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Improving Nurses' Performance Towards Non- Pharmacological Pain Management Among Neonates In Neonatal Intensive Care Unit

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Abstract: *Despite the availability of evidence based clinical guidelines regarding the effectiveness of the non-pharmacological methods of procedural pain relive in hospitalized neonates, the majority of these methods still underused.* ***The aim*** *of this study was to improve nurses' performance towards non pharmacological pain management among neonates in neonatal intensive care unit through the implementation of an educational program.* ***Design:*** *A quasi-experimental design was used in carrying out the study.* ***Setting:*** *The study was conducted at the neonatal intensive care unit affiliated to Mansoura University Children's Hospital.* ***Subjects:*** *A convenience sample of 51 neonatal nurses working in the previously mentioned setting.* ***Tools:*** *Data were collected by using: Predesigned questionnaire sheet to assess nurses' knowledge about neonatal procedural pain and its non-pharmacological management and the observation sheet to assess nurses' application of non-pharmacological pain management methods in the neonatal intensive care unit.* ***Results:*** *There was statistically significant difference regarding nurses' knowledge and practices about neonatal pain and its non-pharmacological management methods pre, immediately post and at follow up of the program implementation.* ***Conclusion:*** *There was a significant positive effect of the educational program in improving nurses' performance towards non-pharmacological pain management in neonatal intensive care unit* ***Recommendations:*** *Conducting more periodical continuing education for neonatal nurses that encouraging more frequent use of non-pharmacological methods in clinical care with necessity of follow up that must be motivated by a multidisciplinary team to be a routine care inside the unit.*

Key Terms: *Neonatal Nurses, Neonatal procedural pain management, NICU, Non-pharmacological methods.*

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I. Introduction

Pain is a common and frequent symptom of a possible disease process which forces individuals to seek out medical advice, and it is considered as a foremost distress influencing all aspects of life. Repeated untreated pain in neonates has a cost attached as it causes neurological developmental issues which are sometimes irreversible **(Lunkuse, 2017; Grunau 2013& Pölkki et al. 2010)**.

Throughout treatment procedures that needed for diagnostic and therapeutic reasons, the high- risk neonates hospitalized in the neonatal intensive care unit (NICU) are repetitively exposed to daily agonizing procedures that may possibly provoke different intensity of pain or suffering **(Jeong, Park, Lee, Choi, & Lee, 2014)**. Early exposure to repeated procedural pain is a main factor contributing to negative physiological, cognitive, behavioral and psychological consequences in infants. This is because newborn infants are more vulnerable to pain than older children and can experience pain at the same, if not greater, level of intensity as adults experience pain **(Liaw, Yang, Wang, Chen, Chang& Yin, 2012).**

Neonatal pain management is considered to be a challenging task to neonatal care providers as these neonates cannot talk or verbalize when they experience pain (**Cong et al. 2014).** So, management of pain rests in the hands of the neonatal nurses and definitely considers an issue of importance in neonatal nursing **(Nimbalkar, Dongara, Phatak & Nimbalkar, (2014).** The American Academy of Pediatrics argues all health care professionals who work with neonates to make pain management as number one goal not only because it's ethical but also because of consequences that come with pain **(Akuma & Jordan, 2011; Carbajal et al. 2008).**

Optimal pain management requires competent pain assessment, which can be especially difficult to perform in neonates because they cannot self-report **(Suciu et al., 2015)**. According to international guidelines for pain

management, pain is considered the fifth vital sign, and it should be assessed as such **(Gradin, Eriksson, & NeoOpioid investigators Group, 2011).** The pain-assessment tool used should be multidimensional, including measurements for both physiologic and behavioral indicators of pain **(Rita de Cassie, Balda, & Guinsburg, 2016).**

Neonatal care nurses play an important role in neonatal pain management, their goals are minimize the experience of pain and maximize the neonate's capacity to cope with and recover from the many painful procedures in the NICU **(Walter-Nicolet, Annequin, Biran, Mitanchez,& Tourniaire, 2010).** It is more difficult to avoid painful procedures in neonates. Therefore, there are several measures for pain management in neonates. These measures including: either "pharmacological", "non-pharmacological" methods, or a combination of both. The pharmacological methods, although effective for severely painful procedures, are not the effective method for the treatment of several minor procedures such as heel lance. Therefore, non-pharmacological methods or a combination of the two need to be incorporated to ameliorate the effects of procedural pain due to these procedures **(Walter-Nicolet et al., 2010).**

Studies show that non-pharmacological methods are economical, tolerated well by newborns, effective in reliving mild to moderate pain and the these methods have proven to be effective whether used alone or combined with pharmacological methods **(Baulch, 2010; Walter-Nicolet et al., 2010 & Asadi-Noghabi, Tavassoli-Farahi, Yousefi, & Sadeghi, 2014)**.

Non-pharmacological methods includes oral sweet solutions, non-nutritive suck with and without sweet solutions, positioning, swaddling, facilitated tuck, kangaroo care, human touch, skin-to-skin contact, multi-sensorial stimulation and modification of environmental stimuli, these methods can be used before and after application of any painful procedure **(Morrow, Hidinger, & Wilkinson-Faulk, 2010& Walter-Nicolet et al., 2010)**.

The need to understand barriers that prevent the provision of optimal non pharmacological pain management for neonates by nurses is considered as a vital importance in order to eliminate unnecessary pain experienced by them **(Baulch 2010)**. To provide effective and good nursing care for neonates, nurses must assess pain and recognize that neonatal procedural pain occurs, apply different pain management methods and identify barriers for pain management and tray to overcome these in order to break the gap between the knowledge and practice **(Pölkki et al., 2010).** Therefore, improving nurses' practice of procedural pain management is necessary and the use of non-pharmacological methods is mandatory **(Suciu et al., 2015)**.

