
Intervention Program for Nurses about Care of Preterm Neonates Undergoing Continuous Positive Airway Pressure

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Abstract:

Continuous positive airway pressure (CPAP) is used when the preterm neonate is breathing spontaneously without a mechanical ventilator. Nursing care provided to preterm neonates undergoing CPAP is essential for improvement neonates' condition. **The study aimed** to improve nursing care provided to preterm neonates undergoing CPAP ventilation. This study was carried out at Neonatal Intensive Care Units of Specialized Pediatric Hospital at Benha city. **Sample of the study** was a convenient sample for nurses and purposive sample for preterm neonates who consisted of 55 preterm neonates on CPAP and 55 nurses who cared for them at previously mentioned settings. **Tools of data collection** included three tools, (1) A structured Interviewing Questionnaire Sheet which composed of personal data of the nurses and Nurses, knowledge regarding nursing care for preterm neonates undergoing CPAP ventilation, (2) Medical Record of Preterm Neonates undergoing CPAP Ventilation, and (3) observational checklist for nursing care provided for preterm neonates undergoing CPAP ventilation. **The main results** of this study revealed that, there was highly statistical significant improvement in the studied nurses' total level of knowledge and total performance post program implementation. **The main recommendation** is conducting an orientation programs for nurses in NICU with regular updates of knowledge and practice regarding continuous positive airway pressure.

Key words: Continuous positive airway pressure - preterm neonates.

INTRODUCTION

Preterm neonates are neonates who born alive before 37 weeks of gestation. There are sub-categories of preterm birth, based on gestational age; extremely preterm (<28 weeks), very preterm (28 to <32 weeks) and moderate to late preterm (32 to <37 weeks). Common causes of preterm birth include; multiple pregnancies, infections and chronic conditions, such as; diabetes and high blood pressure (*World Health Organization, 2018*).

Preterm neonates are vulnerable to respiratory problems and

complications. One of the most common respiratory complications is respiratory distress syndrome (RDS). Moreover, it is a major cause of neonatal respiratory morbidity and mortality. Neonates with it can be managed by using of CPAP to maintain alveolar distention during spontaneous breathing, giving exogenous surfactant, mechanical ventilation and administration of surfactant therapy with rapid extubation as part of INSURE (Intubation, Surfactant, Rapid Extubation) protocols (*Shim, 2017*).

Continuous positive airway pressure (CPAP) is used when the preterm neonate is breathing spontaneously without a mechanical ventilator. The benefit of it comes from the positive pressure within airways and alveoli that diminish the closure of airways and alveoli at the end of expiration. So, CPAP can be indicated for respiratory problems as respiratory distress syndrome, meconium aspiration syndrome, and apnea of prematurity. In addition it can be used by invasive or noninvasive mechanical ventilation (*Dries & Marini, 2018*).

Invasive mechanical ventilation is the primary treatment for respiratory failure in most preterm neonates, but there is a concern that it is a major contributor to lung injury. Noninvasive continuous positive airway pressure (CPAP) represents the application of a constant level of positive pressure at the airway opening during spontaneous breathing, without the hazards associated with full endotracheal intubation and mechanical ventilation (*Brochard et al., 2016*).

Complications of NCPAP in preterm neonates which result from the fixation devices include; nasal prongs when it didn't fit the nostrils, resulting in gas leak and inability to maintain a baseline pressure. Moreover, the set CPAP level is rarely maintained in the pharynx. Complications may also include nasal leaks because the nasal cannula fits loosely in the nostrils and nasal trauma which considered a common problem with CPAP. It is mostly caused by incorrect positioning of the prongs (*Dibiasi, & Courtney, 2017*).

Nursing care provided to preterm neonates undergoing CPAP either invasive or noninvasive CPAP is essential for improvement neonates' condition. It includes; monitoring,

suctioning, gas humidification, and fluid management. Monitoring assists in the ongoing management of neonates' condition. The key monitoring of the ventilated neonates for comfortable ventilation include; oxygenation, work of breathing, heart rate, blood pressure, and temperature (*Katira et al., 2018*).

The role of intervention programs is to improve nurses' skills to provide proper care. As inadequately trained nurses considered the major risks for providing an effective nursing care to preterm neonates undergoing CPAP. In addition to nurses need to update their knowledge. So, they need these intervention programs which consist of the theoretical and practical training given to nurses with the purpose to improve their knowledge and practice (*Price & Reichert, 2017*).

