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The Effect of Oral Glucose and Non-Nutritive Sucking in Reducing Needle-Related Procedural Pain among Infants

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Abstract

Background: Pain management in young babies has been largely neglected in more clinical settings, despite subjecting them to painful procedures. However, the non-pharmacological methods as administration of oral glucose and non-nutritive sucking before minor painful procedures may relieve the infants' pain. **Aim**: The aim of this study was to evaluate the effect of oral glucose and non-nutritive sucking in reducing needle-related procedural pain among infants. **Sampling:** A purposive sample of 120 infants was selected by specific criteria and randomly distributed into one control and three experimental groups. **Setting:** The study was carried out at the Paediatric Emergency Department and Outpatient Clinics at Ain Shams University Children's Hospital and the Immunization Center for Children affiliated to Ministry of Health in Benha City. **Tools:** The tools used in collecting data classified into: 1) A structured questionnaire sheet directed for infants' caregivers, 2) FLACC behavioral observation scale to assess infant's pain, and 3) Crying time. **Results:** The results of the study revealed that there were very highly statistically significant differences of total FLACC behavioral score between the experimental groups and the control group after the intervention, as well as, mean of their crying time. **Conclusion:** This study concluded that, the use of fifty percent oral glucose and non-nutritive sucking is effective in reducing pain for infants undergoing needle related procedures. **Recommendation:** The study recommended that, oral glucose and non-nutritive sucking should be used in pediatric units as a routine intervention to reduce pain during minor needle related procedures for infants.

Key words: Oral glucose, Non-nutritive sucking, Procedural pain, Infants.

Introduction

Pain is a highly individualized, subjective experience that can affect any person at any age. It is a complex phenomenon that involves multiple components and is influenced by several factors; while, it involves both sensory and emotional factors **(International Association for the Study of Pain "IASP", 2012)**.

In children, pain is a highly prevalent problem; it is a predominantly subjective emotional distress that leads to impairment in their quality of life **(Canbulat et al., 2014).** The most common and important sources of pain experiences by infants are

medical pain; primarily needle pain such as venipunctures and immunizations. Indeed, Infants experience pain similarly and probably more intensely than older children and adults **(Michael & Ric, 2010)**.

The experience of untreated pain early in life can lead to physiological and psychological consequences for children, as increase oxygen consumption and increased distress during later painful procedures. While, treating pain decreases the need for physical restraints, and prevents short and long-term consequences of pain **(Kyle & Carman, 2013)**.

Part of the reluctance to aggressively treat pain during infancy was rooted in the belief that the pain system was not yet fully developed. Also, due to the nonverbal nature of infants, they are incapable of reporting and describing the subjective phenomenon of pain **(Bissonnette et al., 2011)**.

Reduction of pain is both a professional imperative and an ethical expectation. Scientific and clinical evidence points to the efficacy of natural, non-pharmacological strategies to reduce pain due to minor procedures **(Academy of Breastfeeding Medicine Protocol Committee, 2010)**.

Some of these strategies are feeding of sweet compounds such as sucrose, glucose, and saccharine; non-nutritive sucking on pacifiers **(Michael & Ric, 2010)**.

Sucrose and glucose are the most commonly used sweet-tasting solutions; however, they are effective, simple and fast-acting non-pharmacological method to use and have no documented side effects. There is no fully accepted explanation for the pain-reducing effect of sweet-tasting solutions, but activation of endogenous opioids has been suggested as a possible mechanism **(Suhrabi et al., 2014)**.

Offering a pacifier is the most common way to provide non-nutritive sucking to an infant **(Liu et al., 2010)**. These interventions may modulate pain sensation and response to pain through changes in attention and decreasing apprehension **(McGrath et al., 2014)**.

Worldwide, routine medical procedures are common in infancy and acute procedural pain remains one of the most common adverse stimuli experienced by infants **(Kassab et al., 2012a)**. Infants exposed to needle-related painful procedures; during intramuscular injections for scheduled of immunizations, and medical procedures performed during the course of illnesses. In 2010, an estimated 109 million infants received the three diphtheria and tetanus immunization **(World Health Organization, 2011)**.

