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Analgetic effect of non-nutritive sucking for neonates during invasive procedures

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**Abstract :** Background: Neonates treated in the Neonatal Intensive Care Unit often receive invasive procedures that can cause pain. The aim of this study was to analyze the effectiveness of non-nutritive sucking as an analgesic for neonates who were given invasive procedures. Methodology: This experimental study implemented a post-test-only control group design, involving 64 neonates in the Neonatal Intensive Care Unit, selected using a simple random sampling technique, who were then divided into a treatment group and a control group, 32 neonates each. The treatment group was given non-nutritive sucking, while the control group was given standard intervention, then the pain response was measured in both groups. Next, the pain levels of the two groups were compared using the Mann-Whitney U test. Results: The measurement results showed that there was a difference in the mean scores of pain response between treatment and control group, respectively 1.53125 and 5.8125. The p-value of the difference test was 0.000000004252, so it could be interpreted that there was a significant difference in pain levels between the two groups. Conclusion: It was concluded that non-nutritive sucking is an effective method for reducing the pain response in neonates during invasive procedures.

**Keywords :** Infant; Pacifiers; Pain management

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## ORIGINAL RESEARCH

### Analgetic effect of non-nutritive sucking for neonates during invasive procedures

Tri Ratnaningsih<sup>1</sup>, Tri Peni<sup>2</sup>, Nafidatul Firdausiyah<sup>3</sup>, Heru Santoso Wahito Nugroho<sup>4</sup>

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#### ABSTRACT

**Background:** Neonates treated in the Neonatal Intensive Care Unit often receive invasive procedures that can cause pain. The aim of this study was to analyze the effectiveness of non-nutritive sucking as an analgesic for neonates who were given invasive procedures.

**Methodology:** This experimental study implemented a post-test-only control group design, involving 64 neonates in the Neonatal Intensive Care Unit, selected using a simple random sampling technique, who were then divided into a treatment group and a control group, 32 neonates each. The treatment group was given non-nutritive sucking, while the control group was given standard intervention, then the pain response was measured in both groups. Next, the pain levels of the two groups were compared using the Mann-Whitney U test.

**Results:** The measurement results showed that there was a difference in the mean scores of pain response between treatment and control group, respectively 1.53125 and 5.8125. The p-value of the difference test was 0.000000004252, so it could be interpreted that there was a significant difference in pain levels between the two groups.

**Conclusion:** It was concluded that non-nutritive sucking is an effective method for reducing the pain response in neonates during invasive procedures.

**Keywords:** Infant; Pacifiers; Pain management



## 1. INTRODUCTION

Neonates as babies who are less than a month old must adapt to extraordinary changes, namely from intrauterine life to extrauterine life, as well as the growth and development of all systems in their body as an organism.<sup>1-3</sup> Therefore, the neonatal phase is a very vulnerable period for the baby; especially if the baby has to be faced with a situation that requires intensive care in hospital (hospitalization).<sup>4-6</sup>

There are many things that cause a baby to have to be given intensive care, for example the baby is born without crying immediately (asphyxia), birth weight below normal, amniotic fluid poisoning mixed with meconium, congenital abnormalities and so on. While undergoing intensive care, neonates require various invasive procedures, such as the installation of a venous catheter (infusion) for parenteral therapy, taking venous or arterial blood samples, and so on. Conditions like those mentioned above cause various problems for babies.<sup>7-9</sup> Several previous studies reported that invasive procedures on neonates in the intensive care unit can cause stress with a relatively high prevalence and skin damage.<sup>10-12</sup>

A preliminary study conducted in the Neonatal Intensive Care Unit (NICU) of Bangil Regional Hospital, Indonesia using medical record data from August to October 2022, showed that all babies (100%) had to undergo invasive procedures, such as taking blood samples for laboratory tests, intravenous procedures for therapy, intramuscular injections and so on. More than 75% of these babies were given infusion procedures and several venous catheter changes according to their respective conditions. The average frequency of replacing a venous catheter is three times in twelve days of treatment, or at least once every 3 days according to local standard operating procedures.<sup>13</sup>

Of course, invasive procedures that injure the skin and underlying tissue will have impacts, both in the short and long term. The main short-term impact is causing pain, which can then have an impact on behavioral changes and physiological changes in babies, such as changes in cardiovascular status, metabolism, intracranial pressure, resulting in increased morbidity and mortality. Meanwhile, long-term impacts that can arise are neurobehavior disorders, motor disorders, functional disorders, and developmental delays.<sup>14</sup>

As a real short-term impact of invasive procedures on neonates, pain must receive immediate and serious attention so that the pain response can be reduced and complications can be minimized as much as possible.<sup>15</sup> Pain management that can be carried out by nurses independently, safely and does not require expensive costs, is by non-pharmacological methods.<sup>16-18</sup> Many non-pharmacological methods have been used, such as direct breastfeeding, the kangaroo method, fixation with swaddling clothes, and also using non-nutritive sucking.<sup>19-21</sup>

