

Original Article



Comparison of the Effect of Nesting and Swaddling on Sleep Duration and Arousal Frequency among Preterm Neonates: A Randomized Clinical Trial

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Email: vetriselvijipmer1967@gmail.com**Abstract**

Introduction: Sleep contributes a pivotal part in neurological improvement of new borns. New-borns admitted to neonatal intensive care unit (NICU) perceive many sounds of monitors and this disturb their rest period. To enhance the sleep duration of neonates many non-pharmacological methods are available like placing newborn in a nest made with rolled cotton bed sheet and wrapping the baby with white cotton cloth. In this research effect of these two positions were assessed.

Methods: A randomized clinical trial was carried out on 76 preterm neonates in NICU of a tertiary care center. Neonates were included in the study by random method. Sleep duration and frequency of arousal was assessed through direct observation. Physiological parameters were assessed by using cardiac monitor. The information collected were analyzed using SPSS version 21.

Results: Sleep duration of nesting group showed significantly higher than swaddling group, which mean (SD) was 206.4 (28), 183.1 (34.78) minutes, respectively. Additionally, waking up was observed less frequency in the nesting group.

Conclusion: Nesting enhances the duration of sleep among preterm neonates and hence this can be given priority in NICU.

Introduction

Availing rest is an important behavioral state in neonates. In first trimester itself fetus has a routine of rest period. After birth preterm neonates confront with developing circadian rhythm due to several environmental factors. Hence they adapt to multiple cycles of sleep across the day and night.¹ Sleep occurs when there is an active mechanism among the forebrain and the brain stem. Adequate rest among neonates contribute to the cognitive abilities.² On an average preterm infants sleep for 50-70 minutes in one cycle of sleep.³ It is well established that sleep is essential for memory and learning functions.⁴ Sleep enhances cerebrum development and linkage of cerebral segments.⁵⁻⁷ Inadequate rest leads to illness and also cause psychological problems.⁸⁻¹⁰ When neonates were in womb and also after their birth rest periods for them encounter continuous modification.^{11,12} Newborn avail rest many times in a day and it was related to their suckling.¹³ Adequate rest is essential to newborn since it helps in maturation of sight, smell, Hearing, taste and touch. It also aids in maturation of cerebral segments.^{14,15}

Preterm babies shift from intrauterine to extra uterine environment is spiraled up with various stimuli, specially while admitted in neonatal intensive care unit (NICU). Factors such as light, noise from monitors, and light from phototherapy, heel prick procedure, feeding, diaper change and routine nursing care causes sleep deprivation in preterm neonates. Among newborns inadequate rest can lead to cessation of breathing for a while and discomfort.¹⁶ Newborns in health centers faces many disturbances and this interferes with their rest. So comfort of the newborns are essential and it may be provided through methods like kangaroo care, skin to skin contact, massage or gentle touch, sleeping position, lullaby, music, grasping, and nesting.¹⁶ Though many methods are available to increase the sleep duration of neonates in this study swaddling and nesting were chosen because by swaddling it reduces arousal frequency by restricting motor movements and also provides normothermia.¹⁷ In addition to that supine positioning while swaddling has reduced incidence of sudden infant death syndrome. Restriction of limbs was positively associated with

reduction of extensor startle.¹⁸ Nesting provides stability to body posture, keeps head in midline flexed or semi flexed along midline providing a feel of containment as in the womb. It decreases spontaneous movements and enhances sleep. Most common sleep assessment methods are polysomnography, videosomnography, actigraphy and sleep diaries.¹⁹ Rest period of newborns are assessed by watching them.²⁰ Placing newborn in a nest made up of white cloth facilitates womb position.²¹ Newborns who are wrapped with white cotton cloth also experienced more rest period.²² Only few researches were done to assess the sleep duration of newborns. Franco et al and Gerard et al conducted a research to assess the impact of wrapping the newborn with cotton sheet on length of rest period.^{23,24} No separate research was done to assess the role of nesting on length of rest period. Only Abdeyazdan et al did a study to identify the impact of placing newborn on a nest and wrapping with cotton sheet on length of rest period among neonates but the research design used was crossover trial.²⁵ So the researcher aimed to conduct a parallel randomized clinical trial to collate impact of placing baby on a nest made with cotton cloth and wrapping baby with white cotton cloth on length of rest period among preterm neonates and to utilize the best method in clinical practice. Moreover Meyer and Erler though conducted a similar study the participants were only low birth weight babies.²⁶

