

# Correlations of Handling Procedures and Sleep Patterns of the Infants Admitted to the Neonatal Intensive Care Unit

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## ABSTRACT

**Background:** The present study aimed to assess handling procedures and their effects on the sleep-wake time in the preterm infants admitted to the neonatal intensive care unit (NICU).

**Methods:** This observational cross-sectional study was conducted in the NICU of Vali-e-Asr Teaching Hospital affiliated to Tehran University of Medical Sciences (TUMS), Iran in 2016. Sample population consisted of 15 preterm infants, and duration of the handling procedures was considered to be 15 days or 360 hours. Handling procedures were recorded within an uninterrupted 24-hours period. Sleep patterns of the infants were checked at 8 AM-8 PM using Als' behavioral states scale of Newborn Individualized Developmental Care and Assessment Program (NIDCAP sheet).

**Results:** Mean frequency of the handling procedures during 24 hours was  $59.93 \pm 15.86$ . Within 12 hours, mean frequency of the care/monitoring, therapeutic, and supportive procedures was  $41.20 \pm 12.14$  during the day, while it was  $18.73 \pm 5.43$  at night. Mean handling procedures in minutes was  $18.73 \pm 5.43$  for care/monitoring procedures,  $13.60 \pm 13.28$  for therapeutic procedures, and  $76.21 \pm 93.08$  for supportive procedures. In therapeutic and care/monitoring handling procedures, sleep duration decreased in the infants, while it increased in the supportive procedure. Mean total oxygen saturation was  $94.80 \pm 2.81$ , and mean total heart rate was  $147.30 \pm 16.76$ .

**Conclusion:** According to the results, supportive handling could increase sleep duration in preterm infants. Therefore, it is recommended that this technique be applied for the comfort of preterm infants in the presence of parents.

**Keywords:** Handling, Neonatal intensive care unit (NICU), Preterm infant, Sleep

## Introduction

Preterm infants who are admitted to the neonatal intensive care unit (NICU) require special care to survive (1). Due to the routine care or life-saving measures taken for preterm infants in the NICU, they are often exposed to several stressors, such as abundant handling in order to perform painful and painless procedures (e.g., injection) or even changing sheets and diapers. However, preterm infants are not able to tolerate such stress in the extra-uterine environment (2). Handling is defined as the

physical interventions that are intended to provide monitoring, therapy, and supportive care for patients (3, 4). Although handling is a necessary procedure, but this routine care in the NICU might lead to the vulnerability of the nervous system, mutability, calorie loss, and disruption of the physiological conditions of preterm infants (5). According to the literature, preterm infants at the NICU are manipulated more than 100 times over 24 hours (6, 7), which leads to sleep deprivation in addition to other

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adverse outcomes (5, 6, 8). Sleep-deprived infants in the NICU are unable to organize and adjust their sleep and wake states. Moreover, the healthcare team in the NICU may disrupt passing from the sleep state to the wakeful state, and the subsequent sleep disorders could impair brain growth in these infants (6).

Sleep is a major portion of the day in the life of neonates and infants (9). Several studies have acknowledged the importance of sleep as a biological base in the growth of the brain. Sleep cycles play a pivotal role in the growth of the brain cortex and sensory nerves. Environmental differences may influence the sleep patterns of preterm infants; such example is the neonates admitted to the NICU (10, 11). During the past two decades, findings have confirmed that sleep is critical to the development of the sensory system in the embryonic period, maintaining the flexibility of the brain, brain growth to establish long-term memory, and essential learning in the childhood and adulthood (3, 6). Furthermore, sleep cycles are crucial to normal neurosensory and cortex development of the fetus and neonate (10). Sleep duration in newborns is 16-18 hours per day, which constitutes approximately 70% of 24 hours (4). Sleep is basically a behavioral state. It has been estimated that sleeping accounts for one-third of life in adults (12), adults usually sleep at night (11). The average amount of sleep gradually decreases from week 16 of life (13). In this period, sleep is divided into three stages of active sleep (AS) with irregular heartbeats and breathing. Quiet sleep (QS) with slower electroencephalogram (EEG) waves, and indeterminate sleep (IS), which is clearly defined in EEG (4). Each of the mentioned sleep stages is characterized by specific clinical, physiological, and behavioral criteria (9, 10).

Preterm infants were admitted to the NICU are more often in active sleep and experience sleep deprivation, interrupted sleep, and high drowsiness states (14). The behavioral, clinical, and physiological criteria of infants in the sleep and wakefulness states could be observed and recorded using various instruments by skilled experts (15). Although studies have introduced polysomnography as a identify different sleep states, According to clinical observations Brazelton developed six sleep-wake states and proposed them in Brazelton Neonatal Behavioral Assessment Scale (NBAS). NBAS is used to evaluate the behaviors of preterm infants as well (16). In this regard, Heidelise ALS Et Al, adapted the Assessment of Preterm Infants' Behavior

(APIB) based on NBAS. APIB is a practical method to evaluate and observe the sleep-wake behaviors of preterm infants, which is also used in the Newborn Individualized Developmental Care and Assessment Program (NIDCAP) (15).