Untreated pain as a result of medical procedures not only results in immediate pain and fear in infants at the time of the procedure, but leads to long term consequences, including long term fears of needle pain and avoidance of medical care **(Harrison et al., 2011)**. Much attention has been devoted to a variety of non-pharmacological strategies for reducing infants' procedural pain **(Flick & Hebl, 2013)**.

Significance of the study

During the clinical experience of the researcher it was observed that, many infants in pediatric healthcare settings have acute pain due to needle-related procedures as blood sampling, intravenous catheter insertion, and injections for vaccination. However, there was no nursing intervention for pain relief measures was implemented for those infants. Many studies denote that non-nutritive sucking is a comfort measure for infants and helps them to calm. Oral administration of 30% glucose combined with sucking provided better control of pain induced by blood sampling in newborns at neonatal unit **(Mekkaoui et al., 2012)**. Therefore, this study will be conducted to shed the light on the importance of performing such non-pharmacological measures to relieve pain

among infants undergoing acute painful procedures.

Aim of the study

The aim of this study was to evaluate the effect of oral glucose and non-nutritive sucking in reducing needle-related procedural pain among infants.

Research hypothesis

The use of oral glucose and non-nutritive sucking as well as the combination of both will reduce pain in infants' undergoing needle related procedures.

Subjects and methods

Technical design

Research Design:

An experimental research design was utilized in this study.

Research Setting:

The study was conducted at the Paediatric Emergency Department and Outpatient Clinics at Ain Shams University Children's Hospital and at the Immunization Center for Children affiliated to Ministry of Health in Benha City.

Subject:

The subjects of the present study included a purposive sample of 120 infants of both sexes and their caregivers were recruited in this study. Those infants were constituted 10% of the total number of infants (1200) who were enrolled in the study settings according to the statistics of the previous year (2011). Infants were selected based on the following criteria:

- **Inclusion criteria**

- Infants' age, beyond the neonatal period up to 12 months.

- Infants undergoing needle related minor procedures; including subcutaneous, intramuscular injections and venipuncture.

- **Exclusion criteria**

- Infants subjected to any painful procedures prior one hour of needle related procedure.

- Infants with known fructose or sucrose intolerance.

- Infants with altered physical or physiological status like cerebral palsy, seizure and neurological disorders.

- Infant given Ibuprofen or Acetaminophen 6 hours before the needle related procedure.

Tools and data collection:

Data were collected through using the following tools:

Tool (1): ***Infant Assessment Sheet:***

It was developed by the researchers after reviewing the relevant literatures. The data were collected through an interview with the infants' caregivers. It concerned with characteristics of studied infants undergoing needle related procedures that include: age, gender, present weight, and presence of health problems.

Tool (2): Flacc behavioural pain scale: The

Face, Legs, Activity, Cry, and Consolability Pain Scale (FLACC) which adopted by **Merkel et al., (1997)**, to measure pain in preverbal or nonverbal (two months - seven years). It was used by the researchers to measure pain in infants in 5 categories of behavior. Each category on a scale scored from 0–2, resulting in a total score of 10, the higher the score, the greater the pain response.

❖ **Scoring interpretation:**

0 = No pain 4–6 = Moderate pain

1–3 = Mild pain 7–10 = Severe pain

Tool (3): *Crying time*:

It was designed by the researchers after reviewing the related literature. **Curtis et al. (2007)**, reported that the majority of infants stops to cry within three minutes from procedural pain. It was used to measure total crying time, which monitored by a stopwatch from the infant's first cry after needle related procedure and recorded as the number of seconds that vocalizations were sustained, up to 5 minutes.

❖ **Scoring interpretation:**

0 Seconds = No pain

≤ 60 seconds = Mild pain

61-120 seconds = Moderate pai

≥121 seconds = Severe pain

Operational design

1 -The preparatory phase

A review of the past and current related literature and different studies using available books, periodicals, articles, and magazines to get acquainted with the various aspects of the research problem and develop the study tools. The validity of the study tools assessed by a panel of 5 experts in the field of pediatric nursing for its clarity, content and sequence of items.