Materials and Methods

This is a randomized clinical trial carried out from December 2020 to June 2021 in a tertiary care center. Having obtained written consent from parents and permission from Ethics Committee with the code number of JIP/CON/IEC/M.SC/2019/PN/1 and having registered the study in Clinical Trial Registry India (CTRI) with the code number CTRI/2020/12/029640 the study was conducted in NICU.

Study inclusion criteria were preterm neonates with gestational age of 31-34 weeks admitted in NICU with age from 1 to 28 days with feeding pattern of every two hours and not treated with sedation. The total time of a complete sleep cycle at 27-30 weeks of gestational age is about 40 minutes whereas at 31-34 weeks is about 50-70 minutes. To have homogeneity in the sample neonates with gestational age of 31-34 weeks were included in the study. Preterm neonates who had congenital defects, abnormal neurological findings, those who were on Kangaroo mother care, on phototherapy and those who needed any medical procedure and instability in the physiological status were excluded from the study. The sample size was estimated with an alpha error of 0.05 and power of 0.9 and non-inferiority limit of 15 minutes, 38 preterm neonates were enrolled in each group for a total of 76. Epi Info program was used to estimate the sample size.

Block randomization with varying block size generated through the computer was used to randomize the

participants into study groups. Allocation concealment was done by using sealed opaque and serially numbered envelopes. Everyday preterm neonates who met the inclusion criteria were selected through simple random sampling method. Informed consent was obtained from parents of both groups.

Data collection instrument had three sections. The first section included data regarding clinical and demographic characteristics of preterm neonates. It comprised of gender, gestational age and birth weight. In second section sleep assessment proforma was used to collect the data regarding starting time of sleep, ending time of sleep, number of arousal and total sleep duration in minutes. Third section assessed the physiological parameters. It comprised of pulse rate, respiratory rate, oxygen saturation and temperature. The content validity of the three sections of the tool was obtained from the experts of neonatology and nursing filed. Reliability was established by comparing the ratings of two observers and agreement in their measurements. Providing individualized developmental care like nesting or swaddling to the neonates promotes not only the sleep but also stabilizes physiological parameters. So in this study along with sleep duration physiological criterion were also measured.

In swaddling the neonate white cotton cloth was used. The cotton cloth was spread out and folded one corner down. The neonate was laid in supine position with their head at the edge of the folded corner. Pick up the left corner of the cloth and bring it across neonate body and tuck under right side of the body. Now pick up the right corner of the cloth and bring it across the body and tuck under left side of the baby. The bottom corner of the cloth was tucked under chin. In nesting neonates were positioned in supine position in a nest which was made with rolled up cotton bed sheet in order to provide support all around the neonate head, body, back, limbs and feet. Then the neonates were connected to cardiac monitor through electrodes to measure their heart rate, respiratory rate and oxygen saturation. Digital thermometer was used to check their axillary temperature.

As the feeding intervals were routinely every two hours in NICU and the sleep cycle of neonates of gestational age 31-34 weeks is 50-70 minutes the sleep duration and physiological parameters were evaluated at two sleep cycles. In nesting group the preterm neonates were fed and laid in a nest made of cotton bed sheet and to measure physiological parameters neonates were connected to cardiac monitor through electrodes that was stucked to either side of the chest and one on lower abdomen. These electrodes were attached by wires and detect activity of the heart, lung and transmit it to the monitor and by this heart rate, respiratory rate and oxygen saturation were monitored and recorded. For each neonate separate digital thermometer was used to check the axillary temperature. Sleep duration, frequency of arousal, and physiological parameters were monitored

for next two hours. Similarly in swaddling group preterm neonates were fed and swaddled with a cotton cloth and sleep duration, frequency of arousal and physiological parameters were monitored for next two hours. In both groups it was done twice a day. Figure 1 shows flowchart of the study.

