

## COMPARISON OF THE EFFECT OF NON NUTRITIVE SUCKING AND COLD COMPRESSION ON PAIN DURING HEEL STICK PROCEDURE AMONG PRETERM NEONATES-A RANDOMIZED CLINICAL TRIAL

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Received : 03/11/2023  
Received in revised form : 21/12/2023  
Accepted : 04/01/2024

**Keywords:**

Heel Stick, Pain, Non Nutritive Sucking and Cold Compression.

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DOI: 10.47009/jamp.2024.6.1.170

Source of Support: Nil,  
Conflict of Interest: None declared

*Int J Acad Med Pharm*  
2024; 6 (1); 867-871

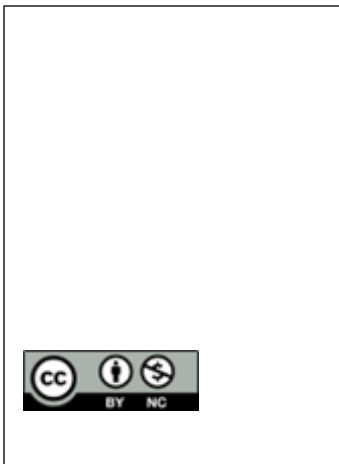
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### Abstract

**Background:** Ten to fourteen grueling operations are performed on infants admitted to the NICU every day. There are both immediate and long-term consequences from these recurrently unpleasant stimuli. There are efficient pharmacological and non-pharmacological ways to manage pain. One of the most popular non-pharmacological techniques for easing an infant's discomfort during a heel prick is non-nutritive sucking. However, this approach need other personnel in addition to the practitioner. Therefore, the need of the hour is for a non-pharmacological technique of managing newborn pain that is more efficient, less expensive, and requires less time and labor. The purpose of the current study was to evaluate the impact of cold compression and nonnutritive sucking on discomfort during heel stick procedures in preterm newborns at JIPMER, Puducherry. **Materials and Methods:** This study employed a basic random sampling strategy in a randomized clinical trial. The preterm newborns who had heel stick procedures were the study's target population. Before the heel stick operation (n=121), nonnutritive sucking was given as opposed to cold compression (n=121). The Neonatal Infant Pain Scale (NIPS) and physiological data were used to measure the result, which was the pain score. The parents were given a brief explanation of the study before providing their informed written permission. The newborns were randomly divided into two groups, Group 1 & Group 2, after the parent's written informed agreement. Utilizing computer-generated random numbers hidden in opaque envelopes stored in the neonatal critical care unit, the allocation was carried out. Clinical characteristics for group 1 were gathered from the case sheet. Before the heel stick operation began, the infant was given non-nutritive sucking (the mother's finger), which was continued both throughout and after the treatment's four minutes. One minute, two minutes, and four minutes following the surgery, the pain score was measured. Clinical features for group 2 were gathered from the case sheet. Before performing the heel stick treatment, cold compression was administered (the ice cube was wrapped in a piece of 2 by 2 gauze) to the outside of the heel region for 20 seconds. The operation was completed during the first, second, and fourth minutes of assessment of discomfort. **Result:** 49 new-borns experienced no discomfort to moderate pain and 14 experienced severe pain during the heel prick in the non-nutritive sucking group, whereas 17 neonates experienced severe pain and 50 had no pain to mild pain in the cold compression group. The non-nutritive sucking group experienced less severe discomfort, but the difference was not statistically significant. Following a one-minute procedure, 119 newborns in the non-nutritive sucking group experienced no pain to mild pain, 2 had mild to moderate pain, and no newborn experienced severe pain. In contrast, 114 newborns in the cold compression group experienced no pain to mild pain, 6 had mild to moderate pain, and 1 had severe pain. Neonatals in the non-nutritive sucking group reported less severe discomfort, but the difference was not statistically significant. Following the



operation, 120 newborns experienced no discomfort to light pain, 1 had medium to moderate pain, while 114 had no pain to mild pain and 7 had mild to moderate pain in the cold compression group after two minutes. More newborns in the cold compression group experienced pain for a longer period of time than the non-nutritive sucking group, and this difference was statistically significant at the  $p < 0.05$  level. In the non-nutritive sucking group, birth weight, gestational age, and gender all had an impact on how painful the surgery was. However, throughout the surgery and even one minute later, the birth weight and gestational age had an impact on the amount of discomfort in the cold compression group. **Conclusion:** In the Neonatal Intensive Care Unit, the use of non-pharmacological pain management techniques for preterm newborns is crucial. Pain management is aided by giving the newborn non-nutritive sucking before an invasive treatment. This easy, non-invasive, low-cost intervention can be utilized as a non-pharmacological way during an uncomfortable operation to help the baby feel more secure and comfortable while having a regulated reaction.