2- Pilot study:

It was conducted on 10% of total subject's size (infants and their caregivers) to assess the time required to fulfil the tools and its applicability. The results of the pilot study helped to make modifications on the tools. The subjects included in the pilot study were excluded from the main study sample.

3- Field work

The actual work started by explained the aim of the study to the infants' caregivers who was interviewed individually by researchers to obtain their consent to participate in the study. The questionnaire was filled by the researchers to gather information about the infants' characteristics and exposure to painful procedures. The infants who met the inclusion criteria for the study were distributed randomly within the experimental groups by taking the 4th infant, according to their admission in the study settings, while the first thirty infants were assigned to the experimental group 1, the second thirty infants were assigned to the experimental group 2, the third thirty infants were assigned to the experimental group 3, and the last thirty infants were assigned to the control group. The intervention for each group was done as follows:

a. **Experimental group 1:**

the infants in group one submitted to an oral glucose solution where, each infant was receiving 2 ml of 50% glucose orally one time by syringe, over 30 seconds on the anterior aspect of the tongue by the researcher 1-2 minutes before the needle related procedure. Caregivers were allowed to interact with their infants by voice or touch as normal.

b. **Experimental group 2:**

the infants in group two submitted to pacifier where, each infant was given the pacifier 2 minutes before the injection and held gently in the infant's mouth by the caregiver. The infant was allowed to continue to suck pacifier throughout and after needle related procedure.

c. **Experimental group 3:**

The infants in group three submitted to oral glucose solution and pacifier where, each infant was receiving 2 ml of 50%

glucose orally one time by syringe, 1-2 minutes before the start of the needle related procedure. The solution was administered by the researchers to the anterior aspect of the tongue over 30 seconds via syringe and followed immediately by the insertion of a pacifier into the infant's mouth. The pacifier was held gently in the infant's mouth by the caregiver 2 minutes before, during, and after needle related procedure. Caregivers were allowed to interact with their infants by voice or touch as normal.

d.**Control group:** no intervention was conducted for this group.

The researchers evaluated the infant's pain induced by the needle related procedure using FLACC Behavioral Pain Scale before (1-5 min.) as standard & immediately after (between 30 sec. – 1 min.) the needle related procedure for the experimental groups and the control group. Also, total crying time was measured with the help of nurses working in the study settings by stopwatch and recorded as the number of seconds for each infant in each group after needle related procedure.

Administrative design:

An official letter including the title and purpose of the study were submitted from the Dean of the Faculty of Nursing, Ain Shams University to the directors of Ain Shams University Children's Hospital and the Immunization Center for Children affiliated to the Ministry of Health in Benha City, to get an approval for conducting the study.

Ethical consideration:

The researchers followed ethical research principles as the following:

- Informed consent was obtained from infants' caregivers who participated in the study and physician who present in the study settings.

- Anonymity and confidentiality of the study subjects were assured.

- No physical or psychological harm was caused for the study subjects.

- The infants' caregivers allowed withdrawing from the study at any time freely.

Result:

Table (1): As observed from this table that 46.7%, 56.7%, 53.4% and 60% of infants in experimental group 1, 2, 3 and control group, their age ranged from 5 – ≤ 8 months respectively. Meanwhile, the mean infants' weight in experimental group 1, 2 and 3 were 7.30 ± 1.91, 6.55 ± 1.35 and 6.18 ± 1.65 kilograms respectively. While, for the control group it was 6.99 ± 1.76 kilograms. As regards to their gender 43.3%, 53.3%, and 56.7% of infants in experimental group 2, 3 and control group were females respectively. While half (50.0%) of infants in experimental group 1 were males.

Figure (1): In relation to the presence of a health problem, this figure revealed that 63.3%, 80.0%, 73.3%, and 63.3% of infants in the experimental group 1, 2, 3 and control group have no associated health problems respectively.

Table (2): This table represented that, all of the experimental groups and control group (100%) had exposed to a previous painful procedure related to immunization and all boys related to circumcision. While, more than one third (43.3%, 36.7%, 40.0%, and 40.0%) of studied infants in experimental group 1, 2, 3 and a control group had previous venipuncture or I.M painful procedure respectively.