NIDCAP sheet has been translated into Persian by the office for mothers and infants at the Iranian Ministry of Health and Medical Education.

In the case of preterm infants, the term 'behavior' encompasses behavioral responses such as crying, floating, roving or darting eye movements, and measurable movements of the hands and legs, as well as physiological and autonomic parameters, such as the heart rate, respiratory rate, and oxygen saturation (1, 16, 17).

Considering the innate characteristics of the premature infants who require supportive medical and clinical care involving frequent handling in the NICU environment, the present study aimed to evaluate various handling procedures in 24 hours and their effects on the 12-hour sleep-wake time of premature infants admitted to the NICU. The main objective of the research was to investigate the correlation between handling procedures and sleep pattern of the preterm infants in the NICU. It is hoped that the findings could be incorporated into the care programs for hospitalized infants to enhance their sleep quality.

## Methods

This observational cross-sectional study was approved by the School of Nursing and Midwifery at Tehran University of Medical Sciences (TUMS) in Tehran, Iran in 2016. The study was conducted in the NICU of Vali-e-Asr Teaching Hospital affiliated to TUMS; the hospital has 15 NICU beds that distributed in a spacious room (12 single wall incubators, 5 Double-walled incubators and 4 radiant warmers) and an isolated room. Neonatal care was provided by a multidisciplinary healthcare team as the collaboration of professors and undergraduate and graduate students in various fields. During the routine procedures in the hospital, parents are allowed to stay with the infants in the NICU.

In total, 15 preterm infants were enrolled in the study with 15 days (360 hours) of handling procedures. Handling procedures involving direct contact with the body of the infants were recorded within 24 hours, and sleep behaviors of the infants were recorded at 8 AM-8 PM.

Inclusion criteria of the study were as follows: 1) care in an incubator; 2) gestational

age of  $\leq 37$  weeks; 3) stable vital signs; 4) no invasive/noninvasive hemodynamic or respiratory support and 5) no brain problems/seizures. Exclusion criteria were as follows: 1) use of phototherapy; 2) intraventricular hemorrhage (grade II, III, and IV); 3) prescription of opioid drugs; 4) infections caused by care processes; 5) major congenital anomalies and 6) history of substance abuse in parents.

Variables were selected to characterize the handling procedures and sleep stages in the preterm infants through the observation of the infants and the performed procedures inside the incubator. The variables were determined based on the possible handling procedures (occurrence, frequency, single or multiple handling) and adjusted in checklists. Handlings were divided into three groups based on the handling and care procedures (e.g., changing sheets and diapers, hygiene, comfort), therapeutic measures (e.g., drug and fluid administration, medical examinations) and supportive measures (e.g., parental fondling, Kangaroo care by mother or father, breastfeeding or milk feeding by father). The procedure was initiated at 8 AM and continued by recording the handling procedures based on the mentioned demographic data until 8 AM of the next day.

NIDCAP sheet was used to measure the physiological variables (respiratory rate, heart rate, and oxygen saturation), motor conditions, sleep-wake states (active sleep, quiet sleep, and drowsiness, quietly awake, actively awake, and crying), attention/interaction, and self-regulation. Each sleep-wake state encompassed particular behavioral and physiological cues, such as regular respiratory pattern, presence/absence of rapid eye movement, openness/closeness of the eyes, facial expressions, gross body movements, skin color, and mouth movements; these cues were divided into two-minute periods. Reliability and validity of NIDCAP sheet have been confirmed in the previous studies in Iran (18). In the present study, we only used the physiological variables of NIDCAP sheet to assess the sleep-wake states of the preterm. In order to evaluate the physiological variables, sleep-wake states were examined at two-minute intervals during 30 minutes (4 minutes per hour). Moreover, drowsiness, active sleep, quiet sleep, and wakefulness of the neonates were observed meticulously by the research over 12 hours (8 AM-8 PM) for a total of 48 minutes.

In continuation, the researcher observed the sleep behavior of infants in 25 times and entered their data into the scale at two-minute intervals every 30 minutes for 12 hours (8 AM-8 PM). Simultaneously, the observer was recording the type of handling procedures for the infants with its exact time and duration. Recording of the data continued until 8 AM on the next day (8 AM-8 AM).