Significant of the study:

Continuous positive airway pressure (CPAP) distends the continuous pressure in a spontaneously breathing neonate and increases the functional residual capacity of the lung resulting in better gas exchange for preterm neonates. Also it has been shown to reduce the risk of mortality by 48% and the need for surfactant and mechanical ventilation by about 50%. So, it has become the standard of care in managing sick preterm neonates with respiratory distress (*Thukral et al., 2016*).

The preterm birth is estimated by 10% -12% from neonates born in Egypt (*Anwar, 2016*). Meanwhile, preterm neonates in Neonatal Intensive Care Unit (NICU) of Specialized Pediatric Hospital at Benha city at 2016 are estimated as 920 neonates with majority of them under CPAP ventilation (*Specialized Pediatric Hospital statistics*

department, 2016). So, this intervention program is performed to improve the nursing care provided to preterm neonates undergoing CPAP.

AIM OF THE STUDY

This study aimed to improve nursing care provided to preterm neonates undergoing Continuous Positive Airway Pressure (CPAP) ventilation through:-

- 1- Assess nurses' knowledge and practice regarding nursing care provided to preterm neonates undergoing CPAP ventilation.
- 2- Design and Implement intervention program about care of preterm neonates undergoing CPAP ventilation.
- 3- Evaluate the effect of intervention program on the care provided by the neonatal nurses for preterm neonates undergoing CPAP ventilation.

This study was carried out to answer the following questions:

Research Questions:

- 1- What are the nurses' knowledge and performance about care provided to preterm neonates undergoing CPAP?
- 2- Are the nurses' knowledge and performance improved after program intervention about care of preterm neonates undergoing CPAP?
- 3- Are there relation between nurses' characteristics and their level of knowledge and performance post program intervention about care of preterm neonates undergoing CPAP?

SUBJECTS AND METHODS

Research design:-

A quasi-experimental design was utilized in the current study.

Research settings:-

This study was carried out at Neonatal Intensive Care Units (NICU) of Specialized Pediatric Hospital at Benha city which affiliated to Egyptian Ministry of Health and Population, and composed of two rooms with 28 incubators.

Subjects:-

Data of the present study were gathered through 9 months period, from the above mentioned study settings, the sample was a convenient sample for nurses and purposive sample for preterm neonates, it consisted of:-

- 1- All nurses (55) who cared for preterm neonates on CPAP at previously mentioned settings.
- 2- Preterm neonates (55) with certain criteria.

Inclusion criteria:

- Gestational age less than 37 weeks.
- On continuous positive airway pressure (CPAP).
- Free from any congenital anomalies.

Tools of data collection:-

Data was collected through using the following three tools in four parts:

Tool (1) A structured Interviewing Questionnaire Sheet:

It was designed by the researcher under thesis supervisors in the light of relevant studies as books, magazines, articles, journals, and web sites. It was written in an Arabic language to suit the nurses' educational level.

Part (I):

Personal data of nurses: It included personal characteristic of nurses such as; age, gender, academic qualifications, years of experiences and attendance of training courses related to nursing care provided to preterm neonates on CPAP ventilation.

Tool (2): Medical record of preterm neonates undergoing CPAP ventilation.

Part II: Characteristics of preterm neonates undergoing CPAP ventilation: The data obtained from the hospital medical record, and it included; diagnosis, gestational age, gender, on admission and current weight, length of CPAP connection, type of CPAP

ventilation, method of CPAP connection, vital signs and laboratory investigation.

Part III:

Nurses' knowledge regarding nursing care for preterm neonates undergoing CPAP ventilation which included:

- a) Preterm neonates such as; definition, causes, complications and nursing care.
- b) Mechanical ventilation such as; definition, diseases, indications, types and indications of each type.
- c) Continuous positive airway pressure (CPAP) ventilation such as; definition, indications, contra indications, cases, types, and complications.
- d) Practical knowledge regarding nursing care provided to preterm neonates undergoing CPAP ventilation such as; CPAP application, connection and weaning of preterm neonates from CPAP.
- e) Nursing care provided to preterm neonates undergoing CPAP ventilation such as; suctioning, endotracheal tube insertion, oxygen administration, blood gases techniques and gavage feeding of preterm neonate.

Scoring system of Nurses' Knowledge:-

- The studied nurses' answers were compared with a model key answer, where scored as; don't know had score (0), incomplete correct answer had score (1), and complete correct answer had score (2).
- The level of nurses' knowledge was categorized as the following:
 - Poor knowledge (< 60%)
 - Average knowledge (60 % to < 85%).
 - Good knowledge (≥ 85 %).