Table (3): This table reflected that, I.M injection was the most common painful procedure which performed in 43.3%, 80%, and 70.1% of the experimental group 1, 2,

and 3 respectively and in 56.6% of the control group of infants. As regards to infant behavioral state before the painful procedure, this table showed that, the calm and relaxed behavior was observed among the majority of infants (93.3%, 100%, 96.7%, and 93.3%) in experimental group 1, 2, 3 and control group respectively.

Table (4): This table demonstrated that, all caregivers (100%) either in the experimental groups and control group used non-pharmacological pain relief measures for their infant during painful procedures and the majority (100%, 93.3%, 50%, and 90%) non-pharmacological pain relief measure used other than administration of oral glucose and non-nutritive sucking for the experimental group 1, 2, 3 and control group was consolability respectively.

Table (5): As regards to the degree of pain among the studied infants after the interventions, this table shows that, four fifths (73.3%) of the control group had severe pain compared to less than one fifth (13.3%, 16.7% and 13.3%) of the experimental group 1, 2 and 3 respectively. Also, this table represented that there were very highly statistical significant differences as regard degree of pain among the infants in experimental groups and control group after needle related procedure (x^2 = 49.94 and P > 0.001).

Table (6): In relation to duration of crying after intervention as observed from this table, the mean crying time of the control group was 47.36 ± 52.90 compared to 23.40 ±16.55, 26.06 ± 22.54, and 21.66 ±17.26 of the experimental group 1, 2, and 3 respectively with a significance difference detected between experimental groups and control group.

Table (1): Number and percentage distribution of infants in experimental groups and control group as regards to their characteristics (n=120).

Item	Experimental group 1 * (n=30)		Experimental group 2 ** (n=30)		Experimental group 3 *** (n=30)		Control group (n=30)	
	No.	%	No.	%	No.	%	No.	%
Age (months)								
▪ **< 5**	8	26.7	12	40	13	43.3	7	23.3
▪ **5 – < 9**	14	46.7	17	56.7	16	53.4	18	60.0
▪ **9 – ≤ 12**	8	26.7	1	3.3	1	3.3	5	16.7
Gender								
▪ **Male**	15	50.0	17	56.7	14	46.7	13	43.3
▪ **Female**	15	50.0	13	43.3	16	53.3	17	56.7
weight (kg)								
▪ **4 – < 6 kg**	14	46.6	16	53.3	22	73.3	16	53.3
▪ **6 – < 8 kg**	8	26.7	14	46.7	5	16.7	9	30.0
▪ **8 – ≤ 12 kg**	8	26.7	0	0.0	3	10.0	5	16.7
$\bar{X}$ ± SD	7.30 ± 1.91		6.55 ± 1.35		6.18 ± 1.65		6.99 ± 1.76	

(*) Oral glucose group, (**) Pacifier group, (***) Oral glucose & Pacifier group

Figure (1): Percentage distribution of the studied infants according to their presence of health problem (n=120).

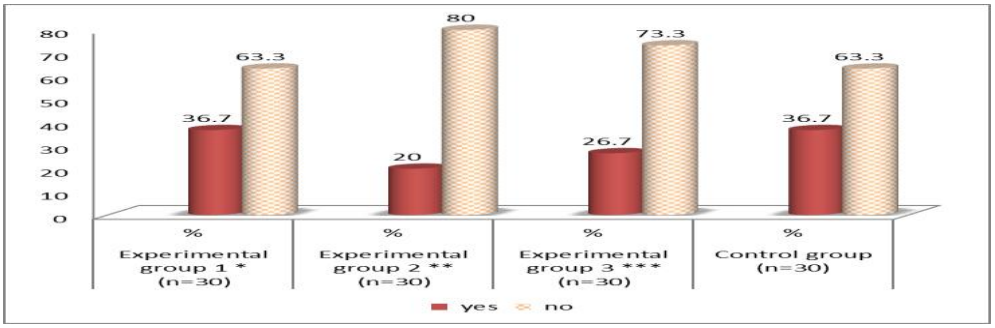

Table (2): Number and percentage distribution of infants in experimental groups and control group regarding their previous exposure to painful procedures.