Non-nutritive sucking is a baby's oral activity using a pacifier which can stimulate the baby's sucking response without providing nutrition or other food to the baby.<sup>22</sup> There have been previous studies on non-nutritive sucking interventions to reduce pain responses in various settings such as in the postpartum care room,<sup>23</sup> in the ophthalmology care unit<sup>24</sup> and most importantly in the NICU.<sup>25</sup> Of course, in the NICU, many invasive procedures are carried out as part of intensive care which cause a pain response in neonates so they require more special attention.<sup>11</sup>

Previous research on the use of non-nutritive sucking in the NICU has been carried out in many previous studies, but the control variables are still different,<sup>23-25</sup> so it needs to be researched again with different control variables, namely including sex, maturity, age, weight, type of invasive procedure and frequency of invasive procedure. Therefore, by enriching these control variables, research was conducted with the aim of analyzing the effectiveness of non-invasive sucking to reduce pain levels in neonates who received invasive treatment in the form of infusion.

## 2. METHODOLOGY

This research was an experimental study with a post test only with control group design. The study population was neonates aged less than 1 month with invasive procedures (infusion) in the NICU at Bangil Regional Hospital, Pasuruan, Indonesia. The sample size was 64 neonates selected using random sampling technique. The inclusion criteria in sampling were: 1) had a good general condition, but were still undergoing treatment in the NICU at Bangil Regional Hospital; 2) be calm before any invasive action was carried out; 3) able to display the sucking reflex; 4) could not get breast milk directly from the mother because the condition of the mother and/or baby had not recovered. The exclusion criteria were: 1) experiencing a respiratory emergency (with a Down Score  $\geq 6$ ), with an endotracheal tube inserted; 2) had congenital abnormalities or motor disorders; 3) post-operative. The sample was divided into two, namely the treatment group and the control group, each consisting of 32 neonates.

As is the principle of experimental studies, the independent variable was treatment, namely the provision of non-nutritive sucking, with 2 categories, namely given and not given, respectively for the treatment group and the control group. When an invasive procedure was carried out in the form of an infusion, the treatment group was given non-nutritive sucking to suck for 2 minutes before installing the infusion; while the control group followed daily standards, namely not being given non-nutritive sucking.

The dependent variable was the pain response in neonates when invasive procedures (infusion) are performed. Thus, in both groups pain responses were measured using the Neonatal Infant Pain Scale (NIPS), which includes 6 indicators, namely facial expressions, crying, breathing patterns, arm movements, leg movements, and alert status. From the scoring results, the categories of no pain, mild-moderate pain (non-pharmacological pain management with re-assessment at the 30th minute), and severe pain (pharmacological and non-pharmacological pain management with re-assessment at the 30th minute) would be obtained, with a total of the maximum score was 7.

To ensure equality between the two groups, a test for equality of sex, age, maturity, body weight and frequency of invasive procedures on neonates was carried out using the Chi-square test because the data was categorical. Next, the Mann-Whitney U test was carried out to compare the level of pain between neonates who were and were not given non-nutritive sucking.

This research had applied the principles of health research ethics and was proven by a certificate of ethical suitability from the STIKes Mojopahit Health Research Ethics Committee, with Number: 069/KEPK-SM/2023.

## 3. RESULTS

To ensure equality in the characteristics of neonates between those given and not given non-nutritive sucking treatment, an equality test was first carried out which includes four aspects, namely sex, age of the neonates, maturity of the neonates based on gestational age at birth and birth weight of the neonates. The results of the Chi-square test for the four variables showed that the p value was more than 0.05, so it could be interpreted that there were no differences in sex, age, gestational age at birth and birth weight between the treatment group and the control group (Table 1). This showed that the two groups were relatively equal, so that measurement bias in comparing intervention results for the two groups could be minimized.

Table 1: Results of tests for equality of neonate characteristics between groups given and not given non-nutritive sucking

Neonates characteristics		Given non-nutrive sucking		Not given non-nutrive sucking		p-value
		Frequency	Percentage	Frequency	Percentage	
Sex	Male	20	63	17	53	0.4623
	Female	12	37	15	47	
Age (days)	0-7	25	78	28	88	0.3464
	8-28	7	22	4	12	
Gestational age (weeks)	<37	23	72	22	69	0.3533
	37-41	9	28	8	25	
	>42	0	0	2	6	
Birth weight (gram)	>2500	8	25	4	13	0.4550
	1500-2500	16	50	22	68	
	1000-1500	7	22	5	16	
	<1000	1	3	1	3	

The results of measuring the pain response in the two groups showed that there was a significant difference in the mean scores of pain response between the groups that were given and not given non-nutritive sucking, respectively 1.53125 and 5.8125. In the pain level range of 0 to 7, it appears that the difference in the mean pain scores of the two groups was quite large. The results of the Mann-Whitney U test showed that there was a significant difference in pain response scores between the groups given and not given, as indicated by the p value = 0.000000004252 (Table 2).

