

# Effect of Horizontal Rocking on Maternal-Neonatal Attachment Behaviors in Mothers with Premature Neonates Hospitalized in NICU: A Randomized Clinical Trial Study

Zahra Nikbakhti<sup>1</sup>, Zahra Pourmovahed<sup>2\*</sup>, Mitra Soltanian<sup>3</sup>

1. Department of Nursing, School of Nursing and Midwifery, Shahid Sadoughi University of Medical Sciences, Yazd, Iran

2. Department of Nursing Education, Research Center for Nursing and Midwifery Care, Comprehensive Research Institute for Maternal and Child Health, Shahid Sadoughi University of Medical Sciences, Yazd, Iran

3. Department of Nursing, School of Nursing and Midwifery, Shiraz University of Medical Sciences, Shiraz, Iran

## ABSTRACT

**Background:** Mother-neonate attachment is impaired when a premature neonate is hospitalized, affecting the neonate's growth and development and the mother's ability to care for the infant. This study aimed to determine the effect of horizontal neonate rocking on the attachment behaviors of mothers with premature neonates admitted to the neonatal intensive care unit (NICU).

**Methods:** This clinical trial was conducted on 64 mothers with premature neonates hospitalized in the NICU of Hafezieh Hospital and Hazrat Zeinab Hospital in Shiraz in 2023. Participants were selected using convenience sampling and randomly assigned to control and intervention groups. In the intervention group, mothers performed horizontal rocking for two weeks, five days a week, four times a day for three minutes each time, half an hour before feeding their neonates. The Avant attachment questionnaire was completed by all participants. Data were analyzed using SPSS 24 with independent t-tests, paired t-tests, and chi-square tests.

**Results:** After the intervention, the mother-neonate attachment score was significantly higher in the intervention group ( $18.58 \pm 3.85$ ) compared to the control group ( $12.91 \pm 2.70$ ) ( $P < 0.001$ ). In the intervention group, the mean scores for emotional behaviors increased from  $4.64 \pm 1.43$  to  $6.84 \pm 1.93$ , and proximity behaviors increased from  $2.61 \pm 1.45$  to  $7.10 \pm 1.51$  ( $P < 0.001$ ). However, the mean score for caring behavior showed no significant difference between before ( $5.55 \pm 1.06$ ) and after ( $4.65 \pm 1.14$ ) the intervention ( $P > 0.05$ ).

**Conclusion:** Horizontal rocking of neonates increased attachment behaviors, specifically emotional and proximity behaviors, in mothers with premature neonates. It is recommended that nurses in the NICU teach mothers the correct method of rocking premature neonates horizontally to enhance mother-neonate attachment.

**Keywords:** Horizontal rocking, Maternal-infant attachment, Neonatal intensive care unit, Premature neonate

## Introduction

The birth of premature neonates is a major cause of neonatal mortality in developed countries, with a death rate in preterm infants estimated at 27.1% (1, 2). In Iran, infant mortality is

approximately 9.3 per thousand live births, primarily due to premature birth (3). Premature neonates who survive often require hospital care for weeks or months (4). Separation of the mother

\* Corresponding author: Zahra Pourmovahed, Department of Nursing Education, Research Center for Nursing and Midwifery Care, Comprehensive Research Institute for Maternal and Child Health, Shahid Sadoughi University of Medical Sciences, Yazd, Iran. Email: movahed446@yahoo.com

Please cite this paper as:

Nikbakhti Z, Pourmovahed Z, Soltanian M. Effect of Horizontal Rocking on Maternal-Neonatal Attachment Behaviors in Mothers with Premature Neonates Hospitalized in NICU: A Randomized Clinical Trial Study. Iranian Journal of Neonatology. 2026 Jan; 17(1). DOI: [10.22038/ijn.2025.81106.2565](https://doi.org/10.22038/ijn.2025.81106.2565)



