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Effect of Educational Program on Nurses' Knowledge and Practices Regarding Preterm Infants' Pain Response and Nonpharmacological Strategies

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Abstract: Many preterm infants suffer from unrelieved pain in neonatal intensive care unit (NICU) causing distress. Lack of knowledge regarding pain management and the nurses' assessment of preterm infants' pain could act as barriers to effective pain management and consequently affect preterm infants suffering. This study aimed to evaluate the effect of educational program on nurses' knowledge and practices regarding preterm infants'pain response and nonpharmacological strategies. One group pre/post-test quasi-experimental design was utilized. A convenient sample of nurses were working in NICU at Pediatric University Hospital with total number 41 nurses. The study was conducted in the NICU at Pediatric University Hospital which is affiliated to Cairo University Hospitals. Three tools were used, which include I: Nurses'personal and professional data sheet. II: Nurses' Knowledge questionnaire regarding pain assessment and non-pharmacological management and tool III: Nurses' practices regarding pain response. The obtained results revealed that less than three quarters of nursesdid not receive pain training program. Highly statistically significant differences were found regardingnurses' level of knowledge about pain assessment and non-pharmacological management, nurses' mean score of practices regarding Premature Infant Pain Profile (PIPP) re-demonstrations after the program than before, mean PIPP score during and after painful stimuli after nurses' application of non-pharmacological strategies to relieve pain among preterm infants than before. The study concluded that the educational program was effective in improving nurses' knowledge and practices regarding pain intervention in post-program than before also there was a significant difference in the application of PIPP and the effect of the non-pharmacological strategies to relief painon preterm infants pain intensity during and after painful stimuli post the program than before. The study recommended that the provision of a continuing educational programregularly is suggested to update nurses' knowledge and practices in NICU.

Key words: Educational Program · Preterm Infants · PIPP · Nurses Knowledge and Practices · Non-Pharmacological Pain Strategies

INTRODUCTION

A preterm infant is an infant born before completion of 37 weeks of gestation, regardless of birth weight but who has a greater than average chance of morbidity and mortality because of conditions or circumstances superimposed on the normal course of events associate with birth and adjustment to extrauterine existence [1]. Worldwide, the prevalence of preterm infants has increased; the incidence of preterm birth was 15 million per year [2]. Neonates experience pain just as older children experience pain; In fact, preterm infants have demonstrated an exaggerated acute response to pain and worse behavioral and sensory long term outcomes when compared to term neonates this is because the experience of pain occurs during a critical time of neurologic maturation [3].

Many preterm infants suffer from unrelieved pain in hospital settings[4]. It was pointed out that preterm infants averagely undergo 10-16 painful procedures per day during the early days of their lives [5]. The preterm neonates have a pain threshold that is 30-50% lower than that of the adults and lower pain tolerance compared to the elder children and adolescents with a history of prematurity and NICU admission [6]. Because of the immature nerve myelination, the descending pathway and

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neonatal cortex lead to little control over pain processes [7]. As many preterm infants who are small and vulnerable with limited resources to deal with pain and stressful experiences and unable to self-report or communicate so in those vulnerable population is challenging issue to health care providers due to difficulty recognizing pain presence and severity [8].

The International Association for Study of Pain (IASP's) [9], defined pain as an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage. Pain is always subjective and the inability to communicate verbally does not negate the possibility that an individual is experiencing pain and requires appropriate pain-relieving treatment [10]. Pain is under-appreciated problem among critically ill patients including preterm infants [11]. Moreover, the pain has been recognized as the "fifth vital sign" that should be routinely monitored in the clinical examination [5]. Treating pain in preterm infants and newborns is essential, pain can lead to decreased oxygenation, hemodynamic instability and increased intracranial pressure [12]. Pain also affect behavioral and physiological response for sick neonates in NICU usually do not receive an analgesic for painful procedures such as heel prick, peripheral or central venous catheter insertion, venipuncture, intubation/ extubation, chest drainage tube insertion and urinary catheterization [13].

Besides, preterm infants are exposed to frequent painful procedures and agitating stimuli over the many weeks of their hospitalization in the NICU [14]. Furthermore, repetitive invasive, painful procedures affected regular head growth and short term cognitive scores in preterm infants in the infancy stage[13]. Neonatal nurses' perceptions of pain assessment and management in NICUs were inadequate [15]. Pain management is in the process of improvement, while there is little pain assessment using validated scales [16]. It is apparent from a descriptive cross-sectional survey that nurses agreed that pain assessment is essential, but over half of nurses reported being able to assess pain in a reliable way without using pain assessment scales and 73.5% of nurses not at all know PIPP scale and most nurses reported to use not at all the pain assessment scales in neonates [15].

