Original Article

Effect of Educational Instruction Program on Nurses' Knowledge and Practices Regarding Care of Patients with Meningitis

Rasha Alsayed Ahmed [1], Ola Abdelwahab Abdallah Srour [2]

[1,2] Lecturers of Adult Health Nursing, Faculty of Nursing, Helwan University, Egypt
*Corresponding author: olasrour01 @gmail.com OR drolasrour@yahoo.com

Abstract

Meningitis is a serious health problem that is considered an endemic disease in Egypt. Nursing personnel play an active role in the control and management of meningitis **Aim:** to evaluate the effect of an educational instruction program on nurses' knowledge and practices regarding care of patients with meningitis**. Design:** A quasi experimental research design (pre- and post-test) was utilized. **Setting:** Helwan Fever Hospital in Helwan city, Egypt. **Subjects:** A convenient sample of all nurses working in selected settings (50 nurse). **Tools for data collection:** Three tools were used, including the nurses' personal characteristics, the knowledge assessment interview questionnaire, and the lumber puncture observational checklist. **Results:** the studied nurses gained a satisfactory level of knowledge (92%) during the post-test phase followed by follow-up test phase (90%) as compared with pre-test phase (34%). Moreover, there was a highly statistically significant difference between total mean score of knowledge as well as total mean score of practices throughout study phases among the studied nurses at $P = 0.000$. Significant positive correlation between of total knowledge and practices among the studied nurses. **Conclusion:** there was a highly statistically significant difference between total mean score of knowledge as well as practices during pre, post & three months follow up among studied nurses. Additionally, there was a large effect size of educational instruction program on nurses' knowledge and practices pre, post and follow-up educational instruction program. **Recommendations**: Periodical on-the-job training programs for nurses regarding the management of meningitis.

Keywords: Educational Instruction, Meningitis, Nurses knowledge, Practices.

Introduction

Meningitis is a serious inflammatory condition affecting the meninges, the membranes that cover the brain and spinal cord. Worldwide; meningitis burden remains high, causing a major morbidity and mortality **(Zunt 2019).** Meningitis is one of the four largest contributors to neurological disability adjusted life years (DALYs) globally. Millions of cases are observed worldwide each year, with 170000 of them being life-threatening, and 10% of survivors having disabled neurologic sequelae or other complications. **(Redenbaugh, Eoin, and Flanagan, 2022).**

In Egypt, meningitis is a widespread illness. Due to the poor socioeconomic conditions, it is more common in developing nations, where the endemicity rates are 1.5 per 100,000 people

and 20 per 100,000 people, respectively. The incidence of bacterial meningitis (BM) is a significant burden in adults, with a mortality rate of up to 30%, and it requires prompt recognition and treatment (**Dawod et al., 2019**).

Meningitis is caused by an infectious process in the meninges, whose etiological cause may be bacterial, viral, fungal, or parasitic. Bacteria and viruses are the most common causes of meningitis, but bacterial meningitis is usually severe and common. Accurate and timely identification of the etiological agents is vital to initiate public health measures and appropriate management (**Tigabu et al., 2021**).

Pneumococcal meningitis was recently the leading cause of bacterial meningitis in Egypt, reflecting epidemiological changes in the illness since Neisseria meningitides was the common cause for a long time (**Abdelkader et al., 2017**). Due to the implementation of various immunization programs and antibiotic treatments that significantly decreased mortality. The epidemiology of meningitis has significantly changed with regard to the distribution of the causative agents and patients' age group (**Roos and Tyler, 2017**).

Meningitis is divided clinically into acute and chronic diseases. A number of infectious agents can cause acute meningitis, which manifests over the course of hours or days. Chronic meningitis has an onset that may last for weeks to months, but is generally determined when symptoms, signs, and the cerebrospinal fluid remain abnormal for at least 4 weeks. Headache, stiffness in the neck, fever, photophobia and vomiting are common clinical signs of acute meningitis. The patient becomes agitated and frequently prefers to lie still as this develops within hours or minutes. Neck stiffness and a positive Kernig's sign usually appear within hours (**Abdel Monem et al., 2021**).

Cerebrospinal fluid (CSF) analysis, which includes a white blood cell count, glucose, protein, culture, and, in some cases, a polymerase chain reaction (PCR)., is used to diagnose meningitis .Moreover, lumbar puncture (LP) is used to obtain CSF, and the opening pressure can be determined (**Güldemir et al., 2018**). The early recognition of the pathology's signs and symptoms, such as acute pain, changes in the mental state, nausea, and vomiting, still in the disease's first hours, and the early handling are vital to achieve qualified assistance because the therapeutics' early beginning may decrease the morbidity and mortality, which will reflect in the improvement of the patient's prognosis and the reduction of complications (**Moura et al., 2020**).