II. Significance Of The Problem

There is a gap between the knowledge of neonatal nurses regarding neonatal pain, the consequences of uncontrolled pain and its management practices. Studies indicated that the use of non -pharmacological methods is the most effective way for relieving neonatal procedural pain. Therefore, it is important to conduct this study.

Aim of the study

This study aimed to improve nurses' performance towards non pharmacological pain management among neonates in neonatal intensive care unit.

Research hypothesis:

1. Implementation of an educational program for neonatal nurses may improve their knowledge and practices about neonatal pain, and its non-pharmacological management.

2. Neonatal nurses may use the non-pharmacological methods for relieving neonatal procedural pain as a routine care in the unit.

III. Subjects And Methods

Design:

A quasi-experimental design was utilized for this study.

Setting:

The study was conducted at the neonatal intensive care unit (NICU) affiliated to Mansoura University Children's Hospital (MUCH).

Subjects:

The subjects of the present study included a convenience sample of all bedside/ working nurses (no=51), who were available during the period of data collection in the previously mentioned setting and providing direct neonatal care regardless their age, qualifications or years of experience.

Tools: The data were collected by the following study tools:

Tool I: Predesigned questionnaire sheet (pre & posttest and follow up) It was designed by the researcher in a simple Arabic language after reviewing the related literature to assess nurses' knowledge about neonatal pain, and its non-pharmacological management in NICU. Different types of questions used including open & closed - ended questions, and multiple-choice questions. It was divided into parts:
Part (I): Characteristics of the studied nurses were collected that included age, qualification, years of experience in NICU, as well as the attendance of previous educational sessions related to neonatal pain.
Part (II): Nurses' knowledge regarding neonatal pain and its management methods.

Scoring system:
Scoring system of the tool I:
Nurses' knowledge was computed and the items were classified and evaluated as follow:
A: The open ended questions were evaluated as follow:

- Complete correct answer was given the score: 2
- Incomplete correct answer was given the score: 1
- Incorrect answer or don't know was given the score: 0

B: The closed ended questions were evaluated as follow:

- Correct answer was given the score: 2
- Incorrect answer or don't know was given the score: 0

The studied nurses' answers checked with a model key answer.

- Poor level of knowledge (< 60%).
- Average level of knowledge (60 %- < 75%).
- Good level of knowledge (≥ 75%).

Tool II: Nurses' observation sheet:
The researcher developed it after reviewing the related literature to assess the nurses' practices concerning non-pharmacological pain management methods before and after implementation of the program. The sheet consisted of:

- ***Part (I):*** The observation sheet about pain management (which non-pharmacological method was the nurse used during the painful procedure.

- ***Part (II):*** Procedure checklist to evaluate how the nurse performed the used non-pharmacological method (Ora-sweet solution, nonnutritive sucking, positioning (nesting or/ swaddling), Skin- to- Skin contact, and modification of environmental stimuli as controlling light and noise.

Scoring system of the tool II:
Scores were estimated to evaluate the nurses' practices based on the researcher's observation sheet and checklists; which evaluated as follows:

- Completely done was given the score: 2
- Incompletely done was given the score: 1
- Not done was given the score: 0

The total score of observation sheet was categorized as:

- Incompetent practice (< 85%)
- Competent practice (≥ 85%).

Operation of the study:
The preparatory phase:

- Review of the related literature covering different aspects of neonatal pain, and its non-pharmacological management in the unit. This was done using books, articles, magazines and internet research available to find relevant and current literature and studies to develop relevant tools for data collection. The guiding booklet was prepared by the researcher. It was specially designed in a simple Arabic language to meet nurses' practical needs or knowledge deficits

- Data collection tools were presented to five experts in the nursing / pediatric sector at the Faculty of Nursing / Medicine of the University of Mansoura to evaluate the validity of the content. The modifications of were made according to the experts' judgment on the clarity of the sentences, the adequacy of the content and the sequence of the elements. Experts agree with the content, but recommend minor changes in the language that would make the information clearer and more accurate. Suggested changes have been made.

- Internal consistency reliability of all items of the tools was assessed using coefficient alpha. It was 0.77 for Structured Questionnaires Sheet and 0.92 for Nurses Practices Observation sheet.

Administrative phase

- Permission to get an approval for conducting the study to access the neonatal unit and conduct the study was obtained from head of NICU after showing title and the purpose of the study.

Ethical consideration

- Approval was obtained from the research ethics committee of Mansoura Faculty of Nursing to conduct the study.
- The researcher obtained the approval consent from each nurse for her participation after explaining the aim of the study and securing the confidentiality of the collected data. The nurses were assured that they can withdraw at any stage from the study without any responsibilities.

Pilot study:

- A pilot study was conducted on 10% of the total sample size (5 neonatal nurses) to demonstrate viability and applicability of the tools, and to assess the time required to fulfill the tools. Because no radical modifications were carried out on the study tools, the subjects included in the pilot study were included in the study sample.

Implementation phase and Field work:-

- The data was collected from June 2013 to January 2014. The purpose of the study was explained by the researcher to each nurse. The researcher was available at different times on morning and afternoon shifts for data collection.

- Each nurse was assessed for their knowledge through a predesigned questionnaire sheet, and practical observation sheet was used to assess the actual nurses' performance.
- Based on the findings of the assessment and review of literature, the educational program developed and implemented for the neonatal nurses. The program was consisted with theoretical and practical sessions. Time for each session was varied from 45 to 60 minutes. The program included the following items:

Knowledge about:

- Neonatal pain,
- Management of neonatal pain:-

a) Non-pharmacological pain management methods e.g

☒ Oral sweet solutions,
☒ Non-nutritive sucking,
☒ Positioning e.g swaddling, nesting, or facilitated tucking,
☒ Skin to skin contact" kangaroo care", touch, and
☒ Modification of environmental stimuli.

