Original Article

# Comparison of Massage and Prone Position on Heart Rate and Blood Oxygen Saturation Level in Preterm Neonates Hospitalized in Neonatal Intensive Care Unit: A Randomized Controlled Trial

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## Abstract

**Background:** These days, most of the admitted infants in neonatal intensive care units (NICU) are premature infants. Infant massage and prone position has been recommended for several decades to have a positive effect on preterm and low birth weight infants. The objective of this study was to determine the effects of neonatal massage with prone positioning in preterm infants on Heart Rate (HR), and Oxygen Saturation ($O_2Sa$) status. **Materials and Methods:** This is a controlled randomized three-group clinical trial study conducted on hospitalized infants in selected hospitals of Alborz University of Medical Sciences in Karaj-Iran. There are about 75 preterm infants (33-37 weeks) who met inclusion criteria were randomly assigned to groups of position, massage as intervention groups, and a control group. Intervention (prone position and massage) was administrated for five straight days. The repeated measure ANOVA test was performed to evaluate and compare the effect of interventions. $p$ value less than 0.05 was considered as statistical significance. **Results:** The Repeated Measure two-way Analysis of Variance (RM-ANOVA) result showed a significant difference in HR and $SaO_2$ in different time points among control, position and massage groups with RM-ANOVA ($F_{10,360} = 10.376$, $p < 0.001$). HR values was reduced and $SaO_2$ values was increased in intervention groups with RM-ANOVA ($F_{5,360} = 2.323$, $p < 0.001$). **Conclusions:** Results showed that massage and prone position equally led to the reduction of HR and increase of $SaO_2$, compared to control group.

**Keywords:** *Heart rate, intensive care units, massage, neonatal, oxygen, preterm infants, prone position*

## Introduction

High prevalence of preterm infants' birth is counted as a serious problem in health system in recent decades. From 1980, this trend reached 12.3% in US so that there is one preterm birth out of 8 births (an annual rate of 500 cases).[1] According to statistics, this rate is 12% in Iran (i.e. one out of 10).[2] As most of the admitted infants in Neonatal Intensive Care Units (NICU) are premature infants, problems of high risk infants are mostly associated with these infants.[3] Premature infants often have poor muscular tonicity and their neck, thoracic area and most of their limbs are in extension position influencing the development of their neuro-psychomotor skills.[4] Therefore, they are exposed to some disorders such as cerebral palsy, delayed learning and psychomotor problems.[1,5]

Each position has its own advantages and disadvantages that should be identified by nurses. Therefore, each infant is better to be assessed individually and receive appropriate position according to its personal condition and behavioral reactions.[6] Until before 1990, almost all infants were laid in prone position in US. In 1996, American Pediatrics Association suggested supine position as the best position and tried to prevail that in public.[7-9] Candia *et al*. (2014) published an article on the influence of prone positioning on premature newborn infants' stress, assessed by means of salivary cortisol measurement. They reported that prone position significantly reduced stress level.[10]

Among other methods that can reduce the stress level and improve cardiopulmonary function is massage, and refers to regular movements on skin to stimulate the infants. In fact, massage is a kind of methodological touch to stimulate the infant. Numerous studies have reported its positive effects.[11]



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Massaging the infant can help reduction of the imposed stress and affect preterm and low weight infants' growth and development.[12] Gray *et al*., in a study on blood sampling from infants' heel, reported that the infants undergoing massage for 15 minute prior to sampling cried less and had a milder increase in their Heart Rate (HR), compared to control.[13] Massaging infants reduces stress level through lowering the cortisol and nor epinephrine serum levels.[14,15] Massage can be conducted by a professional massager or the mother. In fact, advantages of massage include circulation and digestive system stimulation, better weight gain, positive effect on neurologic growth, a better infant –parent's relationship, improvements and reduction of stress behavior, earlier discharge from NICU, skin integrity increase, and better sleep. Massage therapy is known as a beneficial method with no hazards.[11,16] Previous studies suggest various positions for the infants although prone position should be administrated just in hospital and under supervision of a nurse. All studies also indicate that massage is a method to improve vital signs, weight gaining, infants' feeding and reduce stress pressure and has positive effect on neurological growth.[17-19] It seems that these methods can be applicable among the preterm neonates to improve their comfort and health. Both of them are easy and cost effective for health care workers. Following as above studies, No study has compared these two palliative methods with each other. Therefore, the present study aimed to show the effect of two massage methods and laying the infants in prone position on HR reduction and oxygen saturation ($SaO_2$). In case of being effective, it can be used as a simple and available method to promote preterm infants' health.