Consequently, adequate pain management of preterm and sick newborn infants is a critical issue in the NICU [17]. Most procedures and clinical practices established in NICUs uniformly denied the occurrence of neonatal pain but routine assessment and management of neonatal pain should become an important therapeutic goal in NICU [18]. Consequently, a lack of knowledge regarding pain assessment and management for preterm infants could act as barriers to effective pain management [19]. To increase awareness of the importance of assessing and managing pain, researhers suggest that pain should be considered to minimize adverse event because pain may lead to neurodevelopmental, sensorial and motor impairment [20]. The use of pain assessment instruments must be applied correctly to achieve consistency and improve continuity in care and treatment among clinicians [17].

Thus, pain assessment in premature can be carried out through specific instruments that allow professionals to obtain assessment scores and plan treatment [21]. It is clearly stated that identifying the presence or absence of pain requires the use of reliable and valid pain assessment tools to determine intensity of pain, aid diagnosis, direct treatment and evaluate effectiveness after discrete interventions that can be used for both research and clinical assessment [22]. PIPP is a validated, reliable and multi-dimensional tool to assess pain in preterm infants [23].

Unfortunately, it seems that pain is still under-recognized and under treated in preterm infants in many countries, thus, the scope of this issue is broad and universal [15]. Neonatal nurses play a critical part in implementing pain management effectively. They must therefore have a solid foundation of knowledge and a positive attitude and practice toward pain assessment and management [24]. The quality of pain management depends on the knowledge and skills of the care providers [12]. In the same context, Nurses often act as mediators between the doctor and the patient and serve as the primary observer of pain in the preterm infants. However, nurses need to have systematic training in pain-related topics to enhance their knowledge, skills and attitude to manage pain and to improve patient satisfaction [25]. Daily monitoring of pain is essential for both diagnostic purposes and for evaluating pain management. In addition, one of the nurses' responsibility is assessing the preterm infants' pain intensity to implement appropriate pain management [12].

Therefore, needed non-pharmacological pain relief interventions to include environmental control by using skin to skin care, swaddling, facilitated tucking, therapeutic touch/massage, musical therapy; feeding methods by using non-nutritive sucking and breastfeeding, other interventions such as acupuncture, glucose solution [26]. These methods utilize environmental and behavioral approaches by activating a "gate control mechanism" that prevents the pain

sensation from traveling to the central nervous system; the current method could be considered an alternative to other methods of analgesia, but untreated pain require medication [27].

Concerning the significance of the study, Costa *et al*. [21] reported that 34.7% of the nurses never using pain assessment scales in NICU. An emerging evidence from recent study by Mohamed *et al.* [28] concluded that there was an obvious increase in the total mean scores of knowledge and practice in post and follow up program phase compared with pretest phase and the education program had a significant impact on pediatric nurses' knowledge and practices regarding selected nonpharmacologic techniques to relieve pain in neonates. Pain management in preterm infants should not just be driven by ethics or empathy but should be viewed as part of normal medical and nursing care [29]. Pain is a particular problem of the preterm which elicits specific behaviors, activates the somatosensory cortex and stimulates neuroendocrine stress responses thus leading to short and long term clinical consequences and many factors that worse the consequences as earlier gestational age at birth and cumulative pain exposure from the tissue breaking in medical, nursing and/or surgery procedures [30].

Consequently, health care providers' awareness of preterm infants care is a major concern in health care to minimize morbidity and mortality, decrease nurse's physical and psychological burden as well as cause unnecessary costs for health care [31]. This raised the issue of the prevention and management of pain in preterm should be the goal of all caregivers to minimize the potential risk of neurodevelopmental impairment as the smallest and sickest preterm most likely to be exposed to the greatest number of painful stimuli in NICU [32].

Although there are major gaps in nurses, knowledge regarding the most effective way to prevent and relieve pain in preterm, proven and safe therapies are currently underused for routine minor yet painful procedures [7]. Every health care facility caring for preterm and neonates should implement an effective pain interventions program which includes strategies for routinely assessing pain, minimizing the number of painful procedures performed, effectively using pharmacologic and nonpharmacologic therapies for the prevention of pain associated with routine minor procedures and eliminating pain associated with surgery and other major procedures [33].

The current study aimed to evaluate the effect of educational program on nurses' knowledge and practices regarding preterm infants'pain response and non-pharmacological strategies.