from the neonate limits physical contact, a critical factor in attachment, impairing the attachment process. Attachment begins before birth, strengthens during pregnancy, and evolves through mother-neonate contact during the neonatal period (3). Interactions between mother and neonate are vital for attachment, proximity, and the neonate's cognitive development (5). The quality of these interactions varies depending on the neonate's prematurity (6). Multisensory stimuli can foster attachment in neonates (7), and multisensory stimulation improves neurobehavioral development in high-risk infants (8). Rocking premature neonates slowly, regularly, and rhythmically mimics intrauterine rhythms, benefiting their development (9). Studies show that multisensory stimulation techniques, including horizontal rocking, mitigate some adverse neurological effects of premature birth and prolonged hospitalization (10). Due to the soothing effect of rhythmic stimulation, rocking has been utilized in NICUs for over 50 years (11). Admitting a neonate to the NICU is stressful for both the neonate and parents, exposing the neonate to unfamiliar sensory stimuli, such as loud noises and bright lights, unlike the intrauterine environment (12). While some studies have explored multisensory stimulation and physical growth in premature neonates, as well as vestibular stimulation's effects on neonate behaviors, no study has specifically examined the effect of horizontal rocking on maternal attachment behaviors. As horizontal rocking is hypothesized to improve the mother-neonate relationship in the NICU (13), this study aimed to evaluate its effect on attachment behaviors in mothers of premature neonates hospitalized in the NICU.

## Methods

### Study Area

This clinical trial was conducted in the NICUs of Hafezieh Hospital and Hazrat Zeinab Hospital in Shiraz, with the ethics code IRCT2023 0312057699N1, from June to November 2023.

### Study Design and Sampling Procedure

Based on a similar study (14), the initial sample size was estimated at 29 mothers, with a test power of 80% and a significance level of 5%. Accounting for a 20% attrition rate, the final sample size was set at 36 participants per group. Due to one neonate's death, three discharges, and four neonates requiring mechanical ventilation, 64 mothers were ultimately divided into control (33 mothers) and intervention (31 mothers) groups

using random allocation (Diagram 1). Inclusion criteria included mothers with neonates of 33–36 weeks gestational age, no need for mechanical ventilation, hemodynamic stability, no congenital malformations, no chronic maternal disease, and the ability to have dermal, visual, or auditory contact with the neonate, with no care provided by other family members. Exclusion criteria were lack of maternal cooperation, infant death, or neonates requiring mechanical ventilation or resuscitation.

### Data Collection

Data were collected using a demographic questionnaire and the Avant attachment checklist, which includes 13 behaviors categorized into three types: emotional behaviors (kissing, looking, caressing, talking, checking the neonate, smiling, and rocking), proximity behaviors (hugging without touching the mother's body, circling arms around the neonate), and caring behaviors (changing diapers, patting the neonate's back to expel stomach gas, tidying up the neonate). Behaviors were observed for 15 minutes, with the first 30 seconds of each minute used for observation and the second 30 seconds for recording. Each behavior was recorded once per minute, with one point assigned per observed behavior. The minimum score per behavior was zero, and the maximum was 15. Higher total scores indicated greater maternal attachment. The Avant questionnaire's validity was established by Avant, emphasizing affective and cognitive dimensions of parent-to-infant attachment (16). The Persian version's validity was confirmed by Vakilian et al. (2007) and Toosi et al. (2011) (17, 18), with reliability established by Vakilian et al. (2009) at a correlation coefficient of 98% (19). Informed consent was obtained from mothers and fathers, and a demographic questionnaire (including mother's age, occupation, education level, and baby's gender and age) was completed. The Avant attachment behavior checklist was also completed. To prevent information exchange, the control group was sampled first, followed by the intervention group after the control group's discharge.

The intervention involved mothers rocking calm and alert neonates horizontally half an hour before feeding for 12 minutes daily (four sessions of three minutes each) for five days a week, alongside routine care. The neonate was hugged and gently rocked horizontally (cephalo-caudal). The researcher taught mothers the correct method practically and supervised its

implementation, monitoring for neonatal stress signs every 10 seconds. If stress signs were observed, the intervention was paused for 15 seconds and resumed. If stress signs occurred three times consecutively, the intervention was stopped for that session (7). Stress signs, based on Als' Synactive theory, included physiological changes (heart rate >200 bpm or <100 bpm, respiratory rate >20 above baseline, arterial oxygen saturation <86% for >15 seconds) and behavioral signs (startle, panic, yawning, finger splaying, tone or posture changes, gaze aversion, crying, hiccups, tongue protrusion) (7). After two weeks, both groups completed the questionnaires again, and data were compared to pre-intervention results. The control group received only routine care.

