

*Original Article***The effect of breastfeeding, oral sucrose and combination of oral sucrose and breastfeeding in infant's pain relief during vaccination**

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Abstract

BACKGROUND: Pain is a global health problem which exists from birth to the last stages of our life. It has been proven that infants are able to feel the painful stimulus. Infants routinely experience the pain in the hospitals especially during the vaccination procedure. Therefore, finding a non pharmacological pain relieving method is necessary. The aim of this study was to compare the pain relieving effect of oral sucrose, breastfeeding and combination of them during the first vaccination of infants with less than 3 months of age.

METHODS: In this quasi-experimental study, 120 infants under 3 months of age who referred to Tabriz Health Centers in 2009 were categorized randomly in four groups; 25% oral sucrose, breastfeeding, combined method and control groups. In the case groups, vaccination was implemented two minutes after the mentioned intervention. Neonatal Infant Pain Scale (NIPS) was used to determine the pain score at 0, 5 and 10 minutes after the vaccination. The duration of the infants' crying and pulse rate was also measured. The data were analyzed using the SPSS software and statistical chi-square, ANOVA and Kruskal-Wallis tests.

RESULTS: The findings of the present study indicated that in breastfeeding group the mean pain score was the lowest immediately after the vaccination, but this difference was significant only in breastfeeding and control groups ($p = 0.007$). The minimum crying time was 66.6(32.62) seconds in breastfeeding group and the maximum time was 126.26(46.15) seconds in control group. The ANOVA test results showed that all the conducted interventions made a significant reduction of crying time in comparison with the control group. The ANOVA also showed that none of the above interventions had any effect on preventing from the increase of the following tachycardia.

CONCLUSIONS: According to the findings of the present study, the lowest pain score and crying time was in breastfed neonates. Considering the fact that breastfeeding is a natural, useful and free intervention and does not need any special facility, this method is suggested in pain management and control during painful procedures for infants.

KEY WORDS: Infant, vaccination, pain, sucrose, breastfeeding.

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Neonatal period care is of high priority in providing community health.¹ Today, in advanced countries, one of the most prevalent painful procedures in infants is vaccination which requires continuous intramuscular injection during the first year of life.² Studying the painful experiences of infants has significantly increased during the

past two decades.³ Recently, it was believed that young infants and newborns were not able to feel the pain due to lack of evolution in the central nervous system.⁴⁻⁷ But, nowadays, it is recognized that physiological, anatomical and nervous-chemical structures which lead the pain, have been well evolved several weeks before the birth.⁵⁻⁹

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Although vaccine injection creates a short period of pain, studies show that this short-term pain distresses the infants, parents and vaccinators during the injection.^{2,10} In addition to the mentioned immediate effects, pain had short-term and long-term effects on infants.^{7, 11-15} Short-term effects included decline in oxygenation, hemodynamic instability and increase in intracranial pressure.¹³ In spite of the fact that long-term effects of pain and stress were not known yet, some obtained studied evidences from animals showed that uncontrolled pain and stress experienced by infants caused some changes in the central nervous system.^{16,0} These changes included a permanent impairment in the cognitive development of learning, memory,¹⁴ IQ¹¹ and behavior. They also caused an increase in physical impairment,¹⁴ anxiety, emotional complications, hyperactivity and disturbed attention in the childhood period.¹³

Considering the short and long term negative effects of uncontrolled pain and undeniable necessity of vaccination, an effective and secure pain controlling method seems necessary.¹⁷ Non pharmacological methods included sweet solutions such as oral sucrose and glucose,^{5, 12, 13, 18-21} pacifiers, skin contact¹⁸ and breastfeeding.^{17, 18, 22} Sucrose is an available and non-sedative substance with short-term effects. The findings of Hatfield et al indicated that oral sucrose administration was an effective and easy method with short-term effect during the routine immunization process.¹⁴ The results of Irani et al in Gonabad also showed the effectiveness of oral sucrose on pain reduction during Hepatitis B vaccination.²³ On the contrary, the results of NikRoos et al in Yasuj showed that oral glucose had no pain relieving effects.²⁴ Some studies also suggested that more investigations and studies are needed in order to conclude about the pain relieving effects of sweet solutions.^{19, 25} The implemented studies about the impact of breastfeeding on pain relief in infants indicated that this was a physiological, accessible, practical and safe method which could easily be accepted by the parents and health care providers.²⁶ Osianaike et al observed that breastfeeding had an analgesic effect on neonates during

the venipuncture prick.²⁷ But, in another study made by Bilgen et al breastfeeding had no impact on the duration of crying after receiving the heel lance.²⁸ Regarding the acute pain resulting from blood sampling in term neonates, Malekan Rad et al concluded that while breastfeeding had no impact on their pain, glucose and lidocaine cream reduced the pain and crying time.¹¹

