

Nurses' Performance towards Care of Neonatal Meningitis: Effect of an Educational Program

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Abstract:

Background: Neonatal meningitis is a serious medical condition which is more common in the neonatal period and is rapidly fatal if untreated. Bacterial meningitis is more common in the first month than at any other time of life. Despite advances in neonatal intensive care, neonatal meningitis remains a devastating disease. **Aim:** The current study aimed to evaluate the effect of an educational program on nurses' performance towards neonates with meningitis at Neonatal Intensive Care Units.

Sample: A comprehensive sample composed all available nurses (100 nurses).

Design: One group pre/post-test, quasi- experimental design was utilized to fulfill the aim of this study.

Settings: This study was conducted at Neonatal Intensive Care Units at Benha University, Benha Specialized Pediatric and Benha Teaching Hospitals.

Tools: A structured interviewing questionnaire used to assess nurses' knowledge about neonatal meningitis and observational checklists to assess nurse's actual practice towards neonates with meningitis.

Results: revealed that, the mean age of the studied nurses was 23.9±3.8 years and there was a statistically significant improvement of studied nurses' knowledge and actual practices scores post-program implementation compared with pre-program implementation.

Conclusion: Nurses' performance towards care of neonatal meningitis was significantly improved post implementation of an educational program compared with pre implementation.

Recommendations: Periodic educational programs for nurses are necessary to help them to improve their performance regarding care of neonates with meningitis at neonatal intensive care units to reduce its complications.

Keywords: Meningitis, Educational program, Nurses' performance, Neonates, Neonatal Intensive Care Units

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I. Introduction

Neonatal meningitis is a serious medical condition that is rapidly fatal if untreated. Meningitis is an inflammation of the meninges and the protective membranes of the central nervous system. It is more common in the neonatal period than any other time in life. Also, neonatal meningitis is considered an important cause of morbidity and mortality globally (Shane et al., 2017). Mortality is roughly half in developing countries and ranges from 8%-12.5% in developed countries (Global Burden of Disease, 2016).

Neonatal meningitis is still a disease with high morbidity, although advances in perinatal care over the last few decades have been able to reduce its mortality rates to approximately 10%. Nevertheless, 20 to 58% of survivors show neurological sequelae. Another worrisome issue is the association of sepsis with meningitis, which has remained constant and rather frequent, showing rates of approximately 25%. A recent review study on neonatal infections has reported meningitis incidence ranging from 0.8 to 6.1 cases in every 1,000 live newborns (**Thaver & Zaidi, 2017**).

Meningitis is a life-threatening disease, affecting 0.1–0.4 neonates per 1,000 live births, with a higher incidence in preterm and chronically hospitalized infants (**Global Burden of Disease, 2016**). Approximately 10% of affected infants die, and 20–50% of survivors develop seizures, cognitive deficiencies, motor abnormalities, and hearing & visual impairments. Despite declines in mortality, morbidity has not improved since the 1970s (**Okike et al., 2014**).

Prevention and control of infections are important concerns for all types of health care agencies. The infection control practitioner is usually a nurse with advanced training in infection control practices and spread of infections. An assessment of the knowledge, attitude and practice of standard precautions by healthcare workers is a prerequisite for initiating and implementing a successful infection prevention and control strategy in any health facility. Knowledge and training in standard precautions and high risk perception have all been associated with improved compliance with standard precautions among health workers (**Ogoina et al., 2015**).

Nurses in the neonatal intensive care units (NICUs) are the key element in neonatal care and take the big responsibility in observing the early signs and symptoms of infections. Nurses in NICUs play an active role in control and management of meningitis through early observation, diagnosis and by following a defense inverse infection technique. Therefore, nurses in NICUs, should be trained through continuous educational programs to upgrade their knowledge level and improve their practical skills regarding control and management of neonatal meningitis (**Obaid et al., 2016**).