Figure 1: CONSORT diagram of participant flow

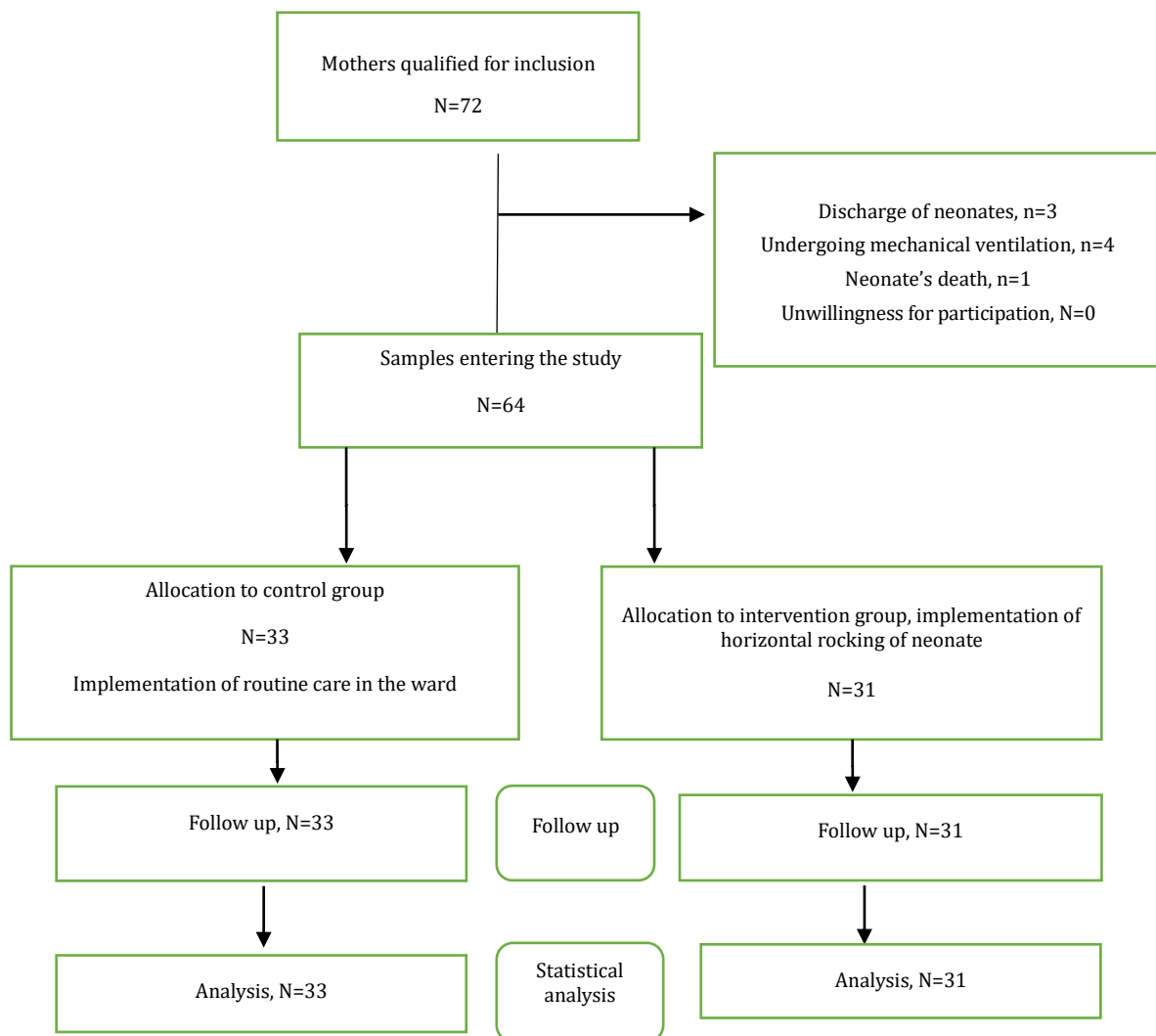


Diagram 1. Consortium diagram of participants

through each stage of the study.

