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ORIGINAL ARTICLE

Effect of maternal heart sound on crying time and pain level in newborns during heel blood collection: A randomized controlled study

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ABSTRACT

Objective: Pain is a distressing experience for newborns and a significant source of stress that affects their overall health and development. This study was conducted to determine the effect of maternal heart sounds listened to by newborns during heel blood collection on pain level and crying time.

Material and Methods: This is a randomized two-group experimental study. The sample consisted of 60 newborns who presented for heel blood sampling. The newborns in the experimental group (n=30) listened to maternal heart sounds during the blood collection process. Routine heel blood was taken from newborns in the control group (n=30). An information form, the Neonatal Infant Pain Scale (NIPS), a hand Doppler device, a camera, and a voice recorder were used to collect data.

Results: In the experimental group, mean pain scores during the heel blood collection procedure (control group: 5.850±1.3967; experimental group: 3.333±1.9623) and after the procedure (control group: 3.200±2.2992; experimental group: 0.967±1.4910) were found to be statistically significantly lower than those in the control group ($p<0.05$). Crying times during the procedure were also significantly shorter in the experimental group (control group: 155.87±111.462 sec; experimental group: 61.77±51.882 sec) ($p<0.05$).

Conclusion: Newborns who listen to maternal heart sounds during heel blood collection experience less pain and have shorter crying times. Maternal heart sounds can be recommended as an effective method to reduce pain in newborns.

Keywords: Heart sound, newborn, pain, pain management.

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INTRODUCTION

Pain is unpleasant sensory and emotional distress associated with actual or potential tissue damage.[1] Nowadays, pain is accepted as a separate diagnosis.[2] The American Pain Association (APS) considers pain to be the fifth vital sign.[3] Newborns are exposed to moderate or severe pain caused by illness or medical interventions. Heel blood sampling is one of the most common invasive procedures in newborns. Heel blood sample, which is frequently taken for newborn screening tests and blood glucose level tracking, causes pain experience.[4] Studies have shown that newborns experience pain or stress frequently and are exposed to an average of 7.5–17.3 painful procedures per day. This situation is more common in preterm newborns than in term newborns.[5,6] It is also important that newborns, especially premature newborns, are frequently exposed to sensory stimuli that cause pain, in terms of adverse effects on the hypothalamic-pituitary-adrenal (HPA) axis.[7,8] This may alter the functional connectivity and adversely affect the baby's brain development for a long time.[7–9] Painful stimuli can change the stability of physiological parameters that affect respiration, oxygen saturation, heart rate, somatosensory thresholds, brain structure, and cognitive and behavioral development in the short term.[10,11]

Since newborns cannot express pain verbally, serious difficulties are experienced in the assessment of pain. Despite this, the "American Academy of Pediatrics and the International Evidence-Based Neonatal Pain Group" recommend the use of neonatal pain assessment scales to determine and manage the severity of pain in the newborn. Constant pain should be evaluated during the baby's stay at the hospital.[7]

While there is no clear recommendation for the management of pain in neonates, there are treatments that have proven safe for painful procedures. However, these methods are not used enough today. Since data on the use of analgesics in neonates are limited, caution should be exercised when using analgesics.[7] However, minimizing the number of painful procedures, evaluating pain routinely, and applying pharmacological and non-pharmacological pain relief methods are important and should be applied in newborns.[7,12,13] Many non-pharmacological methods of pain management, such as kangaroo care, non-nutritive sucking, breastfeeding, distraction methods, massage, music, acupuncture, and listening to maternal heart sounds, are safe, easy to apply, and cost-effective.[4,14]

It is thought that newborns are affected by the heartbeat sounds of their mothers in the womb and these sounds have a calming effect on the newborn in the postnatal period,[15] and cause the newborn to feel safe.[16] In a study conducted by Chirico et al.,[17] to determine the effect of a mother's voice on pain in premature infants who received heel blood, they found that the level of pain has been significantly lower in infants whose mother's voice has been listened to. In a study comparing the effects of the mother's voice, musical sound, and white noise applied during venous blood collection attempts in newborns; it was found that the pain was lower in newborns who listened to the mother's voice compared to the others.[18] It was found that the level of pain in premature babies, whose mother's heart sound was listened to during the aspiration procedure, was lower than in the control group.[19]

The current literature states that more research is needed on the use of non-pharmacological methods to prevent pain in the newborns.[7] In this direction, this study was conducted as a randomized controlled experimental study to determine the effect of maternal heart sound heard by the newborn during heel blood sampling on pain level and crying time.