Tool (3): Observational Checklists:

Part IV:

It was adapted from (Bowden & Greenberg, 2016) and certain modifications were done by the researcher under thesis supervisors to suit the nature of the study as arrangement of steps, writing it in a simple statement and addition of using pulse oximetry. It was used to assess nurses' performance about care provided to preterm neonates on CPAP ventilation that include;

Scoring system of nurses' performance in care provided to preterm neonates on CPAP ventilation:-

- Scoring system for performance of the studied nurses was calculated as the following:
 - The nurses' performance was classified as; not done had score (0), incorrectly done had score (1) and correctly done had score (2).
 - According to the nurses' actual performance, their level of performance was categorized as the following:
 - Incompetent (< 85%).
 - Competent (≥ 85 %).

Preparatory Phase:

The researcher reviewed the local and international related literatures covering various aspects of the research problem to get acquainted with the needed knowledge for preparing the tools of data collection and conducting the study.

- Ethical Considerations:

Aim, nature and expected outcomes of the research were explained to nurses under the study before their inclusion.

-Pilot Study:

A pilot study was carried out on 10% of predetermined sample which accounted as (5) preterm neonates undergoing CPAP ventilation and (5) nurses providing care for these neonates to test the clarity, applicability and time

consumed to filling the study tools. The necessary modifications were done in the form of addition of some questions in nurses' knowledge about nursing care of preterm neonates undergoing CPAP ventilation. Moreover, omission of collection blood gases samples by arterial method because it didn't performed by nurses according to hospital policy.

-Field of Work:

Assessment phase:

The current study was carried out from the first of September, 2017 to the end of May, 2018. The researcher was available at the study setting four days per week during morning and afternoon shifts. Each preterm neonate involved in the study was observed by the researcher and data were collected from the medical record (this was taken nearly 15 minutes for each preterm neonate).

The researcher gave the studied nurses the questionnaire to fill and assess their knowledge about nursing care of preterm neonates undergoing CPAP ventilation. Each nurse was observed separately for three times and mean was taken to assess performance by using observational checklists during their actual performance.

Preprogram implementation:

-Firstly:

A pretest was carried out using the previous tools to assess knowledge and performance of nurses about care of preterm neonates undergoing CPAP as showed previously, and it took about 12 weeks.

-Secondly:

The pre-test findings was analyzed to detect the actual needs of nurses' performance and knowledge then, general and specific objectives of intervention program was stated and implemented to satisfy the nurses' actual needs.

Implementation of the intervention program (Appendix II):

The contents of the program were prepared in the light of actual need assessment of the studied nurses after reviewing the related literature. The program consisted of (10) sessions for theoretical and practical parts, the time of each session took about 1 hour, and it took about (12) weeks. In addition to, (12) weeks for pre-program, and (12) weeks for post-program. Total number of the studied nurses was 55 who divided in to 9 equal groups and each group consisted of 6 nurses.

The Sessions of the program composed of 3 sessions for theories and 7 sessions for practices.

A guide Booklet:-

The guide booklet was designed by the researcher using simple Arabic language and different illustrated pictures and videos in order to facilitate nurses understanding and intervention program was implemented.

Teaching methods:

Different teaching methodology was used as lectures, group discussion, demonstration and re demonstration.

-Thirdly (Evaluation):

Evaluation was carried out by using the same pretest format as a post test and it took 12 weeks. Motivation of the studied nurses by encouraging words to gain their participation.

Written permission

An official permission for data collection was obtained from the administrator of the study setting to carry out the study. A clear explanation was given about the nature, importance and expected outcomes of the study.

Data analysis

The collected data were organized, categorized, and analyzed, using frequencies, percentage, mean scores, standard deviation, fisher exact test, F test, and correlation test. Data were

presented in the form of tables and figures by using SPSS version 20.

Limitations of the study:-

Demonstration of all procedures on preterm neonates undergoing CPAP ventilation such as; collection blood gases samples and endotracheal tube suction were difficult due to hospital

policy. These limitations had been overcome by using videos and giving information about procedures during nurses' performance of procedures on preterm neonate.