## Materials and Methods

This is a controlled randomized three-group clinical trial registered in Iranian Clinical Trial Center (IRCT20130202012346N2). Subjects were 75 infants, hospitalized in NICUs of Shahid Bahonar and Kamali hospitals in Karaj, Iran from July – Sep 2016 [Consort Diagram Figure 1]. Groups included: (a) prone position, (b) massage therapy, and (c) control with no intervention. Subjects were selected through simple sampling, random allocation (lotto card with no replacement) to prevent bias.

Based on sample size formula with confidence of 95% (1.96), power of 0.80 and d = 0.80 SD. The number of subjects was calculated as 21 in each group, which with regard to 20% of attrition, was finalized as 25. Infants were randomly assigned to each group (total of three groups), through random computation. Inclusion criteria were conscious infants, 34-37 weeks of gestational age, weight over 1500 gram, being breast fed, the need for at least one week hospitalization, primary diagnosis of respiratory distress, being dependent to $O_2$ with Oxihood (after winning $O_2$, the $SaO_2$ drop under 85%), no involvement in congenital cardiac diseases and their respiratory complications, no active hemorrhage, least level of $SaO_2$ of 89%, no contraindications for touch, no

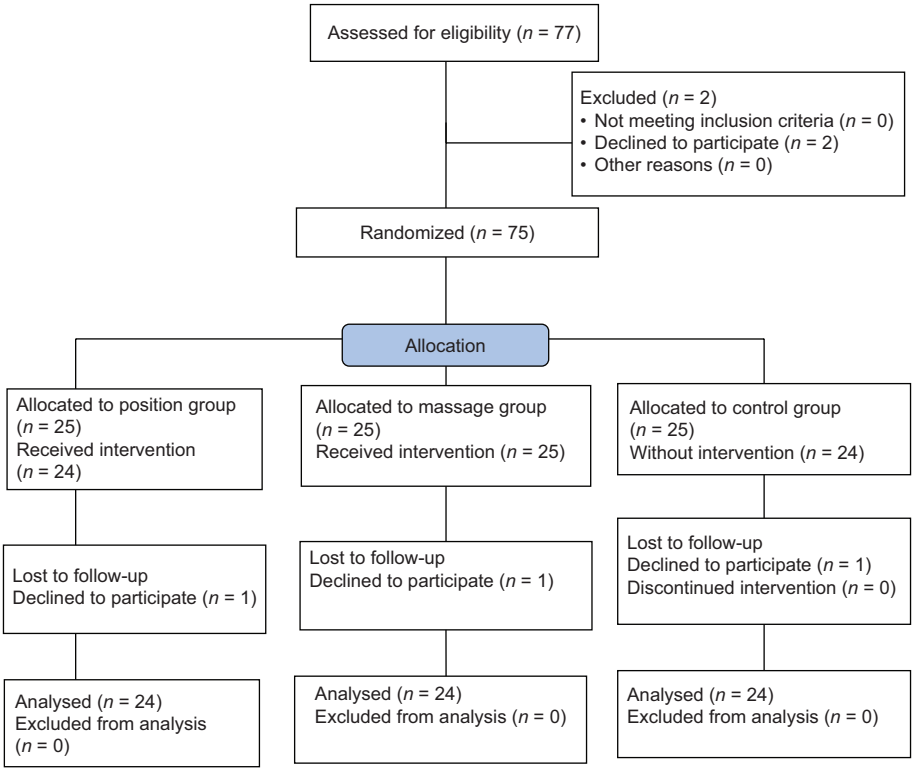


**Figure 1: Flow chart of the study**

dermal complications, no mothers' addiction to cigarette and alcohol, no paralysis in the limbs, no congenital major abnormalities and asphyxia.