Data analysis was performed in SPSS version 18 using frequency, highest/lowest mean, and standard deviation for the quantitative variables. In addition, correlations between the variables of sleep patterns and handling procedures were determined using linear regression analysis and Pearson's correlation-coefficient. In all the statistical analyses, the significance level was 95%.

It is notable that the researchers of this study have adequate skills since engaged in developmental care and NIDCAP training under the direct supervision of Heidelise Als, who was involved with the issue of UNICEF support during 2013-2016.

## Results

In total, 15 preterm infants who were admitted to the NICU (10 males and 5 females) were enrolled in the study. The infants were born via caesarean section. Mothers of 73% of the infants were housewives, and 60% of the fathers were self-employed. The most frequent diagnosis for the infants was respiratory distress syndrome (60%). Mean birth weight of the female and male infants was  $1372.00 \pm 284.43$  and  $1533.500 \pm 710.01$  grams, respectively. The results of Pearson's correlation-coefficient showed direct, significant correlations between the birth weight, age, and sleep of the neonates, so that increased birth weight and age was associated with increased sleep ( $P < 0.001$ ).

Mean light level in the surrounding environment of the infants was  $3.42 \pm 2.17$  foot-candles (due to the incubator cover), and the sound level outside the double-walled incubators was  $60.85 \pm 6.643$  decibel. Mean frequency of handling during 24 hours was  $59.93 \pm 15.86$ , so that mean handling during daytime (12 hours) was  $41.20 \pm 12.14$  and mean handling during nighttime was  $18.73 \pm 5.43$ . Handling procedures were classified into three groups in terms of the frequency in each contact with the infants, including care/monitoring, therapeutic, and supportive procedures. Mean duration was estimated at  $52.13 \pm 12.64$  minutes for the

**Table 1.** Frequency of Sleep Stages Concerning Handling of Preterm Infants in NICUs (minute)

Index	Variable			
	Active Sleep	Quiet Sleep	Drowsiness	Wakeful
	Mean±SD	Mean±SD	Mean±SD	Mean±SD
Care or Monitoring Handling	16.26±9.65	13.20±7.75	10.00±5.63	16.28±14.47
Therapeutic Handling	4.22±3.34	5.33±4.63	3.62±2.32	7.41±814.51
Supportive Handling	33.45±46.66	25.00±20.09	25.25±20.41	31.08±57.59

**Table 2.** Linear Correlations between Handling Procedures and Sleep Pattern in Preterm Infants

Sleep Pattern	Unstandardized Factors		P-value
		B	
Care or Monitoring Handling	Active Sleep	0.992	<0.000
	Quiet Sleep	0.989	<0.000
	Drowsiness	1.014	<0.000
	Wakefulness	0.985	<0.000
Therapeutic Handling	Active Sleep	1.293	<0.000
	Quiet Sleep	0.721	0.009
	Wakefulness	0.857	<0.000
Supportive Handling	Active Sleep	2.0741	0.005
	Quiet Sleep	1.243	0.006
	Wakefulness	0.905	0.033

care/monitoring procedure, 13.60±13.28 minutes for the therapeutic procedure, and 76.21±93.08 minutes for the supportive procedure.

In the present study, 25 times recorded observation of the behavioral sleep in duration 12 hours during daytime showed the mean handling estimated at 81.60±14.82 minutes in this period. In addition, mean oxygen saturation was 94.80±2.81, and mean total heart rate was 147.30±16.76.

Associations of the handling procedures and sleep stages (active sleep, quiet sleep, drowsiness, and wakefulness) in the infants are presented in Table 1. The results of regression analysis indicated a direct, linear correlations between care/monitoring handling procedure and active sleep, quiet sleep, drowsiness, and wakefulness of the preterm infants over 12 hours (8 AM-8 PM). Moreover, supportive handling was correlated with active sleep. It is also noteworthy that wakefulness of the infants increased with fondling and Kangaroo care (Table 1). The linear correlations between various handling procedures and active sleep, quiet sleep, drowsiness, and wakefulness of the infants at 8 AM-8 PM suggested that the amount of sleep increased in infants in supportive handling (Table 2).

## Discussion

Despite applying developmental care protocols in the NICU of the selected hospital (e.g., covering of incubators, controlling light and sounds), presence of the parents (especially mothers), promotion of breastfeeding, and

conducting cluster care, our findings demonstrated that the frequency of handling was high, particularly during 12 hours in daytime. Another study in this regard showed that the frequency of handling was higher in the morning compared to other times of the day (4).

Today, caring styles for preterm infants in the NICU have attracted the attention of researchers. To the best of our knowledge, this was the first study to focus on the correlation of the handling of infants admitted to the NICU and their sleep patterns through the observation of behavioral criteria. During the study, handling procedures were carried out continuously, even when the infants were asleep.