RESULTS

Table (1): Percentage distribution of the studied nurses according to their personal data (n=55)

Items	No	%
Age in years		
20 < 25	26	47.3
25 < 30	16	29.1
≥ 30	13	23.6
Range	20-39	
Mean ±SD	26.02 ±5.10	
Academic qualifications		
Secondary nursing education	15	27.3
Nursing technician institute	29	52.7
Bachelor of nursing	11	20.0
Years of experience		
<5	23	41.8
5 < 10	12	21.8
≥ 10	20	36.4
Range	1-20	
Mean ±SD	6.76±5.18	
Attaining training programs regarding to nursing care provided to preterm neonates undergoing on CPAP ventilation		
Yes	15	27.3
No	40	72.7
Training programs (n=15)		
Nursing care for preterm neonates in NICU	9	60.0
Cardiopulmonary resuscitation	6	40.0

As illustrated in table (1), slightly less than half of the studied nurses' ages (47.3%) were between 20 < 25 years. While more than half of them (52.7%) had nursing technician institute. Regarding years of experience 41.8% of the studied nurses had <5 years, additionally 72.7% of them didn't attain training programs regarding nursing care provided to preterm neonates undergoing CPAP ventilation.

Table (2): Percentage distribution of the studied preterm neonates undergoing CPAP ventilation according to their characteristics (n=55)

Characteristics	No	%
Medical diagnosis		
Respiratory distress syndrome (RDS)	22	40.0
Pneumonia	18	32.7
Neonatal Sepsis	15	27.3
Gestational age (weeks)		
24 < 28	0	0%
28 < 32	10	18.2
32 ≤ 36	45	81.8
Mean ± SD	33.65 ±2.30	
Gender		
Male	43	78.2
Female	12	21.8

As revealed in table (2), regarding medical diagnosis of the studied preterm neonates undergoing CPAP ventilation, it was founded that 40% of them had respiratory distress syndrome. In addition to more than three quarters of them (78.2%) were male, and 81.8% of them their gestational age were between 32 ≤ 36.

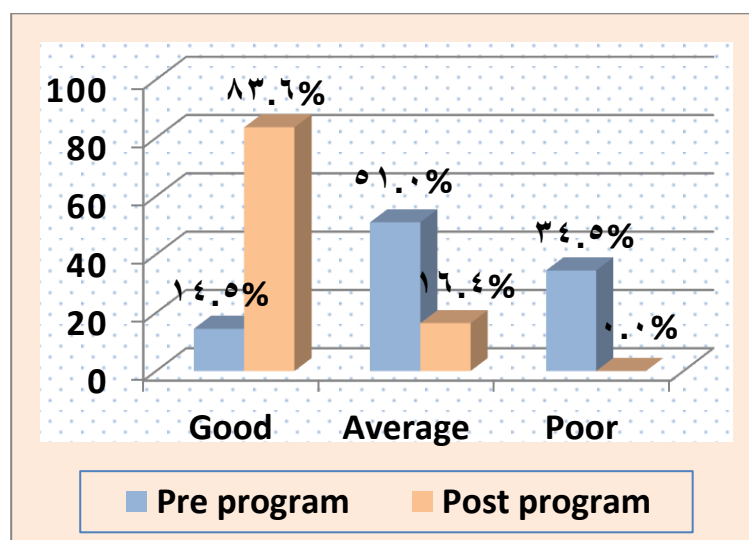


Figure (1): Percentage distribution of the studied nurses' total level of knowledge regarding nursing care for preterm neonates undergoing CPAP ventilation pre and post program implementation (n=55)

As shown in figure (1), the minority of the studied nurses (14.5%) had good level of knowledge regarding nursing care for preterm neonates undergoing CPAP ventilation preprogram implementation compared with 83.6% post program implementation. This indicated that there was improvement in the studied nurses' level of knowledge post program implementation.

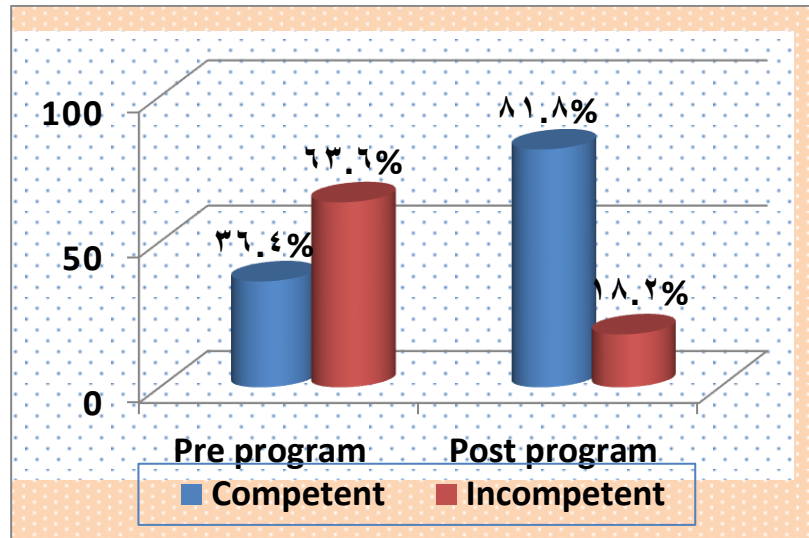


Figure (2): Percentage distribution of the studied nurses according to total level of performance regarding care provided to preterm neonates on CPAP ventilation pre and post program implementation (n=55)