MATERIALS AND METHODS

Research Hypotheses:

- The level of nurses' knowledge will be higher post educational program than before.
- The mean score of nurses' practices will be higher post educational program than before.
- The mean score of PIPP will be lower in post application of selected non-pharmacological strategies to relief pain than before.

Design: The study used a pre-post test quasi-experimental design to evaluate the effect of an educational program on nurses' knowledge and practices regarding preterm infants'pain response and non-pharmacological strategies at NICU. This quasi experimental research resembles experimental research but is not true experimental research. It is very similar to the true experimentaldesign except there is lose one criterion [34].

Setting: The study was conducted in the NICU at Pediatric University Hospital ((El- Mounira), which is affiliated to Cairo University Hospitals. NICU at (El-Mounira Pediatric Hospital) provides a specialized care for preterm infants in need for critical, intermediate and neonatal jaundice care. The capacity of the unit is 52 incubators. The annual admission for preterm in the NICU at Pediatric Cairo University Hospital in 2017 was 118, which represented 15.6%from the total admission. The total number of nurses in the NICU was 50, including nurses, provide direct patients care and nurses responsible for administrative work and infection control.

Sample: A convenient sample of nurses who worked at the NICU in Pediatric University Hospital and agreed to participate in the current study was 41 nurses, those 41 nurses wasconsidered as study and control group. The nurses included in the study were providing direct patient care during the study period.

Tools: Data collection tools were presented in 3 main tools to collect the required data.

Tool I and II developed by the researcher after extensive review of literature.

Nurses' Personal and Professional Data Sheet to assess personal background of nurses such as nurses' age, gender, job title, years of clinical experiences in NICU, previous training program about pain assessment and management. It composed of 5 questions in form of multiple choice questions.

Nurses' Knowledge Assessment Sheet: It used to assess nurses knowledge regarding pain assessment and non-pharmacological management in preterm infants, It composed of 84 questions, were in form of 24 closed-ended questions and its responses in the form of yes, no and do not know and 60 multiple choice questions.

Nurses' Practices Assessment Sheet: That include PIPP tool which adapted from Stevens, *et al*. [23], it was a standardized, validated tool to assess behavioral measure of pain for preterm infants and modified by the researcher and it was translated into Arabic language by the researcher and reviewed by panel of expert in pediatric nursing and neonatology. It was used two parts:

Part A: The PIPP tool wasused by the nurses to assess preterm infants' pain response during and after exposure to painful stimuli before and after application of non-pharmacological strategies. PIPP covering seven indicators of gestational age, behavioral state, heart rate maximum, oxygen saturation minimum, brow bulge, eye squeeze and nasolabial furrow, these indicators reflect contextual, behavioral and physiological indicators for the preterm infants pain response, each indicator is rated on a Likert scale ranging from 0 to 3, with total score ranged from 0-21 the highest score indicates intense pain.

Part B: The same tool was used by the researcher as an observational checklist for nurses'practices for re-demonstration of PIPP. The researcher set 8 steps for redomnstration of PIPP including 7 steps which covering PIPP seven indicators and the eighth step for the total score of PIPP.

Scoring System

- Scoring system of nurses' knowledge questionnaire regarding pain assessment and non-pharmacological management in preterm infants was 84questions, the total score of knowledge was 84, each correct answer took one score and each incorrect or do not know answer took zero scores. the total score converted into a percentage score and nurses' level of knowledge classified as the following:
- Satisfactory level ≥ 60 %.
- Unsatisfactory level <60 %.
- Scoring system of nurses' practices included the following:

Part A: Nurses' assessment for the pain response on preterm infants using PIPP, this tool composed of seven indicators each indicator ranging from 0 to 3, with total score ranged from 0-21 the highest score indicate intense pain, the intensity of pain was categorized as the following:

- Score 0 – 6 represents no or minimal pain
- Score 7 – 12 represents moderate pain
- Score >12 represents intense pain.

Part B: Observational checklist for nurses' re-demonstration of PIPP on preterm infants during the painful event, the number of steps were 8 with total score 8, the response was done correctly took score one and done incorrect or not done took zero scores. The total score converted into a percentage score and nurses' competence of practices classified as the following:

- Competent ≥ 70%.
- Incompetent <70%.

Validity and Reliability: The tools tool II and III reviewed by 3 experts in pediatric nursing and neonatology to test the content validity of tools. Modifications were done. Reliability of the tools II and III was performed to confirm its consistency. The internal consistency with a Cronbach's alpha was 0.80.