### Statistical Analysis

Data were analyzed using SPSS version 24 with independent t-tests, paired t-tests, and chi-square tests ( $P=0.05$ ). The Kolmogorov-Smirnov test confirmed data normality, showing no significant differences between groups.

### Ethical approval

The study was approved by the Committee of Ethics in Human Research at Shahid Sadoughi University of Medical Sciences, Yazd (code: IR.SSU.REC.1402.002). Participants were informed of the study's objectives, assured of confidentiality and anonymity, and provided written informed consent. They could withdraw from the study at any time.

**Table 1.** Demographic Characteristics of Neonates and Mothers in the Intervention and Control Groups

| Qualitative Demographic Variables  | Intervention (N=31) | Control (N=33)   | P-Value |
|------------------------------------|---------------------|------------------|---------|
| Gender                             |                     |                  | 0.11*   |
| Male                               | 22 (71%)            | 17 (51.5%)       |         |
| Female                             | 9 (29%)             | 16 (48.5%)       |         |
| Mother's Job                       |                     |                  | 0.31**  |
| Housewife                          | 27 (87.1%)          | 31 (93.9%)       |         |
| Employed                           | 4 (12.9%)           | 2 (6.1%)         |         |
| Mother's Level of Education        |                     |                  | 0.13*   |
| High School                        | 8 (25.8%)           | 5 (15.2%)        |         |
| Diploma                            | 8 (25.8%)           | 18 (54.5%)       |         |
| Bachelor Degree                    | 14 (45.2%)          | 9 (27.3%)        |         |
| Master Degree                      | 1 (3.2%)            | 1 (3%)           |         |
| Quantitative Demographic Variables | Mean $\pm$ SD       | Mean $\pm$ SD    |         |
| Infant's Gestational Age (weeks)   | 34.61 $\pm$ 1.26    | 34.36 $\pm$ 1.22 | 0.42*** |
| Mother's Age (years)               | 31.35 $\pm$ 6.42    | 31.70 $\pm$ 5.23 | 0.82*** |

\*Chi-square test

\*\*Fisher's exact test

\*\*\*Independent t-test

## Results

Table 1 shows no significant demographic differences between groups ( $P>0.05$ ). The mean attachment score did not differ significantly between groups before the intervention ( $P=0.24$ ).

However, post-intervention, the intervention group's score ( $18.58\pm3.85$ ) was significantly higher than the control group's ( $12.91\pm2.70$ ) ( $P<0.001$ ). Within the intervention group, the attachment score increased significantly from  $12.77\pm2.94$  to  $18.58\pm3.85$  ( $P<0.001$ ), while the control group showed no significant change ( $P=0.13$ ) (Table 2). Emotional ( $6.84\pm1.93$ ) and

proximity ( $7.10\pm1.51$ ) behavior scores in the intervention group were significantly higher than the control group's ( $5.27\pm1.61$  and  $3.10\pm1.40$ , respectively) post-intervention ( $P<0.05$ ), but caring behavior scores showed no significant difference ( $P=0.71$ ). Before the intervention, no significant differences were found in any attachment behavior dimensions between groups ( $P>0.05$ ). In the intervention group, emotional and proximity behavior scores increased significantly post-intervention ( $P<0.001$ ), but caring behavior scores decreased slightly (from  $5.55\pm1.06$  to  $4.65\pm1.14$ ) with no significant difference ( $P>0.05$ ) (Table 3).