The most important and significant factor in the survival of patients with meningitis is the standard of nursing care provided to meet their requirements. Thus, the nurse must possess both broad knowledge of different methods of care for patients with meningitis and practical skills in the application of therapies directed toward solving the problems that patients exposed to invasive procedures face (**Nguce, 2018**).

Nursing is an indispensable profession for the health and well-being of all nations and is the backbone of the healthcare system (**Al-Hamdan and Bani Issa, 2021**). Nurses constitute the largest part of the healthcare workforce, and their professional ability plays an important role in the effective operation of healthcare systems (**Said and Chiang, 2020**). As well, nursing personal play an active role in the control and management of meningitis through early observation, diagnosis, and following an inverse infection technique. Therefore, nurses should be trained through continuous educational programs to upgrade their knowledge level and improve their practical skills regarding the control and management of meningitis (**Hussien et al., 2021**).

The educational instruction for nurses provides a comprehensive plan that demonstrates the feasibility of the program. The nursing teaching program provides the content that ensures nurses receive the theoretical and clinical practice experiences required to meet the applicable standards and competencies. The nursing teaching program has formal systems and processes in place to measure nursing performance as well as program effectiveness (**Mohammed, Mohammed, and Ahmed 2019**).

Significance of the study

Meningitis remains a major global public-health challenge. Additionally, it considered a devastating disease with a high case fatality rate and leading to serious long-term complications (**WHO, 2021**). As mentioned by **Diederik et al., (2021)** the number of cases that have been reported has increased over the past decade, and incidence is strongly correlated with measures of deprivation. However, the majority of cases still occur in Africa, particularly in the Sahel region of west and central Africa.

Meningitis is regarded as an endemic disease in Egypt. In addition to being endemic, the African meningitis belt experiences a violent periodic epidemic every 6 to 12 years (**Zelano and Westman, 2020**). Meningitis disease was prevalent in Egypt (58%) and Minia (19%) per 100,000 people (**Abdel-Razik et al., 2017).** There were 48 meningitis patients in the governorate of Qaliubiya in 2011 alone (**El Kareh et al., 2020).**

From the researchers' clinical experience and observation of the actual situation during clinical training, it is obvious that the care of patients with meningitis occupies a considerable amount of time for many nurses. Additionally, it was observed that many nurses have misconceptions about the direct care of patients with meningitis. Therefore, developing educational instruction program regarding the care of patients'

with meningitis is considered important for improving the quality of care.

Aim of the study

The aim of this study is to evaluate the effect of an educational instruction program on nurses' knowledge and practices regarding care of patients with meningitis through:

1. Assessing the level of a nurse's knowledge and practices regarding care of patients with meningitis.
2. Developing an educational instruction program based on the pre-assessment of the nurse's knowledge and practices.
3. Evaluating the effect of the educational instruction program on the nurses' knowledge and practices about the care given to the patients with meningitis.

Research hypotheses

1. There will be a statistically significant difference between pre, post and follow-up nurses' knowledge and practices after the educational instruction program.
2. There will be a large effect size of educational instruction program on nurses' knowledge and practices pre, post and follow-up after the educational instruction program.
3. There will be a positive correlation between nurse's knowledge and practices after implementation of an educational instruction program.

Subjects & Methods

Technical design
Research design

A quasi-experimental research design was utilized in this study with a broad range of nonrandomized, pre-posttest approaches. The researchers selected this design for ethical or practical reasons. This design is frequently used when it is not logistically feasible or ethical to

conduct a randomized controlled trial (**Muse & Baldwin, 2021**).

Setting of the study

The study was conducted in the critical care units and general medical departments at Helwan Fever Hospital in Helwan city, Egypt. The hospital consists of five buildings. The first building has one floor.

The ground floor includes an emergency room, a spinal cord endocrinology room, X-ray departments, a pharmacy, a laundry room, a morgue, a security room, and administrative departments. The second building has two floors (the ground floor and the first floor). The male department, the urology unit, and the maintenance department are located on the ground floor. The first floor includes female units 1 and 2, plus the training department. The third building has one floor, including an intensive care unit, an intermediate care unit, and a quarantine department located on the ground floor. The fourth building has one floor, which involves a blood bank, laboratory, and restaurant. An infection control unit is located in the fifth and final buildings. The total hospital capacity is 119 beds. The bed capacity for the selected department was distributed as follows: ICU (10 beds), intermediate ICU (10 beds), female unit one (20 beds), female unit two (20 beds), and male unit (25 beds). At Helwan University, this setting was chosen due to its geographical proximity.

Sample

A convenient sample of all nursing staff working in selected settings (50 nurses) was included in the study. It is a non-probability sampling method where all units are selected for inclusion in the sample. The researchers selected this type of sampling due to the availability of the nurses at a given time and the willingness of the studied nurses to participate in this study (**Stratton, 2021**).