Therefore, considering the short and long-term effect of uncontrolled pain on the infant's health, and the fact the relieving the pain of the patients is the nursing mission, and in order to clarify the mentioned diversities and contradictions in the results of different studies, more studies are needed to find out the most effective and safest non pharmacological pain controlling method. Also, no study has been done yet to conduct the impact of breastfeeding and oral sucrose on pain management of the neonates. The aim of the present study was to compare the pain relieving effects of non pharmacological methods (breastfeeding or oral sucrose) and their combination on the first time vaccination of the infants.

Methods

This was a quasi-experimental study with two-group (pre-test & post-test) blind design conducted in Shahidan Ebrahimi and Eram health centers in Tabriz, year 2009. According to previous studies a sample size of 120 infants was selected. All the infants were in similar circumstances and were randomly divided into four groups: 1) breast fed infants 2) fed with 25% oral sucrose 3) simultaneous combination of breast feeding and 25% oral sucrose 4) control group (no intervention). The samples were selected from the accessible infants referred to the mentioned health centers for receiving their first vaccine. All these infants were eligible for the diphtheria, tetanous and pertosis vaccines (DTP), they were term infants with less than 3 months of age, had no specific disease and were not born from a diabetic mother. Participants were assigned in different groups via random closed envelope method i.e. at the beginning, the first of four subjects randomly picked one of the en-

velopes and entered a group, then, the next subjects followed the procedure and entered another one of the four groups. In the first group (oral sucrose), 0.6 cc of 25% oral sucrose (per/kg) was administered via a 5 cc syringe. In the 2nd group (breastfed group), mothers were asked to be in a comfort position and take their infants in their arms and feed them with their milk. In the 3rd group (combination group), breastfeeding was done earlier and 0.6 cc of 25% oral sucrose (per/kg) was administered after that. The duration of the breastfeeding in both 2nd and 3rd groups was based on the infant's appetite. No interventions were conducted before the vaccine injection in the control group. DTP and hepatitis vaccination was performed two minutes after the above interventions. The intensity of the pain was accomplished by the partner of the researcher who was blind about the groups. The vaccinator also was blind about the subjects' classification. Both vaccines had been prepared before the injection time by the vaccinator and been injected consecutively. Immediately after the injection, the pain intensity and crying time was measured at the beginning of the procedure by the Neonatal Infant Pain Scale (NIPS) and a stopwatch. The pulse rate was also measured by a pulse oximeter. The severity of the pain and pulse rate was assessed 5 and 10 minutes after the vaccination by the researcher's partner. It should be noted that if the pain score was zero, 5 minutes after injection, pain intensity was not assessed anymore. Finally, the controlled items were recorded in the relevant checklist.

The data collection tools in this study included two parts. The first part was related to the demographic, social and health history of the infants. The second part included the NIPS device for the pain intensity assessment which included the figure parameters (0-1), the crying state (0-2), respiratory patterns (0-1), the arms state (0-1), the legs (0-1) and infant arousal condition (0-1) which were graded from 0-7 scores. This tool was first designed and used by Lawrence in 1993.⁸ In order to obtain valid scientific data, content validity method was used, thus for the content validity, a questionnaire was

given to 11 faculty members of Tabriz University of Medical Sciences. Kappa coefficient method was used to check the reliability coefficient i.e. the pain management was done on 10 infants by two trained neonatal nurses. The data were analyzed by SPSS software and Pearson's coefficient 0.91 was obtained.

The collected and encrypted data was entered in SPSS¹¹ and analyzed using descriptive and inferential statistics, chi square, ANOVA, Kruskal Wallis and the Friedman tests.

Results

According to table 1, using chi square test and ANOVA, no significant difference was observed between the studied groups in terms of demographic data.