Table 2: Results of analysis of differences in mean scores of pain response between groups given and not given non-nutritive sucking

Statistics	Given non-nutrive sucking	Not given non-nutrive sucking	p-value (Mann-Whitney U)
Mean	1.53125	5.8125	0,000000004252
Standard deviation	0.87931	1.119836	
Minimum-Maximum	0-3	3-7	
Range	3	4	

#### 4. DISCUSSION

All invasive procedures performed on patients will cause a pain response,<sup>26</sup> including neonates who receive infusion procedures. Pain resulting from this invasive procedure is classified as nociceptive pain which involves nociceptors due to tissue damage at the site of invasion. It needs to be understood that nociceptive pain is part of the body's defense which is a warning that something has happened that damages tissue integrity. The pain response makes the individual aware that tissue damage has occurred so that further damage can be anticipated. However, nociceptive pain often bothers patients, especially those who have a low pain threshold.<sup>27</sup> Because this painful feeling often bothers patients, good treatment is needed, both pharmacological and non-pharmacological,<sup>28</sup> and non-nutritive sucking is one of the options for non-pharmacological methods that can be applied very easily and very cheaply.<sup>29</sup>

The results of this study indicate that non-nutritive sucking is effective in reducing the pain response in neonates when invasive infusion procedures are carried out in the NICU. For neonates, the mouth is the main instrument for receiving stimulation and pleasure, therefore non-nutritive sucking is an intervention to minimize pain according to needs to strengthen optimal physical, psychosocial and neurological development.<sup>30</sup> So the pain felt by neonates in the group given non-nutritive sucking was much lower than the pain felt by neonates who did not receive non-nutritive sucking, because they focused their attention on the stimulation received through their mouths. This shows that non-nutritive sucking is an effective non-

pharmacological method for reducing pain in babies, as has been proven in previous research in various settings such as postpartum care rooms,<sup>23</sup> ophthalmology care units,<sup>24</sup> intensive care units<sup>25</sup> and so on.

Non-nutritive sucking is a sucking action that is not accompanied by food intake, which is often used as a method to calm babies.<sup>31</sup> Various studies have shown that non-nutritive sucking is effective in reducing the pain response in babies, especially during invasive procedures such as blood sampling, drug injection and so on.<sup>32</sup> The mechanism behind the analgesic effect of non-nutritive sucking is not fully understood, but it is believed that non-nutritive sucking stimulates the release of endorphins, which are the body's natural analgesics, and can distract the baby from pain. In addition, non-nutritive sucking can help stabilize heart rate and blood oxygenation, which can be disrupted due to pain. Research also shows that the combination of non-nutritive sucking with the administration of sweet solutions, such as sucrose, can further increase the analgesic effect on babies during invasive procedures.<sup>33</sup>

Although many studies on non-nutritive sucking have been carried out on babies, this research attempts to control the influence of several confounding factors, the first of which is to homogenize the confounding factors by setting them as inclusion criteria, namely that the type of invasive action is limited specifically to infusions only. Apart from that, it also ensures the homogeneity of several other factors through an equality test between the treatment group and the control group before carrying out a comparison test. The factors in question include sex, age of the baby, gestational age when the baby is born (baby maturity) and the baby's weight. Of course, by homogenizing these confounding factors, more accurate analysis results will be obtained because biases from confounding factors can be minimized. It is hoped that these more accurate results will further convince units providing neonatal care that non-nutritive sucking is very important for improving the quality of services, especially those related to invasive procedures.

Seeing the effectiveness of non-nutritive sucking in reducing the pain response as described above, this intervention deserves to be promoted massively, especially in relation to invasive procedures on babies in hospitals. To promote the use of non-nutritive sucking, the first step is to provide comprehensive education to health staff regarding the benefits and techniques for implementing non-nutritive sucking. Studies have shown that non-nutritive sucking can be effective in reducing pain during invasive procedures in neonates, especially as measured by infant-specific methods such as NIPS or perhaps other methods to assess effectiveness. Furthermore, it is important to integrate non-nutritive sucking into standard patient care protocols, including training for nurses and physicians on how to implement non-nutritive sucking safely and effectively. Non-nutritive sucking can be combined with other interventions such as oral sucrose administration, which has also been shown to be effective in reducing the pain response in neonates during invasive procedures. Of course, this should be implemented within an evidence base practice framework, which requires further research locally, to verify again that this intervention is truly effective. Additionally, use as a non-pharmacological pain management should be well documented in the patient's medical record to ensure continuity of care and ongoing evaluation of outcomes. With a multidisciplinary approach and commitment to evidence-based practice, promotion of non-nutritive sucking can improve the comfort and quality of care for neonates undergoing invasive procedures in hospital settings.<sup>30</sup>

Thus, efforts need to be made so that providing non-nutritive sucking in invasive procedures for babies, especially in the NICU, can be prioritized as a permanent procedure in hospitals. Of course, to decide whether it is a priority program, it must go through accurate methods, for example USG (urgency, seriousness and growth),<sup>34</sup> difficulty-usefulness pyramid (DUP),<sup>35-38</sup> quadrant of difficulty-usefulness (QoDU)<sup>39,40</sup> or others.