Previous exposure of infants to painful procedures®	Experimental group 1 * (n=30)		Experimental group 2 ** (n=30)		Experimental group 3 *** (n=30)		Control group (n=30)	
	No.	%	No.	%	No.	%	No.	%
- Circumcision (boys)	15	50.0	17	56.7	14	46.7	13	43.3
- Intravenous cannulation	2	6.7	1	3.3	4	13.3	2	6.7
- Previous immunization	30	100.0	30	100.0	30	100.0	30	100.0
- Venipuncture / I.M	13	43.3	11	36.7	12	40.0	12	40.0
- Surgery	1	3.3	0	0.0	1	3.3	0	0.0

(*) Oral glucose group, (**) Pacifier group, (***) Oral glucose & Pacifier group

® Number not mutually exclusive

Table (3): Number and percentage distribution of infants in experimental groups and control group regarding their present exposure to a painful procedure.

Item	Experimental group 1 * (n=30)		Experimental group 2 ** (n=30)		Experimental group 3 *** (n=30)		Control group (n=30)	
	No.	%	No.	%	No.	%	No.	%
Present painful procedure performed for the infant								
• S.C injection	6	20.0	0	0.0	1	3.3	2	6.7
• I.V injection	0	0.0	0	0.0	0	0.0	0	0.0
• Blood sample	5	16.7	3	10.0	4	13.3	8	26.7
• I.M injection	13	43.3	24	80.0	21	70.1	17	56.6
• I.V cannulation	6	20.0	3	10.0	4	13.3	3	10.0
Numbers of exposure to painful procedure								
• One time	29	96.7	29	96.7	29	96.7	28	93.3
• Two times	1	3.3	1	3.3	1	3.3	2	6.7
Infant behavioral state before the painful procedure								
• Calm, relaxed	28	93.3	30	100.0	29	96.7	28	93.3
• Distressed, fussy	0	0.0	0	0.0	1	3.3	0	0.0
• Cry	2	6.7	0	0.0	0	0.0	2	6.7

(*) Oral glucose group, (**) Pacifier group, (***) Oral glucose & Pacifier group

Table (4): Number and percentage distribution of infants in experimental groups and control group regarding to their caregivers use of non-pharmacological pain relief measures during a painful procedure.

Item	Experimental group 1 * (n=30)		Experimental group 2 ** (n=30)		Experimental group 3 *** (n=30)		Control group (n=30)	
	No.	%	No.	%	No.	%	No.	%
Using non-pharmacological Pain relief measures by caregivers during a painful procedure.								
• Yes	30	100.0	30	100.0	30	100.0	30	100.0
• No	0	0.0	0	0.0	0	0.0	0	0.0
The used non-pharmacological pain relief measures. ©								
• Pacifier	0	0.0	30	100.0	30	100.0	0	0.0
• Oral glucose	30	100.0	0	0.0	30	100.0	0	0.0
• consolability	30	100.0	28	93.3	15	50.0	27	90.0
• Swaddling	10	33.3	10	33.3	4	13.3	7	23.3
• Toy	0	0.0	0	0.0	2	6.7	0	0.0

(*) Oral glucose group, (**) Pacifier group, (***) Oral glucose & Pacifier group

Table (5): Number and percentage distribution degree of pain among the studied infants in experimental groups and the control group after the interventions.

Study groups	FLACC behavioral scale								X^2	P-value
	No pain		Mild		Moderate		Severe			
	No.	%	No.	%	No.	%	No.	%		
Experimental group 1 * (n=30)	0	0.0	2	6.7	24	80.0	4	13.3	49.94	< 0.001
Experimental group 2 ** (n=30)	0	0.0	2	6.7	23	76.7	5	16.7		
Experimental group 3 * (n=30)**	1	3.3	4	13.3	21	70.0	4	13.3		
Control group (n=30)	0	0.0	0	0.0	8	26.7	22	73.3		

(*) Oral glucose group, (**) Pacifier group, (***) Oral glucose & Pacifier group

Table (6): Comparison among the experimental groups and the control group regarding duration of crying after intervention.