Significance of the study:

The incidence and mortality of neonatal meningitis in developing countries remain unacceptably high, variably reported as 0.8-6.1 per 1000 live births and 40-58% respectively (**Cantey and Milstone, 2015**). A cerebral insult related to meningitis has a greater impact on the vulnerable, developing brain, thus, a younger age during disease is usually associated with a poorer outcome (**Ku et al., 2015**). The survival of a neonate with neonatal meningitis depends mainly on both advanced medical care and competent nursing management which subsequently, will lead to a reduction in the mortality and the lifelong sequelae (**Lassi and Bhutta, 2015**). Thus, the current study was conducted to investigate the effect of an educational program on nurses' performance towards care of neonatal meningitis in neonatal intensive care units.

Aim of the Study

The present study aimed to evaluate the effect of an educational program on nurses' performance towards care of neonatal meningitis in Neonatal Intensive Care Units. This was achieved through assessing:

- Nurses' knowledge regarding neonatal meningitis.
- Nurses' actual practice related to care of neonatal meningitis.
- The effect of an educational program on nurses' knowledge and actual practices towards care of neonatal meningitis.

Research hypothesis:

The research hypothesis was as follows: nurses in NICUs exposed to educational program regarding care of neonatal meningitis will show higher scores of knowledge and practice after implementation of the program than that before.

II. Subject And Methods

Research Design:

The current study was one group pretest and post-test a quasi-experimental research design utilized to conduct this study. This design helped to investigate the effectiveness of a nursing intervention in achieving the desired outcomes in a natural setting (**Grove et al., 2013**).

Settings:

This study was conducted at Neonatal Intensive Care Units (NICUs) affiliated to Benha University Hospital (which included one room with well-equipped 7 incubators), Benha Specialized Pediatric Hospital (which located in two floors; the first one equipped with 5 incubators and the other divided into two rooms, one of them have 21 incubators and the other equipped with 7 incubators) and Benha Teaching Hospitals (which included one room and equipped with 13 incubators).

Sample:

A comprehensive sample composed of all nurses (100 nurse) working in the previously mentioned settings as 20 nurses was from Benha University Hospital, 50 nurses from Benha Specialized Pediatric Hospital and 30 nurses were from Benha Teaching Hospital. Nurses were selected under the following criteria; having experience in NICUs for more than 1 year regardless their age.

Tools of data collection:

Two tools were used for data collection. The tools were designed and written in simple Arabic Language and consisted of:

Tool 1: A structured interviewing questionnaire to assess nurses' knowledge regarding care of neonatal meningitis pre and post implementation of the educational program, it was developed by the researchers and divided into two parts. **Part one:** Concerned with demographic characteristics of the studied nurses, namely nurse's age, qualification, years of experience, previous training about infection prevention in NICUs and place of work. **Part two:** This part was developed to assess nurses' knowledge pre and post implementation of the educational program regarding, definition, signs & symptoms, causes, laboratory investigations, diagnosis, complications, methods of infection prevention, isolation measures and nursing care given to neonates with meningitis.

Scoring system: Items for assessing nurses' knowledge were consisted of 12 closed ended questions and 30 open ended questions, which were given a total score of 100 distributed according to importance of each item. Accordingly, the total level of knowledge were categorized based on nurses' responses as good ($\geq 75\%$), average ($< 75\% : 50\%$) and poor ($< 50\%$).

Tool 2 : An observational checklists: adopted from **Bowden & Greenberg, (2016), Loveday et al., (2014) and WHO, (2009)** used to assess nurses' actual practices (vital signs measurements, growth measurements, hand hygiene, wearing protective clothing, intravenous cannulation & administration of IV fluids, gavage feeding and naso- tracheal suctioning) regarding care of neonatal meningitis pre and post implementation of the educational program. It was checked by the researchers as correctly

done (2 marks), incorrectly done (1 mark) and not done zero. Time consumed for assessing nurses' actual practices was approximately 60 minutes. Each nurse was observed three times for each procedure and then the average score was obtained.

Scoring system: Nurses' actual practices total score was 298, these scores were converted into a percent score. The nurses' actual practice level was considered competent if the percent score is 85% or more and incompetent if scored less than 85%.