As reflected in figure (2), more than one third (36.4%) of the studied nurses had competent level pre program implementation compared with 81.8% of them had competent level of performance post program implementation. This indicated to improvement in nursing performance after implementation of the program.

Table (3): Correlation between studied nurses' total knowledge and performance score regarding care provided to preterm neonates on CPAP ventilation pre and post program implementation (n=55)

Variables		Total knowledge score			
		Pre program		Post program	
		r	P value	r	P value
Total performance score	Pre program	0.542	0.000**	-	-
	Post program	-	-	0.561	0.000**

*Statistical significant difference ** highly statistical significant difference.

As illustrated in table (30), there were highly statistical significant differences with positive correlation between the studied nurses' total knowledge and performance score regarding care provided to preterm neonates on CPAP ventilation pre and post program implementation ($P < 0.000$).

Table (4): Relation between total nurses' knowledge score and their personal data pre and post program (n=55)

Phases Variable	Total knowledge score Pre program						FET (P Value)	Total knowledge score Post program				FET (P Value)
	Good n=8		Average n=28		Poor n=19			Good n=46		Average n=9		
	No	%	No	%	No	No		No	%	No	%	
Age (years)												
20 < 25	7	87.5	14	50.0	5	26.3	11.535 0.021*	8	88.9	18	39.1	7.787 0.020*
25 < 30	0	0.0	10	35.7	6	31.6		0	0.0	16	34.8	
≥ 30	1	12.5	4	14.3	8	42.1		1	11.1	12	26.1	
Gender												
Male	3	37.5	0	0.0	1	5.3	13.149	4	8.7	0	0.0	0.844 0.358
Female	5	62.5	28	100.0	18	94.7	0.001*	42	91.3	9	100.0	
Academic qualifications												
Secondary nursing education	0	0.0	6	21.4	9	47.4	23.862 0.000**	9	19.6	6	66.7	9.684 0.008*
Nursing technician institute	2	25.0	20	71.5	7	36.8		28	60.8	1	11.1	
Bachelor of nursing	6	75.0	2	7.1	3	15.8		9	19.6	2	22.2	
Years of experience												
<5	5	62.5	15	53.5	3	15.8	17.722 0.001*	22	47.8	0	0.0	18.832 0.000**
5 < 10	2	25.0	8	28.6	2	10.5		13	28.3	0	0.0	
≥ 10	1	12.5	5	17.9	14	73.7		11	23.9	9	100.0	
Attaining training programs regarding to nursing care provided to preterm neonates undergoing on CPAP ventilation												
Yes	8	100.0	7	25.0	0	0.0	28.531 0.000**	14	30.4	1	9.1	1.417 0.234
No	0	0.0	21	75.0	19	100.0		32	69.6	8	88.9	

*A statistical significant difference (P ≤ 0.05) **A highly statistical significant difference (P ≤ 0.001) FET=Fisher Exact Test

As revealed in table (4), there were statistical significant differences between the studied nurses' total knowledge score and their age and academic qualifications post program implementation (P<0.020, & P<0.008). Also there was a highly statistical significant difference between the studied nurses' score and their years of experience. While there were no statistical significant differences between the studied nurses' total knowledge score and their gender and attaining programs.

Table (5) Relation between total nurses practice score and their personal data pre and post program (n=55)