## INTRODUCTION

The International Association for the study of Pain defines pain as "an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage." (IASP).<sup>[1]</sup>

It can be challenging to gauge a baby's level of pain, particularly in premature newborns. The best method for evaluating pain is self-explanatory. Newborns used to communicate their anguish in different ways since they were unable to articulate it as adults could. The fetus begins to experience discomfort during the 25<sup>th</sup> week of pregnancy. All of the pain-modulating receptors and neurotransmitters are present and begin to react. The newborns used to suffer agony because of this. Neonatals experiencing pain will have behavioral and physiological changes. Therefore, behavioral and physiological data will be evaluated in order to determine the pain score. Changes in behavior, such as sobbing, arm movements, body language, and facial expressions, are used to gauge how much pain the baby is experiencing.<sup>[2]</sup> The primary physiological means of expressing pain is via crying. The majority of babies react by moving their bodies more and changing their physiological characteristics.

In order to get blood samples for several diagnostic laboratory testing, NICUs must undergo the uncomfortable and stressful heel prick blood collection technique. Acute pain increases stress and triggers physiological reactions in the body, including breathing difficulties, chest pressure, changes in arterial blood pressure, and organ vasoconstriction. Pain alters the way the central nervous system develops, alters behavior, and seriously harms an infant's psychological health.<sup>[3]</sup>

According to a prospective research, newborns admitted to the neonatal intensive care unit (NICU) average 14.5 operations per day on average  $\pm$  SD. On their first day of care, newborns were subjected to a number of uncomfortable procedures for observation. The researchers discovered that 39.7% of neonates

had not had any analgesic medication, and that less than 35% of newborns got it daily.<sup>[4]</sup>

During their hospital stay, preterm and term newborns may have one to twenty-one heel punctures or venepunctures every day to check their health. Rarely are analgesics used during blood sample procedures.<sup>[5]</sup>

Most doctors perform capillary blood collection of term infants via heel prick as a routine technique. A little incision is created with a needle or lancet for heel pricks, and a drop of blood is collected on a stick or card. It is recommended as part of the regular nationwide screening process for congenital hypothyroidism and phenylketonuria (PKU) in newborns. Additionally, in some situations of jaundice, it is used to estimate serum bilirubin levels and to measure blood glucose in neonates who are hypoglycemia or thought to be hypoglycemic.<sup>[6]</sup>

In order to treat discomfort in preterm newborns, nursing comfort measures should be offered. Nesting, swaddling, breastfeeding, assisted tucking, containment holding, non-nutritive sucking, kangaroo mother care, gentle music, tactile soothing, and having the mother converse with the infant are a few nursing comfort techniques.

One of the most calming and relaxing methods for newborns during painful treatments is non-nutritive sucking. Neonatals can get NNS at any time and in any circumstance. Even in neonatal critical care units, NNS is an inexpensive and efficient way to provide comfort to newborns without the need for specialized training or abilities.<sup>[7]</sup>

Many people use cold compression to ease the discomfort of vaccinations. It is simple to use and readily available. It also takes less time.

## MATERIALS AND METHODS

This chapter provides an explanation of the study's methodology. It covers the following: research design; study setting; population; sample; tool description; tool validity and reliability; data collecting process; data analysis strategy; and human subject protection.

**Research approach:** Research approach used for the present study is quantitative approach.

**Research design:** The research design adopted for the present study was randomized Clinical trial.

**Variables:**

**Independent variables**

- Gestational Age
- Birth weight
- Gender

Outcome variables

Pain Score of the preterm neonates, physiological parameters of pre-term neonates.

