Original Article

The Effect of Gentle Touch on Cardiorespiratory Indices and Pain Behaviors Related to Venipuncture and Blood Sampling in Preterm Infants Under Intensive Care

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Abstract

Background: Infants undergo extremely painful procedures in a Neonatal Intensive Care Unit (NICU), which if left uncontrolled may cause complications. Therefore, this study was conducted to investigate gentle touch effect on cardiorespiratory indices and pain behaviors related to venipuncture and blood sampling in preterm infants. **Materials and Methods:** A quasi-experimental study was undertaken in gentle touch and control groups in three stages. The population included premature infants in NICU of Al-Zahra Hospital, Isfahan, Iran. Using convenience sampling, 52 infants were randomly selected and assigned to two groups (n = 26). Gentle touch technique and measurement of cardiorespiratory indices were performed 5 minutes before, during, and 5 minutes after procedure, and routine care was provided for control group. Neonatal pain and cardiorespiratory indices were assessed using the Neonatal Infant Pain Scale (NIPS) and an intensive care monitor. Data was analyzed using repeated measures ANOVA, independent t-test, and Chi-square test in SPSS software. **Results:** The independent t-test revealed a significant difference between mean pain score of the infants in two groups during the procedures (t_{50} = -3.32, p = 0.002), but no significant different was between groups before and after the procedure ($p > 0.05$). However, the cardiorespiratory indices were not significantly different before, during, and after the procedure ($p > 0.05$). **Conclusions:** The results suggest that gentle touch reduced the infants' pain during venipuncture and blood sampling. Thus, it is recommended this method be applied to mitigate pain in premature infants.

Keywords: *Blood pressure, heart rate, oxygen saturation, pain, premature birth, respiration rate, touch*

Introduction

The neonatal period is of paramount importance as the infant mortality rate is one of the major indicators of health and development of countries in international standards.[1] The neonatal period refers to the first 4 weeks of life. This period is characterized by dramatic changes, and many natural events take place over these 28 days. It is a highly vulnerable time for the infant.[2] According to the World Health Organization (WHO), the term "preterm" describes infants who are born before 37 weeks of gestation.[3] Every year, 15 million premature or preterm infants are born worldwide.[4] Overall, it is estimated that 15–20% of infants worldwide suffer from low birth weight and prematurity, which accounts for more than 20 million births/year.[5] Premature infants admitted to the Neonatal Intensive Care Unit (NICU) are susceptible to a wide range of constant stimuli and stress. In 1987, scientists learned that infants were capable of feeling pain, and their pain was measurable. Subsequently, numerous studies have shown that infants feel pain, and uncontrolled neonatal pain will have short-term and long-term consequences.[6]

The short-term effects include reduced oxygenation, hemodynamic instability, and increased intracranial pressure. The long-term effects include anxiety, pain hypersensitivity, irritability, sleep disturbance, reduced nutrition, and delay in body immune system activity, disturbance in emotional relationships, hyperactivity, and attention deficit.[7,8] According to the American Academy of Pediatrics (AAP), the mortality rate is exceedingly higher in infants exposed to severe and long-term pain, and they will respond differently to painful actions in the future. Moreover, complications of untreated pain include increased heart rate, hypertension,

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and hemoglobin-bound oxygen, and behavioral responses to pain including crying, changes in body movements from relaxed state to flexion-extension, and changes in facial expressions like contracting facial muscles. Therefore, nursing intervention to treat pain and prevent its short-term and long-term complications is crucial for infants exposed to severe and recurrent pain. From an ethical standpoint, it is the nurse's job to diagnose and mitigate pain in infants. Nurses are in the best position to evaluate, diagnose, treat, and prevent pain in the hospital because they tend to forge a closer relationship with the patients.[6,9]

In the NICU, infants undergo very painful treatment procedures, which their resulting pain can cause problems if left uncontrolled, such as changes in the respiratory pattern, heart rate, and blood oxygen saturation,[10] hypertension, and cardiorespiratory indices and behavioral responses to pain.[6] Thus, neonatal pain can be observed through biological responses (heart rate and oxygen saturation) and behavioral responses (crying, changes in facial expression, and changes in body movements) can be employed as indicators of pain when assessing the effect of analgesic interventions.[11,12]

In light of their experiences in the NICU, and due to the importance of pain management and prevention of its numerous and irreversible complications in neonates, the researchers desired to mitigate the pain of premature infants under intensive care and treatment, who are unable to express their pain. In this regard, a question was raised by the researchers: "Can gentle touches sooth and relieve pain related to venipuncture and blood sampling?" Therefore, the present study was conducted with the aim to investigate the effect of gentle touch on cardiorespiratory indices and pain behaviors related to venipuncture and blood sampling in preterm infants admitted to NICUs.

