Original Article

# Effect of Environmental and Behavioral Interventions on Pain Intensity in Preterm Infants for Heel Prick Blood Sampling in the Neonatal Intensive Care Unit

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## Abstract

**Background:** Recent researches suggest that preterm infants understand pain and stress. Because of the wide range of effects of pain on infants, the present study was conducted on the effect of environmental and behavioral interventions on pain due to heel-prick blood sampling in preterm infants. **Materials and Methods:** A clinical trial was conducted among 32 infants with gestational age of 32–37 weeks in the intervention and control groups. The effects of noise reduction by earplugs, light reduction by blindfolds, reduction of nursing manipulation, and creation of intrauterine position for neonates, 30 minutes before taking blood samples until 30 minutes after it, were measured during the intervention stage. Data were collected using the Neonatal Infant Pain Scale (NIPS) in 5 stages (before intervention, 2 minutes before sampling, during the sampling, and 5 minutes and 30 minutes after the sampling). The data were analyzed using analysis of variance (ANOVA) and paired *t*-test in SPSS software. **Results:** The paired *t*-test results showed no significant differences between the control and intervention stages in terms of pain scores at base time ($P = 0.42$) and 2 minutes before sampling ($P = 0.12$). However, at the sampling time ($P = 0.0$), and 5 minutes ($P = 0.001$) and 30 minutes after the sampling ($P = 0.001$), mean pain score in the intervention stage was significantly less than that in the control stage. **Conclusions:** Based on the findings, environmental and behavioral interventions reduced pain and facilitated heel-prick blood sampling in preterm infants.

**Keywords:** *Intervention, Iran, pain, preterm*

## Introduction

Premature birth is the most important cause of disease and infant mortality. Since 1990, the number of premature births has increased by almost 20%. Infants whose life or quality of life is at risk are placed in high risk groups and require vigilant professional supervision. Prematurity and low birth weight often occur together and are associated with increased rate of mortality.[1] Premature infants can understand pain. Therefore, the hypothesis of the present study was that premature infants are more sensitive to pain than others because their pain modulation system is not complete, and even non-painful stimuli may cause pain reactions in them.[2,3] Repeated exposure to pain early in life may have long-term effects on infants. These effects include changes in response to stress, behavioral changes, vulnerability to psychosomatic problems, and mental disorders.[4] Early and prolonged exposure to painful stimuli before the development of nervous system results in permanent behavioral changes.[5-7] Pharmacological and nonpharmacological methods have been introduced for pain control in infants.[8] Recent studies have shown that simple nondrug interventions such as non-nutritive sucking,[9,10] oral sucrose,[10] skin contact with the mother,[11,12] breastfeeding,[13] and reduction of multisensory stimulation can effectively reduce pain responses to painful procedures in neonates. Carbajal *et al*. showed that, on average, infants admitted to the neonatal intensive care unit (NICU) for a period of 16 days of hospitalization experienced 115 painful procedures.[14] Of these procedures, 79.2% were performed without medical or nonmedical relief methods, 2.1% were performed using analgesics, 18.2% using analgesic nonpharmacological interventions, and 20.8% using both analgesic interventions and nonmedical pain



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relief methods.[14] It was indicated that the most painful procedure performed on Infants in the NICU was heel-prick blood sampling procedure, which accounted for 56% of all painful procedures in the NICU.[15]

Heel-prick sampling is a painful and stressful procedure which is performed in neonatal wards for diagnostic tests. According to research, reaction to pain due to heel prick significantly differed from venous blood sampling and infants experienced more intense pain.[16] Currently, no specific measure is taken to reduce the pain caused by this procedure. Moreover, stressors, including specific noise and light, acute and chronic diseases, separation from parents, and invasive procedures are present in the NICU. Thus, the researcher used environmental and behavioral interventions and monitored their effect on the pain caused by heel prick in premature infants admitted to NICUs. These interventions included closing the newborns' eyes using eye pads to dim the light, reducing auditory stimuli using ear plugs, creation of intrauterine position for neonates using the available facilities in the ward, reducing unnecessary manipulation of the nurses by controlling the nurses' behavior, and preventing manipulation by the researcher, and thus, creating an environment more similar to the environment of the womb for the neonates.