Pilot Study: A pilot study was conducted on 10% of nurses in the NICU of a pediatric university hospital to ensure the clarity of content and simplicity of tools item and to assess the time needed to fulfill the tool. Modifications were done as rearrangement of the questions and restate some words in the close end and multiple-choice questions in nurses' knowledge assessment sheet regarding pain assessment and non-pharmacological management in preterm infants. The pilot study was excluded from the total study sample.

Operational Definitions: Non-pharmacological strategies to relieve pain in the current study include the following: massage, oral glucose, holding and cuddling, swaddling, reposition, reduce stimuli, skin to skin contact, using a pacifier, breastfeeding or/and soft music that observed and recorded by the researcher.

Nurses Practices in the current study include the Nurses're-domonstration for PIPP on preterm infants during painful stimuli at NICU.

Pain response in the current study include assessment of preterm infants pain intensity by using PIPP during and after exposure to painful stimuli.

The aim of the current study was to evaluate the effect of educational program on nurses' knowledge and practices regarding preterm infants' pain response and non-pharmacological strategies.

Procedure: The study was carried out through three phases: preliminary, implementation andevaluation phases.

Preliminary Phase: This study was concerned with obtaining official permission from the director Pediatric University Hospital and the director the NICU (and the head nurse of NICU). The purpose of the study explained to them to facilitate data collection. Nurses in the NICU was invited to participate in the study. The purpose and nature of the study were explained to each nurse individually. Written informedconsent was obtained from each nurse to get acceptance as well as gain nurses' cooperation.

Program Implementation: The total program consisted of 4 sessions, offered in one session/weak. Each session took about 1-2 hours /week.

The First Session: The aim of this session was to identify the researcher with the study sample (nurses in the NICU) and contractof work in the program and the contract containsan agreement to participate in the study, the schedule of the meeting, time of the meeting and commitment to continue. Preprogram assessment was carried out in the interview conducted for all nursesinside the unit and between the time of care to fill nurses'personal and professional data (tool I). Nurses filled out a set of questionnaire including Nurses' Knowledge regarding pain assessment and non-pharmacological management in preterm infants (tool II) which took 30-40 minutes and preterm infants pain intensity during and after exposure to painful stimuli before application of non-pharmacological strategies to relief pain on preterm infants before the program (part A in tool III)and checklist of PIPP demonstration before the educational program (part Bin tool III) which took 15-20 minutesthe researcher met 2-4 nurses according to the nurses availability of time at the morning shift and afternoon shift. The researcher gave the three tools as a pretest.

The Second Session: The aim of this session was to explain the aim of the study, content outlines of the program sessions. Each session was preceded by open discussion about the topic discussed. The teaching method was lectureby using powerpoint presentation, video and booklet, discussion and individual instruction. In this session, the researcher started by the explanation of basic pain topic; introduction, definition, myths, causes, types and pathophysiology of pain.

The Third Session: The aim of this session was to discuss manifestations, complication and assessment of pain responses and intensity include PIPP and explanation for non-pharmacological pain relief strategies using powerpoint presentations, pictures and video material about the application of non-pharmacological strategies as:- oral glucose solution (by using 0.5?- 1?ml 5% glucose in a 3 ml syringe and was given orally to the preterm infants by the assigned nurse. The nurse used one hand to support the preterm infant's head and neck and slowly administered the glucose solution into the preterm infant's mouth 2?minutes before the painful stimuli as blood samplingand suctioning).

- Skin to skin contact (by preparing the preterm infant wore only a diaper and was placed prone and upright between maternal breasts as the mother sat in a chair at the breastfeeding room. A sterile gown from the unit was placed across the preterm infant's back and the mother's chest closed over that. The nurse apply the painful procedure as heel stick, venous blood sample or cannula insertion and recorded PIPP from the portable pulse oximeter to record heart rate and oxygen saturation and the behavioral indicators were observed in 30 seconds).
- Breastfeeding (instruct the mother to hold her preterm infant in a cradle position and give breastfeeding immediately before painful stimuli and continue during and after painful stimuli), reduce stimuli (reduce the number of painful events as number of penetrating skin in blood sampling and cannula insertion procedures, separate the group of painful stimulations procedure to give a rest period between each one, reduce loud noise of machine sounds and health care team providers sounds), holding and cuddling for the preterm infants during painful stimulation, swaddling (use a sterile linen with a technique as mummy restrain to cover and wrapping the preterm infants body), using pacifier (small size sterile pacifier and give it 2 minutes before painful stimuli, during and after painful stimuli), light massage (at the site of painful stimulation include heel lance and venous blood sampling by gentle

massage and rubbing for 2 minutes before painful stimuli), reposition, soft music (using soothing voice) and of the previously mentioned non-pharmacological strategies was explained to the nurses by the researcher and the nurses apply which were suitable to the preterm infants.