In order to compare the pain scores in each group, Friedman nonparametric test was used based on non-normal distribution of pain. As it can be seen in table 2, there were significant differences in the number of measurements in terms of pain. Statistical nonparametric Kruskal-Wallis test was used for the comparison of the pain intensity between the groups of the study. The findings of this study showed that there were some significant differences only after the injection in terms of pain score between different groups of the study. Based on the tukey post hoc test, significant difference was found only between breastfeed and control groups ($p = 0.007$). No significant relationship was observed between the groups in terms of pain score before, at 5 and 10 minutes after the injection of the vaccine. The maximum crying time was in control group with 126.26 (46.15) seconds and the minimum crying time was in breast feed group with 66.60 (32.62) seconds. Using statistical nonparametric Kruskal Wallis test a significant difference was observed between the groups of the study in terms of crying time ($p < 0.001$). The findings of the tukey post hoc test showed that there was a significant difference between each one of intervention groups and the control group. Mixed ANOVA test was used to compare (multiple assessments) the pulse frequency in different number of measurements. As in table 3, results showed

Table 1. Demographic profile of the participants in different groups

group profile	sucrose		breastfeeding		Combination of breastfeeding and sucrose		control		p-value
	SD	mean	SD	mean	SD	mean	SD	mean	
Maternal age (year)	5.03	25.65	4.73	26.30	5.20	26.50	5.40	27.10	0.75
Infant's weight (g)	496.12	5401.66	638.80	5261.66	776.11	5388.33	650.0	5648.0	0.18
Infants age (day)	2.83	61.93	2.86	62.06	2.02	61.90	5.04	63.13	0.44
Gender (percent)	Female	50%	50%		63.3%		50%		0.65
	Male	50%	50%		36.07%		50%		
Nutrition status (percent)	Exclusive breastfeeding	90%	96.7%		93.3%		96.7%		0.43
	Powdered milk	0	0		0		3.3%		
	Both	10%	3.3%		6.7%		0		
Mother' job (percent)	Home job	0	3.3%		0		0		0.61
	Outside work	0	3.3%		3.3%		3.3%		
	Housekeeper	100%	93.3%		96.7%		96.7%		
Infants status (percent)	Awake	63.3%	70%		63.3%		43.3%		0.17
	Drowsy	36.7%	30%		36.7%		56.7%		

Table 2. Mean pain score before, at 0, at 5 and 10 minutes after the vaccine injection in each group of the study

Pain score	Before injection		Immediately after injection		5 min after injection		10 min after injection		p value
	SD	Mean	SD	Mean	SD	Mean	SD	Mean	
Sucrose group	0.69	0.26	1.04	5.73	1.64	0.83	0	0	< 0.001
Breastfeed group	0.61	0.20	0.79	5.16	1.09	0.63	0	0	< 0.001
Combination group	0.76	0.20	1.05	5.70	1.09	0.80	0	0	< 0.001
Control group	0.61	0.20	0.73	6.53	1.00	0.76	0.18	0.03	< 0.001
p value	0.89		< 0.001		0.71		0.36		----

Table 3. Mean pulse frequency before, at 0, at 5 and 10 minutes after vaccination in each group of the study

Pulse frequency	Before injection		Immediately after injection		5 min after injection		10 min after injection		p value
	SD	Mean	SD	Mean	SD	Mean	SD	Mean	
Sucrose group	18.87	145.33	17.25	157.60	19.24	151.13	22.25	151.08	< 0.001
Breastfeed group	16.19	142.56	15.76	151.143	15.65	148.73	9.33	133.50	< 0.001
Combination group	19.54	143.40	16.79	154.90	18.15	150.41	17.64	146.37	< 0.001
Control group	18.27	145.66	20.39	157.60	19.98	149.33	19.27	152.0	< 0.001
p-value	0.89		0.48		0.85		0.24		----

that pulse changes in different number of measurements were significant in all the groups. The comparison of pulse frequency in different numbers of measurements showed no significant difference between the groups of the study.

Discussion

The results of this study showed that breastfeeding significantly reduces vaccination pain comparing with the control group. However, oral sucrose and combination of sucrose and breastfeeding did not have any significant pain reduction intensity in comparison with the control group. Also, breastfeeding significantly reduced crying time in comparison with the control group but had no effect on preventing the following tachycardia after the procedure. The findings of this study were in accordance with the findings of Efe & Savasar in which crying time was shorter in oral sucrose group and breastfeeding group in comparison with the control group. And the pain scores of the mentioned groups were lower in comparison with the control groups, but no significant difference was observed in sedative effects of breastfeeding and sucrose.⁵ Carbajal et al also showed that breastfeeding and oral glucose significantly reduced the pain intensity of the neonates during heel lance in comparison with the control group, but no significant difference was observed between the pain intensity of breastfeeding and oral glucose groups.²² Golestan et al showed that the crying time was shorter in oral glucose group in comparison with water and not implementing any intervention but there was no significant difference between the groups of that study in terms of changes in pulse frequency.¹³ Regardless of methods of the studies, the findings of the present study were in accordance with Golestan's study. The findings of Bauer et al showed that oral glucose significantly decreased the pain and crying time after vein puncture in comparison with the control group. But, it did not prevent pulse rate increase following the painful procedure.²⁹ Regardless of different sweet solutions, the difference of the above studies might be due to me-