**Table 2.** Comparison of Maternal-Neonatal Attachment Behavior Scores in Intervention and Control Groups

| Variable                               | Intervention (M $\pm$ SD, n=31) | Control (M $\pm$ SD, n=33) | *Between-Group P-Value ** |
|--|---------------------------------|----------------------------|---------------------------|
| Maternal-Neonatal Attachment Behaviors |                                 |                            |                           |
| Before                                 | 12.77 $\pm$ 2.94                | 11.97 $\pm$ 2.54           | 0.24                      |
| After                                  | 18.58 $\pm$ 3.85                | 12.91 $\pm$ 2.70           | <0.001                    |
| Within-Group P-Value                   | <0.001                          | 0.13                       |                           |

\*Independent t-test

\*\*Paired t-test

**Table 3.** Comparison of Dimension Scores of Maternal-Neonatal Attachment Behaviors in Intervention and Control Groups

| Dimension of Maternal-Neonatal Attachment Behaviors | Intervention (M $\pm$ SD, n=31) | Control (M $\pm$ SD, n=33) | *Between-Group P-Value ** |
|---|---------------------------------|----------------------------|---------------------------|
| Emotional Behavior                                  |                                 |                            |                           |
| Before  | 4.64 $\pm$ 1.43                 | 4.58 $\pm$ 1.44            | 0.85                      |
| After   | 6.84 $\pm$ 1.93                 | 5.27 $\pm$ 1.61            | 0.001                     |
| Within-Group P-Value                                | <0.001                          | 0.12                       |                           |

| Dimension of Maternal-Neonatal Attachment Behaviors | Intervention<br>(M±SD, n=31) | Control<br>(M±SD, n=33) | *Between-Group<br>P-Value ** |
|---|------------------------------|-------------------------|------------------------------|
| Proximity Behavior                                  |                              |                         |                              |
| Before  | 2.61 ± 1.45                  | 2.24 ± 1.54             | 0.33                         |
| After   | 7.10 ± 1.51                  | 3.10 ± 1.40             | <0.001                       |
| Within-Group P-Value                                | <0.001                       | 0.14                    |                              |
| Caring Behavior                                     |                              |                         |                              |
| Before  | 5.55 ± 1.06                  | 5.15 ± 0.97             | 0.12                         |
| After   | 4.65 ± 1.14                  | 4.55 ± 1.00             | 0.71                         |
| Within-Group P-Value                                | 0.13                         | 0.11                    |                              |

\*Independent t-test

\*\*Paired t-test

## Discussion

The results showed a significant increase in attachment scores in the intervention group post-intervention, with higher emotional and proximity behavior scores compared to the control group. However, caring behavior scores decreased slightly post-intervention and were not significantly different between groups. This may be due to obsessive care behaviors in mothers of premature neonates, as noted by Daneshvar et al. (2020), who found that 36% of maternal behaviors were driven by injury prevention concerns (20). Wolke et al. (2014) reported that 32% of premature and low birth-weight neonates had impaired attachment, highlighting the need for such studies (21). No prior study has exclusively examined horizontal rocking's effect on maternal attachment, though multisensory stimulation and kangaroo care have been studied. Kurt et al. (2020) found kangaroo care increased maternal attachment (22), and Dehghani et al. (2020) reported similar effects from infant massage (23). These findings align with the current study, though the intervention timing differed. Korja et al. (2010) noted that mother-infant separation in the NICU impairs physical contact, increasing maternal stress and reducing responsiveness (24). The control group in this study, with limited physical contact, showed lower emotional and proximity behaviors, supporting Korja's findings. Karimi et al. (2013) found hugging care increased attachment, recommending it as a simple, cost-effective method (25). Sydor et al. (2022) noted that harmonic rocking has a calming effect and improves sleep cycles in neonates, bridging intrauterine and postnatal environments (26). Zimmerman and Barlow (2012) reported that vestibular stimulation before feeding modulates

respiratory rates in premature neonates, with a methodology similar to this study (27). Zeraati et al. (2018) found multisensory stimulation, including vestibular stimulation, improved neuromuscular development (28). Toosi et al. (2014) showed that teaching attachment behaviors increased maternal attachment (29). Seassau et al. (2023) found multisensory care enhanced attachment, though their study included multiple stimuli and younger neonates (9). Provasi et al. (2021) emphasized rhythmic stimulation's role in mimicking intrauterine patterns, aiding emotional, social, and cognitive development (11). Korja et al. (2008) found prematurity does not always impair mother-neonate interaction, as prolonged holding may compensate (30). It can be stated that several psychological factors influence on the interaction of mothers and neonates in NICUs. Also, feeding of neonates and mothers' attitudes in this regard can promote attachment behaviors in them(31,32). The lack of prior studies directly examining vestibular stimulation and attachment makes this study innovative.