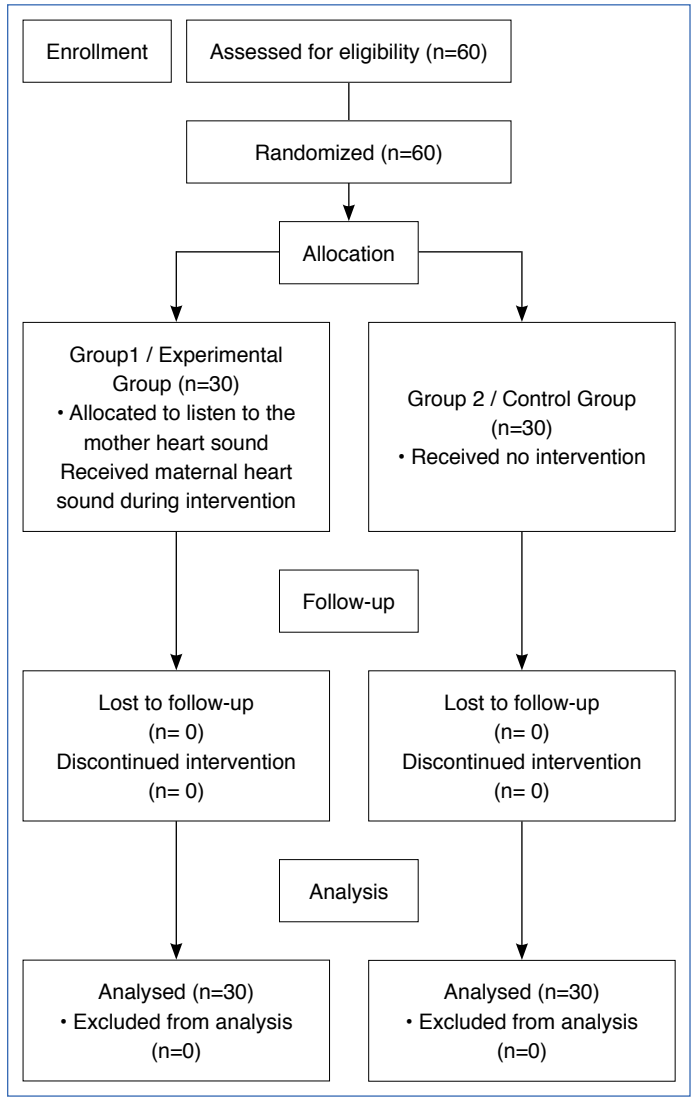

Figure 1: Study flow diagram.

Hypotheses of the Study

H1. Maternal heart sound, which is listened to by the newborn during the heel blood collection procedure, reduces the level of pain.

H2. Maternal heart sound, which is listened to by the newborn during the heel blood collection procedure, shortens the crying time.

MATERIAL AND METHODS

Design of the Study

The study was designed as a randomized controlled experimental clinical trial to evaluate the effects of maternal heart sound on crying duration and pain level during the heel blood procedure in healthy term newborns. The Consolidated Standards of Reporting Trials (CONSORT) diagram of the study phases is presented in Figure 1.

Sample of the Study

The population of the study consisted of healthy newborns who applied to a family health center in Türkiye between October 2019 and March 2020 for heel blood sampling. Power analysis was performed using the G*Power (v3.1.9) program to determine the sample size of the study. Calculations were made taking into account the pain parameter in the study of Küçük Alemdar and Güdücü Tüfekci,[19] with 0.05 Type I error (α), 0.85 test power (1-β), and Cohen's d effect size=0.8264984. It was determined that at least 28 participants were needed per group. Accordingly, a total of 60 newborns, 30 in each group, were included in the study. There was no data loss in the study.