## Materials and Methods

This randomized clinical study was conducted in two shifts of intervention and nonintervention methods on 32 premature infants hospitalized at the NICU of Shahid Beheshti Hospital (Isfahan, Iran) in 2014. This study is registered with the Iranian Registry of Clinical Trials (IRCT ID: IRCT2015092024100N1). The sample size based on the confidence level of 95% and percentage test sensitivity of 80 was 32. The inclusion criteria included gestational age of 32–37 weeks, chronological age of 7 days or younger, admittance to the NICU, lack of administration of oxygen before and during the study, full consciousness of the baby, the probability of having at least two orders of heel-prick sampling for 2 consecutive days, and lack of administration of anticonvulsants and anesthetics for at least the past 24 hours. The exclusion criteria included parents' withdrawal of their infants from the study, the newborns' need for oxygen therapy for any reason, and infants' critical status. In this study, because sampling was conducted for 2 consecutive days, sample loss was not considered. The relevant data were gathered using a demographic questionnaire and the neonatal infant pain scale (NIPS). The demographic questionnaire included 7 items of duration of pregnancy, weight at birth, fetal gender, current infant weight, embryonic age, age, Apgar at 1 minute, Apgar at 5 minutes, and type of delivery. NIPS is a standard pain assessment tool containing 6 items; 5 behavioral items (changes in facial expression, crying, arm movement, leg movement, and state of consciousness) and 1 physiological item (breathing pattern). Its overall score ranges between 0 and 7. Score 0 represents the least pain and 7 represents the maximum pain.

In the intervention stage, when the infant was selected and before any intervention, the demographic questionnaire and NIPS checklist, as the basis, were completed. Then, the relevant environmental and behavioral interventions were carried out by the researcher. After 30 minutes of continued intervention, heel-prick blood sampling was performed by an experienced nurse. A graduate student who had knowledge of the tool, had at least 1 year working experience in the neonatal ward, and was unaware of the purpose of the study completed the NIPS in 5 stages; basic stage, 2 minutes before blood sampling, during blood sampling, 5 minutes after blood sampling, and 30 minutes after blood sampling. After 1 hour, the infant was removed from the study. In the nonintervention stage, no environmental and behavioral interventions were implemented. However, the entire process of collecting information and completing the NIPS was carried out simultaneously to and in the same manner as the first shift. Data collected in the questionnaire and NIPS were analyzed using repeated-measures analysis of variance (ANOVA), and the information received on the two shifts were compared using paired *t*-test using the SPSS software (version 16, SPSS Inc., Chicago, IL, USA).

### Ethical considerations

Ethical principles, such as explaining the study and obtaining parental consent, preventing damage to the baby, and the baby's withdrawal from the study by the parents at any time were applied.

## Results

Data analysis regarding the demographic characteristics of the participants such as gender (17 females and 15 males) and type of delivery, Apgar score at birth (mean value of 6.7 and 8.2 with standard deviation of 1.8 and 1.6 for Apgar 1 and Apgar 5, respectively), birth weight (mean value of 1672.5 g and standard deviation of 490), and gestational age (mean value of 32.4 and standard deviation of 1.5) and age of the infant (mean value of 4.7 days and standard deviation of 1.8) showed no significant relationship with any of the variables. The paired *t*-test results showed no significant differences between the control and intervention stages in terms of pain scores at base time ($P = 0.42$) and 2 minutes before sampling ($P = 0.12$). Figure 1 shows that the highest score of pain was related to the heel prick in infants in the nonintervention stage, and that the pain score had significantly decreased in the intervention stage ($P = 0.001$), whereas at the sampling time ($t$-value = 7.78, $P = 0.001$), 5 minutes ($t$-value = 8.17, $P = 0.001$) and 30 minutes after the sampling ($t$-value = 3.16, $P = 0.001$), mean pain score in the intervention stage was significantly less than the control stage.