Practical skills regarding:

- Non-pharmacological pain management methods e.g

☒ Oral sweet solutions,
☒ Non-nutritive sucking,
☒ Positioning e.g swaddling, nesting, facilitated tucking,
☒ Skin to skin contact" kangaroo care", touch, and
☒ Modification of environmental stimuli.

- Nurses were divided into small groups; five to eight in each group. Various teaching methods were used in the form of lectures, group discussions, group activities questions, brain storming, demonstration and re-demonstration. Numerous teaching media were used, such as power point, figures, flipcharts, pens, papers and illustrated videos. The program was carried out in the unit and in the conference room of the unit.

The evaluation phase:

- Nurses' knowledge and practices were reassessed immediately post the implementation of the program (posttest), and three months later (follow up).

Statistical Analysis

- The collected data were revised, coded, tabulated and analyzed by using the number and percentage distribution.
- Data were analyzed using compatible personal computer using the Statistical Package for Social Sciences (SPSS) for Windows version 22 (SPSS Inc., Chicago, IL, USA).
- Graphics were done by using Excel program.
- Chi-square test ($\chi 2$), Friedman test, Fisher exact test and Wilcoxon Signed Ranks test (Z test) were used to estimate the statistical significance between variables of the study.
- A significant difference was considered when ($P < 0.05$).

IV. Results

Concerning nurses' characteristics **Table (1)** shows that, 45.1% of the studied nurses were aged 30 years old or more, and 58.8% with bachelor degree in nursing science. It is also apparent that 70.6% of them didn't attend any previous training courses about neonatal pain.

As regards the studied nurses' years of experience at NICU, **Figure (1)** illustrates that 43% of the nurses had more than or equal 10 years of experience working as a neonatal nurse. Meanwhile, only 8% of them had less than one year of experience.

Table (2), shows that all of the nurses had poor knowledge regarding oral sweet solution as one of non-pharmacological methods for neonatal procedural pain preprogram compared with 90.2% and 80.4% of them had good knowledge post program and at follow up respectively, with highly statistically significant difference ($p< 0.001$)**.**

The same table shows that all of the nurses had poor knowledge regarding nonnutritive sucking as one of non-pharmacological methods for neonatal procedural pain preprogram compared with 84.3% of them had good knowledge at both post program and at follow up, with highly statistically significant difference ($p< 0.001$).

Table (2) also illustrates that all of the nurses had poor knowledge about positioning as one of non-pharmacological methods for neonatal procedural pain preprogram compared with 94.1% and 82.4% of them had good knowledge post program and at follow up respectively, with highly statistically significant difference ($p< 0.001$).

Regarding skin to skin contact as one of non-pharmacological methods for neonatal procedural pain, all of the nurses had poor knowledge preprogram compared with 92.2% and 82.4% of them had good knowledge post program and at follow up respectively, with highly statistically significant difference ($p< 0.001$).

Additionally, **table (2)** clearly revealed that, most (80.4%) of the nurses had poor knowledge about the standard level and reduction strategies for both light and noise as the basics regarding modification of environmental stimuli as one of non-pharmacological methods for neonatal procedural pain preprogram compared with 92.2% and 94.1% of them had good knowledge post program and at follow up respectively, with highly statistically significant difference ($p< 0.001$).

Regarding nurses' practices of oral sweet solution **table (3)** proves that, none of nurses (0%) got competent practice preprogram, compared to more than two thirds of them (70.6%) immediately post program and near two thirds (62.7%) at follow up, with a very highly statistically significant difference ($p=0.000$).

Concerning the nurses' practices regarding non-nutritive sucking, this table represented that, none of nurses (0%) achieved competent practice preprogram implementation, compared to all (100%) and 66.7% of them were competently perform the procedure immediately post program and at follow up respectively, with a very highly statistically significant difference ($p=0.000$).

In relation to, nurses' practices to positioning, as observed from **table (3)** that, only 29.4% of the nurses had competent practices related to positioning preprogram implementation. Compared to an observed improvement in their practices immediately post program and at follow up respectively, with a statistically significant differences ($p=0.028$).

In relation to nurses' practices regarding skin to skin contact (kangaroo mother care), this table indicated that preprogram, none of the nurses had competent practices related to kangarooing. While the same table clarified that, all (100%) of them had competent practices post program implantation and declined to 37.3% follow up, with a very highly statistically significant differences ($p=0.000$).

Table (3); finally shows that, 72.5% of the nurses had incompetent level of practices regarding modifying of environmental stimuli preprogram, compared with 88.2% and 68.6% of them had competent level of practice post program and at follow up respectively, with a highly statistically significant difference (p=0.000).

As regards of the nurses' practices regarding frequency of using non- pharmacological pain management methods **figure (2)** illustrates that, in comparison with preprogram implementation, post program and follow up phases noticed an increased frequency using of all non- pharmacological methods by order (nesting, light reduction, using pacifier alone, oral sweet solution, pacifier with sweet solution, followed by limited noise reduction then, the extremely rare percentage for kangaroo care.

In relation to total nurses' knowledge regarding neonatal pain and its non-pharmacological management preprogram, immediately post and at follow up, **table (4)** reveals that, all (100%) the nurses had poor knowledge preprogram. While 92.2%, and 80.4% of them had good knowledge, immediately post the program and at follow up respectively with a very high statistical significant difference (p =0.000).

Concerning the total nurses' practice regarding neonatal pain and its non-pharmacological management, preprogram, immediately post and at follow up, **table (5),** illustrates that, all the nurses (100%) had incompetent practice preprogram, while, 88.2% and 55% of them achieved competent practices immediately post program and at follow up respectively with high statistically significant difference (χ^2 **= 68.844 & P < 0.001**).

Concerning the relation between total nurses' knowledge and their total practices, **table (6)** reveals that, there was no statistical significant relation between total nurses' knowledge and their total practice immediately post and at follow up of the program implementation.