The Fourth Session: In this session the researcher continued working in pain assessment using PIPP and the researcher demonstrated for all nurses how to apply PIPP and then the researcher allowed to all nurses to re-demonstrate the PIPP for 2 times until be competent and the third one considered evaluation.

Evaluation Phase: The researcher assessed nurses' knowledge using tool II as a post-test and assess nurses practicesusing tool III (part A) PIPP for nurses assessment to the pain response on preterm infants during and after exposure to painful stimuli after application of non-pharmacological strategies to relief pain on preterm infants, (part B) Observational checklist for nurses' re-demonstration of PIPP on preterm infants during the painful event and the post-test was done one week after the fourth session.

The study took 8 months as the study started in December 2018 and finished inJuly 2019.

Ethical Considerations: The written informed consent was obtained from the nurses after a complete explanation to the purpose and the nature of the study. Nurses were informed that participation in the study is voluntary. The researcher informed the nurses about their rights to withdraw from the study at any time without giving any reason, confidentiality assured to each nurse.

Statistical Analysis: A compatible personal computer (PC) was used to store and analyze data. The Statistical Package for Social Sciences (SPSS), version 24 was used. Data were collected and summarized using mean, the standard deviation for quantitative variables and percent for qualitative variables. The collected data tabulated and summarized. Data were computerized and analyzed using appropriate descriptive and inferential statistical tests. A comparison between qualitative data carried out by using a nonparametric chi square test. A comparison of means was performed using a paired sample t-test and correlation between variables was used. The level of significance at $p<0.05$ was used as the cut of the value for statistical significance.

RESULTS

Nurses Personal and Professional Data: Table (1) demonstrates that nearly two thirds of the nurses (65.9%) were females and were between 18-29 years of age. More than half of nurses (56.1%) their clinical experiences in the high-risk neonates were 1-5 years. The majority of nurses (85.4%) were staff nurses and less than three quarters (72.2%) didn't receive previous pain training program.

Nurses' Knowledge Questionnaire Regarding Pain Assessment and Non-Pharmacological Strategies to Relief Pain in Preterm Infants: Table (2) indicates that majority of nurses (82.9%) had unsatisfactory level of knowledge before the program and majority of nurses (87.8%) had satisfactory level of knowledge after the program. There were highly statistically significant differences regarding nurses' level of knowledge in pain assessment and non-pharmacological strategies to relief pain among preterm infants before and after the program (X^2 =17.780, p = 0.001 & X^2 =23.439, p = 0.001 respectively).

Table (3) proved that nurses' total mean score of knowledge before the program was 35.9756 ± 12.18295 and increased to 67.1707 ± 9.60964 after the program with a highly statistically significant difference (t =-13.162, p = 0.000).

Table 1: Percentage Distribution of Nurses Personal and Professional Data (n=41)

Items	No.	%
Gender:		
- Male	14	34.1
- Female	27	65.9
Age (years):		
- 18-29	27	65.9
- 30-39	10	24.35
- Missing	4	9.8
Clinical experiences in the high-risk neonates (years):		
- 1-5	23	56.1
- 6-10	4	9.8
- 11-15	10	24.4
- >15	3	7.3
- Missing	1	2.4
Job title:		
- Staff nurse	35	85.4
- Head nurse	6	14.6
Received previous training program on pain assessment and management:		
- Yes	3	7.3
- No	38	92.7

Table 2: Nurses' Level Of Knowledge Regarding Pain Assessment And Nonpharmacological Strategies To Relief Pain In Preterm Infants Before And After The Program In Percentage Distribution (n=41)

	Before		After			
Items	No.	%	No.	%	X^2	P
Satisfactory knowledge	7	17.1	36	87.8	17.780	0.001**
Unsatisfactory knowledge	34	82.9	5	12.2	23.439	0.001**

Table 3: Comparison Between Nurses' Total Mean Score of Knowledge Regarding Pain Assessment And Non-pharmacological Strategies To Relief Pain In Preterm Infants Before And After The Program In Percentage Distribution (n=41)

Items	Mean ± SD	t-test	P
Nurse total knowledge mean score before the program	35.9756± 12.18295	-13.162	0.000**
Nurse total knowledge mean score after the program	67.1707± 9.60964		