thod of prescription of the oral glucose; in Bauer's study it was given through the pacifier (non-nutritive sucking), however the pain relieving effects of sucking should also be considered. The results of Gray et al showed that breastfeeding effectively caused a reduction in pain intensity and crying time after receiving heel lance in comparison with the control group; it also prevented tachycardia following the procedure.³⁰ The findings of Gray's study were in accordance with this study in terms of effectiveness of breastfeeding in pain reduction and crying time. But, there was a difference between two above studies in terms of breastfeeding efficacy in preventing from tachycardia following the procedure. The reason could be due to different methods; for example, in the study conducted by Gray et al breastfeeding lasted during the heel lance. The difference in types of tachycardia procedures also could be the difference between these two studies. The study findings of Malekan Rad et al showed that crying time during vein puncture was significantly shorter in the group in which 33% oral glucose solution was administered, in comparison with the control group. But breastfeeding did not bring about a significant decrease in crying time and pain score.¹¹ There was a difference between the findings of two studies; it might be due to the difference in breastfeeding process.

Finally, the findings of this study showed that breastfeeding caused reduction in pain and crying time in neonates immediately after the vaccine injection. According to the findings of this study and considering the fact that breastfeeding was a safe and free method accepted by mothers and health center staff, it can be advised for painful procedures in order to reduce infant's pain. It can also encourage mothers for breastfeeding and facilitate maternal and childhood links. Besides, breastfeeding can provide psychological benefits for mothers due to their participation in infant's care without incurring any additional cost to the health care system. Moreover, since hospitalized neonates are particularly premature infants who need to be hospitalized for a long time and may suffer painful

procedures, similar studies are recommended about the effectiveness of breastfeeding and oral sucrose on hospitalized premature infants.

The authors declare no conflict of interest in this study.