Randomization: Newborns were randomly assigned to the experimental and control groups using the simple randomization method from the computer-assisted online website www.randomizer.org.

Inclusion Criteria for Research: It consisted of newborns with a gestational age of 38–41 weeks and a chronological age of 2–28 days, without any physical, metabolic, or genetic disease, who were not given any analgesics before the procedure, and whose parents gave written permission.

Data Collection Forms

Personal Information Form: This form has been prepared based on the literature and consists of a total of 12 questions that query the physical and demographic information of the newborn.[4,17,19]

Newborn Infant Pain Scale (NIPS): The scale was developed by Lawrence et al.,[20] to evaluate the behavioral and physiological pain responses of newborn babies to invasive procedures. On the scale; breathing pattern, facial expression, arm movements, leg movements, and alertness were scored as 0 or 1; crying is scored as 0,1, or 2 points. The total score of the scale is between 0–7, 0–2 points indicate no pain, 3–4 moderate pain, and values above 4 points indicate a high level of pain. The Turkish validity and reliability of the scale were performed by Akdovan[21] (1999), and Cronbach's alpha internal consistency coefficient was found to be between 0.83 and 0.86. In this study, Cronbach's alpha value has been determined as 0.86.

Application of the Study

Before the application, the families were given the necessary information about the study and camera recording. Verbal and written consent was obtained from the families with an "Informed Consent Form."

In the control group, the infants' height and weight were measured first. Behaviors of newborns were recorded with a camera for 1 minute before the procedure. To observe the facial expression and arm and leg movements of the newborn during the procedure, the newborn was placed on his mother's lap in an upright position with his back to his mother. Heel blood was collected from the left heel with the help of a lancet and a single puncture procedure by the same midwife. Behavioral responses of the newborn were recorded with a camera throughout the procedure. After the procedure, the behavior of the newborn was recorded with a camera for 1 minute.

The height and weight of the newborns were measured in the experimental group. The heart sounds of each newborn's mother were recorded on a voice recorder with a fetal hand Doppler device for 2 minutes. The Bluetooth speaker was placed 50 cm from the newborns and the recorded maternal heart sound was connected to the speaker and the volume was set to 55dB. Before the procedure, the newborns listened to their mother's heart sounds for 1 minute. Meanwhile, their behavior was recorded with a camera. To observe the facial expression and arm and leg movements of the newborn during the procedure, the newborn was placed on his mother's lap in an upright position with his back to his mother. Heel blood was collected from the left heel with the help of a lancet and a single puncture procedure by the same midwife. Behavioral responses of the newborn, whose maternal heart sound continued to be listened to as before the procedure, continued to be recorded with the camera. After the heel blood collection, the mother's heart sound was continued to be listened to for 1 minute and the baby's behavior was recorded with a camera.

In both groups, NIPS scoring was done by two separate midwives trained in the scale. Each midwife watched the camera recordings independently of each other and gave points to the parameters in the scale before, during and after the procedure. The arithmetic mean of the scores given by the two midwives formed the NIPS scores of the newborns and was recorded in the study registration form. The agreement between the newborn infant pain scores of the two observers was analyzed using the intraclass correlation coefficient (ICC) method; NIPS concordances among observers; It was determined as pre-procedure (100%), post-procedure (96.6%–99%) and post-procedure (99.2%–100%) and found to be perfectly compatible. With the help of the time information contained in the camera recordings, the processing time and the crying time were calculated by two midwives and recorded in the application registration form.

Evaluation of Data

In the analysis of the data obtained in the study, SPSS 20.0 program was used; independent simple t-test, chi-square test, likelihood ratio test, Mann-Whitney U test, Kruskal-Wallis test, and Pearson correlation coefficient were used. The results have been evaluated at the 95% confidence interval and the significance level of $p<0.05$.