Table 4: Comparison Between Nurses' Total Mean Score Of Practices Regarding PIPP Re-demonstration On Preterm Infants Before And After The Program In Percentage Distribution (n=41)

Items	Mean±SD	t-test	P
Nurse total practices mean score before the program	0.1098±0.26249	-32.700	0.001**
Nurse total practices mean score after the program	6.0488±1.19794		

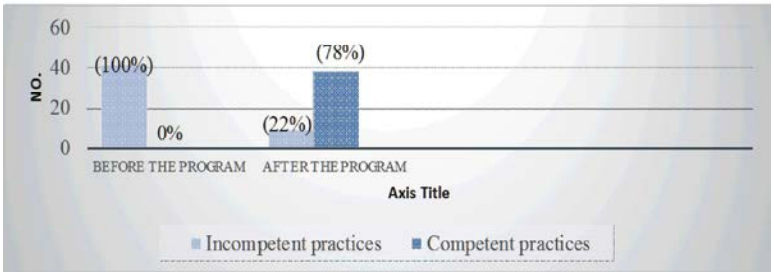

Fig. 1: Nurses' Competent Level of Practices Regarding PIPP re-demonstration on Preterm Infants Before and After The Program in Percentage Distribution (n=41)

Table 5: Comparison BetweenTotal Mean Score of PIPP For Preterm Infants During and After Painful Stimuli Before and After Nurses Application of Non-pharmacological Strategies (n=41)

Total mean score of PIPP	Before Mean±SD	After Mean±SD	t-test P
During painful stimuli	12.0244±4.15625	8.3171±3.18935	18.525 0.000**
After painful stimuli	8.3902±3.82674	2.2195±1.75374	14.039 0.000**

Table 6: Nurses' Use for Non-pharmacological Strategies to Relief Pain During Painful event Among Preterm Infants Before and After The Program (n=41)

	Before		After	
Items	No.	%	No.	%
Used non-pharmacological strategies to reliefpain:				
- Yes	15	36.6	41	100.0
- No	25	61.0	0	0.0
- Missing	1	2.4	0	0.0

Table 7: Correlations Between Nurses'Selected Personal Data and Total Score of Practices and Knowledge

	Total Practices Score		Total Knowledge Score	
Items	r	P	r	P
-Age (n=37)	0.117	0.492	-0.015	0.929
-Years of clinical experience in high risk neonates (n=40)	0.087	0.594	0.114	0.485

**Correlation is significant at the 0.01 level

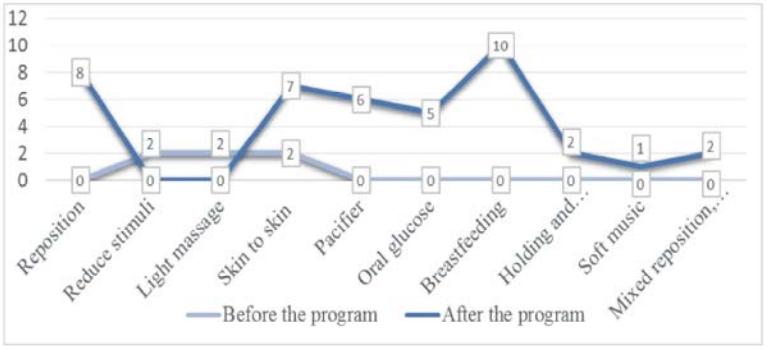

Fig. 2: Non-pharmacological Strategies to Relief Pain Used During Painful Stimuli Among Preterm Infants Before Program (n=15) and After Program (n=41).

Nurses' Practice Regarding Pain in Preterm Infants: Table (4) reveales that the nurses' total mean score and standard deviation of practices regarding PIPP redemonstrations on preterm infants before and after the program were (0.1098 ± 0.26249 & 6.0488 ± 1.19794 respectively), with a highly statistically significant (t-test= 32.700, p= 0.001).

Figure (1) illustrates that all of the nurses (100%) had incompetent practices regarding PIPP re-demonstration before the programe and decreased to only (22%) of nurses had incompetent practices after the program. More than three quarter of nurses (78%) had competent practicesregarding PIPP re-demonstration on preterm infants after the program.

