time between swaddling and nesting period and control periods.⁴

Gehan et al., performed a quasi-experimental study on 60 neonates, who were divided into 30 study and 30 control group. The study group received nested and swaddled prone positioning and control group received prone position only as routine NICU care. Physiological parameters were assessed before and after one hour of nesting position for study group and prone position for control group. Sleep states were assessed using Brazelton and Nugent's index after one hour of intervention in both the groups. It was found that the mean heart rate and mean respiratory rate of the study group decreased as compared to control group after giving intervention and was statistically significant. Furthermore, the mean oxygen saturation after nesting and swaddling were higher than before in study group and the difference was statistically significant. The percent of deep sleep and light sleep infants in study group were more than in control group. Crying was not observed in study group as it was seen in control group infants.³

IV. Discussion

The different sensorimotor experience of premature infants compared with term infants may interfere with their sensorimotor development.⁹ Preterm as well as low birth infants are vulnerable group who require advanced medical intervention and highly specialized nursing care in order to survive.^{3,7,10} They require support to facilitate and maintain postures that improve motor control, physiological functioning and decrease stress. Nesting as well as swaddling provides flexion of the limbs and trunk and facilitates midline skills along with assisting neonate's self-regulation and maximizes neonate's stability, preserves energy, growth and promote neurobehavioral organization. It has also seen to be effective in maintaining neonate's physiological parameters, prevents fluctuations in cerebral blood flow and fragile blood vessels in brain from rupturing. Hence studying the effect of nesting and swaddling in neonates in NICU is very essential.³

Nesting position is comfort measure that stimulates in-utero feeling of lack of space by providing a 'Nest' with rolled up blankets. Nesting is effective in improving postures of preterm infants as it promotes flexed posture of limbs with adduction of shoulders, which helps in minimizing the heat loss and weight loss as it reduces the surface exposed to environment. It also helps in facilitating the peaceful sleep patterns.³ Swaddling is a well-known technique in developmental program care. It involves wrapping the infants in blanket to promote a flexing position and limit extension. It helps in self-regulation of infants and has positive effect in calming and promoting sleep in infants. It also helps in lowering the physiological and behavioral responses.⁸ Many studies support the effect of positioning in developmentally appropriate posture on neonates, & emphasized its effect on early development of neonates, showing reduced abnormal postures reflexes, physiological status, sleep & neurobehavioural regulation.

Sleep is fundamental for the motor development, neurodevelopment, sensory maturation in newborn infants.⁴ The infant's sleep is often disturbed in the NICU setting, due to the environment as well as the need to perform the procedures necessary to maintain the newborn's life.^{6,11}

Pharmacological as well as non-pharmacological interventions are used to promote the sleep. The pharmacological interventions have the effect of reducing active sleep as a side effect, which may hamper growth & neurodevelopment in infants. Non-pharmacological interventions are preferred in young infants to enhance sleep.

Adequate positioning and restraint are important interventions, since they contribute to the self-regulation of the infants and avoid motor disorganization.^{2,14} The developmental supportive policy gives importance to nesting and swaddling. Nesting provides secure positioning, simulates the intrauterine boundaries, that reduces the effect of environmental stimuli and minimizing sudden movements. Swaddling involves wrapping an infant in a sheet or blanket which mimics coziness of womb soothing and helping to calm the infants.

There are studies concluding that nesting,

- Improves neonates' sleep quality through preservation of neonates' curved limb position and reduction of sudden movements as well as immobility of the arms and legs.^{2,11,17}
- It has a pain reducing effect, enhancing comfort, and reducing stress.¹²
- Also, a positive effect on neurobehavioral status of preterm infant.^{14,16}
- Has shown improvement in physiological parameters.^{2,13,7}

There are studies suggesting that swaddling,

- Sleep time in infants has increased.^{6,17}
- Improvement in neuromuscular development, less physiological distress, better motor organization, increase in self-regulatory capacity.^{8,18}
- Pain reducing effect, and decrease in crying period.^{13,17}
- As swaddling provides flexion position it facilitates midline skills.¹⁷

As nesting and swaddling individually has many benefits, hence when both nesting and swaddling when provided together can enhance their combine effect. This review was done on studies which has focused on sleep and physiological parameters in preterm infants when provided with nesting and swaddling together. The limited number of studies were found evaluating effect of nesting & swaddling on sleep cycle of infants. The positive effect on sleep and physiological parameters. The study reviewed showed there is increase in sleep duration of infants quite as well as active. As the proper positioning promoted relaxation along with less energy expenditure, it facilitated the sleep among them.

The nesting & swaddling was also effective in reducing crying episodes, as provided content environment mimicking the safe environment in womb. There was reduction in mean heart rate and respiratory rate of the infants. There was increase in oxygen saturation level among these infants.

There is scarce literature on combined effect of Nesting & swaddling. Some of the studies were paid, so could not be included in this review. The available articles have not clearly recommended about the duration of

nesting & swaddling used in a day or the intervals to be used in the administration of these techniques together. Further detail review is recommended, for indepth understanding of beneficial effect of Nesting & swaddling for preterm infants with low birth weight.

V. Conclusion

With the present review, it was possible to gather the existing scientific evidence regarding effective strategies in the protection and promotion of sleep patterns and maintenance of physiological patterns. Adequate sleep patterns should be given importance as it has strong impact on development of the infants. Along with sleep patterns physiological parameters also play an important role in development of infants. This practice should be further used in NICU. Appropriate training for caregiving staff is also recommended for the safe & scientific use of Nesting & swaddling. In the humid & hot environment the technique should be administered gradually, observing the infant's responses. Further studies with more specific inclusion & exclusion criterions considering the physiological & environmental factors may guide the importance of nesting & swaddling in preterm infants.

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