Tools validity and reliability:

Tools were reviewed by a panel of three experts in the field of pediatric nursing and two in infection control medical staff from hospitals to test its content validity. Modifications were done accordingly based on their judgment. Reliability was done by Cronbach's Alpha coefficient test which revealed that each of tools consisted of relatively homogenous items as indicated by the moderate to high reliability (internal consistency) of each tool (knowledge = 0.92, practice= 0.83).

Preparatory phase:

Review of the past and current local and international related literature using articles, journals, scientific periodicals magazines and books, was done to develop the study tools and to get acquainted with various aspects of the research problem.

Pilot study:

A pilot study was carried out included 10% of the studied nurses (10 nurses) to test the applicability and feasibility of the study tools, modification was done according to the results of the pilot study. Nurses included in the pilot study were excluded from the main study sample since some modifications were done in the form of rephrasing for some statements. The final form of the tools was then obtained and the time needed for completing each tool was also determined.

Ethical considerations:

An official permission to conduct the study was obtained through an issued letter from the Dean of the Faculty of Nursing, Benha University to the medical and nursing directors of the previously mentioned settings. The letter included the title, aim and the expected outcomes of the study. Before carrying out the present study, oral consent was obtained from all studied nurses. For data collection, the studied nurses were informed about the nature, purpose and the expected outcomes of the study. The researchers informed the studied nurses that, the participation in the study is voluntary & they have the right to withdraw from the study at any time without giving any reason and that, their responses would be held confidentially. Studied nurses were also assured that, anonymity and confidentiality will be guaranteed, as well the gathered data used for the research purpose only.

Field work:

A written official permission to carry out the study was obtained from director of Benha University, Benha Specialized Pediatric and Benha Teaching Hospitals through a formal letter that was issued from Dean of the Faculty of Nursing, Benha University explaining the purpose of the study and methods of data collection.

The study was carried out through four phases: assessment, planning, implementation, and evaluation. These phases were carried out from beginning of October, 2017 to the end of March, 2018

over a period of six months. The previous mentioned settings were visited by the researchers two days/week (Saturday and Monday) from 9.00 am to 2.00 pm during (morning and afternoon) shifts.

A) Assessment phase: The researchers had attended to NICUs one day for two shifts (morning & afternoon shift) for each setting by rotation. They introduced themselves to the studied nurses and explained purpose of the study and importance of neonatal meningitis prevention. The researchers interviewed each nurse individually using pre-designed interviewing questionnaire to obtain the data needed, each interview lasted 10-15 minutes. The interview was conducted to collect baseline data from nurses regarding their knowledge about meningitis and nursing care given to neonates with meningitis. Nurses were observed and evaluated for their actual practices of care they provided to neonates with meningitis by an observational checklist. Areas of weakness in nurses' knowledge and practices were identified and designing program objectives were set.

B) Planning phase: The researchers planned nursing care after reviewing the related literatures based on assessment of nurses' knowledge obtained from the questionnaire sheet and nurses' practices which obtained through nurses' observational checklist.

C) Implementation phase: The program implementation was implemented at the study settings. A booklet was designed based on level of nurses' knowledge and practices. It contained meaning, signs and symptoms, disease contribute to neonatal meningitis, differential diagnosis, complications, treatment, mode of transmission of infection, methods of infection prevention, isolation measures and methods used with isolated neonate.

Six teaching sessions were conducted focusing on information included in the booklet. Nurses were divided into 10 groups, 10 nurses in each group. The educational program was provided in 6 sessions (2 theoretical sessions and 4 practical sessions). Time needed for each session was 30 minutes for theoretical part and 30-45 minutes for practical part. Sessions were given in three days a week (Sunday, Monday and Tuesday) for all hospitals by rotation. Teaching methods used were; lecture, discussion, demonstration and re-demonstration, while teaching materials were handout and real equipment.

D) Evaluation phase: Nurses' knowledge and practices were assessed post program implementation, using the same tools which used pre- program implementation. Evaluation of nurses' knowledge and practices was conducted immediately post- program implementation.