Exclusion criteria were infants' unstable body temperature, blood and blood products transfusion, an indication for re-intubation, involving in pneumothorax or chest tube, and mother's lack of cooperation or their exaggerated anxiety and infants' apnea during procedure stopping intervention.

To conduct intervention, after explanation of research goals to the head nurses, she conducted the intervention. The co-researcher (Master of nursing), together with the researcher were selected and trained to cooperate and complete demographic and other data. Researcher was also trained concerning superfacial Strocking method according to massage method based on Tiffany field and had adequate skills in this regard. A total of 25 notes were considered for each group (total = 75) with the number and title of each group on them (a-prone position, b- massage, c-control with no intervention). Then, the notes were folded, mixed and put in an envelope. Next, a note was randomly drawn out for each qualified infant so that the subjects were randomly assigned to three groups. Data collection tools were demographic characteristics questionnaire including personal information, and recorded weight and hieght and plasoximetery data. After detection and selection of the qualified subjects (infants over 34 weeks and near term), with preior coordination, their parents were explained about research goals, and their written consents and trust were attained. Finally, their infants were entered in the study.

If the infant would be assigned to the first group, it would be laid in prone position for one hour. During this time, its heart rate and oxygen saturation changes were recorded by a pulse oximetry device every 15 minutes. In massage group, the infant was massaged through of stroking method for 10-15 minutes. It was conducted by superficial stroking method with use of Tiffany field conventional technique. Infants underwent massage for 15 min so that in the first 5 min, the infant was laid in prone position and massaged by fingers from head to toe through superficial stroking method. In the second 5 min, the infant was laid in supine position and underwent arms and legs extension and flexion. In the last 5 min, the infant was laid in prone position again and underwent massage. Then, it underwent pulse oximetry in no specific position for one hour. In control group, the infant underwent pulse oximetry for one hour with no intervention. It should be noted that during one hour, infants' vital signs were recorded each15 min. Each infant underwent intervention for 5 straight days during which its HR and $SaO_2$ were recorded as baseline, and then received intervention. This was a blind study. Therefore, all stages were recorded by a handy camera so that each recording was coded based on the group the infant was in and was reviewed and scored by a person who was blind to the grouping of the subjects in study. He had no idea to which group belonged the infant he was watching (film and questionnaire codes were consistent), and scoring was conducted just based on the codes to prevent bias. The flow diagram of the study is provided in Figure 1. The collected data were analyzed using descriptive (mean and standard deviation, and frequency distribution), and inferential statistics (Chi-square, Repeated Measurement Two way ANOVA) using Statistical Package for the Social Sciences software (version 16, SPSS Inc., Chicago, IL, USA). For normality assumption we used one sample Kolmogorov-Smirnov test to assess whether the variables are normal or not. Then, if the variables were normal, parametric tests were used, otherwise, non-parametric test were used.

### Ethical consideration

To conduct the research, researcher referred to NICUs after attaining a written consent and an introduction letter from Alborz Nursing and Midwifery school and vice-chancellery for research of the relevant university. After explanation of research goals to the head nurses, she and her co-researcher conducted the research for collecting data. It was also approved in ethics committee of Alborz University of Medical Sciences (Abzums.Rec. 1396.47).

## Results

Results showed that 46.70% of the subjects were male. The lowest age was 33 weeks and the highest was 37 weeks. The mean and standard deviation of age and weight was 34.75 (0.94) weeks and 2206.62 (395.71) gram respectively.

The results showed $SaO_2$ changed over time ($p = 0.02$) and there was significant difference between groups ($p < 0.001$) [Table 1]. Bonferroni *post hoc* test showed a significant difference among control with position and massage groups. Also HR changed over time ($p = 0.02$) and there is significant difference between groups ($p < 0.001$) [Table 2].