Materials and Methods

This quasi-experimental intervention, which is a part of a greater research, was conducted in 2014–2016 for the duration of 15 months on 52 preterm infants hospitalized in the NICU of Alzahra Hospital in Isfahan, Iran. The sample size (n = 25) was calculated by comparing the mean of variables between the two groups in 95% CI with a test power factor of 80%. Considering a dropout rate of 20%, a sample size of n = 31 was determined for each group to ensure the validity of the study. Convenience sampling method was adopted to select the participants. The selected participants were randomly divided into two equal groups of intervention (A-group or gentle touch) and control (B-group). The samples were placed into the groups, respectively [sample 1 in A-group, sample 2 in B-group, sample 3 in A-group, sample 4 in B-group, sample 5 in A-group, sample 6 in B-group, and.].

The study inclusion criteria were: 1) age of less than 37 weeks of gestational based on medical records, 2) no feeding less than 1 hour prior to the intervention, 3) no injection of sedatives 2 hours before the intervention, 4) lack of maternal drug abuse during pregnancy, 5) full consciousness of the baby, 6) ability to suck and respond to painful stimulation, 7) need for venipuncture or blood sampling from a vessel or artery, 8) lack of performance of any painful procedures 30 minutes before the intervention in order to prevent the effect of fatigue on the heart and respiratory status, 9) relaxed state of the infant (a crying baby was soothed before the procedure), and 10) Iranian nationality of the infant. The exclusion criteria were: 1) withdrawal of the parents from the research and 2) the deterioration of the infant's health during the intervention. The final analysis was performed on 26 infants in each group because five infants were excluded from each study group due to withdrawal of parents, deteriorated health of infants, or blood sampling from the heel instead of intravenous or arterial blood sampling [Figure 1].

To address the goals of the research, the data were collected using questionnaires, checklists, the intensive care monitor, a pulse oximeter, and a blood pressure cuff. The 16-item questionnaire contained questions about the demographic characteristics of participants, including age, body temperature, gender, birth weight, current weight, type of disease, oxygen therapy and procedure, and gestational age. The questionnaires were completed based on the infants' health records and weight, observations, and inquiry from the parents. Moreover, the respiration rate of the infant was determined by counting the number of respiratory movements, pulse rate and arterial oxygen saturation were measured using a pulse oximeter and intensive care monitor, and blood pressure was reported from the monitor. Pulse oximetry was valid, and to ensure the reliability of research tool, only one pediatric pulse oximeter was used for all participants. Equivalent reliability method was also used to evaluate the reliability of the monitor; its accuracy was compared with another device each time before the intervention.

Pain behavior was evaluated using the Neonatal Infant Pain Scale (NIPS), which is a measure of pain assessment in term and preterm infants who are unable to verbally express the presence or severity of pain. This pain measurement tool is a multidimensional instrument that assesses six behavioral characteristics including facial expression (relaxed = 0, grimace = 1), crying (no cry = 0, whimper = 1, vigorous crying = 2), breathing pattern (relaxed = 0, change in breathing = 1), movement of arms (relaxed = 0, flexed/extended = 1), movement of legs (relaxed = 0, flexed-extended = 1), and state of arousal (sleeping/awake = 0, fussy = 1) to evaluate pain related to the procedure. The total score of the NIPS ranges between 0 and 7, with a score of 3 or more indicating pain. This standard instrument (NIPS) has already been utilized in many studies to measure pain in full-term and preterm infants.[13,14] In order to evaluate the reliability of the checklist used for recording blood pressure, respiration rate, heart rate, oxygen saturation, and neonatal pain score, the simultaneous observation