Table (1); Characteristics of the Nurses in Frequency Distribution, (n=51).

Characteristics	No	%
Age (years)		
- < 20	1	2
- 20 - < 25	11	21.6
- 25 - < 30	16	31.4
- ≥ 30	23	**45.1**
Mean ± SD	30.6±2.7	
Qualification	30	**58.8**
- Bachelor degree in nursing science	2	3.9
- Technical nursing institute	19	37.3
- Diploma of nursing		
Attendance training courses about neonatal pain		
- Yes	15	29.4
- No	36	**70.6**

Figure (1): Percentage Distribution of the Nurses regarding their Years of Experience at NICU, (n=51).

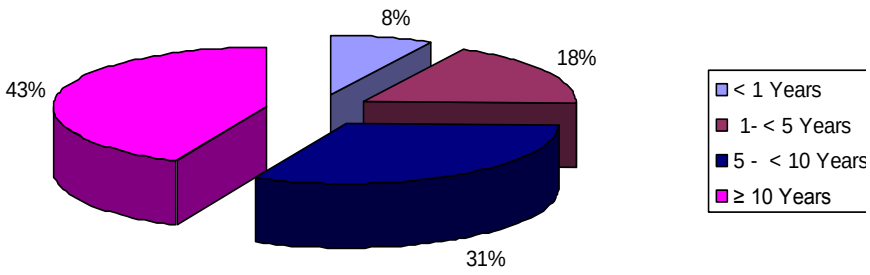


Table (2); Nurses' Knowledge Levels regarding Non-pharmacological Pain Management Method Pre, Immediate Post and at Follow Up

Knowledge items	Total number of nurses = 51 (100%)						
	Pre		**Immediate post**		**Follow up**		**Test of significance**
	No	%	No	%	No	%	χ^2 & P
Nurses' knowledge level about oral sweet solution							
- Good	0	0	46	**90.2**	41	**80.4**	77.587
- Average	0	0	2	3.9	0	0	**< 0.001****
- Poor	51	**100**	3	5.9	10	19.6	
Nurses' knowledge level about nonnutritive sucking							
- Good	0	0	43	84.3	43	84.3	90.241
- Average	0	0	2	3.9	3	5.9	<0.001**
- Poor	51	100	6	11.8	5	9.8	
Nurses' knowledge level about positioning							
- Good	0	0	48	94.1	42	82.4	85.452
- Average	0	0	2	3.9	2	3.9	<0.001**
- Poor	51	100	1	2	7	13.7	
Nurses' knowledge level about skin to skin contact							
- Good	0	0	47	92.2	42	82.4	84.696
- Average	0	0	3	5.9	2	3.9	< 0.001**
- Poor	51	100	1	2	7	13.7	
Nurses' knowledge level about modifying environmental stimuli							
- Good	2	3.9	46	90.2	48	94.1	78.013
- Average	8	15.7	5	9.8	0	0	< 0.001**
- Poor	41	80.4	0	0	3	5.9	

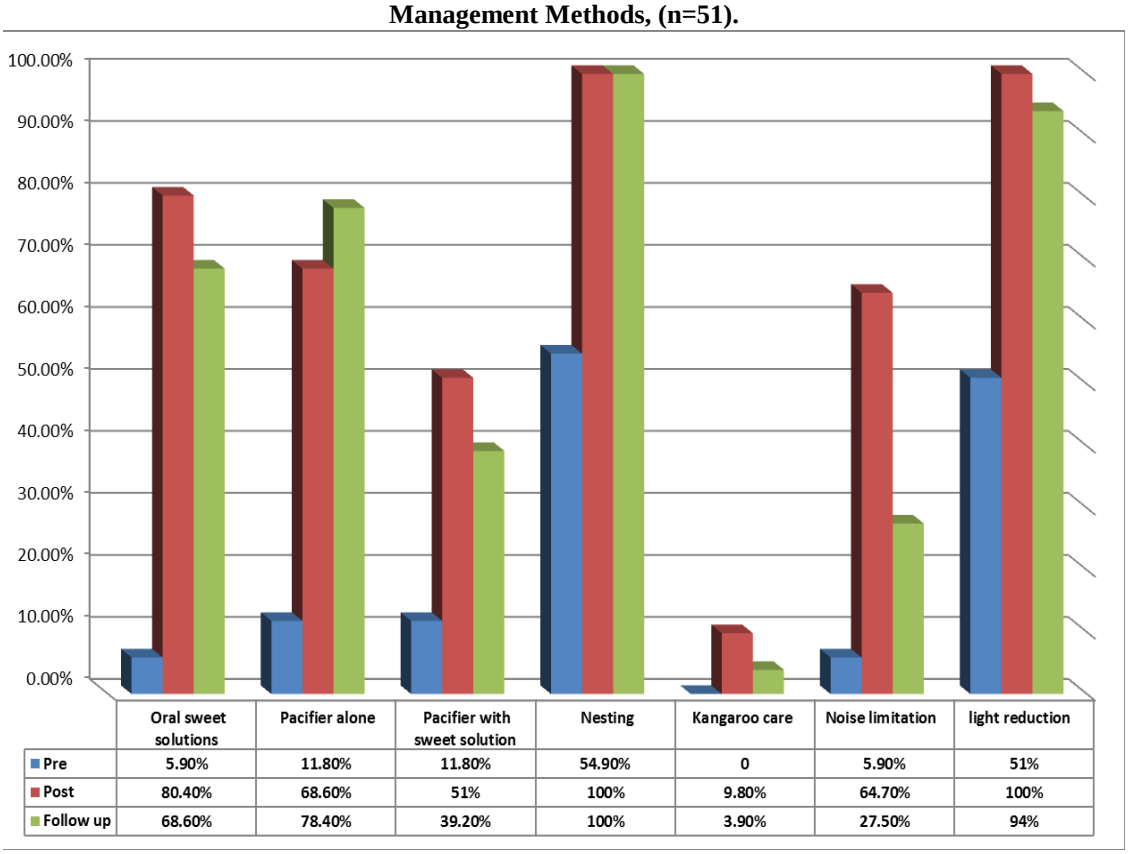
(*) Statistically significant at P < 0.05