Statistical analysis:-

The collected data were organized, revised, scored, tabulated and analyzed using the number and percentage distribution. Statistical analysis was done by computer using Statistical Package for Social Sciences (SPSS) version 20. Qualitative variables were compared using chi-square test and quantitative variables were compared using t-paired test and Pearson correlation coefficient test. The significance of the results was considered as follows: When $P < 0.05$ & $P < 0.001$: it was statistically significant difference.

Limitation of the study:

Data collection and program implementation took long period because of frequent absenteeism of nurses, overload of nurses' work, and drop out of some nurses due to days off especially during program implementation.

III. Results

Table (1): Percentage distribution of the studied nurses according to their demographic characteristics (n=100)

Items	No.	%
Age/ Year		
- < 20	19	19.0
- 20 < 30	70	70.0
- ≥ 30	11	11.0
$\bar{X} \pm SD$	23.9 ± 3.8	
Nursing qualification		
- Diploma in nursing	14	14.0
- Technical institute in nursing	21	21.0
- Bachelor in nursing science	65	65.0
Years of experience		
- 1 < 3	57	57.0
- 3 < 5	25	25.0
- ≥ 5	18	18.0
$\bar{X} \pm SD$	3.22 ± 1.9	
Previous training		
- No	82	82.0
- Yes	18	18.0

Table (1) shows that, the mean age of the studied nurses was 23.9±3.8 years and 65% of them had bachelor of nursing. Also, 57% of the studied nurses had years of experience ranged between 1 to less than 3 years, while, 82% of them had no previous training regarding infection prevention in neonatal intensive care units.

Figure (1): Percentage distribution of the studied nurses in relation to their work place (n=100)

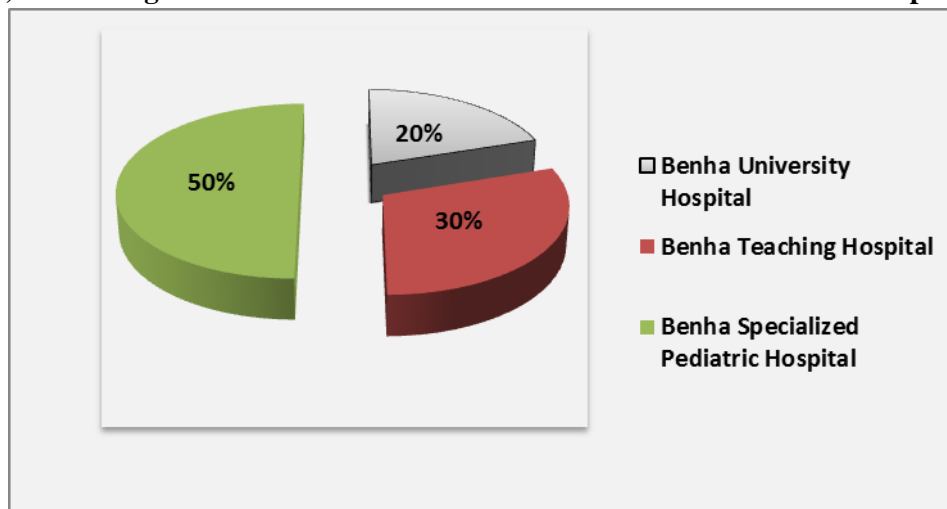


Figure (1) illustrates that, half of the studied nurses (50%) worked at Benha Specialized Pediatric Hospital, 30% worked at Benha Teaching Hospital while 20% of the studied nurses worked at Benha University Hospital.