The Ethical Aspect of the Research

The research was conducted in accordance with the principles of the Declaration of Helsinki. Prior to the study, approval was obtained from the Health Sciences University Hamidiye Non-invasive Research Ethics Committee (28/12/2018-18/101), and written permission was granted by the institution where the study was conducted. The purpose of the study was explained to the participants, and both their written and verbal consent were obtained. The trial was registered on ClinicalTrials.gov (NCT05520164).

RESULTS

Introductory characteristics of newborns in the research group: it was found that the groups were similar in terms of gender, mode of

Table 1: Comparison of newborns in the experimental and control groups according to some characteristics

Variables	Experimental group (n=30)		Control group (n=30)		Total (n=60)		Testing and materiality
	n	%	n	%	n	%	
Gender							χ^2=1.071, p=0.301
Girl	14	46.7	18	60.0	32	53.3	
Boy	16	53.3	12	40.0	28	46.7	
Type of birth							χ^2=0.069, p=0.793
Normal	17	56.7	18	60.0	35	58.3	
Cesarean section	13	43.3	12	40.0	25	41.7	
Baby's nutrition							χ^2=0.073, p=0.787
Breast milk	20	66.7	19	63.3	39	65.0	
Mixed (breast milk and formula)	10	33.3	11	36.7	21	35.0	
Number of blood samples taken							LR=0.000, p=1.000
1–3 times	26	86.7	26	86.7	52	86.7	
4–10 times	2	6.7	2	6.7	4	6.7	
More than 10	2	6.7	2	6.7	4	6.7	

χ^2: PearsonChi-Square; LR: Likelihood ratio test.

Table 2: Comparison of the experimental and control groups according to their postnatal characteristics

Variables	Experimental group (n=30)		Control group (n=30)		Testing and materiality	
	Mean	SD	Mean	SD	t	p
Gestation age (weeks)	38.87	0.973	38.83	0.986	0.132	0.896
Birth weight (g)	3293.83	436.41	3284.17	428.482	0.087	0.931
Birth height (cm)	50.200	1.7499	50.133	2.0759	0.134	0.893
Postnatal age (days)	17.47	8.020	10.07	6.528	3.919	0.000
Weight during the procedure (g)	3750.50	541.583	3523.83	517.392	1.658	0.103
Length during the procedure (cm)	51.17	1.763	50.63	2.173	1.044	0.533

SD: Standard deviation; t: Independent Simple t Test.

delivery, diet, number of blood samples taken (Table 1), gestational age, birth weight and height, average weight, and height during the procedure (Table 2) (p>0.05). It was determined that the mean postnatal age of the babies in the control group (7.47±8.020 days) and the babies in the experimental group (10.07±6.528 days) were statistically significantly different (p<0.05, Table 2).

The average NIPS score during the procedure was 5.850±1.3967 points in the control group and 3.333±1.9623 points in the experimental group; it was determined that the average pain score was higher in the control group with a statistically significant difference (p<0.01, Table 3).

Post-procedure NIPS score averages: it was determined as 3.200±2.2992 points in the control group and 0.967±1.4910 points in the experimental group, with a statistically significant difference; the mean pain score in the control group was higher (p<0.05, Table 3).

When the newborns were examined according to the crying times, it was found that the average was 155.87±111.462 seconds in the control group and 61.77±51.882 seconds in the experimental group; with a statistically significant difference, the crying time was longer in the control group (p=0.000<0.01, Table 3).

When newborn babies were examined according to their processing time, it was determined that the mean time was 92.83±57.333 seconds in the control group and 84.97±40.780 seconds in the experimental group, and there was no statistically significant difference (p=0.543>0.05, Table 3).