Apparently, Table (5) showes that the mean and standard deviation oftotal PIPP score for preterm infants before and after nurses application of non-pharmacological strategies to relief pain during painful stimuliwere (12.0244 ± 4.15625 & 8.3171 ± 3.18935 respectively) while the mean and standard deviation of total PIPP score after painful stimulibefore and afterthe program were (8.3902 ± 3.82674 & 2.2195 ± 1.75374 respectively). There were highly statistically significant differences regarding total PIPP score for preterm infants before and after nurse's application of non-pharmacological strategies to relief pain during and after painful stimuli (t = 18.525, p = 0.000 & t = 14.039, p = 0.000 respectively).

Table (6) indicates that nearly two thirds of nurses (63.4%) didn't use non-pharmacological strategies to relief pain during painful stimuli among preterm infants before the program and all of the nurses (100%) used non-pharmacological strategies to relief pain among preterm infants during painful stimuli after the program.

Figure (2) illustrates that only (22%) of nurses used reposition and no one use pacifier, breastfeeding and soft music to relief pain among preterm infants before the program while there were variations in using non-pharmacological strategies to relief pain among preterm infants during painful stimuli as breastfeeding, reposition, skin to skin and pacifier after the program (24.4%, 19.5%, 17.1% & 14.6% respectively).

Table (7) indicates that there were positive correlations between nurses' age and total practices score and between nurses' years of clinical experiences in the high-risk neonates and total practices score and total knowledge score , while a negative correlation with no significant difference was found between nurses' age and thetotal knowledge score after the program.

DISCUSSION

The quality of pain control depends on the knowledge and skills of those who provide the treatment. Nurses play a critical role in this process, as nurses, the main observer of pain and discomfort for the preterm infants. However, nurses need to have systemic training in pain-related topic to enhance the knowledge and skills in pain management [35]. In the current study data before implementing the program are so far about pain knowledge and practices and it was showed that nurses need different educational programs about knowledge and practices in pain assessment and non-pharmacological management

The overall impact of the educational program for nurses in the current study are similar to the findings of Stenkjaer *et al*. [17] in Denmark, for evaluation of NICU nurses' competence in pain assessment and implantation of pain scale and found that most of the nurses in the follow-up group had improved theirskills in the application of COMFORTscale used for all infants in the NICU including preterm, newbornand can be applied for

assessment of prolonged and acute pain with significant level p<0.000. In the current study there was an improvement in the nurses' total mean score and standard deviation of practices to PIPP re-demonstrations on preterm infants in NICU during the painful event after the educational program with a highly statistically significant difference. In this respect, the current studywas dissimilar with a descriptive cross-sectional study by Costa *et al*. [21] in Curitiba and its Metropolitan Region for evaluating knowledge and practices regarding the management of neonatal pain as more than one-third of the nurses reported never using pain assessment scales.

The study results were supported by a quasi experimental study by Mohamed *et al.* [28] in Egypt about the effect of educational program on pediatric nurses' knowledge and practice regarding selected non-pharmacological techniques to relive pain in neonates, the study concluded that there was a noticeable increase in the total mean scores of knowledge and practice in post and follow-up program phase compared with pretest phase with a significant impact on pediatric nurses' knowledge and practices regarding selected nonpharmacologic techniques to relieve pain in neonates. In the current study most of nurses had satisfactory level of knowledge after the program than before with a highly statistically significant difference in nurses' level of knowledge regarding pain assessment and non-pharmacological strategies to relieve pain among preterm infants after the program compared to before the program. Furthermore, the study results were contradicted with a cross-sectional descriptive study by Mehrnoush *et al*. [5] in Ardebil, Iran, who concluded that the nurses had an adequate level of knowledge about the neonatal pain. However, less than half of nurses believed in receiving suitable training on this issue.

On the same line, Alzghoul and Abdullah [19] who studied pain management practices by nurses: an application of the knowledge, attitude and practices (KAP) model in the Jordanian public hospitals, reported that the majority of nurses had never attended a pain management training program whereas the knowledge of pain management had a strong association with pain management practices. From the researcher point of view and based on previous literatures, practices of pain assessment and management should be based on scintific base of knowledge in pain topics and developing a protocol of care for pain assessment and management is important in the NICU to relief the preterm infants suffering and from the researcher clinical observation in our setting there is no educational program about pain assessment and management applied and nothing of pain assessment tools were used at the NICU of pediatric university hospital.