Table (2): Percentage distribution of the studied nurses' knowledge regarding neonatal meningitis pre/post- program implementation (n=100)

Nurses' Knowledge	Pre		Post		X ² P-value
	No.	%	No.	%	
Definition					
- Good	43	43	77	77	24.88 P <0.05*
- Average	44	44	20	20	
- Poor	13	13	3	3	
Signs and symptoms					
- Good	21	21	74	74	57.9 P <0.05*
- Average	76	76	23	23	
- Poor	3	3	3	3	
Causes:					
- Good	21	21	73	73	54.8 P <0.05*
- Average	72	72	23	23	
- Poor	7	7	4	4	
Laboratory investigations:					
- Good	18	18	79	79	74.8 P <0.05*
- Average	69	69	19	19	
- Poor	13	13	2	2	
Complications of meningitis:					
- Good	16	16	73	73	70.9 P <0.05*
- Average	48	48	23	23	
- Poor	36	36	4	4	
Methods of infection prevention					
- Good	18	18	69	69	53.6 P <0.05*
- Average	74	74	26	26	
- Poor	8	8	5	5	
Isolation measures					
- Good	23	23	85	85	77.5 P <0.05*
- Average	62	62	13	13	
- Poor	15	15	2	2	
Nursing care					
- Good	14	14	77	77	82.3 P <0.05*
- Average	70	70	23	23	
- Poor	15	15	0	0	

*P-value<0.05 ----- statistically significant

Table (2): clarifies that, 77%, 73%, 74%, 79%, 73%, 69%, 85% & 77% of the studied nurses had good knowledge post- program implementation compared to pre- program implementation as regards definition, causes, signs & symptoms, laboratory investigations, methods of infection

prevention, isolation measures and nursing care of neonatal meningitis, respectively with a statistical significance difference at $P < 0.05$.

Table (3): Distribution of the studied nurses according to their total knowledge scores regarding management of neonatal meningitis pre/post- program Implementation (n=100)

Knowledge total scores	Pre		Post		Significance test
	No	%	No	%	
Good ($\geq 75\%$)	9	9	64	64	t-test = 4.61 P < 0.001**
Average (<75% : 50 %)	40	40	21	21	
Poor (< 50 %)	51	51	15	15	

*P-value < 0.05 ----- statistically significant

Table (3): clarifies that, 9% of the studied nurses had good knowledge regarding management of neonatal meningitis pre- program implementation, compared to 64% post- program implementation with a statistical significant difference at $P < 0.001$.

Table (4): Percentage distribution of the studied nurses' actual management practices regarding care of neonatal meningitis pre/post- program implementation (n=100)

Items	Nurses' Practices				X ² P-value
	Pre		Post		
	Competent	Incompetent	Competent	Incompetent	
Vital signs	63%	37%	87%	13%	15.3 P < 0.05*
Growth measurements	40%	60%	89%	11%	22.1 P < 0.05*
Hand hygiene	39%	61%	91%	9%	24.6 P < 0.05*
Wearing protective clothing	43%	57%	90%	10%	27.9 P < 0.05*
Intravenous cannulation & administration of IV fluids	55%	45%	87%	13%	24.8 P < 0.05*
Gavage feeding	38%	62%	78%	22%	6.09 P < 0.05*
Naso- tracheal suctioning	32%	68%	94%	6%	21.9 P < 0.05*

*P-value < 0.05 ----- statistically significant

Table (4) illustrates that, the majority of the studied nurses' (87%, 89%, 91%, 90%, 87%, 78% and 94%) had competent practices regarding vital signs, growth measurements, hand hygiene, wearing protective clothing, intravenous cannulation & administration of IV fluids, gavage feeding and naso-tracheal suctioning post-program implementation compared to pre-program implementation respectively with a statistical significant difference.

Table(5): Distribution of the studied nurses according to their total actual management practices scores regarding care of neonatal meningitis pre/post- program implementation (n=100)

Actual practice total scores	Pre		Post		Significance test
	No	%	No	%	
Competent ($\geq 85\%$)	59	59	86	86	t-test = 5.55
Incompetent ($<85\%$)	41	41	14	14	P <0.001**

*P-value<0.05 ----- statistically significant

Table (5): shows statistically significant improvement in studied nurses' total actual management practices scores of neonatal meningitis post-program implementation compared with pre-program with a statistical significant difference at P <0.001 .