## **5. Strengths and weakness**

Strengths: This research applies a practical intervention that can be implemented very easily, cheaply and simply. Weaknesses: the scope of this study is limited to neonates in the NICU, which could actually be developed in other care units.

## 6. CONCLUSION

Based on the results of this research, it was concluded that non-nutritive sucking is an effective method for reducing the pain response in neonates during invasive procedures.

## 7. Data availability

Data presented in this study will be available on a fair request to the corresponding author of first author.

## 8. Acknowledgment

Highest thanks are expressed to all leaders of Universitas Bina Sehat PPNI, Mojokerto, Indonesia who have facilitated this research and publication.

## 9. Conflict of interest

All authors declare no conflict of interest.

## 10. Author's contribution

Based on the results of this research, it was concluded that non-nutritive sucking is an effective method for reducing the pain response in neonates during invasive procedures.

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Table 1: Results of tests for equality of neonate characteristics between groups given and not given non-nutritive sucking

Neonates characteristics	Given non-nutrive sucking	Not given non-nutrive sucking	p-value
--------------------------	---------------------------	-------------------------------	---------

		Frequency	Percentage	Frequency	Percentage	
Sex	Male	20	63	17	53	0.4623
	Female	12	37	15	47	
Age (days)	0-7	25	78	28	88	0.3464
	8-28	7	22	4	12	
Gestational age (weeks)	<37	23	72	22	69	0.3533
	37-41	9	28	8	25	
	>42	0	0	2	6	
Birth weight (gram)	>2500	8	25	4	13	0.4550
	1500-2500	16	50	22	68	
	1000-1500	7	22	5	16	
	<1000	1	3	1	3	

Table 2: Results of analysis of differences in mean scores of pain response between groupsgiven and not given non-nutritive sucking

Statistics	Given non-nutrive sucking	Not given non-nutrive sucking	p-value (Mann-Whitney U)
Mean	1.53125	5.8125	0,000000004252
Standard deviation	0.87931	1.119836	
Minimum-Maximum	0-3	3-7	
Range	3	4	

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## Anaesth. pain intensive care

### Analgetic effect of non-nutritive sucking for neonates during invasive procedures

**Journal Name :** Anaesthesia, Pain & Intensive Care

**Manuscript ID :** APIC-2024-04-080

**Manuscript Type :** Original Research

**Submission Date :** 27-Apr-2024

**Abstract :** Background: Neonates treated in the Neonatal Intensive Care Unit often receive invasive procedures that can cause pain. The aim of this study was to analyze the effectiveness of non-nutritive sucking as an analgesic for neonates who were given invasive procedures. Methodology: This experimental study implemented a post-test-only control group design, involving 64 neonates in the Neonatal Intensive Care Unit, selected using a simple random sampling technique, who were then divided into a treatment group and a control group, 32 neonates each. The treatment group was given non-nutritive sucking, while the control group was given standard intervention, then the pain response was measured in both groups. Next, the pain levels of the two groups were compared using the Mann-Whitney U test. Results: The measurement results showed that there was a difference in the mean scores of pain response between treatment and control group, respectively 1.53125 and 5.8125. The p-value of the difference test was 0.00000004252, so it could be interpreted that there was a significant difference in pain levels between the two groups. Conclusion: It was concluded that non-nutritive sucking is an effective method for reducing the pain response in neonates during invasive procedures.

**Keywords :** Infant; Non-nutritive sucking; Pain management; Neonatal intensive care

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# 1 ORIGINAL RESEARCH

2

3 Analgetic effect of non-nutritive sucking for neonates during invasive procedures

4

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19

## 20 ABSTRACT

21

22 **Background:** Neonates treated in the Neonatal Intensive Care Unit often receive invasive  
23 procedures that can cause pain. The aim of this study was to analyze the effectiveness of non-  
24 nutritive sucking as an analgesic for neonates who were given invasive procedures.

25 **Methodology:** This experimental study implemented a post-test-only control group design,  
26 involving 64 neonates in the Neonatal Intensive Care Unit, selected using a simple random  
27 sampling technique, who were then divided into a treatment group and a control group, 32  
28 neonates each. The treatment group was given non-nutritive sucking, while the control group  
29 was given standard intervention, then the pain response was measured in both groups. Next,  
30 the pain levels of the two groups were compared using the Mann-Whitney U test.

31 **Results:** The measurement results showed that there was a difference in the mean scores of  
32 pain response between treatment and control group, respectively 1.53125 and 5.8125. The p-  
33 value of the difference test was 0.000000004252, so it could be interpreted that there was a  
34 significant difference in pain levels between the two groups.

35 **Conclusion:** It was concluded that non-nutritive sucking is an effective method for reducing  
36 the pain response in neonates during invasive procedures.