Study groups	Duration of crying (sec) $\bar{X} \pm SD$	t-test	P-value
Experimental group 1 * Experimental group 2 **	23.40 ±16.55 26.06 ± 22.54	0.52	> 0.05
Experimental group 1 * Experimental group 3 ***	23.40 ±16.55 21.66 ±17.26	0.39	> 0.05
Experimental group 1 * Control group	23.40 ± 16.55 47.36 ± 52.90	2.36	< 0.05
Experimental group 2 ** Experimental group 3 ***	26.06 ± 22.54 21.66 ±17.26	0.84	> 0.05
Experimental group 2 ** Control group	26.06 ± 22.54 47.36 ± 52.90	2.02	< 0.05
Experimental group 3 * Control group**	21.66 ±17.26 47.36 ± 52.90	2.52	< 0.05

(*) Oral glucose group, (**) Pacifier group, (***) Oral glucose & Pacifier group

Discussion

Infants are exposed to multiple minor painful procedures during the first year of their life. They are frequently subjected to painful procedures often performed shortly after birth. So, there is considerable need for non-invasive and safe methods of infant procedural pain relief **(Hatfield et al., 2013**).

Pediatric pain management is a broad, complex topic that spans multiple disciplines. The last two decades in particular brought substantial developments to the understanding of pediatric pain and its management. The World Health Organization (WHO) and many international professional pain societies advocate that optimal pain management is not only ethical practice, but also a fundamental human right **(Petovello, 2012)**. There has been using non-pharmacological treatment options such as breastfeeding, nonnutritive sucking, and sweet solution administered to relieve pain **(Kassab et al., 2012a)**.

Concerning the characteristics of the studied infants among the experimental groups and control group, the present study results reflected that, almost half of infants in the experimental groups and more than half of them in the control group, their age ranged from 5 to 8 months. While, more than three fifths of the studied infants with no health problem. This due to, near to half of infants in the present study in immunization center while they attend only for vaccination not for any other health problem .

Regarding the gender of infants, the present study showed that, about half of infants in all groups were females. This consistent with **Mekkaoui et al. (2012)**, who conducted a study about analgesic effect of 30% glucose, milk and non-nutritive sucking in neonates, they found that 61% of infants who included in the study were females .

In the present study, it was found that all experimental groups and control group had a previous painful procedure related to immunization and all boys related to circumcision. Meanwhile, more than one third of infants in the studied groups had previous venipuncture or intramuscular painful procedure. This result may be explained as the schedule of immunization for infants started from birth while, male circumcision is a part of religious law in Judaism and is an established practice in Islam and Christianity, and performed in early infancy. This finding is in accordance with a study conducted by **Bellieni et al. (2013)**, who study the analgesia for infants' circumcision, and mentioned that male circumcision is one of the oldest and most common painful procedure performed all over the world. It can be performed for different religious, cultural and medical reasons.

The findings of the present study pointed out that, I.M injection was the most painful procedure performed for the experimental groups and control group. This finding is supported by **McGrath et al. (2014)**, who mentioned that the vaccination schedule for infants consists primarily of intramuscular or subcutaneous injection. As regards the behavioral status among infants in the current study before the painful procedure, it was found that, the majority of them were calm and relaxed. One of the leading causes that, the infants were not subjected to any painful procedures for an hour prior the present needle related procedure therefore; the infants were calm and relaxed.

The result of the current study illustrated that, all caregivers in the experimental groups and in the control group used non-pharmacological pain relief measures for their infants during painful procedures either by consolability or pacifier, with consolability was the most

common measure used among them. This result is emphasized by the study of **Harrison et al. (2014)**, about a systematic review of pain management practices during immunizations, stated that the distraction of infants in immunization by using talking or singing was the most commonly used pain management strategy in infants less than 12 months.

In the light of the present study findings, it was observed that oral glucose decreased facial expression as one category of FLAAC pain scale of the studied infants, while the mean score for the oral glucose group was 1.26±0.50 and 1.70±0.46 for the control group. This finding is supported by the study of **Stevens et al. (2013)**, about sucrose for analgesia in newborn infants undergoing painful procedures, who mentioned that the administration of sucrose decreased behavioral (cry behaviors; facial action) indices of pain.