method was used during the intervention. Data on eight infants were collected by two researchers separately, from the monitor and through observing the neonates' reactions. The reliability of collected data was obtained through the correlation coefficient test [blood pressure (0.99), respiration rate (0.89), heart rate (0.93), oxygen saturation (0.94), and pain score (before = 0.98, during = 0.99, after = 0.97)]. For the sampling, after ensuring that infants were ready for sampling, the researchers performed venipuncture and arterial blood sampling, then, the intervention was performed using Heath and Bainbridge's rotational-tactile technique in three stages (5 minutes before, during, and 5 minutes after venipuncture and blood sampling). In the control group, no intervention was performed, and infants only received routine care. The neonatal cardiorespiratory indices such as blood pressure were measured 5 minutes before, immediately before, during, immediately after, and 5 minutes after the procedure. The arterial oxygen saturation and pulse rate were measured and recorded every 30 seconds using a neonatal monitor, and the number of breaths was recorded every 1 minute. At the same intervals, neonatal pain was assessed every 1 minute using NIPS by an experienced specialist using the intervention method. To do so, after watching the videos of the infant's face and body recorded by research assistants throughout the intervention, and based on the measurement and records of arterial oxygen saturation and blood pressure, the number of pulses in these time intervals was assessed and recorded in the related checklists. The blood was drawn from the infant's artery by a skilled nurse. In order to ensure the consistency of the conditions, the intervention was scheduled for shifts in which the nurse was on duty in the ward. Venipuncture was also performed by an experienced nurse after preparing the essential equipment and washing the hands. At the end, the results attained from each group were analyzed by a person blind to the intervention method. The data were analyzed using SPSS software (version 15; SPSS Inc., Chicago, IL, USA). For data analysis, the independent t-test, Chi-square test, and repeated measures analysis of variance (ANOVA) were used.

Ethical considerations

After obtaining permission and identifying the eligible participant, the research goals and procedure were explained to the parents of the participants, and written consents were obtained from them. Parents were given the option to opt out of the study at any time. The identities of all the participants were kept anonymous.

Results

According to the results of the independent t-test, there was no significant difference between the study groups (gentle touch and control) in terms of the demographic variables (age, birth weight, current weight, body temperature, gestational age) ($p > 0.05$). Moreover, the results of Chi-square test did not reveal a significant difference between the groups in the demographic variables (gender, type of disease, and oxygen therapy) ($p > 0.05$) [Table 1]. Therefore, the two groups were identical in terms of demographic characteristics.

The results of repeated measures ANOVA illustrated a significant within-group difference in mean pain score based on NIPS at different times (5 minutes before, during, and 5 minutes after the procedure) in the intervention group ($F_{2,50} = 57.25$; $p < 0.001$) and control

Table 1: Comparison of some demographic characteristics (gestational age, birth weight, current weight, body temperature, oxygen therapy, type of disease, and the infant's gender and age) between the intervention and control groups

Group	Intervention	Control	Independent t-test	
Statistical index	**Mean (SD)**	**Mean (SD)**	t_{50}	*p*
Demographic features				
Birth weight (g)	1738.85 (589.66)	1500.38 (493.46)	1.58	0.12
Current weight (g)	1772.69 (586.14)	1581.92 (545.81)	1.22	0.23
Infant's age (day)	10.54 (11.53)	11.12 (13.13)	0.17	0.87-
Gestational age (day)	222.54 (17.67)	222.31 (21.99)	0.04	0.97
Body temperature	36.62 (0.19)	36.61 (0.15)	0.00	>0.99
Statistical index	***n* (%)**	***n* (%)**	**Chi-square test**	
			χ^2	*p*
Gender				
Male	19 (73.00)	17 (65.40)	0.36	0.548
Female	7 (27.00)	9 (34.60)		
Type of disease				
Respiratory distress syndrome	13 (50.00)	13 (50.00)	9.14	0.243
Other types	13 (50.00)	13 (50.00)		
Oxygen therapy				
Yes	10 (38.50)	12 (46.20)	7.20	0.126
No	16 (61.50)	14 (53.80)		

group ($F_{2,50}$ = 80.45; $p < 0.001$). Additionally, the intergroup comparison using independent t-test revealed a significant difference between the two groups in terms of pain score during the procedure, with mean (SD) pain score of 3.76 (1.92) in the intervention group and 5.29 (1.37) in the control group (t_{50} = -3.32, $p = 0.002$). However, this difference was not significant between the two groups 5 minutes before and 5 minutes after the procedure (p > 0.05) [Table 2].