37 **Keywords:** Infant; Non-nutritive sucking; Pain management; Neonatal intensive care

38

39

40



## 411. INTRODUCTION

42

43 Neonates as babies who are less than a month old must adapt to extraordinary changes, namely  
44 from intrauterine life to extrauterine life, as well as the growth and development of all systems  
45 in their body as an organism.<sup>1-3</sup> Therefore, the neonatal phase is a very vulnerable period for  
46 the baby; especially if the baby has to be faced with a situation that requires intensive care in  
47 hospital (hospitalization).<sup>4-6</sup>

48 There are many things that cause a baby to have to be given intensive care, for example the  
49 baby is born without crying immediately (asphyxia), birth weight below normal, amniotic fluid  
50 poisoning mixed with meconium, congenital abnormalities and so on. While undergoing  
51 intensive care, neonates require various invasive procedures, such as the installation of a  
52 venous catheter (infusion) for parenteral therapy, taking venous or arterial blood samples, and  
53 so on. Conditions like those mentioned above cause various problems for babies.<sup>7-9</sup> Several  
54 previous studies reported that invasive procedures on neonates in the intensive care unit can  
55 cause stress with a relatively high prevalence and skin damage.<sup>10-12</sup>

56 A preliminary study conducted in the Neonatal Intensive Care Unit (NICU) of Bangil Regional  
57 Hospital, Indonesia using medical record data from August to October 2022, showed that all  
58 babies (100%) had to undergo invasive procedures, such as taking blood samples for laboratory  
59 tests, intravenous procedures for therapy, intramuscular injections and so on. More than 75%  
60 of these babies were given infusion procedures and several venous catheter changes according  
61 to their respective conditions. The average frequency of replacing a venous catheter is three  
62 times in twelve days of treatment, or at least once every 3 days according to local standard  
63 operating procedures.<sup>13</sup>

64 Of course, invasive procedures that injure the skin and underlying tissue will have impacts,  
65 both in the short and long term. The main short-term impact is causing pain, which can then  
66 have an impact on behavioral changes and physiological changes in babies, such as changes in  
67 cardiovascular status, metabolism, intracranial pressure, resulting in increased morbidity and  
68 mortality. Meanwhile, long-term impacts that can arise are neurobehavior disorders, motor  
69 disorders, functional disorders, and developmental delays.<sup>14</sup>

70 As a real short-term impact of invasive procedures on neonates, pain must receive immediate  
71 and serious attention so that the pain response can be reduced and complications can be  
72 minimized as much as possible.<sup>15</sup> Pain management that can be carried out by nurses  
73 independently, safely and does not require expensive costs, is by non-pharmacological  
74 methods.<sup>16-18</sup> Many non-pharmacological methods have been used, such as direct  
75 breastfeeding, the kangaroo method, fixation with swaddling clothes, and also using non-  
76 nutritive sucking.<sup>19-21</sup>

77 Non-nutritive sucking is a baby's oral activity using a pacifier which can stimulate the baby's  
78 sucking response without providing nutrition or other food to the baby.<sup>22</sup> There have been  
79 previous studies on non-nutritive sucking interventions to reduce pain responses in various  
80 settings such as in the postpartum care room,<sup>23</sup> in the ophthalmology care unit<sup>24</sup> and most  
81 importantly in the NICU.<sup>25</sup> Of course, in the NICU, many invasive procedures are carried out  
82 as part of intensive care which cause a pain response in neonates so they require more special  
83 attention.<sup>11</sup>

84 Previous research on the use of non-nutritive sucking in the NICU has been carried out in many  
85 previous studies, but the control variables are still different,<sup>23-25</sup> so it needs to be researched  
86 again with different control variables, namely including sex, maturity, age, weight, type of  
87 invasive procedure and frequency of invasive procedure. Therefore, by enriching these control  
88 variables, research was conducted with the aim of analyzing the effectiveness of non-invasive  
89 sucking to reduce pain levels in neonates who received invasive treatment in the form of  
90 infusion.

## 92.2. METHODOLOGY

93

94 This research was an experimental study with a post test only with control group design. The  
95 study population was neonates aged less than 1 month with invasive procedures (infusion) in  
96 the NICU at Bangil Regional Hospital, Pasuruan, Indonesia. The sample size was 64 neonates  
97 selected using random sampling technique. The inclusion criteria in sampling were: 1) had a  
98 good general condition, but were still undergoing treatment in the NICU at Bangil Regional  
99 Hospital; 2) be calm before any invasive action was carried out; 3) able to display the sucking  
100 reflex; 4) could not get breast milk directly from the mother because the condition of the mother  
101 and/or baby had not recovered. The exclusion criteria were: 1) experiencing a respiratory  
102 emergency (with a Down Score  $\geq 6$ ), with an endotracheal tube inserted; 2; had congenital  
103 abnormalities or motor disorders; 3) post-operative. The sample was divided into two, namely  
104 the treatment group and the control group, each consisting of 32 neonates.

105 As is the principle of experimental studies, the independent variable was treatment, namely the  
106 provision of non-nutritive sucking, with 2 categories, namely given and not given, respectively  
107 for the treatment group and the control group. When an invasive procedure was carried out in  
108 the form of an infusion, the treatment group was given non-nutritive sucking to suck for 2  
109 minutes before installing the infusion; while the control group followed daily standards, namely  
110 not being given non-nutritive sucking.