References

1. Poor-Alizadeh M, Shafi Poor SZ, Farmanbar RA, Atrkar Roshan Z, Elm Shoshtari M. Effect of oral glucose solution on the prevention of pain caused by arterial blood sampling in infants. *Journal of Medical Sciences Gilan* 2007; 16(62): 87-94.
2. Lewindon PJ, Harkness L, Lewindon N. Randomised controlled trial of sucrose by mouth for the relief of infant crying after immunisation. *Arch Dis Child* 1998; 78(5): 453-6.
3. Young KD. Pediatric procedural pain. *Ann Emerg Med* 2005; 45(2):160-71.
4. Codipietro L, Ceccarelli M, Ponzzone A. Breastfeeding or oral sucrose solution in term neonates receiving heel lance: a randomized, controlled trial. *Pediatrics* 2008; 122(3): e716-e721.
5. Efe E, Savaser S. The effect of two different methods used during peripheral venous blood collection on pain reduction in neonates. *Agri* 2007; 19(2): 49-56.
6. Saeedei R, Esna ashri M, Amir Nezhad M, Esmaeeli HA. Kangoroyy effect on pain caused by methods of vaccination in infants. *Journal of Medical Sciences and Sabzevar* 2006; 13(4): 172-7.
7. Khodam H, Zeaee T, Hosseini SA. Effect of skin contact between mother and newborn infant pain relief. ". *Journal of Gorgan University of Medical Sciences* 2002; 4(9): 11-8.
8. Holdcroft A, Jaggat S. *Core Topics in Pain*. 1st ed. Cambridge: Cambridge University Press, 2005. p. 183-91.
9. Codipietro L, Ceccarelli M, Ponzzone A. Breastfeeding or oral sucrose solution in term neonates receiving heel lance: a randomized, controlled trial. *Pediatrics* 2008; 122(3): e716-e721.
10. Reis EC, Roth EK, Syphan JL, Tarbell SE, Holubkov R. Effective pain reduction for multiple immunization injections in young infants. *Arch Pediatr Adolesc Med* 2003; 157(11): 1115-20.
11. Malekan Rad E, Momtaz Manesh N, Barakatin R. Effect of glucose, breast milk and cream lidocaine on pain caused by blood sampling in term neonates. *Faiz Quarterly* 2004; 8(2): 15-20.
12. Modares M, Vasegh Rahimparvar F, Mehran A, Jazayeri AS. Effect of breastfeeding on breast pain during injection in infants. *Journal of Nursing and Midwifery, Tehran Medical Sciences (Hayat)* 2006; 12(4): 31-7.
13. Golestan M, Sadr Bafghi M, Akhavan Karbasi S, Aslami Z, Falah R, Hashemi AA, et al. Comparison of glucose and water in reducing neonatal pain. *Iranian Journal of Pediatrics* 2006; 16(4): 441-5.
14. Hatfield LA, Gusic ME, Dyer AM, Polomano RC. Analgesic properties of oral sucrose during routine immunizations at 2 and 4 months of age. *Pediatrics* 2008; 121(2): e327-e334.
15. Taddio A, Shah V, Hancock R, Smith RW, Stephens D, Atenafu E, et al. Effectiveness of sucrose analgesia in newborns undergoing painful medical procedures. *CMAJ* 2008; 179(1): 37-43.
16. Smailbegovic MS, Laing GJ, Bedford H. Why do parents decide against immunization? The effect of health beliefs and health professionals. *Child Care Health Dev* 2003; 29(4): 303-11.
17. Schechter NL, Zempsky WT, Cohen LL, McGrath PJ, McMurtry CM, Bright NS. Pain reduction during pediatric immunizations: evidence-based review and recommendations. *Pediatrics* 2007; 119(5): e1184-e1198.
18. Leslie A, Marlow N. Non-pharmacological pain relief. *Semin Fetal Neonatal Med* 2006; 11(4): 246-50.
19. Leef KH. Evidence-based review of oral sucrose administration to decrease the pain response in newborn infants. *Neonatal Netw* 2006; 25(4): 275-84.
20. Stevens B, Yamada J, Ohlsson A. Sucrose for analgesia in newborn infants undergoing painful procedures. *Cochrane Database Syst Rev* 2004; (3): CD001069.
21. Cignacco E, Hamers JP, Stoffel L, van Lingen RA, Gessler P, McDougall J, et al. The efficacy of non-pharmacological interventions in the management of procedural pain in preterm and term neonates. A systematic literature review. *Eur J Pain* 2007; 11(2): 139-52.
22. Carbajal R, Veerapen S, Couderc S, Jugie M, Ville Y. Analgesic effect of breast feeding in term neonates: randomised controlled trial. *BMJ* 2003; 326(7379): 13.
23. Irani H, Esna Ashar M, Maarizi P, Naseri F. Oral glucose effect on newborn pain. "Acquired. *Ofogh e Danesh (Journal of Medical Sciences - Gonabad)* 2005; 11(1): 5-9.
24. NikRooz L, Rostami SH, Alijani Renani H, Rasekh AR. Oral glucose effect on pain caused by vaccine in healthy infants 2, 4 and 6 months referred to health centers - University of Medical Sciences Yasuj. *Journal Dena* 2006; 1(3): 11-8.
25. Allen KD, White DD, Walburn JN. Sucrose as an analgesic agent for infants during immunization injections. *Arch Pediatr Adolesc Med* 1996; 150(3): 270-4.

26. Shah PS, Aliwalas L, Shah V. Breastfeeding or breastmilk to alleviate procedural pain in neonates: a systematic review. *Breastfeed Med* 2007; 2(2):74-82.
27. Osinaike BB, Oyedeji AO, Adeoye OT, Dairo MD, Aderinto DA. Effect of breastfeeding during venipuncture in neonates. *Ann Trop Paediatr* 2007; 27(3): 201-5.
28. Bilgen H, Ozek E, Cebeci D, Ors R. Comparison of sucrose, expressed breast milk, and breast-feeding on the neonatal response to heel prick. *J Pain* 2001; 2(5): 301-5.
29. Bauer K, Ketteler J, Hellwing M, Laurenz M, Vermold H. Oral glucose before vein puncture relieves neonates of pain, but stress is still evidenced by increase in oxygen consumption energy expenditure and heart rate. *Pediatrics* 2004; 55(4): 695-700.
30. Gray L, Miller LW, Philipp BL, Blass EM. Breastfeeding is analgesic in healthy newborns. *Pediatrics* 2002; 109(4): 590-3.