Confounding and interacting variables: Nil

**Sample Size:** The sample consisted of 242 Pre-term neonates with gestational age 28- 36 weeks admitted in Neonatal intensive care unit (NICU), JIPMER.

**Inclusion Criteria**

Pre – term neonates admitted in NICU.

Babies with gestational age 28-36 weeks.

Preterm neonates who undergo heel stick procedure with the prerequisite of babies not in cry or sleep.

**Exclusion Criteria**

Pre term neonates who are sick with unstable vital signs.

Preterm neonates who are in any kind of respiratory support (oxygen, Continuous positive airway pressure, high flow nasal cannula and mechanical ventilation).

Preterm neonates who are having congenital defects.

Preterm neonates who received sedatives for 6-8 hrs.

Prior to the procedure.

## RESULTS

The frequency and percentage distribution of pain levels experienced by preterm newborns in the non-nutritive sucking and cold compression groups during the treatment. 49 (40.5%) reported no discomfort to light pain, 58 (47.9%) reported mild to moderate pain, and 14 (11.6%) reported severe pain during non-nutritive sucking. 50 (41.3%) of the groups receiving cold compression reported no discomfort to light pain, 54 (44.7%) reported mild to moderate pain, and 17 (14%), severe pain.

**Table 1: Distribution of the level of pain during the heel stick procedure among preterm neonates in Non Nutritive Sucking and Cold compression groups**

Level of pain	Nonnutritive sucking		Cold compression groups	
	Frequency (N)	Percentage (%)	Frequency (N)	Percentage (%)
No pain to mild pain (0-2)	49	40.5	50	41.3
Mild to moderate pain (3-4)	58	47.9	54	44.7
Severe pain (>4)	14	11.6	17	14

**Table 2: Distribution of the level of pain after 1 minute of the heel stick procedure among preterm neonates in Non-Nutritive Sucking and Cold compression groups**

Level of pain	Nonnutritive sucking		Cold compression groups	
	Frequency (N)	Percentage (%)	Frequency (N)	Percentage (%)
No pain to mild pain (0-2)	119	98.3	114	94.2
Mild to moderate pain (3-4)	2	1.7	6	5
Severe pain (>4)	0	0	1	0.8

**Table 3: Distribution of the physiological parameters in Non-nutritive sucking group**

Sl no.	Physiological parametrs	Before (median, iqr)	During (median, iqr)	1 min (median, iqr)	2 min (median, iqr)	4 min (median, iqr)	P value (fried man test)
1	Heart rate	161,19	166,19	165,18	162,20	156,17	0.000***
2	Respiratory Rate	52,10	58,10	58,12	54, 12	52,10	0.000***
3	Temperature	36.2,0.0	36.2,0.0	36.2,-0.0	32.0,-0.0	36.2,0.0	0.000***
4	Saturation	100,1	100,1	100,1	100,1	100,1	0.000***

The frequency and percentage distribution of discomfort levels among preterm newborns in the non-nutritive sucking and cold compression groups after one minute of the operation. Of those who engaged in non-nutritive sucking, 119 (98.3%) reported no discomfort to mild pain, while 2 (1.7%) reported mild to moderate pain. The bulk of the 114 (94.2%) participants in the cold compression groups reported no discomfort to mild pain, 6 (5%) reported mild to moderate pain, and 1 (0.8%) reported severe pain.

The frequency and percentage distribution of pain levels among preterm newborns in the non-nutritive sucking and cold compression groups two minutes into the operation. One (0.8%) person experienced

mild to severe discomfort during non-nutritive sucking, whereas 120 (99.2%) reported no pain at all. Seven (5.6%) and 114 (94.2%) of the participants in the cold compression groups reported mild to severe discomfort, respectively.

There was significant difference in all physiological parameters over a period of time in the Non-Nutritive Sucking group.

## DISCUSSION

This chapter discusses the study's conclusions, which were arrived at by statistical analysis of the data

gathered, and how they connect to the goals of the investigation as well as pertinent literature reviews.

In this randomized clinical experiment, which took place in the NICU, WCH, and JIPMER, the effects of cold compression and non-nutritive sucking on discomfort during the heel stick procedure among preterm infants were compared.