111 The dependent variable was the pain response in neonates when invasive procedures (infusion)  
112 are performed. Thus, in both groups pain responses were measured using the Neonatal Infant  
113 Pain Scale (NIPS), which includes 6 indicators, namely facial expressions, crying, breathing  
114 patterns, arm movements, leg movements, and alert status. From the scoring results, the  
115 categories of no pain, mild-moderate pain (non-pharmacological pain management with re-  
116 assessment at the 30th minute), and severe pain (pharmacological and non-pharmacological  
117 pain management with re-assessment at the 30th minute) would be obtained, with a total of the  
118 maximum score was 7.

119 To ensure equality between the two groups, a test for equality of sex, age, maturity, body weight  
120 and frequency of invasive procedures on neonates was carried out using the Chi-square test  
121 because the data was categorical. Next, the Mann-Whitney U test was carried out to compare  
122 the level of pain between neonates who were and were not given non-nutritive sucking.

123 This research had applied the principles of health research ethics and was proven by a  
124 certificate of ethical suitability from the STIKes Mojopahit Health Research Ethics Committee,  
125 with Number: 069/KEPK-SM/2023.

126

### 127 3. RESULTS

128

129 To ensure equality in the characteristics of neonates between those given and not given non-  
130 nutritive sucking treatment, an equality test was first carried out which includes four aspects,  
131 namely sex, age of the neonates, maturity of the neonates based on gestational age at birth and  
132 birth weight of the neonates. The results of the Chi-square test for the four variables showed  
133 that the p value was more than 0.05, so it could be interpreted that there were no differences in  
134 sex, age, gestational age at birth and birth weight between the treatment group and the control  
135 group (Table 1). This showed that the two groups were relatively equal, so that measurement  
136 bias in comparing intervention results for the two groups could be minimized.

137

138 Table 1: Results of tests for equality of neonate characteristics between groups given and not  
139 given non-nutritive sucking

140

Neonates characteristics		Given non-nutrive sucking		Not given non-nutrive sucking		p-value
		Frequency	Percentage	Frequency	Percentage	
Sex	Male	20	63	17	53	0.4623
	Female	12	37	15	47	
Age (days)	0-7	25	78	28	88	0.3464
	8-28	7	22	4	12	
Gestational age (weeks)	<37	23	72	22	69	0.3533
	37-41	9	28	8	25	
	>42	0	0	2	6	
Birth weight (gram)	>2500	8	25	4	13	0.4550
	1500-2500	16	50	22	68	
	1000-1500	7	22	5	16	
	<1000	1	3	1	3	

141

142 The results of measuring the pain response in the two groups showed that there was a significant  
143 difference in the mean scores of pain response between the groups that were given and not  
144 given non-nutritive sucking, respectively 1.53125 and 5.8125. In the pain level range of 0 to 7,  
145 it appears that the difference in the mean pain scores of the two groups was quite large. **It was  
146 seen that neonates who received non-nutritive sucking had a much lower level of pain than  
147 neonates who did not receive non-nutritive sucking.** The results of the Mann-Whitney U test  
148 showed that there was a significant difference in pain response scores between the groups given  
149 and not given, as indicated by the p value = 0.000000004252 (Table 2). **The results of this  
150 analysis show that providing non-nutritive sucking is actually able to divert the neonate's  
151 attention from the pain stressor caused by invasive procedures. Thus, it can be said that non-  
152 nutritive sucking is effective in reducing the pain response in neonates who receive invasive  
153 procedures.**

154

155 Table 2: Results of analysis of differences in mean scores of pain response between groups  
156 given and not given non-nutritive sucking

157

Statistics	Given non-nutrive sucking	Not given non-nutrive sucking	p-value (Mann-Whitney U)
Mean	1.53125	5.8125	0,000000004252
Standard deviation	0.87931	1.119836	
Minimum-Maximum	0-3	3-7	
Range	3	4	

158

#### 159 4. DISCUSSION

160

161 All invasive procedures performed on patients will cause a pain response,<sup>26</sup> including neonates  
162 who receive infusion procedures. Pain resulting from this invasive procedure is classified as  
163 nociceptive pain which involves nociceptors due to tissue damage at the site of invasion. It  
164 needs to be understood that nociceptive pain is part of the body's defense which is a warning  
165 that something has happened that damages tissue integrity. The pain response makes the  
166 individual aware that tissue damage has occurred so that further damage can be anticipated.  
167 However, nociceptive pain often bothers patients, especially those who have a low pain  
168 threshold.<sup>27</sup> Because this painful feeling often bothers patients, good treatment is needed, both

169 pharmacological and non-pharmacological;<sup>28</sup> and non-nutritive sucking is one of the options  
170 for non-pharmacological methods that can be applied very easily and very cheaply.<sup>29</sup>  
171 The results of this study indicate that non-nutritive sucking is effective in reducing the pain  
172 response in neonates when invasive infusion procedures are carried out in the NICU. For  
173 neonates, the mouth is the main instrument for receiving stimulation and pleasure, therefore

174 non-nutritive sucking is an intervention to minimize pain according to needs to strengthen  
175 optimal physical, psychosocial and neurological development.<sup>30</sup> So the pain felt by neonates in  
176 the group given non-nutritive sucking was much lower than the pain felt by neonates who did  
177 not receive non-nutritive sucking, because they focused their attention on the stimulation  
178 received through their mouths. This shows that non-nutritive sucking is an effective non-  
179 pharmacological method for reducing pain in babies, as has been proven in previous research  
180 in various settings such as postpartum care rooms,<sup>23</sup> ophthalmology care units,<sup>24</sup> intensive care  
181 units<sup>25</sup> and so on.