Moreover, the results of repeated measures ANOVA in within-group analysis revealed a significant difference at various times of before, during, and after the procedure: in the mean of heart rate in the two groups [intervention ($F_{2,50}$ = 9.26, p = 0.001), control ($F_{2,50}$ = 3.75, p = 0.031)], but this difference was not significant in the mean of blood pressure in 2 groups, whereas respiration rate ($F_{2,50}$ = 4.68, p = 0.014) and oxygen saturation ($F_{2,50}$ = 5.22, p = 0.009) only were significantly difference in within-group analysis of intervention group and were not significant in control group (p < 0.05). Nevertheless, the results of independent t-test in the comparison of these means did not show any significant difference between the intervention and control groups 5 minutes before, during, and 5 minutes after the procedure (p > 0.05) [Table 3].

Table 2: Comparison of the mean pain behaviors score of preterm infants 5 minutes before, during, and 5 minutes after venipuncture and blood sampling procedures in the intervention and control groups

Procedure time	Before	During	After	Repeated measures ANOVA	
Group	Mean (SD)	Mean (SD)	Mean (SD)	$F_{2,50}$	p
Intervention	0.94 (1.17)	3.76 (1.92)	1.14 (1.01)	57.25	<0.001
Control	0.59 (0.83)	5.29 (1.37)	1.80 (2.02)	80.45	<0.001
Independent *t*-test	t_{50}=-1.21 p=0.23	t_{50}=-3.32 p=0.002	t_{50}=-1.45 p=0.15		

Discussion

Based on the findings, the mean pain score differed significantly at different times (5 minutes before, during, and 5 minutes after the procedure) in both groups (gentle touch and control group) (p < 0.001), so that the mean pain score in the intervention and control groups increased during the procedure compared to before and after the procedure. These findings were not unexpected because infants in both groups experienced pain from the needle. Moreover, in the intergroup comparisons, there was no significant difference in the mean pain score between the two groups before and after the procedure, which was also expected. This indicates the absence of any pain-causing factor before the procedure, and that the effect of the intervention declined considerably after the procedure.

In the study by Rafati *et al.*,[15] the mean pain scores in the massage and control groups were not different in the preintervention period, but during the procedure, the mean pain score in the gentle touch group was significantly lower than the control group (p < 0.05), suggesting that infants in the intervention group suffered from less severe pain. In this regard, another study reported that massage reduced the average pain score of neonates compared to the control group.[16] Furthermore, other studies found that the infants had significantly lower pain scores when receiving massage as compared to receiving the control treatment.[17,18] Moreover, the findings of a study on combined interventions like massage and gentle human touch in the treatment of preterm infants with repeated procedural pain indicated that the combined interventions remained efficacious and safe in reducing repeated procedural pain in preterm infants,

Table 3: Comparison of the mean of cardiorespiratory indices of preterm infants on 5 minutes before, during, and 5 minutes after venipuncture and blood sampling procedures in the intervention and control groups

Procedure time	Group	Before	During	After	Repeated measures ANOVA		Independent *t*-test		
Cardio respiratory indices		Mean (SD)	Mean (SD)	Mean (SD)	Time		Intervention/control		
					$F_{2,50}$	p	Bef t_{50} p	Dur t_{50} p	Aft t_{50} p
Respiratory rate	Intervention	55.63 (16.20)	52.43 (16.10)	55.55 (16.10)	4.68	0.014	0.72	-1.28	-1.17
	Control	59.15 (19.10)	58.67 (18.30)	62.40 (24.90)	0.72	0.49	0.50	0.21	0.30
O_2 saturation	Intervention	94.84 (2.50)	93.16 (3.70)	93.11 (4.40)	5.22	0.009	2.14	1.35	-0.74
	Control	92.78 (4.20)	90.53 (9.20)	94.93 (11.70)	1.33	0.27	0.04	0.19	0.50
Heart rate	Intervention	145.80 (23.10)	154.10 (26.70)	150.40 (26.60)	9.26	0.001	-0.73	-0.97	-1.31
	Control	150.30 (21.70)	161.80 (30.50)	159.30 (22.60)	3.75	0.031	0.50	0.34	0.20
Systolic blood pressure	Intervention	69.86 (11.50)	75.21 (14.30)	74.76 (17.30)	1.06	0.38	-0.32	1.19	0.82
	Control	70.33 (12.60)	69.83 (13.10)	72.61 (14.00)	1.23	0.31	0.90	0.24	0.60
Diastolic blood pressure	Intervention	39.40 (10.00)	45.79 (15.00)	45.24 (12.90)	0.70	0.597	0.26	0.97	0.53
	Control	38.54 (9.80)	41.00 (15.10)	42.90 (14.30)	0.42	0.796	0.70	0.34	0.50
Mean blood pressure	Intervention	50.02 (11.20)	56.42 (16.20)	56.02 (13.10)	0.80	0.528	-0.08	1.11	0.36
	Control	51.25 (10.40)	51.00 (13.30)	55.19 (15.40)	0.33	0.857	0.70	0.27	0.80