The parents provided the researcher with their informed consent, and the researcher used a data collecting tool to capture temperature, heart rate, respiration rate, gender, birth weight, gestational age, pain score, and other clinical features. Descriptive and inferential statistics were used to examine the data, and the discussion of the results was organized in accordance with the study's goals. The researcher discovered that in preterm infants, non-nutritive sucking reduces discomfort during heel stick procedures more effectively than cold compression.

#### **Description of the study population**

A total of 242 preterm neonates were included in the study (121 in each group).

#### **The study findings are as follows:**

- Within the 242 research participants, 74 (61.2%) were male and 47 (38.8%) were female in the Non-nutritive Sucking group; similarly, in the Cold Compression group, 69 (57%) were male and 52 (43%) were female.
- Of the 242 participants, 51 (42.1%), 30 (24.8%), and 40 (33.1%) neonates belonged to the non-nutritive sucking group at gestational ages of 28–32 weeks, 32–34 weeks, and 34–36 weeks, respectively. Additionally, in the cold compression group, 38 (31.4%), 30 (24.8%), and 53 (43.8%) neonates corresponded to gestational ages of 28–32 weeks, 32–34 weeks, and 34–36 weeks, respectively.
- Neither of the two groups' 242 participants had any extremely low birth weight babies. In the non-nutritive sucking group, 60 (49.6%) and 43 (35.5%) belonged to the very low birth weight category, respectively. Furthermore, low birth weight individuals comprised 61 (50.4%) and 78 (64.5%) in the non-nutritive sucking group and the cold compression group, respectively.

The first objective was to compare the effect of Non-nutritive sucking and Cold compression in reducing pain during heel prick in preterm neonates.

For newborns in the non-nutritive sucking group, the mother's finger was placed to the baby's mouth prior to the operation, throughout the process, and again four minutes into the procedure. After the operation, the pain score was measured during, one, two, and four minutes. For the newborns in the cold compression group, the heel region was covered with an ice cube wrapped in a piece of 2 \* 2 gauze for 20 seconds prior to the heel stick procedure. A pain score was taken during, one, two, and four minutes following the treatment.

Prior to the heel prick treatment, none of the 242 preterm newborns (121+121) in the non-nutritive sucking group experienced any pain. 49 (40.5%) experienced no discomfort to light pain, 58 (47.9%)

had mild to moderate pain, and 14 (11.6%) had severe pain during the heel prick. The majority of them, 119 (98.3%), experienced no discomfort to mild pain after one minute of the operation, while 2 (1.7%) experienced mild to intense pain. Just 1 (0.8%) patient experienced mild to severe discomfort after the treatment, compared to 120 (99.2%) who experienced no pain at all. Four minutes into the surgery, the newborns showed no signs of suffering. Prior to the heel prick treatment, none of the newborns in the cold compression group experienced any pain. 50 (41.3%) reported no discomfort to light pain, 54 (44.7%) reported mild to moderate pain, and 17 (14%), severe pain during the heel prick. Following a minute of the procedure, 114 (94.2%) of them reported no discomfort to light pain, 6 (5%) reported mild to moderate pain, and 1 (0.8%) reported severe pain. Only 7(5.8%) had mild to moderate pain after the surgery, compared to 114 (94.2%) who reported no discomfort to light pain after two minutes. The neonates had no discomfort after 4 minutes of the treatment. After two minutes of the operation, it was discovered that there was a substantial difference in discomfort between non-nutritive sucking and cold compression ( $p=0.031$ ). Regarding the comparison of the non-nutritive sucking and cold compression groups' mean physiological characteristics with those of premature newborns. It showed that the heart rate and breathing rate in the two groups did not differ statistically significantly. In both groups, there was a statistically significant difference in oxygen saturation and temperature. ( $p<0.001$ )

Because non-nutritive sucking stimulates the newborn sucking reflex, which is triggered by tactile stimulation and relieves acute pain, it acts as a non-opioid mechanism. On the other hand, peripheral nerve conduction time, synaptic activity, and inhibition of sensory receptors are the only ways that local discomfort might lessen pain.