182 Non-nutritive sucking is a sucking action that is not accompanied by food intake, which is often  
183 used as a method to calm babies.<sup>31</sup> Various studies have shown that non-nutritive sucking is  
184 effective in reducing the pain response in babies, especially during invasive procedures such  
185 as blood sampling, drug injection and so on.<sup>32</sup> The mechanism behind the analgesic effect of  
186 non-nutritive sucking is not fully understood, but it is believed that non-nutritive sucking  
187 stimulates the release of endorphins, which are the body's natural analgesics, and can distract  
188 the baby from pain. In addition, non-nutritive sucking can help stabilize heart rate and blood  
189 oxygenation, which can be disrupted due to pain. Research also shows that the combination of  
190 non-nutritive sucking with the administration of sweet solutions, such as sucrose, can further  
191 increase the analgesic effect on babies during invasive procedures.<sup>33</sup>

192 Although many studies on non-nutritive sucking have been carried out on babies, this research  
193 attempts to control the influence of several confounding factors, the first of which is to  
194 homogenize the confounding factors by setting them as inclusion criteria, namely that the type  
195 of invasive action is limited specifically to infusions only. Apart from that, it also ensures the  
196 homogeneity of several other factors through an equality test between the treatment group and  
197 the control group before carrying out a comparison test. The factors in question include sex,  
198 age of the baby, gestational age when the baby is born (baby maturity) and the baby's weight.  
199 Of course, by homogenizing these confounding factors, more accurate analysis results will be  
200 obtained because biases from confounding factors can be minimized. It is hoped that these  
201 more accurate results will further convince units providing neonatal care that non-nutritive  
202 sucking is very important for improving the quality of services, especially those related to  
203 invasive procedures.

204 Seeing the effectiveness of non-nutritive sucking in reducing the pain response as described  
205 above, this intervention deserves to be promoted massively, especially in relation to invasive  
206 procedures on babies in hospitals. To promote the use of non-nutritive sucking, the first step is  
207 to provide comprehensive education to health staff regarding the benefits and techniques for  
208 implementing non-nutritive sucking. Studies have shown that non-nutritive sucking can be  
209 effective in reducing pain during invasive procedures in neonates, especially as measured by  
210 infant-specific methods such as NIPS or perhaps other methods to assess effectiveness.  
211 Furthermore, it is important to integrate non-nutritive sucking into standard patient care  
212 protocols, including training for nurses and physicians on how to implement non-nutritive  
213 sucking safely and effectively. Non-nutritive sucking can be combined with other interventions  
214 such as oral sucrose administration, which has also been shown to be effective in reducing the  
215 pain response in neonates during invasive procedures. Of course, this should be implemented  
216 within an evidence base practice framework, which requires further research locally, to verify  
217 again that this intervention is truly effective. Additionally, use as a non-pharmacological pain  
218 management should be well documented in the patient's medical record to ensure continuity of  
219 care and ongoing evaluation of outcomes. With a multidisciplinary approach and commitment  
220 to evidence-based practice, promotion of non-nutritive sucking can improve the comfort and  
221 quality of care for neonates undergoing invasive procedures in hospital settings.<sup>30</sup>

222 Thus, efforts need to be made so that providing non-nutritive sucking in invasive procedures  
223 for babies, especially in the NICU, can be prioritized as a permanent procedure in hospitals. Of

224 course, to decide whether it is a priority program, it must go through accurate methods, for  
225 example USG (urgency, seriousness and growth),<sup>34</sup> difficulty-usefulness pyramid (DUP),<sup>35-38</sup>  
226 quadrant of difficulty-usefulness (QoDU)<sup>39,40</sup> or others.  
227

## 228 5. Strengths and weakness

229 Strengths: This research applies a practical intervention that can be implemented very easily,  
230 cheaply and simply. Weaknesses: the scope of this study is limited to neonates in the NICU,  
231 which could actually be developed in other care units.  
232

## 233 6. CONCLUSION

234  
235 Based on the results of this research, it was concluded that non-nutritive sucking is an effective  
236 method for reducing the pain response in neonates during invasive procedures.  
237

## 238 7. Data availability

239  
240 Data presented in this study will be available on a fair request to the corresponding author of  
241 first author.  
242

## 243 8. Acknowledgment

244  
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246 Indonesia who have facilitated this research and publication.  
247