The current study findings demonstrated that, the administration of oral glucose before needle-related procedures reduced duration of crying among the studied infants, while the mean duration for oral glucose group was 23.40 ± 16.55 sec., and 47.36 ± 52.90 sec. for control group. These findings are supported by **Shadkam & Lotfi (2008)**, who compare in their study between local anesthetic cream with oral glucose to reduce pain in newborns during venipuncturing, and they found that, oral glucose had a better effect on crying behavior than topical application of lidocaine/ prilocaine. Also, it was reported by **Harrison et al. (2011)**, who studied the efficacy of sweet solutions for analgesia in infants aged 1:12 months during immunization that, sucrose and glucose of various doses and concentrations moderately reduces crying incidence and crying duration, beyond the neonatal period up to 12 months of age. These results are in consistent with an Italy study conducted by **Lago et al. (2014)**, about non-pharmacological intervention for neonatal pain control. It was found that sucrose with or without non-nutritive sucking reduced efficiently behavioral expressions of pain and crying time. On the other point of view, these findings are in disagreement with the results of a study carried out in Sweden by **Morelius et al. (2009)**, who assessed infants' stress at 3 months immunization and it was found that no significant effect of glucose on crying behavior .

The results of the present study illustrated that, administration of oral glucose before minor painful procedure decreased pain scores in infants, while the mean score of total FLACC pain for the oral glucose group was 5.23 ± 1.30 and 7.00 ± 1.11for the control group. These findings are supported by **(Harrison et al., 2011),** who mentioned that over the past century sweet tasting solutions have been used to promote calm and to reduce pain in infants and even before this time Prophet Mohammed, circa 632 AD, recommended giving infants a well chewed date. This goes with the results of a study done by **Chermont et al. (2010)**, about the effect of skin to skin contact and/or oral administration of 25% dextrose for procedural pain relief for term newborn infants, they found that 25% dextrose was effective in reducing pain scores compared to skin-to-skin contact. Similarly, another study conducted by **Hatfield et al. (2008)**, about the analgesic properties of oral sucrose during routine immunizations at 2 and 4 months of age, they found that oral sucrose is an effective, easy to administer, short-acting analgesic for use during routine immunizations. In a similar study done by **Dilen and Elseviers (2010)**, about the use of oral glucose solution as pain relief in newborns, they found that oral administration of 2 ml of 30% glucose 2 minutes before the venipuncture provides the most effective pain reduction in newborns. These findings were supported by the study of **Taddio et al. (2010)**, about reducing the pain of childhood vaccination: an evidence-based clinical practice guideline, they recommended that an administration of a sweet-tasting solution during vaccination reduce pain at the time of injection among infants up to 12 months of age who cannot be breastfed during vaccination.

Glucose is an effective agent for relieving needle-associated pain in infants with no adverse effects associated with its administration, and it has similar effects of sucrose when both are compared to placebo as stated by **(Kassab et al., 2012a)**. Furthermore, another study conducted by **Kassab et al. (2012b)**, about a double-blind randomized controlled trial of 25% oral glucose for pain relief in 2-month old infants undergoing immunization, it was found that 2 ml oral dose of 25% glucose given immediately before an immunization procedure reduces pain in 2-month old infants. Additionally, the results of a study conducted by **Bueno et al. (2013)**, who studied the efficacy of non-sucrose sweet-tasting solutions for pain relief during painful procedures in neonates, and mentioned that glucose reduces pain scores during single heel lances and venipunctures. As well, **McCall et al. (2013)** stated that, oral sucrose solution in a 24% concentration at a dose of 2 ml, approximately 2 minutes prior to the painful procedure, reducing pain during immunizations and venipuncture in the outpatient setting in infants aged 1–12 months old. This finding is supported by **Rouben (2013)**, who summarized that administration of 2 ml 50% oral sucrose before venipuncture is effective among infants in reducing pain