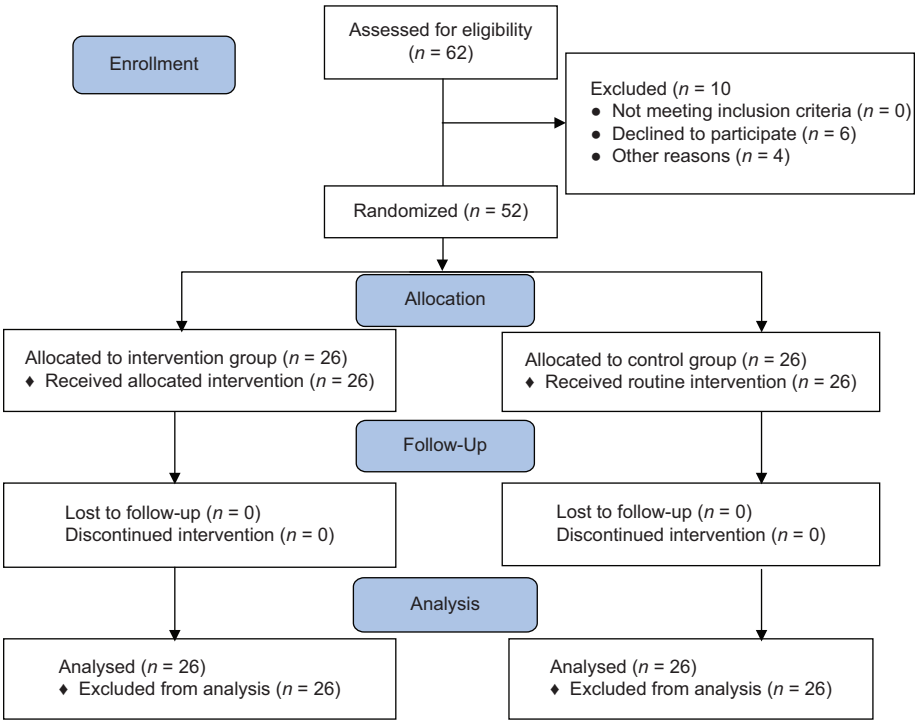

Figure 1: CONSORT flow diagram of the study's enrollment, allocation and analysis phases in control and intervention groups

and this effect may have been mediated through decreased cortisol levels and reduced repeated procedural pain.[19] Another study investigated the impact and mechanism of combined music and touch intervention on pain response in premature infants. They found that the Premature Infant Pain Profile scores were significantly higher in the control group than the experimental group.[20] Therefore, the findings of these studies are in line with the findings of the present study. According to these results, it seems that gentle touch can be effective in reducing the behavioral response to pain related to venipuncture and blood sampling in preterm infants and reverting them to a relaxed state more quickly.