This study faced time limitations and required high precision in rocking neonates. Future research should explore horizontal rocking's effects on paternal attachment and infants' psychological states one year post-birth.

## Conclusion

Horizontal rocking significantly increased maternal attachment behaviors, particularly emotional and proximity behaviors, in mothers of premature neonates. This simple, cost-effective intervention fosters positive mother-neonate interactions. Nurses in NICUs should teach mothers the correct method of horizontal rocking to enhance attachment.



## Acknowledgments

This article was derived from a thesis at Yazd Shahid Sadoughi University of Medical Sciences and Health Services (project code: 13665). We thank the staff of the NICUs at Hafezieh Hospital and Hazrat Zeinab Hospital in Shiraz and the participating mothers for their support.

## Conflicts of interest

None declared.

## References

1. Abebaw E, Reta A, Kibret GD, Wagnew F. Incidence and predictors of mortality among preterm neonates admitted to the neonatal intensive care unit at Debre Markos referral hospital, Northwest Ethiopia. *Ethiop J Health Sci*. 2021;31(5):937–946.
2. Maleki Jamasbi M, Azami H, Ebrahimi Neshat SH, Alipour K, Jahani F, Amiri Bonyad S. Epidemiological study of neonatal mortality in hospitalized neonates in the neonatal intensive care unit of medical-educational hospitals in Hamadan City in 2018. *Pajouhan Sci J*. 2020;19(1):24–31.
3. Dezvaree N, Khanaliagan L, Talebighane E. The Mother-newborn attachment and its related factors in mothers of hospitalized preterm neonates. *J Health Care*. 2016;17:340–349.
4. Mokaberian M, Sheikh M, Noripour Sh, Namazizadeh M. The effect of tactile kinetic stimulation by mother on physical growth of preterm infants. *Motor Behavior*. 2015;7(21):145–160.
5. Nishimura Y, Kanakogi Y, Myowa-Yamakoshi M. Infants' emotional states influence maternal behaviors during holding. *Infant Behav Dev*. 2016;43:66–74.
6. Fuertes M, Martelo I, Almeida R, Gonçalves JL, Barbosa M. Attachment and mother-infant interactions in dyads with infants born full-term, moderate-to-late preterm, and very-to-extreme preterm. *Early Hum Dev*. 2024;105943.
7. Kanagasabai PS, Mohan D, Lewis LE, Kamath A, Rao BK. Effect of multisensory stimulation on neuromotor development in preterm infants. *Indian J Pediatr*. 2013;80(6):460–464.
8. Mohamed EK, Abdelazeim F, Elshafey MA, Nasef N. Neurobehavioral response to multisensory stimulation programme in high-risk neonates. *Bull Fac Phys Ther*. 2018;23(1):22–29.
9. Séassau A, Munos P, Gire C, Tosello B, Carchon I. Neonatal Care Unit Interventions on Preterm Development. *Children*. 2023;10(6):999.
10. Bellieni CV, Buonocore G, Nenci A, Franci N, Cordelli DM, Bagnoli F. Sensorial saturation: An effective analgesic tool for heel-prick in preterm infants. *Neonatology*. 2001;80(1):15–18.
11. Provasi J, Blanc L, Carchon I. The importance of rhythmic stimulation for preterm infants in the NICU. *Children*. 2021;8(8):660.
12. Kim MA, Kim S-J, Cho H. Effects of tactile stimulation by fathers on physiological responses and paternal attachment in infants in the NICU: A pilot study. *J Child Health Care*. 2017;21(1):36–45.
13. Apter G, Devouche E, Gratier M, editors. Early interaction and developmental psychopathology. Volume I: Infancy. Springer, 2019:123–149.
14. Pourmovahed Z, Aryaeenezhad A. Comparison of maternal-infant attachment behaviors and social support in mothers of healthy newborn and premature newborn hospitalized in neonatal intensive care. *Journal of Health and Care*. 2021;22(4):348–357.
15. Tilokskulchai F, Phatthanasiriwethin S, Vichitsukon K, Serisathien Y. Attachment behaviors in mothers of premature infants: A descriptive study in Thai mothers. *J Perinat Neonatal Nurs*. 2002;16(3):69–83.
16. Humenick SS. Analysis of current assessment strategies in the health care of young children and childbearing families. (No Title). 1982:171–178.
17. Vakilian K, Khatamidoost F, Khorsandi M. Effect of kangaroo mother care on maternal attachment behavior before. *HMJ*. 2007;11(1):57–63.
18. Toosi M, Akbarzadeh M, Zare N, Sharif F. Effect of attachment training on anxiety and attachment behaviors of first-time mothers. *Journal of Hayat*. 2011;17(3):69–79.
19. Vakilian K. Impact of Kangaroo mother care immediately after birth on mothers attachment behaviors at one and three months after birth. *Iran J Nurs Res*. 2009;4(14):7–14.
20. Daneshvar F, Barati M, Tapak L, Rezapur-Shahkolai F. Factors associated with mothers' behaviors in injury prevention among premature neonatal in hospital: Applying health belief model. *J Educ Community Health*. 2020;7(2):127–134.
21. Wolke D, Eryigit-Madzwamuse S, Gutbrod T. Very preterm/very low birthweight infants' attachment: Infant and maternal characteristics. *Arch Dis Child Fetal Neonatal Ed*. 2014;99(1):F70–F75.
22. Kurt F, Kucukoglu S, Ozdemir A, Ozcan Z. The effect of kangaroo care on maternal attachment in preterm infants. *Niger J Clin Pract*. 2020;23(1):26–32.
23. Dehghani K, Mirjalili S, Falahzade H. The effect of infant massage on attachment behaviors in mothers of premature infants. *J Babol Univ Med*. 2020;22(1):412–420.
24. Korja R, Ahlqvist-Björkroth S, Savonlahti E, Stolt S, Haataja L, Lapinleimu H, et al. Relations between maternal attachment representations and the quality of mother–infant interaction in preterm and full-term infants. *Infant Behav Dev*. 2010; 33(3):330–336.
25. Karimi A, Tara F, Khadivzadeh T, Aghamohammadian Sharbaf HR. The effect of skin-to-skin contact immediately after delivery on the maternal attachment and anxiety regarding infant. *Iran J Obstet Gynecol Infertil*. 2013;16(67):7–15.
26. Sydor M, Pop J, Jasińska A, Zabłocki M. Anthropo-Mechanical Cradles: A Multidisciplinary Review. *Int J Environ Res Public Health*. 2022;19(23):15759.