In this regard, a study examined the impact of handling on the sleep of infants within a four-hour period. The results of observational, continuous polysomnography indicated the maximum duration of 50.9 minutes between the handling of each infant, with the median of 2.3 minutes between each contact.

In the present study, handling occurred across all behavioral states (active sleep: 29.5%, quiet sleep: 23.1%, wakefulness: 29.9%, indeterminate sleep: 17.4%). Furthermore, arousals occurred in 57% of the handling procedures in sleeping infants (3). Our findings denoted that the duration of handling in the preterm infants constituted approximately 19% of 24 hours. This is in line with two similar studies conducted within a 24-hour period to assess the effects of handling on the sleep of preterm infants, reporting handling to constitute 20% (4) and 18% (19) of the total

time. According to the present study, excessive handling of vulnerable premature infants may be painful and adversely affecting the neonatal system development (20).

Polysomnography is considered a reliable method for sleep study (16, 21, 22), while EEG has been suggested for the study of sleep conditions since it allows the repeated analysis of the brain (3). However, it has been shown to increase the frequency of handling procedures due to the need for the reposition of the electrodes (4). On the other hand, most nurses are not trained to interpret EEGs and only can observe bio behavioral responses to interpret the changes in physiological and behavioral signs (13). In the present study, we could achieve desirable results as the obtained data indicated that supportive handling increased active and quiet sleep in the preterm infants. In addition, frequent contact with the mother through Kangaroo care was observed to increase wakefulness in the infants. Another notable finding in the current research was that handling with medical care diminished the effect on active sleep, quiet sleep, drowsiness, and wakefulness, while increasing the effect of handling on the wakefulness of the infants.

In the present study, no significant differences were observed in the physiological variables of oxygen saturation and heart rate with the handling procedures and sleep stages of infants. However, our findings indicated that high frequency of handling, especially medical and nursing care, may decrease the amount of sleep in the preterm infants. Evidently, high vulnerability in preterm infants could be attributed to the frequent handling; therefore, preterm infants should be adequately protected, especially at the time of sleep.

Considering that preterm infants may be hospitalized in the NICU for a long time (weeks to months), which coincides with their brain growth and development (22), studies have suggested effective care patterns, including performing classified care in addition to NIDCAP in order to prevent sleep disorders in these infants (23). Based on the results of the present study, it is recommended that handling of preterm infants in NICUs be carried out in the form of minified categorized care, so that the infant would be considered the center of care, and the observant would tune in with the priorities and needs of infants (24, 25).

During the current research, the sounds in the NICU environment had no impact on

the sleep of preterm infants since they were all in double-walled incubators. On the other hand, due to the developmental care in the NICU, all the incubators were covered in order to deflect the light from the infants. No difference was observed in the handling procedures (e.g., feeding against medical procedures). One of the limitations of the present study was that the interactions of NICU nurses and physician answers were not assessed, which requires further investigation.

Findings of the current research indicated that supportive and therapeutic handling could be performed without disturbing the sleep of the preterm infants; however, the momentous nature of care in the NICU might require spontaneous care procedures regardless of the sleep-wake state of the admitted neonates. Therefore, medical care may take precedence over sleep disturbance in the infants in the NICU, which is a common issue in hospitals. In any case, maintaining the sleep cycle of infants is vital to their growth and brain development (26).

Since the infants enrolled in the present study did not have critical health conditions, they did not require extensive handling. Nevertheless, it is recommended that infants in poor health be selected for similar studies, so that the frequency of handling and sleep rate could be assessed accurately, especially within 24 hours and upon NICU admission.

Our findings emphasized on the importance of behavioral observation and attention to sleep of infants. Correspondingly, supportive handling could increase the amount of sleep in the preterm infants admitted to the NICU. Therefore, it is recommended that proper conditions be provided for the families of these neonates, especially the parents, to stay with their infant longer. Sensitivity to the sleep of the infant at the NICU could clarify their behaviors through the observation of whether the infant's eyes are open or closed. Such a simple supervision results in the improvement of care in accordance with the physiological conditions (i.e., sleep-wake state) of hospitalized preterm infants, which in turn will enhance the quality of care in NICUs.

## Conclusion

Despite the limitations associated with the long-term use of polysomnography due to the need for electrode reposition on the preterm infants for accurate data recording; it's very interesting Behavioral observations

in the current research revealed the influence of handling on the sleep duration of premature infants, as well as their active and quiet sleep. Conducting similar studies could raise the awareness on the physiological behaviors and changes associated with the frequent handling of preterm infants in the NICU. Therefore, it is suggested that further investigation be focused on the behavioral signs of preterm infants in order to provide a favorable environment for their sleep-wake cycle and adequate development in the NICU environment.

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### Conflicts of interests

None declared.

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