## 248 9. Conflict of interest

249  
250 All authors declare no conflict of interest.  
251

## 252 10. Author's contribution

253  
254 Based on the results of this research, it was concluded that non-nutritive sucking is an effective  
255 method for reducing the pain response in neonates during invasive procedures.  
256

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Table 1: Results of tests for equality of neonate characteristics between groups given and not given non-nutritive sucking

Neonates characteristics	Given non-nutrive sucking	Not given non-nutrive sucking	p-value
--------------------------	---------------------------	-------------------------------	---------

		Frequency	Percentage	Frequency	Percentage	
Sex	Male	20	63	17	53	0.4623
	Female	12	37	15	47	
Age (days)	0-7	25	78	28	88	0.3464
	8-28	7	22	4	12	
Gestational age (weeks)	<37	23	72	22	69	0.3533
	37-41	9	28	8	25	
	>42	0	0	2	6	
Birth weight (gram)	>2500	8	25	4	13	0.4550
	1500-2500	16	50	22	68	
	1000-1500	7	22	5	16	
	<1000	1	3	1	3	

Table 2: Results of analysis of differences in mean scores of pain response between groups given and not given non-nutritive sucking

Statistics	Given non-nutrive sucking	Not given non-nutrive sucking	p-value (Mann-Whitney U)
Mean	1.53125	5.8125	0,000000004252
Standard deviation	0.87931	1.119836	
Minimum-Maximum	0-3	3-7	
Range	3	4	



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## Article Revision Letter for Authors - (APIC-2024-04-080)

1 message

**Anaesthesia, Pain & Intensive Care** <noreply@ejmanager.com>  
To: tritrirratnaningsih@gmail.com

Wed, Jun 19, 2024 at 7:49 AM

Dear Tri Ratnaningsih,

Your manuscript entitled "Analgetic effect of non-nutritive sucking for neonates during invasive procedures" (Ms.Nr. APIC-2024-04-080) was reviewed by editorial board members of the Anaesthesia, Pain & Intensive Care. As initial decision, your manuscript was found interesting but some revisions have to be made before it can reach a publishable value.

Please answer all the comments below point-by-point in an accompanying response letter to your revised submission.

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-----  
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- 1) The title has been written clearly and concisely and can represent the main aspects of this research (good)
- 2) The abstract contains complete elements, but one of the keywords, namely "pacifier", is not appropriate; so it should be replaced with "non-nutritive sucking" because in other sections there is more information with this word. A new keyword also needs to be added, namely "neonatal intensive care" (needs revision)
- 3) The problems behind the implementation of this research have been clearly informed with relevant supporting data, including problems at the hospital where the research was conducted (good).
- 4) The research objectives are stated clearly (well)
- 5) The method chosen is appropriate to answer the research objectives. The method is informed with complete, detailed and sequential components so that it is easy for readers to understand. The selected analysis method is accurate, in accordance with the measurement characteristics of the variables. (Good)
- 6) The results of data analysis are presented clearly in tables and can be trusted for their accuracy; especially the p value which is informed with a very complete decimal in 12 digits. (Good)
- 7) The results of the analysis are interpreted clearly and focused and do not fall into the trap of simply re-reading the figures resulting from data analysis; However, the actual results of the interpretation are not yet complete. After stating that there is a difference in the level of pain between the two groups, it should be continued by stating whether non-nutritive sucking is effective in reducing the pain response in neonates who receive invasive procedures in the NICU? (needs revision)
- 8) The discussion is relevant to the research results. The facts of the analysis results are communicated clearly and accurately. The researcher's opinion on the facts found is clearly stated and includes scientific arguments. Comparison with other research results was carried out well. The strengths and weaknesses of the research are also clearly informed, so that it can be a reference for future researchers. (Good)
- 9) Conclusions can answer the research objectives accurately (well)
- 10) References are adequate in terms of quantity, relevance and up-to-dateness. The way to write citations is correct or in accordance with applicable guidelines, as is the way to write a reference list.

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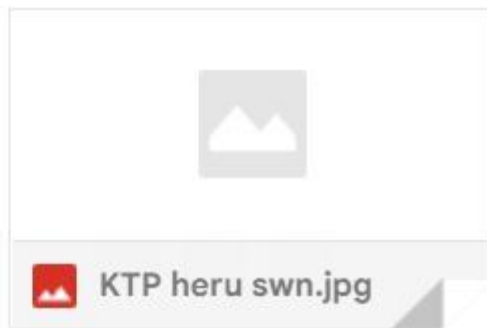
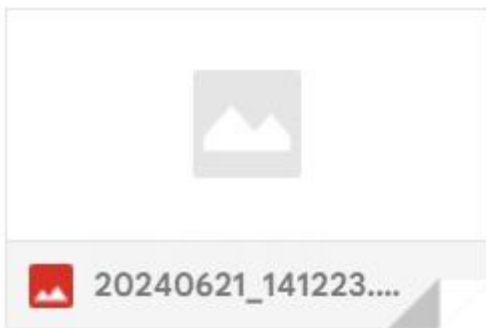
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