## Discussion

Results showed a significant difference in HR scores from the first day to the fifth in different time points. HR

**Table 1: Changes in $SaO_2$ from first to fifth day in 3 groups and comparison of them**

| Study Group | Time | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Base line Mean (SD) | First day Mean (SD) | Second day Mean (SD) | Third day Mean (SD) | Forth day Mean (SD) | Fifth day Mean (SD) | Two-way repeated measure ANOVA | |
| | | | | | | | Within group | Between group |
| Position | 90.24, (0.95) | 94.08, (1.36) | 94.28, (1.41) | 94.61, (1.07) | 94.80, (1.41) | 95.26, (1.46) | $F$=2.32, $p$=0.020 | $F$=10.18, $p$<0.001 |
| Massage | 90.02, (1.96) | 93.26, (1.46) | 93.73, (1.66) | 93.57, (1.66) | 93.88, (2.01) | 94.09, (1.94) | | |
| Control | 90.43, (1.34) | 90.27, (1.12) | 90.63, (1.19) | 90.21, (0.91) | 90.70, (1.41) | 90.47, (0.94) | | |

**Table 2: Changes in HR from first to fifth day in 3 groups and comparison of them**

| Study Group | Time | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Base line Mean (SD) | First day Mean (SD) | Second day Mean (SD) | Third day Mean (SD) | Forth day Mean (SD) | Fifth day Mean (SD) | Two-way repeated measure ANOVA | |
| | | | | | | | Within group | Between group |
| Position | 150.01, (6.34) | 141.54, (6.28) | 140.29, (6.04) | 139.69, (5.77) | 139.31, (5.33) | 138.78, (5.42) | $F$=2.32, $p$=0.020 | $F$=10.18, $p$<0.001 |
| Massage | 151.55, (6.87) | 142.94, (6.42) | 141.56, (5.10) | 140.8, (5.74) | 139.96, (5.84) | 139.24, (5.92) | | |
| Control | 150.34, (8.08) | 151.69, (5.89) | 153.16, (7.05) | 151.8, (5.76) | 152.71, (6.88) | 152.36, (6.03) | | |

also showed a significant difference in various groups. The more days pass from the intervention day, the fewer the HR and the more relaxed the infant is. The results of $SaO_2$ were also similar. Results showed that massage and prone position both equally reduce HR and increase $SaO_2$. Smith studied the effect of massage on vagal response and reported similar results.[16] Although, male infants' HR changes in control group showed a decrease, compared to male infants in massage group, there was no change in female infants' HR. Diego *et al*. suggested a theory that moderate pressure of massage stimulates vagal activity and reduces stress.[20] Also, Kulkarni in a review article suggested that preterm infants receiving massage therapy scored better on the Brazelton Behavior Assessment Scale in terms of 'orientation', 'range of state', 'regulation of state,' and 'autonomic stability'. Improved scores on motor, and range of state behavior were observed.[21] Meanwhile, Yates *et al*. (2014) observed no change in infants' HR during massage and 30 min after.[22] The controversial results may be due to the adopted technique of massage as we conducted five-day Tiffany Field, while Yates *et al*., adopted only one-day massage for each infant, maybe causing the difference in results.

With regard to prone position and HR changes, there are various ideas. Ghorbani *et al*. reported a significant difference in HR after infants' position changes from prone, compared to supine, in both prone and supine position groups.[23] Our results showed that prone position leads to a reduction in HR although some studies reported that it results in higher HR. Ammari *et al*. (2009) argued that prone position leads to infants' higher basal temperature and results in peripheral vasodilatation that ends to an increase in cardiac output, and consequently, higher HR.[24]

Steve, Porter, Grana and Johnston reported that prone position increases infants' HR.[25-28] although, Ammaria focused on body temperature and vascular changes but ignored metabolism. On the contrary, Ma *et al*. (2015) stated that prone position reduced cardiac output.[7] It is notable that studies on prone position and its effects on infants' HR during sleep reported controversial results. For instance, Ammaria and Yiallourou reported a mild increase in HR in prone position in preterm infants.[29] However, Ma *et al*. reported no significant changes in term infants' HR.[7] Anyhow, the controversy in HR changes necessitates further research.