Table (3); Nurses' practice Level regarding Non-pharmacological Pain Management Method Pre, Immediate Post and at Follow Up

Knowledge items	Total number of nurses = 51 (100%)						
	Pre		**Immediate post**		**Follow up**		**Test of significance**
	No	%	No	%	No	%	χ^2 & P
Nurses' practice level about oral sweet solution							
- Competent practice	0	0	36	**70.6**	32	**62.7**	62.000
- Incompetent practice	51	**100**	15	29.4	19	37.3	**<0.001****
Nurses' practice level about nonnutritive sucking							
- Competent practice	0	0	51	**100**	34	**66.7**	79.333
- Incompetent practice	51	**100**	0	0	17	33.3	**<0.001****
Nurses' practice level about positioning							
- Competent practice	15	**29.4**	51	**100**	45	**88.2**	7.161
- Incompetent practice	36	70.6	0	0	6	11.8	**0.028***
Nurses' practice level about skin to skin contact							
- Competent practice	0	0	51	**100**	19	**37.3**	41.864
- Incompetent practice	51	**100**	0	0	32	62.7	**<0.001****
Nurses' practice level about modifying environmental stimuli							
- Competent practice	14	27.5	45	**88.2**	35	**68.6**	10.706
- Incompetent practice	37	**72.5**	6	11.8	16	31.4	**0.005***

(*) Statistically significant at P < 0.05

Figure (2): Percentage Distribution of the Nurses' Frequency Using Non-pharmacological Pain Management Methods, (n=51).



	Oral sweet solutions	Pacifier alone	Pacifier with sweet solution	Nesting	Kangaroo care	Noise limitation	light reduction
Pre	5.90%	11.80%	11.80%	54.90%	0	5.90%	51%
Post	80.40%	68.60%	51%	100%	9.80%	64.70%	100%
Follow up	68.60%	78.40%	39.20%	100%	3.90%	27.50%	94%

-Numbers not mutually exclusive

Table (4); Total Level of Nurses' Knowledge regarding Neonatal Pain and Its Non-pharmacological Management in all Study Phases

Level of total Nurses' Knowledge	Total number of nurses = 51 (100%)						Test of significance		
	pre		Immediately post		Follow-up		Wilcoxon Signed Ranks Test		
	No	%	No	%	No	%	Z_1 & P_1	Z_2 & P_2	Z_3 & P_3
- Good	0	0	47	**92.2**	41	**80.4**			
- Average	0	0	3	5.9	3	5.9	-6.88(a)	-6.441(a)	-2.038(b)
- Poor	51	**100**	1	2	7	13.7	0.000**	0.000**	0.042*
	χ^2 = 85.962 P < 0.001* (Friedman Test)								

(*) Statistically significant at P < 0.05
Z1: Between Pre and immediate post
Z2: Between Pre and follow up
Z3: Between Immediate post and follow up
a Based on negative ranks. b Based on positive ranks.

Table (5); Nurses' Total Level of Practice regarding Neonatal Pain and its Non-pharmacological Management in all Study Phases

Level of total nurses' practices	Total number of nurses = 51 (100%)								
	Pre		Immediately post		Follow-up		Test of significance		
							Wilcoxon Signed Ranks Test		
	No	%	No	%	No	%	Z_1 & P_1	Z_2 & P_2	Z_3 & P_3

- Competent practice	0	0	45	**88.2**	28	**55**	-6.708(a) **0.000****	-5.292(a) **0.000****	-4.123(b) **0.000****
- Incompetent practice	51	**100**	6	11.8	23	45			
	χ^2 = 68.844			**P < 0.001***			**(Friedman Test)**		

(*) Statistically significant at P < 0.05
Z1: Between Pre and immediate post
Z2: Between Pre and follow up
Z3: Between Immediate post and follow up
a Based on negative ranks. b Based on positive ranks.

Table (6); Relation between Total Nurses' Knowledge and their Total Practices regarding Neonatal Pain and its Non-pharmacological Management in all Study Phases

Total number of nurses = 51 (100%)								
Total Practices	**Total Knowledge**						**χ^2**	**P**
	Poor		**Average**		**Good**			
	No	**%**	**No**	**%**	**No**	**%**		
Pre: (51)			**(0)**		**(0)**			
- Competent practice(0)	0	0	0	0	0	0	------	------
- Incompetent practice(51)	51	100	0	0	0	0		
Immediately Post: (1) (3) (47)								
- Competent practice(45)	1	100	2	66.7	42	**89.4**	1.535**	0.464
- Incompetent practice(6)	0	0	1	33.3	5	10.6		
Follow up: : (7) (3) (41)								
- Competent practice(28)	4	57.1	3	100	21	**51.2**	2.703**	0.259
- Incompetent practice(23)	3	42.9	0	0	20	48.8		

(**) Fisher exact test

V. Discussion

According to the World Health Organization and the International Association for Pain Study (IASP), pain is a major global health problem. However, despite large investments and pain-related research efforts, clinical practice is far from "best practices" in hospitals, therefore, is not adequately treated, in both developed and developing countries **(Stevens et al., 2011; Linhares et al., 2012; Breivik, Eisenberg & O'Brien, 2013).** Faced with this alarming reality concerning neonatal pain, the objective of this study was to improve nurses' performance towards non pharmacological pain management among neonates in neonatal intensive care unit.