The results of the present study revealed that among the mean cardiorespiratory indices, blood pressure in both groups of intervention and control and respiration rate and oxygen saturation in control group were not significant different between 5 minutes before, during, and 5 minutes after blood sampling ($p < 0.05$). However, heart rate differed between the study stages in the two groups and respiration rate and oxygen saturation differed significantly in the intervention group ($p < 0.05$). In this regard, the results of a study showed that heart rate and respiration rate were significantly different between the massage and control groups immediately after and 5 minutes after blood sampling, but no significant difference was observed in arterial oxygen saturation,[15] and also, in the other study, there were no significant differences between before and after massage on oxygen saturation, but respiratory and heart rates were reduced after massage.[21] Their results regarding heart rate are consistent with that of the present study, but their results regarding respiratory rate and arterial oxygen saturation are inconsistent with the findings of this study. Another study has reported elevated heart rate and a diminished respiratory rate during blood sampling in the control group, as opposed to the gentle touch group.[22] These findings are in line with the results of the current study in terms of heart rates, but differ with respect to respiratory rate. Mirzarahimi *et al*.[17] reported that the heart rate significantly rose after heel stick sampling compared to the baseline in the intervention group (foot massage) and control groups, which is in agreement with our findings. Moreover, there was a statistically significant difference in the arterial blood oxygen saturation during a three-day intervention before and after massage,[23,24] which is consistent with the present study. Hence, the results of the above study are approved by our study.

In addition, the results of between-group comparisons of mean cardiorespiratory indices did not indicate a difference between the two groups in terms (except oxygen saturation before the procedure) of heart rate, respiration rate, oxygen saturation, and blood pressure 5 minutes before, during, and 5 minutes after arterial venipuncture and blood sampling ($p > 0.05$). Mirzarahimi *et al*.[17] did not observe a significant difference in heart rate and arterial oxygen saturation between the two groups. Moreover, Herrington and Chiodo did not report a significant difference in arterial oxygen saturation between the two groups,[22] which is in line with the results of the present study. Furthermore, Asgari *et al*.[25] found no significant difference in the mean changes of systolic and diastolic blood pressure in the first and second stages between the two groups, and only the

mean changes in diastolic blood pressure were significant in the first stage, 2 minutes before and 2 minutes after the intervention, in the two groups. This is somewhat consistent with the findings of the current study. In general, obtaining the non-significance of cardiorespiratory indices before, during, and after the procedure between the intervention and control groups in this study could be attributed to the small sample size, and a significant difference might be observed in a larger sample size. Thus, it is recommended that future research be undertaken on a larger scale with a greater sample size.

Conclusion

The results showed that the gentle touch intervention was able to significantly reduce the average intensity of pain during venipuncture and blood sampling compared to the control group, and its use caused premature infants to have less pain during venipuncture and blood sampling and show less behavioral response to pain. This non-pharmacological pain relief method can be easily applied. Touching and massage are basic human needs, especially for growth and development, and if this is done gently and calmly, it can have a therapeutic aspect in addition to creating satisfaction. Also, this method is cost-effective. Moreover, as an important professional goal of the medical and nursing community is pain management and relief in newborns, it is suggested that this method be used to reduce the pain of premature infants and be the basis for more extensive studies in the future by increasing the number of samples.

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Conflicts of interest

Nothing to declare.