Both descriptive and inferential statistics were used to analyze the data. Descriptive statistics (frequency, percentage, mean, standard deviation) was used to describe the demographic and clinical variables. Student *t* test was used to compare the sleep duration and physiological parameters between the groups. Mann-Whitney U test was used to compare the frequency of arousal between the groups. Data analysis was done with SPSS 21st version (SPSS Inc., Chicago, Ill., USA).

Results

In nesting group majority were male whereas in swaddling group most of them were female. The Median gestational age in nesting and swaddling group were 33 and 32 weeks respectively. Mean (SD) birth weight was 1.5 (0.38) in nesting group and 1.48 (0.24) in swaddling group (Table 1).

Neonates who were nested surpassed neonates who were swaddled in sleep duration (Table 2).

Comparison of physiological parameters between the groups showed that significant difference were noted in oxygen saturation at 90 minutes in session I and 90 minutes & 120 minutes in session II (Table 3).

Discussion

This randomized clinical trial included 76 preterm neonates with 38 neonates in each group. Current study reported that mean (SD) sleep duration in swaddled group was 183.1 (34.78). A research by Franco et al among swaddled and non-swaddled newborns revealed that swaddled infants had 97.8% sleep efficiency compared

to 93.3% in non-swaddled group.²³ Similarly Gerard et al reported that newborns those who were swaddled had significant increase in length of rest period.²⁴ In consistent with this Yilmaz et al conducted a prospective study at University hospital Turkey and reported that frequent cause for swaddling among Turkish mothers were due to its benefits about sleeping.²⁷ Similarly van Sleuwen et al revealed that swaddled infants had longer sleep duration and lesser arousal.²² In consistent with above results Koçak and Akarsu study also showed that 69.9% of the mothers who swaddled their babies stated that the babies slept well.²⁸ Other studies reported that newborns those who were wrapped in a cotton cloth had rest without any arousal.^{26,29,30} Lipton et al did a case control study and revealed that swaddling increases sleep duration.³¹ Consistent with this result Çağlayan et al also reported that swaddling increases total daytime sleep and less arousal.³²

In current study in nesting group the mean (SD) sleep duration was 206.4 (28). Similarly Ferrari et al conducted a study in University hospital, Modena in Italy and reported that nesting position improved the quality of sleep of neonates.¹⁸ The present study reported that newborns who were placed in nesting showed longer sleep duration. In contrast to this Abdeyazdan et al prospective clinical trial reported that mean (SD) value of total sleep time in swaddling group was higher than nesting group [96.7 (21.1) and 90.2 (18.2) respectively] and it was not significant.²⁵

In current study heart rate in nesting group was lower than swaddling group. In consistent with this study a quasi-experimental study conducted by Maher and Elaroust in Alexandria among 60 low birth with neonates also revealed that neonates mean (SD) heart rate in nesting group 143.40 (14.95) was lower than control group 157.57 (15.88) and it was significant.³³ In the same way Alice Jeba et al also revealed that newborns those who were nested had reduced heart rate and respiratory rate. Regarding oxygenation there were no significant

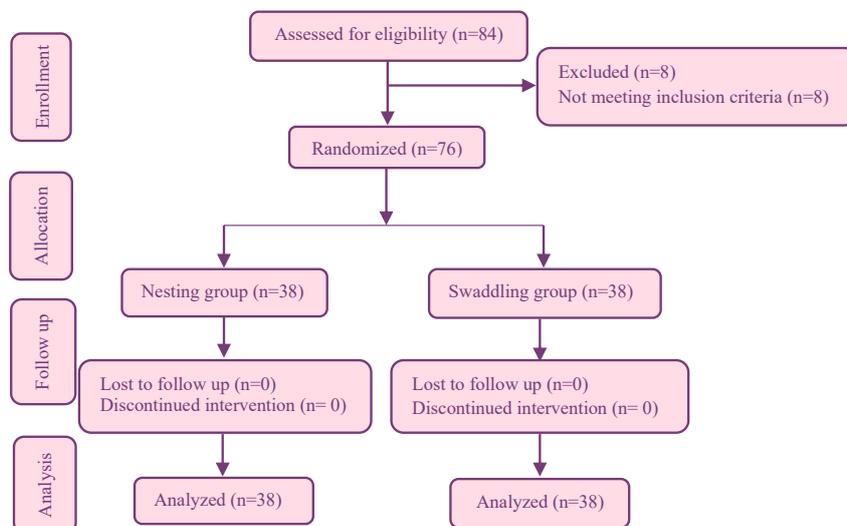


Figure 1. CONSORT flow diagram

Table 1. Data of preterm neonates (N = 76)