Phases Variable	Total practice score Pre program				FET (P Value)	Total practice score Post program				FET (P Value)
	Competent n=20		Incompetent n=35			Competent n=45		Incompetent n=10		
	No	%	No	%		No	%	No	%	
Age (years)										
20 < 25	18	90.0	8	22.9	23.503 0.000**	26	57.8	1	10.0	30.083 0.000**
25 < 30	2	10.0	14	40.0		15	33.3	0	0.0	
≥ 30	0	0.0	13	37.1		4	8.9	9	90.0	
Gender										
Male	4	20.0	0	0.0	7.0549 0.006*	4	8.9	0	0.0	0.959 0.328
Female	16	80.0	35	100.0		41	91.1	10	100.0	
Academic qualifications										
Secondary nursing education	1	5.0	14	40.0	12.033 0.002*	5	11.1	10	100.0	32.593 0.000**
Nursing technician institute	11	55.0	18	51.4		29	64.5	0	0.0	
Bachelor of nursing	8	40.0	3	8.6		11	24.4	0	0.0	
Years of experience										
<5	9	45.0	14	40.0	8.783 0.012*	22	48.9	0	0.0	15.520 0.000**
5<10	8	40.0	4	11.4		12	26.7	1	10.0	
≥ 10	3	15.0	17	48.6		11	24.4	9	90.0	
Attaining training programs regarding to nursing care provided to preterm neonates undergoing on CPAP ventilation										
Yes	15	75.0	0	0.0	36.094 0.000**	14	31.1	1	10.0	1.838 0.175
No	5	25.0	35	100.0		31	68.9	9	90.0	

*A statistical significant difference (P ≤ 0.05) **A highly statistical significant difference (P ≤ 0.001) FET=Fisher Exact Test

As revealed in table (5), there were highly statistical significant difference between the studied nurses' total practice score and their age, academic qualifications, and years of experience post program implementation (P<0.000). While there were no statistical significant differences between the studied nurses' total practice score and their gender and attaining programs.

DISCUSSION

Continuous Positive Airway Pressure (CPAP) is a well-established mode of respiratory support in preterm neonates. Advancement in CPAP technology and better understanding of various respiratory diseases increase survival of extremely preterm neonates on CPAP. So, it is important for nurses to update their knowledge about the recent changes in the practice of CPAP and its implications for resource-limited settings (*Gupta et al., 2015*)

The nurse also should be informed about the side effects of CPAP and should be able to diagnose the presenting problem. In addition to she should be able to preventing it. Moreover, the nurse needs to improve their level of practice as CPAP effectiveness or failure is related to adequacy of the nurse's care and knowledge (*Tiryaki & Cinar, 2016*).

The present study was a quasi-experimental study included 55 preterm neonates on continuous positive airway pressure (CPAP) and 55 nurses from Specialized Pediatric Hospital worked at neonatal intensive care units, this study aimed to improve nursing care provided to preterm neonates undergoing Continuous Positive Airway Pressure (CPAP) ventilation.

Regarding personal data of the studied nurses, the results of the present study revealed that, the nurses' ages were between 20 < 25 year. This finding supported by *Ahmed & Abosamra, (2015)* in a study about "Knowledge of Pediatric Critical Care Nurses Regarding Evidence Based Guidelines for Prevention of Ventilator Associated Pneumonia (VAP)" who showed that, nearly half of studied nurses ages were ranged from 20 to less than 25 years. The finding also in accordance with *Otheeb & Aburaghif, (2016)* in a study

about "Assessment of Nurses' Knowledge and Practices toward Isolation Techniques among Children with Hepatitis at Pediatric Teaching Hospitals in Baghdad City" who mentioned that, most of his study sample was within 20-29 years.

Moreover, *Aziz & Mansi, (2018)* in a study about "Assessment Quality of Nursing Care Provided to Neonates with Respiratory Distress Syndrome at Intensive Care Unit in AL- Nasiriyah City Hospitals" found that two thirds of the studied nurses within age group of (21 – 25) years. In contrast with *Mohammed et al., (2018)* in a study about "Effect of Preterm Neonates' Developmental Supportive Care Program on Nurses' Performance Regarding nurses' age" found that, less than half of the studied nurses were between 30 to less than 40 years old, and 4% of them were 50 years or more.

Concerning academic qualifications of the studied nurses, the present study viewed that, more than half of them had nursing technician institute, this finding was supported by the finding of *Buraihi & Mohammed, (2017)* in a study about " Effectiveness of an Educational Program on Nurses Knowledge Concerning Prevent of Post-Thoracic Surgery Complications at AL-Najaf Teaching Hospitals who demonstrated that, the highest percentage of the study sample are Nursing Institute graduates. But this finding disagreed with *Ahmed & Abosamra, (2015)* who mentioned that, the majority of the studied nurses had bachelor degree in nursing. In contrast with *Bakhshi et al., (2018)* in a study about "Impact of Instructions on the Developmental Status of Premature Infants on the Clinical Practice of Neonatal Intensive Care Unit (NICU) Nurses" who reflected that the majority of the NICU nurses had a master's degree.