27. Zimmerman E, Barlow SM. The Effects of vestibular stimulation rate and magnitude of acceleration on central pattern generation for chest wall kinematics in preterm infants. *J Perinatol.* 2012;32(8):614–620.
28. Zeraati H, Nasimi F, Rezaeian A, Shahinfar J, Zade MG. Effect of multi-sensory stimulation on neuromotor development of premature infants: a randomized clinical trial. *Iran J Child Neurol.* 2018;12(3):32.
29. Toosi M, Akbarzadeh M, Zare N, Sharif F. Comparison of the effects of attachment behavior and relaxation training on maternal fetal attachment and infant in prime pregnant women. *J Fundam Ment Health.* 2014;16(62):142–149.
30. Korja R, Maunu J, Kirjavainen J, Savonlahti E, Haataja L, Lapinleimu H, et al. Mother–infant interaction is influenced by the amount of holding in preterm infants. *Early Hum Dev.* 2008;84(4):257–267.
31. Kazemi A, Nikfarid L, Khanali Mojen L, Nasiri M. Obstacles to parents' interaction with neonates in neonatal intensive care units from parents' and nurses' points of view. *Iran J Neonatol.* 2019; 10(1):78-85.
32. Javadi M, Shahidi S, Pourmovahed Z, Palizban F. Improving attitudes and inclination towards neonatal feeding with milk donated from milk bank in mothers with premature neonates: A comparison of two educational interventions. *Iran J Neonatol.* 2024;15(3):40-48.