There are great opportunities for neonatal nurse to improve their knowledge and skills, and highly training in the management of pain by performing non-pharmacological methods that have proven to be powerful aids in reducing procedural pain in neonates **(Walter-Nicolet et al., 2010**)

Regarding the nurses' characteristics, the present study results revealed that, more than two fifths of the studied nurse's age was between 30 years old or more with mean age of 30.6±2.7, more than half of them had a bachelor degree in nursing science **(table 1)**. This finding was consistent with **Costa et al., (2017)**, who conducted a study about "Nurses' knowledge and practices regarding pain management in newborns" and found that the age of the neonatal nurses varied from 21 to 52 years with an average of 30.8 years. Moreover, it is also with the same line with **Mehrnoush, Ashktorab, Heidarzadeh, & Momenzadeh, (2017**), who conducted a study in Iran about "knowledge and attitude of personnel, key factors in implementation of neonatal pain management in NICU"**,** and found that, the majority of the participating nurses had bachelors' degree of nursing. From the researcher point of view, that the higher degree of nursing qualification always selected to work with the most vulnerable population like high risk neonates. Also, the nurses who work in neonatal care units better to be graduated from a college or university education to be prepared as a highly qualified and practical nurse.

In relation to the studied nurses' attainment of previous training courses, the same table of the current study revealed that more than two thirds of them didn't attend previous training courses about neonatal pain. In accordance with the findings of **El-Sayed, Sabry, Sharkawy, El-Sayed & Ali, (2013)**, who conducted a study about 'establishing basic standards of nursing care protocol at neonatal intensive care unit" and reported that, most of nurses did not attend previous in-service training program related to neonatal care at NICU. But, another study by **De Oliveira Soares, Caminha, Coutinho, & Ventura, (2016)** about " pain in the neonatal unit: the knowledge, attitude and practice of the nursing team "found that more than two thirds (65.6%) of neonatal nurses received training on neonatal pain management.

Also, very recent study results done by **Collados-Gómez , Camacho-Vicente , González-Villalba, Sanz-Prades, & Bellón-Vaquerizo, (2018)** about " Perception of neonatal nurses on pain management " confirmed that near half (47.9%) of the nurses had received specific training in pain management. The researcher relays this to, lack of in-service education, continuous training and staff development in the study settings. Also, the nurses who receive specialized education and training can easily able to gain capability in assessing and identifying neonates' health problems and deal with them effectively. In developed countries, training programs have been shown to improve nurses' response to pain in children.

On the other hand, **Mathew, Mathew, & Singhi, (2011)** and **Maghami, Aghababaeian, Ahmadi Majin, Moosavi & Tahery, (2016)** stated that, data limited by some developing countries suggest that nurses lack training in pain management for a number of reasons. In the absence of formal training in pain management, the knowledge and sensitivity of individual nurses towards pediatric pain become even more important, as they can directly influence their management.

Regarding the nurses' experiences, the current study illustrated that, more than two fifths of them had equal to or more than 10 years of experience working as a neonatal nurse **(figure 1)**. The current finding goes in the same line with the results of the study conducted by **Stevens et al., (2010),** who conducted a study about "Influence of risk of neurological impairment and procedure invasiveness on health professionals' management of procedural pain in neonates" and found the staff held mean of 11.3 ± 8.7 years of working experience in the NICU. This reflects that, nurses in this study had more years of experience and this experience may to be vital in pain management.

Recently, much attention has been paid to reduce procedural pain in neonates using non-drug (non-pharmacological) methods that including and not limited to: oral sweet solutions, positioning, and skin to skin contact. However, studies consistently show sub-optimal use **(Harrison, Elia, Manias & Royle, 2014; Pillai Riddell et al, 2015; Bueno et al, 2013**; **Taddio et al. 2013).**

Regarding oral sweet solution, and nonnutritive sucking (NNS), the nurses' knowledge and practices regarding them as well as their actual frequency of use during the painful procedure performed, as non-pharmacological pain management methods, the results of current study revealed that, all of the nurses had poor knowledge **(table 2)** and had incompetent practices **(table 3)**, with very less frequency performed during painful procedures **(figure 2)** regarding both of them in the same phase of the program, then there was an observed improvement in the nurses' knowledge, practices as well as the frequency using of oral sweet solution and nonnutritive sucking post-program and at follow up with a highly statistically significant difference that concluded, improving nurses' performance towards oral sweet solution and NNS as the most common studied non pharmacological pain management methods all over the neonatal pain management studies that reflected their efficacy when administered according to the evidence based practices. From the researcher view, this improvement, if it is continue and audited by the health care team in this study unit then encouraged and supported by collaboration between nurses and doctors will play a huge progression in the nurses' practice as well as reducing the neonates' suffering during painful procedures which in turn enhance their quality of life, especially when introduced in the form of written guideline that periodically updated according to the new evidence to give proper technique, type and dose of sweet solution to reach to the proper and effective pain management that enhance the neonates' health outcomes.

Using oral sweet solution as glucose was supported by the study finding by **Matar, Arabiat, & Foster, (2016)** about "Oral glucose efficacy on neonate's pain responses at the NICU: A quasi experimental trial of two clinical procedures" who concluded that oral glucose (10%) had a positive effect on pain response during minor pain procedures. Also, **Kamhawy, Holditch-Davis, Alsharkawy, Alrafay & Corazzini (2014)** concluded that non-nutritive sucking improves the physiological and behavioral responses of premature babies. But it was not supported by **Costa, et al, (2013)** who claimed that glucose might not be effective for longer procedures. For example, an RCT did not detect any glucose effect on pain response during ophthalmological examinations.

Concerning positioning that maintain the flexed position of the neonate, the nurses' knowledge and practices regarding it as well as its actual frequency of use during the painful procedures performed, the results of the present study revealed an improvement in the knowledge of nurses and practices post program implementation where, knowledge improved from poor level for all nurses preprogram to good level for the

majority of them post program and at follow up **(table 2)**. Also, nurses' practices improved from incompetent level for less than one third of the nurses preprogram to competent level for all of them post program and majority of them at follow up **(table 3)**, with increase in its frequency of use post program implementation **(figure 2)** where, there was increase in the frequency using positioning as nesting from more than half (54.9%) of the nurses preprogram to all (100%) of them post program and at follow up.