| Variables | Frequency (%) | |
|------------------------------|------------------|--------------------|
| | Nesting (n = 38) | Swaddling (n = 38) |
| Gender | | |
| Male | 23 (53.5) | 20 (46.5) |
| Female | 15 (45.5) | 18 (54.5) |
| Gestational age ^a | 33 (31-34) | 32 (31-34) |
| Birth Weight ^b | 1.5 (0.38) | 1.48 (0.24) |

^a Median; ^b Mean (SD).**Table 2.** Comparison of sleep duration and arousal among pre-term neonates in both groups (n = 76)

| Variable | Nesting (n = 38) | Swaddling (n = 38) | P value |
|--|------------------|--------------------|--------------------|
| Sleep duration in minutes ^a | 206.4(28) | 183.1(34.78) | 0.002 [*] |
| Frequency of arousal ^b | 2 (0-8) | 3 (0-6) | 0.005 [*] |

^a Student t test; ^b Mann-Whitney U test; ^{*}Statistically significant.

difference.³⁴ In consistent with above results Poulouse et al done a study among 60 low birth weight infants and reported that infants those who were nested showed stable heart rate and respiratory rate.³⁵ Similarly research by Franco et al showed reduced heart rate in newborns those who were not intervened.²³ Contradicting this Gerard et al, Giacomani, and Lipton et al revealed decrease in heart rate in swaddled group.^{24,30,31} In current study in swaddling group temperature of the preterm neonates were higher than nesting group. Similarly Short revealed that temperature rose 0.2°C higher during swaddling.¹⁷ Similarly Yilmaz et al revealed that swaddling allowed finer heart control among neonates.²⁷ Similarly a randomized controlled trial conducted by Tsogt et al revealed that there was no distinction.³⁶ In compatible with this Franco et al also revealed no difference.²³

Current study showed that in swaddling group oxygen saturation was higher than nesting group. Franco concluded that there was no distinction.²³ In Narangerel et al research also there was no significant clinical effect on SPO₂.³⁷ In addition to the above result Giacomani³⁰ and Gerard et al²⁴ studies also reported similar results.

In this study in swaddling group respiratory rate was lower than nesting group. Narangerel et al also reported similar results.³⁷ In contrary to this Franco et al reported no distinction.²³ In addition to this Gerard et al and Richardson et al supported the above results.^{24,29}

Sunita et al reported that nested low birth weight babies showed less discomfort level compared to non-nested babies [mean (SD) of 0.67(0.84) and 4.27(0.83), respectively].³⁸ Wiley et al reported that appropriate positioning in preterm infants enhances neurological and musculoskeletal development and reduces stress.³⁹

Since the study was done in one hospital the results were not able to establish.

Nurses working in NICU play a major role in comforting preterm neonates. Nesting is one of the comforting

Table 3. Comparison of effect of nesting and swaddling on physiological parameter among preterm neonates (n = 76)