Table 3: Comparisons of newborns in terms of NIPS pain score averages. crying times and procedure times

Groups	Pre-procedure NIPS score Mean±SD	Order of procedure NIPS score Mean±SD	Post-procedure NIPS score Mean±SD	Crying time (sec) Mean±SD	Processing time (sec) Mean±SD
Control (n=30)	0.00±0.000	5.850±1.3967	3.200±2.2992	155.87±111.462	92.83±57.333
Experiment (n=30)	0.00±0.000	3.333±1.9623	0.967±1.4910	61.77±51.882	84.97±40.780
t	–	5.723	4.464	4.192	0.612
p	–	0.000	0.000	0.000	0.543

NIPS: Neonatal Infant Pain Scale; SD: Standard deviation; t: Independent Simple t Test.

DISCUSSION

In this study, the parameters that could influence neonatal pain sensitivity and development, such as gestational age, length, weight, and the number of pain experiences, were similar in both groups. A review of the literature emphasizes the importance of a homogeneous distribution of developmental characteristics, as it ensures the objectivity of the results and eliminates the effects of confounding variables.[15,21] However, it was determined that the postnatal age of infants in the control group was lower than that of the experimental group. Apart from the difference in postnatal age, other developmental factors were homogeneous, and thus, the effect of age difference on pain was considered minimal. Consistent with this, a study by Aydın and Karakoç[22] assessing neonatal pain perception also found that postnatal age did not influence pain perception in neonates, which supports the findings of this study.

In the research, it has been shown that the maternal heart sound, which is listened to by newborns during the heel blood collection process, reduces the pain level. When the literature is examined; similarly and in different procedures, non-pharmacological methods have been reported to positively affect the pain level of newborns and infants.[17,19,23] Chirico et al.,[17] determined that the pain levels of 28–36 weeks premature babies who listened to their mother's voice during the heel prick procedure were lower than the control group. Küçük Alemdar et al.,[19] found that the pain levels before, during, and after the procedure were significantly lower in babies who listened to the mother's heart sound during the aspiration procedure compared to the control group. In the study conducted by Döra et al.,[24] to determine the effect of white noise and lullabies on pain and vital signs in invasive interventions applied to premature babies, it was determined that the pain levels of the white noise and lullaby group were lower than the control group. In the study by Kanbur,[25] the effects of music, white noise, and heart sound during the heel blood procedure on the pain level of the newborn were investigated. In the group listening to heart sounds, the pain scores during the procedure and at the 20th minute after the procedure were found to be significantly lower than the control group. A study by Tavlar et al.,[23] investigated the effects of breastfeeding, breast milk odor, and the mother's heartbeat on the level of pain during heel blood collection in newborns. It has been reported that the level of pain and stress was lower in infants who listened to the mother's heartbeat during and after the procedure compared to the group that had breast milk odor. During invasive procedures such as heel blood, listening to the mother's heart sound can be an effective method to reduce or control pain.

Research has shown that the maternal heart sound played to the newborn during the heel blood collection process reduces the crying time. In a study by Erkut et al.,[26] which examined the effect of safe swaddling on the perception of pain in the heel blood collection process, it was found that the crying times of newborns in the wrapped group were shorter than those of babies who were not wrapped. In the study conducted by Karakoç et al.,[27] it was reported that the crying time was lower in the group that listened to white noise during and after the heel blood procedure compared to the groups that did not listen to white noise. In a study examining the effect of massage on pain in newborns, it was reported that the group that was massaged after the procedure had a shorter crying time than the group that was not massaged.[28] In line with the results of this study and the literature, the maternal heart sound listening method can be recommended to reduce the baby's stress and prevent crying during invasive procedures such as heel blood.

According to the results of this study, it was determined that there was no difference between the group listening to the maternal heart sound and the control group in terms of the duration of the procedure. In the study of Tanju et al.,[29] which examined the effect of acupressure applied to the newborn before the heel blood collection procedure on interventional pain, it was stated that there was no difference in terms of the duration of the procedure. The result of Kanbur's[25] study is similar to the results of this study in terms of processing time. Contrary to our study, Karabıyık Oğurlu et al.,[30] examined the effect of hot application applied before heel blood collection in newborns on pain level, comfort level, and procedure time, and it was reported that the hot application shortened the total procedure time compared to the routine application. It can be said that listening to the maternal heart sound during invasive procedures such as heel blood is a method that will not affect the duration of the procedure.