References

1. Eshghi F, Iranmanesh S, Bahman Bijari B, Borhani F, Motamed Jahromi M. Effects of yakson therapeutic touch on the behavioral response of premature infants. J Babol Univ Med Sci 2015;17:15-21.
2. Carlo WA. Fetus and neonate. In: Kliegman RM, Stanton BF, St GemeIII JW, Schor NF, editors. Nelson Text Book of pediatrics. 20th ed. Philadelphia, PA: Elsevier Inc.; 2016. p. 532.
3. Nejati R, Abdeyazdan Z, Mohammadizadeh M, Golchin M. Effect of different positions on arterial oxygen saturation during enteral feeding of preterm infants admitted to neonatal intensive care units. Iran J Neonatol 2020;11:48-53.
4. Salmani N, Karjoo Z, Dehghani K, Sadeghnia A. Effect of facilitated tucking created with simulated hands on physiological pain indicators during venipuncture in premature infants. Iran J Neonatol 2017;8:7-12.
5. Asadian S, Talakub S, Sadeghnia A, Golchin M. Effect of development-based care programs by mothers on growth indices of infants with low birth weight. Iran J Neonatol 2019;10:81-7.
6. Golchin M, Sheikhan Soudani E, Bahrami P, Shams Soulari Z. [The effect of combined use of nonnutritive sucking and sucrose on cardio-respiratory indices and pain behavior during blood drawing-phlebotomy procedures in preterm infants in intensive care unit (Persian)]. J Anesth Pain 2016;6:41-54.
7. Dehghani K, Bagheri Ahmadabadi A, Fallahzade H, Salimi T. Comparison of the effect of yakson touch and oral glucose on the severity of phlebotomy pain in preterm infants. Iran J Neonatol 2019;10:25-32.
8. Rihani T, Mohebbi T, Boskabadi H, Gholami H, Ghavami Ghanbarabadi V. The effect of facilitated tucking during venipuncture on pain and physiological parameters in preterm infants. Evid Based Care 2012;2:47-56. [Persian].
9. Pourashoori Z, Hosseini MB, Safaiyan A, Ghorbani F, Arshadi bostanabad M. The impact of blood sampling site on pain score in preterm infants: A crossover randomized clinical trial. Int J Pediatr 2018;6:7157-66.
10. Marofi M, Nikobakht F, Badiee Z, Golchin M. The effect of melody on the physiological responses of heel sticks pain in neonates. Iran J Nurs Midwifery Res 2015;20:405-8.
11. Stadtlander L. Understanding infant pain. Int J Childbirth Educ 2018;33:6-8.
12. Lin ChH, Liaw JJ, Chen YT, Yin T, Yang L, Lan HY. Efficacy of breast milk olfactory and gustatory interventions on neonates' biobehavioral responses to pain during heel prick procedures. Int J Environ Res Public Health 2022;19:1240-54.
13. Obiedat H, Ibrahim Al-Maaitah E. Critique of the use of Neonatal Infant Pain Scale (NIPS). Neonat Pediatr Med 2020;6:186-90.
14. Sarkaria E, Gruszfeld D. Assessing neonatal pain with NIPS and COMFORT-B: Evaluation of NICU's staff competences. Pain Res and Manag 2022;2022:8545372.
15. Rafati Sh, Rejeh N, Tadrisi Sd, Karimi M, Molodi A. Effect of massage on physiological pain responses of blood sampling in infants. Iran J Nurs Res 2015;10:45-53.
16. Özkan TK, Küçükkelepçe DS, Özkan SA. The effects of acupressure and foot massage on pain during heel lancing in neonates: A randomized controlled trial. Complement Ther Med 2019;46:103-8.
17. Mirzarahimi M, Mehrnoush N, Shahizadeh S, Samadi N, Amani F. Effect of non-nutritive sucking and leg massage on physiological and behavioral indicators of pain following heel blood sampling in term neonates. Int J Adva Nurs Stud 2013;2:74-9.
18. Chik YM, Ip WY, Choi KC. The effect of upper limb massage on infants' venipuncture pain. Pain Manag Nurs 2017;18:50-7.
19. Gao H, Xu G, Li F, Lv H, Rong H, Mi Y, Li M. Effect of combined pharmacological, behavioral, and physical interventions for procedural pain on salivary cortisol and neurobehavioral development in preterm infants: A randomized controlled trial. J Pain 2021;162:253-62.
20. Qiu J, Jiang Y-f, Li F, Tong Q-H, Rong H, Cheng R. Effect of combined music and touch intervention on pain response and β-endorphin and cortisol concentrations in late preterm infants. BMC Pediatrics 2017;17:38.
21. Ramezani T, Baniasadi H, Baneshi MR. The effects of massage on oxygen saturation of infants with respiratory distress syndrome treated with nasal continuous positive airway pressure. British J Pharmaceutical Rese 2017;16:1-7.
22. Herrington CJ, Chiodo LM. Human touch effectively and safely

reduces pain in the newborn intensive care unit. Pain Manag Nurs 2014;15:107-15.

23. Jamali Soltani N, Peyman A, Ashk Torab T, Saatchi K, Alimohamadi N. The effect of foot reflection massage on the reduction of respiratory distress syndrome in premature infants under non-invasive ventilation in the neonatal intensive care unit. Avicenna J Nurs Midwifery Care 2021;29:113-25.
24. Miralizadeh A, Peyman A, Jamali Soltani N, Ashktorab T. Comparison of the effect of foot and palm reflexology massage on respiratory distress syndrome in premature infants under noninvasive ventilation. Complement Med Res 2022;29:100–8.
25. Asgari N, Taheri P, Golchin M, Mohammadizadeh M. The effect of open and closed endotracheal tube suctioning system on cardio-respiratory parameters of infants undergoing mechanical ventilation. JNM Adv Res 2013;10:14-20.