The present study revealed that, about two fifth of the studied nurses had <5 years of experiences, this result in accordance with **Hammod & Mohammed (2016)** in a study entitled "Effectiveness of an Educational Program on Nurses Knowledge Concerning Complications Prevention of Mechanical Ventilation at Intensive Care Unit in Al- Hussein Teaching Hospital at Nasiriya City" who mentioned that, most of the study sample had experience 1-4 years of experience. The decrease in the nurses experience years have a negative effect on their performance level which affect on neonatal care if not supported with continuing educational program to re-enforce them.

Moreover , **Aziz & Mansi, (2018)** showed that, half of the studied nurses had less than two years of experience in neonatal care unit and pediatric nursing filed. Moreover, the study finding in accordance with **Abd-Elbaky et al., (2018)** in a study entitled "impact of Simulated Education program on Nurses' Performance of Invasive Procedure at Intensive Care Units" who illustrated that, the majority of the studied nurses had less than 5 years' experience.

The study result disagreed with **Mohammed, (2016)** in a study about "the effect of endotracheal suction intervention on oxygen saturation level in preterm infants" who revealed that, more than half of studied nurses had ≥ 9 years of experiences this may be due to collection of sample from different sites.

The present study showed that nearly three quarters of the studied nurses didn't attain training programs regarding to nursing care provided to preterm neonates undergoing on CPAP ventilation. This finding agreed with **Elsobkey& Amer, (2018)** in a study entitled "Effect of Educational

Guidelines Program about Nursing Care of Neonates Receiving Continues Positive Airway Pressure" revealed that, more than two thirds of the studied nurses didn't have training course regarding CPAP. This result disagreed with **Abdul-Hamza & Aziz, (2017)** in a study entitled "Effectiveness of an Educational Program upon Nurses' Knowledge toward the Continuous Positive Airway Pressure (CPAP) Machine in Neonatal Intensive Care Unit at AL-Hussein and the Pediatric Teaching Hospital" who showed that, more than two thirds of the studied nurses participated in intensive care courses for newborn, and had (1-2) courses.

Concerning the characteristics of preterm neonates, the present study reflected that, less than half of the studied preterm neonates had respiratory distress syndrome. This finding supported by **Mohammed, (2016)** who demonstrated that, nearly half of studied preterm infants had respiratory distress syndrome. Moreover, this finding agreed with **Elsobkey& Amer, (2018)** who showed that, the majority of preterm infant connected to CPAP were had respiratory distress syndrome.

According to gestational age of preterm neonates, the present study showed that, the majority of them were between $32 \leq 36$ gestational ages. This finding agreed with **Mohammed, (2016)** who reflected that more than two third of preterm infants had the gestational age $32 \leq 36$ weeks. These findings may indicate that the preterm neonates with gestational age $32 \leq 36$ (late preterm) are high risk to be ventilated. In contrast with **Zhu et al., (2017)** in a study entitled "Noninvasive high-frequency oscillatory ventilation versus nasal continuous positive airway pressure in preterm infants with moderate-severe respiratory distress syndrome: A preliminary report" who

demonstrated that, the majority of the studied preterm neonates were between 28-34 weeks.

According to the present study more than three quarters of the studied preterm neonates were male. This finding agreed with *Zhu et al., (2017)* who viewed that nearly two thirds of the studied preterm infants were male. Additionally, these finding disagreed with *Sivanandan et al., (2018)* in a study about "Target Oxygen Saturation among Preterm Neonates on Supplemental Oxygen Therapy: A Quality Improvement Study" who demonstrated that, more than two thirds of the studied preterm neonates were female.

Regarding nurses' total level of knowledge regarding nursing care for preterm neonates undergoing CPAP ventilation, the present study showed that, the minority of the studied nurses had good level of knowledge preprogram implementation. While, the majority of them had good level of knowledge post program implementation. This indicated that there was improvement in the studied nurses' level of knowledge post program implementation.

The findings of the present study supported by *Girvan et al., (2018)* in a study entitled "CPAP for infants in rural and metropolitan special care nurseries: Perspectives of Nurse Unit Managers", and *Milligan & Goldstein, (2017)* in a study about "Implementation of an evidence-based non-invasive respiratory support (NIRS) bundle in the NICU to decrease nasal injury complications" who demonstrated that, there were statistically significant improvement in the nurses' knowledge post program implementation.