Limitations of the Study

Due to difficulty in finding cases in the study and time constraints, the wide postnatal age range and the difference in the average postnatal ages of newborns in the experimental and control groups can be considered as limitations of the study.

Implications for Practice

Health professionals working in clinics need effective methods to reduce pain when performing invasive procedures on newborns. Therefore, the maternal heart sound method can be used as an easy, inexpensive, reliable, and effective method to reduce the pain level of newborns. Based on our experience during the study, the midwife or nurse responsible for the care of newborns who undergo invasive interventions can perform these interventions, and no additional personnel is needed.

CONCLUSION

Listening to the maternal heart sound during the heel blood collection process effectively reduces the pain and crying time of newborns. The results of the study support the use of maternal heart sound listening to relieve pain during invasive painful procedures such as heel blood collection. This method can be used as an easy, inexpensive, reliable, and effective method to reduce the pain level of newborns. There is a need to increase the evidence on this subject with studies to be conducted in different age groups and larger sample groups.

Statement

Ethics Committee Approval: The Health Sciences University Hamidiye Non-invasive Research Hospital Ethics Committee granted approval for this study (date: 28.12.2018, number: 18/101).

Informed Consent: Written, informed consent was obtained from the patients' families for the publication of this case report.

Conflict of Interest: The authors have no conflict of interest to declare.

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REFERENCES

1. Abd El SM EK, Elsayed LA. Effect of interactive distraction versus cutaneous stimulation for venipuncture pain relief in school age children. J Nurs Educ Pract 2015;5:32.
2. Bikmoradi A, Khaleghverdi M, Seddighi I, Moradkhani S, Soltanian A, Cheraghi F. Effect of inhalation aromatherapy with lavender essence on pain associated with intravenous catheter insertion in preschool children: A quasi-experimental study. Complement Ther Clin Pract 2017;28:85–91.
3. Friedrichsdorf SJ, Postier A, Eull D, Weidner C, Foster L, Gilbert M, et al. Pain outcomes in a US Children's hospital: A prospective cross-sectional survey. Hosp Pediatr 2015;5:18–26.
4. Usta C, Tanyeri-Bayraktar B, Bayraktar S. Pain control with lavender oil in premature infants: A double-blind randomized controlled study. J Altern Complement Med 2021;27:136–41.
5. Cruz MD, Fernandes AM, Oliveira CR. Epidemiology of painful procedures performed in neonates: A systematic review of observational studies. Eur J Pain 2016;20:489–98.
6. Collados-Gómez L, Camacho-Vicente V, González-Villalba M, Sanz-Prades G, Bellón-Vaquerizo B. Neonatal nurses' perceptions of pain management. Enferm Intensiva (Engl Ed) 2018;29:41–7.
7. Committee on Fetus and Newborn and Section on Anesthesiology and Pain Medicine. Prevention and management of procedural pain in the neonate: An update. Pediatrics 2016;137:e20154271.
8. Tortora D, Severino M, Di Biase C, Malova M, Parodi A, Minghetti D, et al. Early pain exposure influences functional brain connectivity in very preterm neonates. Front Neurosci 2019;13:899.
9. Lan HY, Yang L, Lin CH, Hsieh KH, Chang YC, Yin T. Breastmilk as a multisensory intervention for relieving pain during newborn screening procedures: A randomized control trial. Int J Environ Res Public Health 2021;18:13023.
10. Waxman JA, Pillai Riddell RR, Tablon P, Schmidt LA, Pinhasov A. Development of cardiovascular indices of acute pain responding in infants: A systematic review. Pain Res Manag 2016;2016:8458696.
11. Maitre NL, Key AP, Chorna OD, Slaughter JC, Matusz PJ, Wallace MT, et al. The dual nature of early-life experience on somatosensory processing in the human infant brain. Curr Biol 2017;27:1048–54.
12. Leng HY, Zheng XL, Zhang XH, He HY, Tu GF, Fu Q, et al. Combined non-pharmacological interventions for newborn pain relief in two degrees of pain procedures: A randomized clinical trial. Eur J Pain 2016;20:989–97.
13. Hall RW, Anand KJ. Pain management in newborns. Clin Perinatol 2014;41:895–924.
14. Hsieh KH, Chen SJ, Tsao PC, Wang CC, Huang CF, Lin CM, et al. The analgesic effect of non-pharmacological interventions to reduce procedural pain in preterm neonates. Pediatr Neonatol 2018;59:71–6.
15. Coşar Çetin F, Tan A, Merih YD. The effects of Turkish music on pregnancy and newborn. Zeynep Kamil Med J 2017;48:124–30.
16. Suppanen E, Huotilainen M, Ylinen S. Rhythmic structure facilitates learning from auditory input in newborn infants. Infant Behav Dev 2019;57:101346.
17. Chirico G, Cabano R, Villa G, Bigogno A, Ardesi M, Dioni E. Randomised study showed that recorded maternal voices reduced pain in preterm infants undergoing heel lance procedures in a neonatal intensive care unit. Acta Paediatr 2017;106:1564–8.
18. Kurnaz F, Şener Konuk D. Yenidoğana venöz kan alma girişimi sırasında uygulanan anne sesi, müzik sesi ve beyaz gürültünün ağrı ve fiziksel parametreler üzerindeki etkisi. Yüksek lisans tezi. Düzce: Düzce University Institute of Health Sciences; 2019. [In Turkish]
19. Küçük Alemdar D, Güdücü Tüfekci F. Effects of maternal heart sounds on pain and comfort during aspiration in preterm infants. Jpn J Nurs Sci 2018;15:330–9.
20. Lawrence J, Alcock D, McGrath P, Kay J, MacMurray SB, Dulberg C. The development of a tool to assess neonatal pain. Neonatal Netw 1993;12:59–66.
21. Akdovan T. Sağlıklı yenidoğanlarda ağrının değerlendirilmesi, emzik verme ve kucağa alma yönteminin etkisinin incelenmesi. [Master's thesis]. Marmara Üniversitesi; 1999.
22. Aydın Ö, Karakoç A. Yenidoğan yoğun bakım ünitesinde uygulanan invaziv girişimlerde yenidoğanların ağrı algısının değerlendirilmesi. J Health Sci Manag [Article in Turkish] 2022;2:8–13.
23. Tavlar M, Karakoc A. The effect of breastfeeding, breast milk odour and mother's heartbeat sound on pain level in newborns: A randomized trial. Int J Nurs Pract 2022;28:e13067.
24. Döra Ö, Büyük ET. RETRACTED: Effect of white noise and lullabies