These findings are in an agreement with **Chen et al., (2014)**, who reported that nurses' knowledge regarding neonate's positioning as nesting was improved from half of studied nurses preprogram (58.3%) to the majority of them (92.3%) after implementation of the program. The researcher thinks that, these results reflect the importance of education and continuous training on improving nurses' knowledge, taking into consideration that positioning the newborn comfortably is a nurse's basic responsibility and is one of the most important nursing strategies to reduce pain and promot comfort.

Additionally, the result is supported by an Egyptian study conducted at the same setting by **Abusaad, Abd El Aziz, & Nasef (2017)** about "The Effectiveness of Developmentally Supportive Positioning on Preterm Infants' Pain Response at Neonatal Intensive Care Units" where the researcher found that all preterm infants (100%) had an unacceptable positional preoperation, while after a week of surgery, about two-thirds (64.3%) of the children were placed in an acceptable position. Furthermore, their study concluded that babies who had been placed in a development support position were in an acceptable position and showed less pain scores. So, the researcher encourage giving further attention to maintain infant's flexed position and ensuring the importance of supplies that help nurses in that issue. As well as the neonatal position is not area of interest in the neonatal routine nursing care.

Our results also are supported by another Egyptian study by **El-Nagger & Bayoumi (2016)** about "Effect of Applying Nesting Technique as a Developmental Care on Physiological Functioning and Neurobehavioral Organization of Premature Infants". Which clarified that, the premature infants in their study experienced no or mild pain compared with control group.

Regarding skin-to-skin contact (kangaroo / KMC), nurses' knowledge s **(table 2)** and practices **(table 3),** as well as their actual frequency of use during the painful procedure **(figure 2)**, as a non-pharmacological method for pain management, the results of the present study showed that all nurses had poor knowledge about KMC preprogram implementation. This finding is consistent with the finding of the study conducted by **Chan, Labar, Wall & Atun (2016))** to investigate factors influencing the adoption of kangaroo mother care in different contexts, and with the study conducted by **Ramaiah (2016)**, to determine the knowledge and practices concerning the care of the mother kangaroo among post-natal mothers of premature babies in Indian rural centers, as both researchers found that nurses had inadequate knowledge regarding KMC.

On the other hand, the study result illustrated improvements in nurses' knowledge and practices regarding KMC after implementation of the program **(table 2&3)**. This result was in harmony with several Egyptian researches as the researches done by **El-Naggar, Abed El-Azim & Hassan (2013)** about " Impact of neonatal nurses' guidelines on improving their knowledge, attitude and practice toward kangaroo mother's care", by **El-Nagar, Lawend and Mohammed (2013)** about " Impact of neonatal nurses' guidelines on improving their knowledge, attitude and practice toward kangaroo mother's care", and by **Abd El- Moniem & Morsy (2011)**, about "The effectiveness of kangaroo technique on preterm infant's weight gain", whose concluded that educational programs and guidelines were effectively improved neonatal nurses' knowledge and practice about KMC.

As regards to nurses' practices of KMC, the present study reflected improvement of nurses' practices immediately post implementation **(table 3)**. This result like the result of **Deasi, Darji, Ganti, Darji and Sheth (2013)**, in his study about "Educational method on Kangaroo Mother Care (KMC) among Antenatal care women" where the researcher noted significant improvements in kangarooing practices after an educational program implementation. The researcher believed that, training should leads to improvement in the nurses' practices. But, the researcher when found nurses' reduced practice level and vigorously rare use at the phase of follow up, she rely that to absence of continuous training and believed that training should improve their knowledge and practices regarding that. Also, KMC necessitates the presence of the mother while, mostly it is difficult due to the infants health condition, then both mother and nurse usually not feel comfort especially at the time of painful procedure for the neonate and the nurses usually not encourage her presence in that time. In addition to the unavailability of private area that protect mothers' privacy for performing KMC, each of these causes the researcher considered it as a barrier to see KMC is a usual and routine practice in the unit although the presence of the huge evidences that encourage it. So, all efforts must go through overcome these barriers.

Although, nurses do not give parents, especially mothers, the opportunity to be present during the painful procedure of their child. This is a contradiction with a recent review study that concluded that it was appropriate for parents to have the opportunity to be with their children. Some studies have revealed that parents want more information and participation in the pain management of their children and their presence during

painful procedures would be useful for developing coping strategies to reduce the pain related to their child's pain. **(Piira, Sugiura, Champion, Donnelly, Cole, 2015 & Suciu, etal., 2015).**

Finally, when we come to talk about NICU environment around the neonates, we should know that, the physical environment is an important component of developmental care **(Hutchinson, 2017)**. Evidence found high sound pressure levels in the NICUs and inside the incubators and have indicated the harmful health effects of the newborns **Pinheiro, Guinsburg, Nabuco & Kakehashi (2011)**. However, the noise level in the Egyptian NICU has exceeded the allowed international levels and noisy events have altered the physiological stability of premature babies. Accordingly, staff education is recommended to eliminate noise pollution with its harmful effects in the neonates **(Hassanein, El Raggal & Shalaby, 2013)**.

Therefore, our study focused on that issue and resulted in the findings related to the nurses' knowledge **(table 2)**, and practices **(table 3)**, regarding modification of environmental stimuli in the form of controlling environmental noise and light at NICU as well as its actual frequency of use during the painful procedure **(figure 2)**, majority of the nurses had poor knowledge preprogram implementation compared with improvement in knowledge level of all nurses post program and at follow-up. Also, near three quarters of them had incompetent practices preprogram with a noticed improvement post program and at follow up with a highly statistically significant difference in their knowledge and practice. This finding is coordinated with the Egyptian study conducted by **El-Ziady, Ouda, Hassan, & Waly (2017)** that gave the same result.