Moreover, these findings agreed with *Guiles et al., (2016)* in a study entitled "The Implementation of a

Neonatal Nurse Training Program at the Riley Mother Baby Hospital of Kenya", and *Aloush, (2017)* in a study entitled "Nursing students' knowledge about ventilator-associated pneumonia prevention guidelines" who revealed that the majority of nurses had good level of knowledge post program. Additionally, in accordance with *Ntigurirwa et al., (2017)* in a study about "A health partnership to reduce neonatal mortality in four hospitals in Rwanda" who showed that, nurses' knowledge was improved post program which improved care of neonates on CPAP and mortality was reduced.

Regarding nurses' total level of performance of care provided to preterm neonates on CPAP ventilation pre and post program implementation, more than one third of the studied nurses had competent level pre program implementation. But the majority of them had competent level of performance post program implementation. This indicated to improvement in nursing performance after implementation of the program.

The result of the present study supported by *Elsobkey & Amer, (2018)* who illustrated that, the majority of the studied nurses had competent practice post program implementation. Moreover, in agreement with *Chen et al., (2016)*, who stated that, nurses' knowledge and practice regarding CPAP application improved after implementation of guidelines. This result also in accordance with *Milligan & Goldstein, (2017)* who revealed that, after implementing evidence-based interventions, the total nurses' practice improved which impact on neonatal care by decreasing unintended treatment complications.

Concerning correlation between studied nurses' total knowledge and performance score regarding care provided to preterm neonates on CPAP ventilation pre and post program

implementation, there were highly statistical significant differences with positive correlation between the studied nurses' total knowledge and performance score regarding care provided to preterm neonates on CPAP ventilation pre and post program, this may indicate that the nurses knowledge affects on their practice.

Lack of knowledge may have an effect on nurses' performances regarding nursing care of preterm neonates on CPAP ventilation. So, implementation of intervention program on nursing care for preterm neonates on CPAP ventilation was essential for improving knowledge and practice of the nurses for providing good nursing care and decreasing CPAP complications and mortality rates for preterm neonates.

This finding was consistent with the finding of the study done by *Elsobkey & Amer, (2018)* who demonstrated that, there was a statistically significant correlation between total knowledge and total practice pre & post guideline. In accordance with *Mohammed, (2016)* who showed that, there was positive correlation between nurses' total knowledge and total practice. In addition to, agreed with *Mohammed & Abdel Fattah, (2018)* who stated that, there were highly statistically among knowledge and practices for the studied sample at pre-implementation and post implementation for the educational program.

The result of the study also in constraint with *Ali et al.,(2015)* in a study about "Nurses' knowledge and practice regarding implantable cardiac devices in Egypt" who revealed that, there was a strong correlation between total knowledge score and total practice score.

Regarding relation between total nurses' knowledge score and their personal data pre and post program, the present study showed that, there were statistical significant differences

between the studied nurses' total knowledge score and their age and academic qualifications post program implementation. In addition to, there was a highly statistical significant difference between the studied nurses' total knowledge score and their years of experience. While there were no statistical significant differences between the studied nurses' total knowledge score and their gender and attaining programs. This result may indicate that the ability to acquire knowledge increased with decreasing nurses' age and the program had highly effect on increasing nurses' experiences.

The findings of the study supported by *Elsobkey & Amer, (2018)* who revealed that, there was a statistically significant correlation between total knowledge pre & post guideline with age, education and years of experience. Although these results disagreed with *Hammad & Mohammed, (2016)*, *Buraihi & Mohammed, (2017)* & *(Abdul-Hamza & Aziz, 2017)* they showed that, there was no significant relationship between nurses' knowledge and age, and years of experience.

Regarding relation between total nurses' practice score and their personal data pre and post program, the present study showed that, there were highly statistical significant difference between the studied nurses' total practice score and their age, academic qualifications, and years of experience post program implementation .While there were no statistical significant differences between the studied nurses' total practice score and their gender and attaining programs. The findings of the study in agreement with *Elsobkey & Amer, (2018)* who revealed that, there was a statistically significant correlation between total practice score pre & post guideline with age, education and years of experience.

Moreover, in accordance with *Ali et al., (2015)* who demonstrated that, there were significant statistical

differences among nurses' practice and educational levels, age and years of experiences.

CONCLUSION:

Based on the current study findings, it were concluded that:

- There were highly statistical significant improvement in the studied nurses' level of knowledge and total performance post program implementation.

- There were statistical significant differences between the studied nurses' total knowledge and total performance scores with their age, academic qualifications, and years of experience post program implementation.

RECOMMENDATIONS:

Conducting an orientation programs for nurses in NICU with regular updates of knowledge and practice regarding continuous positive airway pressure (CPAP) to improve the quality and safety of neonatal care by having nurses acquire sufficient knowledge and skills.

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