on pain and vital signs in invasive interventions applied to premature babies. Pain Manag Nurs 2021;22:724–9. Retraction in: Pain Manag Nurs 2023;24:371.

25. Kanbur BN. Yenidoğanlarda topuk kanı alma sırasında müzik, beyaz gürültü ve kalp sesi dinletmenin ağrı üzerine etkisi. [Unpublished doctoral thesis]. İstanbul Üniversitesi-Cerrahpaşa; 2021.
26. Erkut Z, Yıldız S. Bebek bakımında: Geleneksel kundaklama mı? Güvenli sarma mı? In baby care: Is traditional swaddling? Is safe swaddling? Int Ref J Nurs Res 2017;268–83.
27. Karakoç A, Türker F. Effects of white noise and holding on pain perception in newborns. Pain Manag Nurs 2014;15:864–70.
28. Herrington CJ, Chiodo LM. Human touch effectively and safely reduces pain in the newborn intensive care unit. Pain Manag Nurs 2014;15:107–15.
29. Tanju O, Fatma Yilmaz K. Effect of acupressure on procedural pain before heel lancing in neonates. J Tradit Chin Med 2021;41:331–7.
30. Karabıyık Oğurlu Ö, Tural Büyük E, Yildizlar O. The effect of warm compression applied before heel lance on pain level, comfort level and procedure time in healthy term newborns: A randomized clinical trial. J Midwifery Reprod Health 2020;8:1.