Table (6): Correlation between studied nurses' total scores of knowledge and practices regarding management of neonatal meningitis pre/post- program implementation (n=100)

Items	Knowledge scores			
	Pre		post	
	r	P-value	r	P-value
Actual practices scores pre	0.662	0.05*		
Actual practices scores post			0.383	0.05*

* Statistically significance ----- P-value <0.05

Table (6) clarifies that, there was a positive statistical significant correlation between total scores of nurses' knowledge and their total practices' scores regarding management of neonatal meningitis pre and post program implementation at p< 0.05.

Table (7): Relation between demographic characteristics of studied nurses and their total knowledge scores (pre/post program implementation) regarding management of neonatal meningitis (n = 100)

Items	Knowledge level												significance	
	Pre						Post							
	Good		Average		Poor		Good		Average		Poor			
	No	%	No	%	No	%	No	%	No	%	No	%		
Age in years:	4	4	0	0	15	15	17	17	1	1	1	1	X ² = 53.6 P < 0.05*	
	< 20	4	4	36	36	30	30	38	38	19	19	13		13
	20 < 30	1	1	4	4	36	36	9	9	1	1	1		1
Qualifications:	≥ 30	2	2	4	4	8	8	9	9	3	3	2	2	X ² = 18.8 P < 0.05*
	Nursing diploma	3	3	6	6	12	12	15	15	4	4	2	2	
	Technical nursing institute	4	4	30	30	31	31	40	40	14	14	11	11	

B.sc in nursing													
Years of experience:													
1 < 3	1	1	30	30	26	26	40	40	8	8	9	9	X ² = 22.6 P < 0.05*
3 < 5	2	2	6	6	17	17	12	12	9	9	4	4	
≥ 5	6	6	4	4	18	18	12	12	4	5	2	2	
Previous training:													
No	6	6	28	28	48	48	60	60	15	15	7	7	X ² = 77.5 P < 0.05*
Yes	3	3	12	12	3	3	4	4	6	6	8	8	

* Statistically significance ----- P-value <0.05

Tables (7): illustrates a significant statistical relation between total knowledge scores of the studied nurses and their demographic characteristics (age, qualifications, previous training about infection prevention in NICUs and years of experience) pre and post implementation of the educational program (P < 0.05).

Table (8): Relation between demographic characteristics of the studied nurses and their total' actual practice scores (pre/post program implementation) regarding management of neonatal meningitis (n = 100)

Items	Actual practice level								Significance
	Pre				Post				
	Competent		Incompetent		Competent		Incompetent		
	No	%	No	%	No	%	No	%	
Age in years:									
< 20	6	6	13	13	15	15	4	4	X ² = 24.8 P = 0.05*
20 < 30	45	45	25	25	62	62	8	8	
≥ 30	8	8	3	3	9	9	2	2	
Qualifications:									
Nursing diploma	8	8	6	6	10	10	4	4	X ² = 0.92 P = 0.05*
Technical nursing institute	12	12	9	9	18	18	3	3	
B.sc in nursing	39	39	26	26	58	58	7	7	
Years of experience:									
1 < 3	37	37	20	20	50	50	7	7	X ² = 6.09 P = 0.02*
3 < 5	12	12	13	13	20	20	5	5	
≥ 5	10	10	8	8	16	16	2	2	
Previous training:									
No	49	49	33	33	80	80	2	2	X ² = 11.3 P = 0.05*
Yes	10	10	8	8	6	6	12	12	

* Statistically significance ----- P-value <0.05

Tables (8): reveals a significant statistical relation between total actual practice scores of the studied nurses and their demographic characteristics (age, qualifications, previous training about infection prevention in NICUs and years of experience) pre and post implementation of the educational program (P < 0.05).

IV. Discussion

Meningitis refers to an inflammation of the meninges surrounding the brain and spinal cord. Neonatal meningitis is the term used to describe meningitis that occurs in the first 28 day of life (**Grandgirard & Leib, 2010**). Despite of the advent of improved antimicrobial therapy neonatal meningitis continues to retain its importance all over the world as an infectious disease because of its morbidity (**Gordon et al., 2017**).