The present study results showed that non-nutritive sucking alone alleviates infants' pain due to needle related minor procedure, however the mean score of total FLACC pain for pacifier group was 5.40 ± 1.13 and 7.00 ± 1.11for the control group. This finding was supported by **Liaw et al. (2012)**, who compare in their study between non-nutritive sucking and facilitated tucking to relieve preterm infant pain during heel-stick procedures, and found that non-nutritive sucking reduced pain more effectively than facilitated tucking. This finding was consistent with the results of a study conducted by **Harrington et al. (2012)**, who measured the analgesic effectiveness of the 5 S's (swaddling, side/stomach position, shushing, swinging, and sucking) and combined with sucrose, during routine immunizations at 2 and 4 months. They found that physical intervention of the 5 S's provided decreased pain scores on a validated pain scale and decreased crying time among 2- and 4-month-old infants during routine vaccinations. Additionally, in the same line **Lima et al. (2013)**, found in their study about the efficacy of nutritive and non-nutritive sucking stimuli that, the efficacy of both interventions in relieving pain among newborns undergoing venipuncture.

Regarding the administration of oral glucose and non-nutritive sucking together during the painful procedure, the results of the current study revealed that the combination of oral glucose and non-nutritive sucking is more effective for reducing infants' pain than oral glucose alone. This finding is in agreement with the study of **Marcatto et al. (2011)**, about the benefits and limitations of the use of glucose for the treatment of pain in neonates. It was found that, the administration of oral glucose solution is apparently effective for heel punctures, especially when associated with non-nutritive sucking. According to a study conducted by **Mekkaoui et al. (2012)**, it was found that the oral administration of 30% glucose combined with sucking provided better control of pain induced by blood sampling in newborns at neonatal unit. Moreover, **Kassab et al. (2012a)** pointed out that combining glucose with another intervention such as skin-to-skin contact, non-nutritive sucking, or breastfeeding may be more effective than glucose alone. Also, this result goes in the same line with studies conducted by **Naughton (2013)**, and **Carbajal et al. (2014)**, who found that the synergistic effect of sweet solutions and non-nutritive sucking are more effective than the effect of sweet solutions or non-nutritive sucking alone .

In the present study, the results illustrated that oral glucose had an analgesic effect than providing non-nutritive sucking (pacifier) for the studied infants, while the mean score of total FLACC pain for the oral glucose group was 5.23 ± 1.30 and 5.40 ±

1.13 for pacifier group. This result was supported by **Elserafy et al. (2009)**, who studied the effect of oral sucrose and a pacifier for pain relief during simple procedures in preterm infants; they found that, lowest pain scores occurred with the use of 24% sucrose solution compared with a pacifier in neonates undergoing heel stick or venipuncture. Also, this finding was in agreement with the study conducted by **Liaw et al. (2011)**, who compare the effect of nonnutritive sucking and oral sucrose on newborns' pain during intramuscular injection of hepatitis B vaccine, they found that sucrose when administered orally two minutes before injection, it has more effect reduced newborns' pain during injection than NNS. Also, they found that, the cry duration of infants receiving sucrose was significantly shorter than those in the non-nutritive sucking which consistent with the results of the present study. According to **Mekkaoui et al. (2012)**, it was found that, non-nutritive sucking of a teat, had the same analgesic effect as glucose 30% to control pain induced by blood sampling in newborns. This finding is in disagreement with the study conducted by **Liu et al. (2010)**, who study the efficacies of non-nutritive sucking and glucose solution as pain-relief interventions for neonates undergoes a venipuncture procedure, and found that non-nutritive sucking is more effective than the oral glucose solution.

Conclusion

The use of oral glucose and non-nutritive sucking (pacifier) is effective in reducing pain for infants undergoing minor needle related procedures. Meanwhile, the combination of oral glucose and non-nutritive sucking is more effective in relieving infants' pain than the use of oral glucose or non-nutritive separately.

Recommendations

Based on the study findings, it can be recommended that:

- Non-pharmacological pain relief methods for infants should be included in the policy of pediatric health care settings.
- Oral glucose and non-nutritive sucking should be used in pediatric units as a routine intervention to reduce pain during minor needle related procedures for infants.
- Replication of this study with larger sample at different settings and with longitudinal follow up is recommended so that the results could be generalized.

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