This finding is also in consistent with the finding of **Carvalhais, Santos, Vieira da Silva & Xavier (2015)**, in the study about "Is there sufficient training of health care staff on noise reduction in neonatal intensive care units? A pilot study from Neonoise Project" that it found a significant difference between nurses' practices before and after training. From the researcher point of view the training program is very important to improve the nurses' level of knowledge and practice that effectively control noise and light in the NICU.

On contrary, the finding of the Turkish study titled " Turkish pediatric surgical nurses' knowledge and attitudes regarding pain assessment and non-pharmacological and environmental methods in newborns' pain relief" that conducted in **(2013)** by **Efe, Dikmen, Altaş, & Boneval** found that, the most commonly used environmental methods were to avoid talking loudly near the baby, minimal handling, attention when opening and closing the incubator, avoid making noise when using the wardrobe, drawers, waste or nearby devices and reduce the sources of light. The researcher sees that the level of incompetent practice is pre-programmed due to the absence of the standard noise / light control protocol in the study environment.

As regards to the nurses' practices regarding frequency of using non- pharmacological pain management methods **(figure 2)** illustrates noticed post program improvement in the majority of the methods except limited improvement in noise control near absence of kangaroo care. Although this method is strongly recommended from huge number of Egyptian and non- Egyptian studies, it is still rarely used. The researcher mentioned before the expected reasons or barriers from her point of view.

Concisely, although the nurses used some of the non-pharmacological and environmental methods in neonatal pain management, there remains a need for more education about pain management and for more frequent use of these methods in clinical care with necessary of the follow up in order to maintain an acceptable level of practice.

Concerning nurses' total knowledge regarding neonatal pain and its non-pharmacological management methods, the current study **(table 4)** revealed that, there was significant improvement regarding nurses' knowledge about neonatal pain and non-pharmacological methods immediate post and at follow up of the program implementation. This finding was in an agreement with the finding of **Asadi-Noghabi, et al (2014),** in his study about " Neonate pain management: what do nurses really know?" where found the, (48.2%) of the nurses in his study showed knowledge deficits over neonatal pain. Similarly, **Sujatha, Samson, & Sundaresan (2015),** conducted a study about "Nurses' knowledge and neonatal pain management" and their study revealed the effectiveness of structured teaching program and showed statistically significant difference between the Pre-test and Post–test knowledge scores ($t = 1.671$, $p<0.05$).

Additionally, this result is in the same line with Brazilian study conducted by **Christoffel ,Castral , Daré, Montanholi, & Scochi (2016)** about " Knowledge of healthcare professionals on the evaluation and treatment of neonatal pain" where it has demonstrated the benefit of educational programs, such as conferences and courses, and that the development of clinical protocols and audits can positively change the knowledge of health professionals on pain management. The researcher attributed lack of nurses' knowledge regarding pain to lack of attention paid by the physician to neonatal pain, absence of pain assessment tools and lack of recording into the infants' chart.

In relation to total nurses' practices regarding neonates' pain and its non-pharmacological management methods, the present study **(table 5)** indicated that, program implementation positively affect nurses' practices. Where all of the studied nurses got incompetent practice preprogram implementation, while, the majority and more than half of them respectively achieved competent practices immediately post program

and at follow up. This result is supported by other researches from different countries as the Iranian study done by **Mehrnoush, Ashktorab, Heidarzadeh, Momenzadeh, & Khalafi, (2016),** whose found that proper pain management was significantly correlated with adequate training. Additionally, supported by the findings of the cross sectional survey done at Finland by **Polkki , Korhonen, & Laukkala (2018)**, about " Nurses' perceptions of pain assessment and management practices in neonates" where his result indicated that educational methods for nurses are needed to improve pain assessment and management practices.

Moreover, the results of the current study in **table (6)** revealed that there was no statistical significant relation between total knowledge of the nurses and their total practices with a significant negative association between nurses' knowledge and their practices regarding neonatal procedural pain and its non-pharmacological management methods immediately post program and at follow up. This finding was on the same track with the study of **Sujatha, et al (2015)** that showed that there was increase in the knowledge regarding neonatal pain. From the current study, the researcher had generally noticed that the staff nurses had a remarkable increase in the knowledge regarding neonatal pain and its non-pharmacological management when compared to their preprogram knowledge. Also there was an improvement in their total practice but, not in the same level of the knowledge improvement especially at the follow up phase where we found some declinations in the percentage level of nurses' practices, this numerical difference between the knowledge and practice score of our study was indicating that who having adequate knowledge is not sufficient to perform competent practice skill. Additionally, **Hunter, (2015)** identified that most importantly, nurses can learn several skills, but all of that would be a waste if they don't implement the skills in their clinical daily practice.

VI. Conclusion

Based on the study hypotheses, the study concluded that there was an improvement in the nurses' knowledge and practices. This improvement reflected that there was a significant positive effect of the educational program on improving nurses' performance towards non-pharmacological pain management in the neonatal intensive care unit.

VII. Recommendations

Based on the study results, the following recommendations are suggested:

• Conducting more periodical continuing in service education for neonatal nurses that encouraging more frequent use of non-pharmacological methods in clinical care with necessity of follow up that must be motivated by a multidisciplinary team to be a routine care inside the unit.

• Empowered neonatal nurses to practice safe non-pharmacological methods with confidence based on current evidence using a consensual evidence-based guideline.

• Replication of this study with a larger sample size at different neonatal intensive care units and with longitudinal follow-up so that the results could be generalized and compared for differences between Egypt and other countries.

• Continued auditing and feedback, to ascertain appropriate treatment for neonatal pain.

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