As regards, demographic characteristics of the studied nurses the current study revealed that, more than two thirds of the studied nurses' age ranged between 20 to less than 30 years, and were graduated from Faculty of Nursing. While the majority of them had no previous training about prevention of infection in NICUs and nearly their half had experience of less than 3 years in nursing. These findings were similar in some points and contradicted in other points with those of **Al-Wily, (2015)** who conducted a study about Effectiveness of Educational Program on Nurses knowledge toward Nosocomial Infection at NICU in Baghdad Hospital and found that, more than two thirds of the studied nurses were aged between 20 to less than 30 years, graduated from the secondary nursing schools and had experience for less than 3 years in nursing.

The results of the current study indicated that, half of the studied nurses had poor knowledge regarding neonatal meningitis pre implementation of the study intervention which significantly improved post implementation of the study training program. These result was similar to a study done by **Atshan and Aburghif, (2016)** about Effectiveness of an Educational Program on Nurses' Knowledge toward Children with Meningitis at Pediatric Teaching Hospitals in Baghdad City, and found that, nurses' total level of knowledge significantly improved post implementation of the educational program compared with pre implementation. These results were also in agreement with those of **Mohammed et al., (2019)** whom evaluated Effect of Teaching Program regarding Care for Acute Meningitis on Nurses' Performance at Emergency Unit, and reported that, there was statistically significant improvement in nurses' total level of knowledge post implementation of the study intervention compared with their level pre implementation. From the researchers point of view these results could be owed to lack of continuous education of the nurses and motivation to learn.

On assessing the studied nurses' practical skills concerning care provided to neonates suffering from meningitis including, (vital signs, physical, measurements, hand hygiene, wearing protective clothing, intravenous cannulation & administration of IV fluids, gavage feeding and naso-tracheal suctioning), the current study portrayed that, studied nurses' practices were incompetent pre-implementation of the educational program compared with the improvement that, was observed post implementation. These findings, were concurrent with those of **Rahimi et al., (2018)** whom clarified in their study about Impact of Training on Nurses Performance and Productivity at Neonatal Intensive Care Unit that, nurses became more competent in their practical skills post implementation of the educational program compared with pre implementation. These results emphasize on the importance of nurses' on - job training for improving their practical skills. As stated by **Chaghari et al., (2017)** in their study about Empowering Education: A New Model for In-Service Training of Nursing Staff, that, on-job training and education of nurses improves their competency and practical skills.

In addition the current study revealed that, there was a statistically significant correlation between studied nurses' knowledge and practices pre and post implementation of the educational program. These results were supported by those of **Mohammed and Ibrahim, (2016)** whom carried out a study about Effectiveness of Health Educational Program on Nurses Knowledge and Practice regarding Infection Control in NICU at Pediatric Hospitals in Khartoum State, Sudan, and found a statistical significant correlation between nurses knowledge and practice per and post implementation of the educational program. From the researchers point of view these result could be attributed to the fact that, competent practices are linked to sufficient knowledge.

Additionally, the current study, illustrated a significant relationship between studied nurses' demographic characteristics (age, qualifications, years of experience & previous training about infection prevention in NICUs) and both their total knowledge and actual practices regarding management of neonatal meningitis pre and post program implementation. These results were in accordance with those of **Mohammed et al., (2019)**, whom reported that, there was a statistically significant relation between studied nurses' demographic characteristics and both their knowledge and practice levels regarding care of neonatal meningitis pre and post implementing the educational program.

V. Conclusion

Based on the findings of the current study, it is concluded that, nurses' knowledge and practice were significantly improved after implementation of an educational program about management of neonatal meningitis. As a result, the study educational program is effective to be applied at NICUs to manage neonates with neonatal meningitis.

VI. Recommendations:

- Periodical on-job training programs for nurses regarding management of neonatal meningitis.
- Workshops and seminars should be organized to raise awareness of nurses working at NICUs regarding prevention and control of neonatal meningitis.
- Further studies with larger number of nurses and different setting concerning management of neonatal meningitis is required for generalization of the study findings.

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