| Variables | Mean (SD) | | P value ^a |
|-------------------------------|-------------------|--------------------|----------------------|
| | Nesting (n = 38) | Swaddling (n = 38) | |
| Heart rate | | | |
| 1 st Session | | | |
| 30 minutes | 150.97 (16.05) | 152.72 (14.92) | 0.62 |
| 60 minutes | 152.24 (15.52) | 153.69 (14.97) | 0.62 |
| 90 minutes | 152.55 (15.40) | 153.42 (15.73) | 0.81 |
| 120 minutes | 151.97 (15.57) | 152.65 (15.8) | 0.85 |
| 2 nd Session | | | |
| 30 minutes | 152.39 (15.53) | 152.86 (14.28) | 0.89 |
| 60 minutes | 152.11 (15.60) | 152.53 (14.55) | 0.90 |
| 90 minutes | 151.66 (16.05) | 151.56 (14.31) | 0.97 |
| 120 minutes | 152.26 (16.58) | 151.24 (14.79) | 0.78 |
| Respiratory rate | | | |
| 1 st Session | | | |
| 30 minutes | 39 (4.90) | 38.25 (4.87) | 0.51 |
| 60 minutes | 38 (32.52) | 38 (32.48) | 0.42 |
| 90 minutes | 39.87 (4.15) | 39.53 (4.28) | 0.72 |
| 120 minutes | 39.45 (4.82) | 39.97 (4.25) | 0.61 |
| 2 nd Session | | | |
| 30 minutes | 39.82 (4.66) | 39.54 (4.34) | 0.79 |
| 60 minutes | 38.5 (32.52) | 38.5 (32.50) | 0.83 |
| 90 minutes | 39.55 (4.67) | 39.44 (4.62) | 0.91 |
| 120 minutes | 39.71 (4.54) | 39.06 (4.85) | 0.58 |
| SpO ₂ ^b | | | |
| 1 st Session | | | |
| 30 minutes | 99 (93-100) | 99 (96-100) | 0.08 |
| 60 minutes | 99 (94-100) | 99 (96-100) | 0.20 |
| 90 minutes | 99 (92-100) | 99 (96-100) | 0.02 [*] |
| 120 minutes | 99 (93-100) | 99 (96-100) | 0.28 |
| 2 nd Session | | | |
| 30 minutes | 99 (94-100) | 99 (96-100) | 0.32 |
| 60 minutes | 99 (92-100) | 99 (96-100) | 0.42 |
| 90 minutes | 98.50 (93-100) | 99 (96-100) | 0.03 [*] |
| 120 minutes | 98.50 (94-100) | 99 (96-100) | 0.01 [*] |
| Temperature ^b | | | |
| 1 st Session | | | |
| 30 minutes | 97.75 (95.3-98.6) | 97.8 (96.4-98.2) | 0.77 |
| 60 minutes | 97.7 (95.3- 98.6) | 97.75 (96.4-98.2) | 0.70 |
| 90 minutes | 97.7 (95.3-98.6) | 97.8 (96.4-98.2) | 0.57 |
| 120 minutes | 97.8 (95.3-98.6) | 97.8 (96.4-98.2) | 0.75 |
| 2 nd Session | | | |
| 30 minutes | 97.8 (95.3- 98.6) | 97.8 (96.2-98.2) | 0.87 |
| 60 minutes | 97.8 (95.3-98.6) | 97.8 (96.4-98.4) | 0.76 |
| 90 minutes | 97.8 (95.3-98.6) | 97.8 (96.4-98.4) | 0.41 |
| 120 minutes | 97.8 (95.3- 98.6) | 97.8 (96.40-98.40) | 0.80 |

^a Student t test; ^bMean (95% confidence interval) was reported; ^{*}Statistically significant.

Research Highlights

What is the current knowledge?

- Both nesting and swaddling plays a major role in promoting sleep among preterm neonates.

What is new here?

- Compared to swaddling position, nesting position improved sleep duration and reduced frequency of arousal and stabilized vital signs.

measure that can be utilized by them to enhance the sleep duration among preterm neonates.

Conclusion

Newborns who were nested showed improvement in their sleep duration and reduction in number of wake-ups. Providing a nesting position is an inexpensive, effective and safe method and it can be widely used in all NICU's and also in resource poor settings to enhance sleep duration among neonates.

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Authors' Contributions

AJV, VP: Conception and design, analysis and interpretation of the data, drafting of the article, data collection, final approval of the article; VP: Critical revision of the article for important intellectual content.

Conflict of Interests

None declared.

Data Accessibility

The datasets are available from the corresponding author on reasonable request.

Ethical Issues

This study was approved by the Ethics Committee of JIPMER with the code number of JIP/CON/IEC/M.SC/2019/PN/1 and registered in Clinical Trial Registry India (CTRI) with the code number CTRI/2020/12/029640.

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