Results showed a significant difference in $SaO_2$ in different groups so that it was more in massage and position groups, compared to control, while the difference between massage and position groups was not significant. Alinejad (2014), in a literature review, reported that prone position leads to better lungs ventilation and capacity so that the surface the infant is on acts as a brace and improves poor respiratory chest muscles.[30] This position also blocks the movement of other limbs that may impair respiration. Oishi *et al*. (2002), in a control trial study, indicated the advantages of prone position including better lungs function and improving $O_2$ saturation and recommended that.[31] Ghorbani also clearly stated that the infants with prone position significantly had a higher $SaO_2$, compared to supine position. All aforementioned results are in line with our results. On the other hand, Ammari *et al*. reported that the increase of body temperature in prone position leads to hyperventilation and enhances the respiration rate that consequently results in lower $CO_2$ in infants' blood. Meanwhile, she reported no specific idea about changes of $SaO_2$.[24]

Yates reported no notable results concerning $SaO_2$ during massage and 30 min after[22] that as already mentioned, was associated with their use of one-day technique and not the Tiffany five-day one, resulting in controversial results. In summary, we found a significant decrease in HR and increase in $SaO_2$ in neonates placed in prone position and in massage group. These changes returned to baseline after placing the subjects back-to-supine position, or after finished the massage effectiveness. We showed two natural, useful and free interventions for caring of hospitalized neonates that do not need any special facility, these methods are suggested that used by care givers in order to increase the complications of premature infant's hospitalization. Although, both methods of massage and prone position equally improve respiratory function and relief HR, further research is needed with larger sample to investigate the effect of position on infants' HR changes.

One of our research restrictions was difficulty in satisfaction of parents to participant, because data collection and sampling methods became stop if they didn't participated.

## Conclusion

This study demonstrated that massage and prone position equally led to the reduction of HR and increase of $SaO_2$, compared to control. More research is needed to better define what type of positioning or interventions is most developmentally beneficial for preterm infants in the NICU across hospitalization.

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## Conflicts of interest

Nothing to declare.