Moreover, empirical evidence and previously cited research literature by Brant *et al.* [25] who investigated knowledge and attitudes about pain in nurses who work in diverse settings, professional and personal characteristics and whether knowledge attitude about pain (KAP) correlated with patient satisfaction according to hospital consumer assessment of healthcare providers and commented thatnurses having more than 5 years of experience and receiving pain education in the last year were predictive of a higher score on the KAP survey, Certified nurses scored higher on the KAP survey, consistent with other studies. In the current study positive correlations were found between nurses' age and total practices score and between nurses' years of clinical experiences in the high-risk neonates and total practices score and total knowledge score while a negative correlation with no significant difference was found between nurses' age and the total knowledge score.

From the researcher point of view nurses in the NICU with increasing their age and clinical experience in the field of high risk neonates affect positively on nurses over all capability to acquire new skills such as application of PIPP on the other hand with increasing the nurses age acquiring new knowledge need more effort and recurrent educational program.

In accordance with Dolgunand and Bozlak [36] who studied the effect of nonpharmacologic pain control during examination for retinopathy of prematurity and concluded that there were no more differences to reduce the mean PIPP in premature infants during retinal examinations after application of swaddling with oral administration of sucrose, swaddling with oral administration of breast milk and swaddling with oral administration of distilled water but it was better to use non-pharmacological pain control than never. Valeri *et al.* [37] evident that sucrose intervention during acute painful procedures was effective to reduce pain intensity and increase biobehavioral regulation. In the current data, the mean PIPP score of the preterm infants before and after nurses' application of non-pharmacological strategies to relieve pain during and after painful stimuli were decreased after the program compared to before the program with highly statistically significant differences. This support the idea of application of non-pharmacological pain relif is better than never in order to comfort the preterm infants and relief their stress of painful procedures.

Concerning the use of non-pharmacological pain relief, the study results were contradicted with Costa *et al*. [21] who concluded that pain management was recorded by most of the nurses through providing pharmacological and non-pharmacological measures to relieve pain in neonates, non-pharmacological measures were just above two thirds use sweetened solution andmore than half use non-nutritive sucking and positioning. As revealed in the current study findingsnearly two thirds of nurses didn't use non-pharmacological strategies to relieve pain during painful stimuli among preterm infants before the program and all of the nurses used non-pharmacological strategies to relief pain among preterm infants after the program., non-pharmacological strategies to relief preterm infants pain were only less than one-quarter of nurses apply reposition and no one use pacifier, breastfeeding and soft music before the program. At the same time, there were increases in the variations and applicationsof non-pharmacological strategies to relieve pain among preterm infants during painful stimuli as breastfeeding, reposition, skin to skin contact and pacifier after the program. Moreover, empirical evidence and supported a randomized controlledcrossover trial by Uematsu and Sobue [35] who studied the effect of music (Brahms lullaby) and non-nutritive sucking on heel lance in preterm infants and concluded that pain management method, the addition of a recorded Brahms lullaby to non-nutritive sucking, facilitated tucking and holding, demonstrated stronger analgesia and maintenance of homeostasis on heel lance in preterm infantswith mean PIPP of infants during the intervention was significantly lower than during the standard care. Chuang *et al.* [38] found a bundled developmental care included environmental modifications, positioning and containment was significantly reduce pain and stress responses and the time needed for infants to recover their physiological status following the painful procedure.

Likewise, Mehrnoush *et al*. [5] evident that less than half of the nurses reported that pain was well managed in their institution with evidence-based protocols. In addition, more than half of the nurses reported that parents should be involved with the care and comfort of their infants during the painful procedures and concluded that the nurses must be empowered with the knowledge of how to obtain, disseminateand implement evidence-based protocols within their clinical settings. So pain management in neonatal care has posed a long standing challenge for health professionals [39]. As reported by Polkki *et al.* [15] that educational interventions for nurses are needed to improve pain assessment and management practices in the NICUs. In addition, there is a need for national guidelines to ensure equal treatment to all neonates.

CONCLUSION

The study concluded that the educational program was effective in improving nurses' knowledgeabout general knowledge of preterm infants causes, manifestations and non-pharmacological pain management and practices of PIPP and the effect of non-pharmacological strategies to relief pain among preterm infants had a statistically significant impact on PIPP total score during and after painful stimuli after the program compared to before the program.

Recommendations: Based on the findings of the current study, the following recommendations were suggested:

- Provision of continuing educational programs on a regular basis is suggested in order to update nurses' knowledge and practices and adherence to pain assessment and management in NICU.
- Applying the non-pharmacologicalstrategies to relievepain for preterm infants in NICU.
- Adding the PIPP tool as standardized tool in the patient nursing sheet to be assessed regularly with routine care.
- Further studies are needed to link knowledge and practices about pain to preterm infants' outcomes.

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