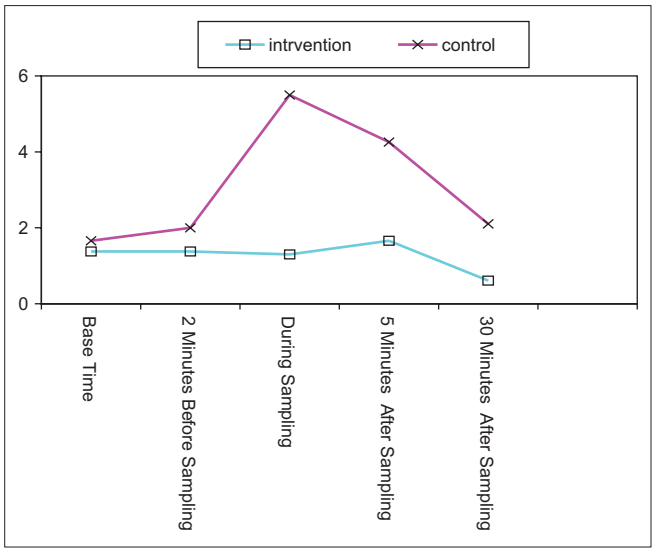


**Figure 1: The comparison of mean pain score at different times during the intervention stage and control stage**

## Discussion

The NICU environment and implementation of health policies in infants causes them discomfort and pain. Developmental care and behavioral and environmental interventions reduce pain in infants indirectly by reducing destructive stimuli and directly by blocking the transmission of pain through the activation of descending pain modulation systems. The implementation of painful procedures in infants in NICUs decreases their pain threshold and increases the severity of their reaction to pain. The results showed that behavioral and environmental interventions, due to reduction of harmful stimuli, decreased the infants' response to pain and increased their pain threshold, and also resulted in more adaptability to painful procedures. In addition, these interventions caused the infant to go through the recovery stage faster. The intervention group showed less pain symptoms 5 minutes and 30 minutes after blood sampling compared to the nonintervention group. This showed that during the intervention the infants in the intervention stage reached the analgesia stage sooner than those in the non-intervention stage.

The numerous studies that have been carried out in this regard have focused only on a specific developmental care in reducing pain.[5,9-12] However, the present research included the simultaneous implementation of a number of environmental and behavioral interventions in accordance with the principles of developmental care. In addition, with the simultaneous implementation of environmental and behavior interventions, this study found more significant results than other studies. This showed that the simultaneous implementation of environmental and behavioral interventions according to developmental care principles provided more suitable conditions that were similar to the uterine environment for the baby. These infants showed signs of significantly less pain during blood sampling under these circumstances. Little research is available regarding the simultaneous implementation of environmental and behavioral interventions, and these studies, with some small differences in working conditions and the type of interventions implemented, reported similar results. This indicated the effectiveness of environmental and behavioral interventions on pain score resulting from different procedures. Catelin *et al*. assessed the impact of environmental and behavioral interventions on biological, behavioral, and physiological responses during weight gain procedures in France. Their study showed that the implementation of environmental and behavioral interventions could significantly reduce the NIPS score.[17] Linda *et al*. implemented environmental and behavioral strategies to prevent and manage pain in 1998.[18] They showed that environmental and behavioral interventions were essential to reducing and managing pain. This review also showed that environmental interventions can reduce the pain associated with this procedure by reducing nursing manipulation, the level of infants' stress, and sound and light.[18] Their findings are in accordance with the study of Lundenberg *et al*. which presents the relation between pain reduction and nursing manipulations.[19] Sizun *et al*. conducted a study on the effect of developmental care on pain symptoms in preterm infants during nursing interventions.[20] They showed that infants that had developmental care before and after weight gain had a significantly lower pain score compared to the nonintervention group.[20] The results of all studies cited were in line with those of the present study and could verify them.

One limitation of this study is the interventions done regularly by the nurses on the babies that the researchers tried to stand behind the babies for all test time to prohibit such interventions.

## Conclusion

Based on the results obtained, the implementation of environmental and behavioral interventions, which are part of the developmental care, can be used as a pain relief option for infants during painful medical and nursing procedures. Training nurses as the main caregivers and advocates of infants and training families regarding the different aspects of developmental care must be considered. Developmental care instructions provided by the Ministry of Health and assessment of developmental care in NICUs can be effective in the improvement of the quality of care for infants. Therefore, it is suggested that through the implementation of these interventions an effective step is taken in order to maintain the physical and mental health of hospitalized infants.

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## Conflicts of interest

There are no conflicts of interest.

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