## References

1. Rangey PS, Sheth M. Comparative effect of massage therapy versus kangaroo mother care on body weight and length of hospital stay in low birth weight preterm infants. Int J Pediatr 2014;2014:434060. doi: 10.1155/2014/434060.
2. Yousefi J, Mirzade M, Tavasoli Askari N. To study the prevalence of LBW and to determine the ratio preterm to IUGR during one year in 22 Bahman Hospital in Mashhad. J Med Sci 2015:5:1-6.
3. Pourashoori Z, Mirnia K, Ghorbani F, Safaiyan A, Nematzadeh MA, Arshadi Bostanabad M. Effect of blood sampling site on the changes in the physiological indices of preterm infants: A crossover clinical trial. Iran J Neonatol 2018;9:42-8.
4. Madlinger-Lewis L, Reynolds L, Zarem C, Crapnell T, Inder T, Pineda R. The effects of alternative positioning on preterm infants in the neonatal intensive care unit: A randomized clinical trial. Res Dev Disabil 2014;35:490-7.
5. Aarnoudse-Moens CS, Weisglas-Kuperus N, van Goudoever JB, Oosterlaan J. Meta-analysis of neurobehavioral outcomes in very preterm and/or very low birth weight children. Pediatrics 2009;124:717-28.
6. Juntaruksa P. Effects of individualized environmental modification program on neurobehavioral organizations of the very low birth weight infants (Doctoral dissertation, Chulalongkorn University); 2009.
7. Ma M, Noori S, Maarek JM, Holschneider DP, Rubinstein EH, Seri I. Prone positioning decreases cardiac output and increases systemic vascular resistance in neonates. J Perinatol 2015;35:424.
8. Sarkhy A, Thomson M. Feeding changes and positioning therapy for infants. In Esophageal and Gastric Disorders in Infancy and Childhood. Berlin, Heidelberg: Springer; 2017. p. 957-61.
9. Rajaram R, Vizhi DM, Kumar VPRS. Effects of early neonatalmassage with therapeutic positioning in preterm and low birth weight babies on neurobehavioral and neurodevelopmental status. Int J Pharm Bio Sei 2017;8:440-6.
10. Cândia MF, Osaku EF, Leite MA, Toccolini B, Costa NL, Teixeira SN, *et al*. Influence of prone positioning on premature newborn infant stress assessed by means of salivary cortisol measurement: Pilot study. Rev Bras Ter Intensiva 2014;26:169-75.
11. Álvarez MJ, Fernández D, Gómez-Salgado J, Rodríguez-González D, Rosón M, Lapeña S. The effects of massage therapy in hospitalized preterm neonates: A systematic review. Int J Nurs Stud 2017;69:119-36.
12. Hymel GM, Rich GJ. Health psychology as a context for massage therapy: A conceptual model with CAM as mediator. J Bodyw Mov Ther 2014;18:174-82.
13. Gray L, Watt L, Blass EM. Skin-to-skin contact is analgesic in healthy newborns. Pediatrics 2000;105:e14.
14. Wolever RQ, Caldwell KL, McKernan LC, Hillinger MG. Integrative medicine strategies for changing health behaviors: Support for primary care. Primary Care 2017;44:229-45.
15. Comerford KC, editor. Nursing 2015 Drug Handbook. Lippincott Willi & Wilkins; 2014.
16. Smith SL, Haley S, Slater H, Moyer-Mileur LJ. Heart rate variability during caregiving and sleep after massage therapy in preterm infants. Early Hum Dev 2013;89:525-9.
17. Eichenwald EC, Hansen AR, Martin CR, Stark AR, editors. Cloherty and Stark's Manual of Neonatal Care. 8th ed. Philadelphia, PA: Wolters Kluwer; 2016. p. 630-40.
18. Zargham-Boroujeni A, Elsagh A, Mohammadizadeh M. The effects of massage and breastfeeding on response to venipuncture pain among hospitalized neonates. Iran J Nurs Midwifery Res 2017;22:308.
19. Oren-Amit A, Berkovitch M, Bahat H, Goldman M, Kozer E, Ziv-Baran T, *et al*. Complementary and alternative medicine among hospitalized pediatric patients. Complement Ther Med 2017;31:49-52.
20. Field T. Preterm newborn pain research review. Infant Behav Dev 2017;49:141-50.
21. Kulkarni A, Kaushik JS, Gupta P, Sharma H, Agrawal RK. Massage and touch therapy in neonates: The current evidence. Indpediatr 2010;47:771-6.
22. Yates CC, Mitchell AJ, Booth MY, Williams DK, Lowe LM, Hall RW. The effects of massage therapy to induce sleep in infants born preterm. Pediatr Phys Ther 2014 winter; 26:405-10.
23. Ghorbani F, Asadollahi M, Valizadeh S. Comparison the effect of sleep positioning on cardiorespiratory rate in noninvasive ventilated premature infants. Nurs Midwifery Stud 2013;2:182.24.
24. Ammari A, Schulze KF, Ohira-Kist K, Kashyap S, Fifer WP, Myers MM, *et al*. Effects of body position on thermal, cardiorespiratory and metabolic activity in low birth weight infants. Early Hum Dev 2009;85:497-501.
25. Desai SA, Nanavati RN, Jasani BB, Kabra N. Comparison of neonatal pain, agitation, and sedation scale with premature infant pain profile for the assessment of acute prolonged pain in neonates on assisted ventilation: A prospective observational study. Indian J Palliat Care 2017;23:287.
26. Bellieni CV, Buonocore G. Sensorial Saturation and the 3Ts rule. In: Neonatal Pain. Springer; 2017. p. 141-6.
27. Chimello JT, Gaspardo CM, Cugler TS, Martinez FE, Linhares MB. Pain reactivity and recovery in preterm neonates: Latency, magnitude, and duration of behavioral responses. Early Hum Dev 2009;85:313-8.
28. Gardner SL, Carter BS, Enzman-Hines MI, Hernandez JA. Merenstein & Gardner's handbook of neonatal intensive care. 8th ed. United States: St. Louis, Missouri: Elsevier; 2015.
29. Yiallourou SR, Walker AM. Effects of sleeping position on development of infant cardiovascular control. Arch Dis Childhood 2008;93:868-72.
30. Alinejad-Naine M. Neonatal positioning during care in neonatal intensive care unit. Iran J Cardiovasc Nurs 2014;3:60-5.31.
31. Oishi Y, Ohta H, Hirose T, Nakaya S, Tsuchiya K, Nakagawa M, *et al*. Combined effects of body position and sleep status on the cardiorespiratory stability of near-term infants. Sci Rep 2018;8:8845.