**The above findings were supported by the following studies:** Hai vu et al,<sup>[8]</sup> (2019) conducted The analgesic impact of non-nutritive sucking in term infants was studied in a randomized control experiment. 42 term babies were involved in this randomized controlled trial: 20 infants in the control group (not getting NNS) and 22 infants in the intervention group (receiving NNS). While newborns in the control group got standard care, those in the intervention group received a silicone pacifier 120 seconds before, during, and after the heel puncture. The N-PASS was used to measure pain-related outcomes at 30s, 60s, 90s, and 120s following the heel prick. Any unfavorable outcomes from the operation were documented. At each of the four assessment points, the Spearman correlation coefficients between the N-PASS pain ratings and those on the NFCS and NIPS scales were determined. Compared to the control group, the NNS group experienced significantly lower mean N-PASS pain scores at 30s, 60s, 90s, and 120s after heel prick:  $4.73 \pm 2.78$  vs.  $7.90 \pm 1.52$  ( $p = 0.0002$ );  $3.64 \pm 3.06$  vs.

5.55 ± 2.95 (p = 0.052); 2.59 ± 3.08 vs. 5.25 ± 3.51 (p = 0.011); and 2.05 ± 2.94 vs. 4.90 ± 3.99 (p = 0.013), respectively. In neither group were any negative outcomes noted. Using the N-PASS as an example, NNS is thought to be a safe and efficient way to relieve discomfort during the heel prick procedure in term infants. These results showed correlations with the NFCS and NIPS pain assessments.

Liaw J J et al,<sup>[9]</sup> (2010) conducted a study to assess the effectiveness of nonnutritive sucking in Taiwan in reducing preterm infants' suffering during heel stick operations. Two groups of preterm babies (gestational age 28.9–37 weeks) were randomly assigned to receive non-nutritive sucking (experimental, n = 52) or not during heel stick operations (control, n = 52). The Premature newborn Pain Profile was used to quantify pain before (for three minutes), during, and after (during a 10-minute recovery period) heel stick operations. Additionally, aberrant physiological markers and behavioral abnormalities in the newborn were evaluated. For moderate-to-severe discomfort and pain, infants in the experimental and control groups had odds ratios of 0.58 and 0.57, respectively. The experimental group of babies undergoing heel stick procedures had reduced rates ratios for "grimace" and "hand to mouth or face" behaviors compared to the control group (0.73 and 0.78, respectively). Nurses may be able to provide non-nutritive sucking as a pain relief strategy for preterm newborns having invasive procedures, since it was found to be beneficial in reducing mild to moderate discomfort as well as behavioral reactions to pain in these infants undergoing heel stick procedures.

Arash malakian et al,<sup>[10]</sup> (2017) conducted a study to assess the impact of chilling during heel prick blood collection on newborn discomfort. 68 babies were divided into case and control groups for the research. Boys made up more study participants (60.95%) than girls. At one day of age, all newborns included in the current research had Apgar scores between nine and ten. 90.62% of individuals in the case group had scores less than 4, while 9.37% had scores more than 4. 40.62% of the participants in the control group had scores less than 4, while 59.37% had scores more than 4. The CRIES scores of the groups differed statistically significantly (P-value<0.001). The arterial oxygen saturation level did not significantly differ between the case and control groups. This study shown that applying local cold can lessen babies' suffering from both early and late problems related to heel prick blood collecting.

The second objective was to identify the association of pain score with clinical characteristics of pre-term neonates.

The association of level of pain with clinical characteristics of preterm neonates such as gender,

gestational age and birth weight was calculated by using Chi-square test.

In the non-nutritive sucking group, the researcher discovered a strong correlation (p<0.001) between the amount of pain experienced during the surgery and birth weight, gender, and gestational age. However, there was a significant correlation (p<0.001) between the heel stick procedure's pain level and the birth weight and gestational age in the cold compression group, as well as a significant correlation (p<0.05) between the procedure's pain level and pregnant age after one minute.

## CONCLUSION

According to our research, non-nutritive sucking can be a helpful intervention that nurses can offer to preterm babies undergoing invasive procedures in order to lessen discomfort in general and behavioral reactions to pain in particular. Using non-pharmacological pain management strategies for preterm infants is essential in the Neonatal Intensive Care Unit. Giving the newborn non-nutritive sucking before to an invasive procedure helps with pain control. During a painful procedure, this simple, low-cost, non-invasive intervention can be used as a non-pharmacological technique to assist the infant feel more secure and comfortable while having a regulated reaction.

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