Tools and data collection

Tool I: **Nurses' personal characteristics**: This tool involved studied nurses' data, such as age, gender, marital status, educational level, years of experience in the field of nursing, working department and attendance at training courses. The questions were formulated in the form of seven closed-ended questions.

Tool II: Knowledge assessment interview questionnaire: This tool was developed by the researchers after reviewing the literature based on meta-analysis studies conducted by **Misra et al., (2020) and Kamal et al., (2019)** to assess the knowledge level regarding care of patients with meningitis among the studied nurses. The tool consisted of open- and closed-ended structured questions. It was created in English and translated into Arabic.

This tool consisted of 59 questions (56 closed and 3 open-ended questions) covering twelve main dimensions regarding the studied nurses' knowledge. These dimensions included the anatomy and function of the nervous system, definitions, causes & types, clinical manifestations, knowledge regarding the mode of transmission, diagnosis, general management, treatment, nutrition, vaccination, complications, and nursing management.

Scoring system for knowledge assessment interview questionnaire: The knowledge obtained from studied nurses was scored and calculated as the following: **(a):** closed-ended questions (Two grade for a correct answer and one grade for an incorrect answer), **(b):** open-ended questions (Three grade for a correct complete, two grads for correct incomplete and one grade for an incorrect answer). The total score for the questionnaire was 121 (equal to 100%). The total score was calculated and classified as less than 75% was considered unsatisfactory and more than or equal to 75% was considered satisfactory. The following table shows all the details of the scoring system.

Knowledge regarding meningitis questionnaire						
Dimension	Type	No of items	Multiply No	Range	Un-satisfactory level < 75%	Satisfactory level ≥ 75%
Anatomy and functions	MCQ	2	×2	2-4	2	3-4
	T/F	2	×2	2-4	2	3-4
Definitions	MCQ	2	×2	2-4	2	3-4
	T/F	2	×2	2-4	2	3-4
Causes and types	MCQ	2	×2	2-4	2	3-4
	T/F	2	×2	2-4	2	3-4
Clinical manifestation	MCQ	5	×2	5-10	5-7	8-10
	T/F	2	×2	2-4	2	3-4
Mode of transmission	MCQ	4	×2	4-8	4-5	6-8
	T/F	2	×2	2-4	2	3-4
Diagnosis	MCQ	2	×2	2-4	2	3-4
	T/F	2	×2	2-4	2	3-4
General management	MCQ	1	×2	1-2	1	2
	T/F	1	×2	1-2	1	2
Treatment	MCQ	3	×2	3-6	3-4	5-6
	T/F	4	×2	4-8	4-5	6-8
Nutrition	MCQ	2	×2	2-4	2	3-4
	T/F	5	×2	5-10	5-7	8-10
Vaccinations	MCQ	2	×2	2-4	2	3-4
	T/F	2	×2	2-4	2	3-4
Complication	MCQ	3	×2	3-6	3-4	5-6
	T/F	4	×2	4-8	4-5	6-8
Nursing management	Open End	3	×3	3-9	5-11	12-15
Total Questionnaire	Mixed	59	56×2 + 3×3	59-121	59-90	91-121

Tool III: Lumber puncture observational checklist: This tool was developed by researchers after reviewing different national and international literatures based on **Abdelmowla, Sayed, and Elmagd (2017) and Lavery & Whitaker (2018).** It was designed to assess nurses' roles pre, during, and after lumbar puncture procedure. It included 13 steps distributed as pre procedure nursing care (4 steps), during the procedure (6 steps), and post-procedure (3 steps).

Scoring system for Lumber puncture observational Checklist: The total score for all steps was 13 with a 26-degree, and each step was evaluated using a three-point Likert scale to assess nurses' practices: two meant it was done correctly, one meant it was done incorrectly, and zero meant it was not done. The total score of the nurse's practices was calculated and classified as follows: less than 75% (20 degree) was in- competent, and more than or equal to 75% (20 degree) was considered competent based on statistical analysis.

Operational design

Preparatory phase

It included the review of recent references, different studies, and theoretical knowledge of various aspects of the problems using textbooks, articles, medical websites, periodicals, and magazines that concern the topic of meningitis and the role of the nurse in every phase of care to develop the tools for data collection.

Validity

The face and content validity of the tools were assessed by a jury group of five experts from Helwan University's Adult health nursing department using an opinion questionnaire sheet to measure the tools' validity.

Jury group members judge tools for comprehensiveness, accuracy, and clarity in language. Based on their recommendations, corrections, additions, and/or omissions of the same items were done.

Construct validity is the degree to which an instrument measures the construct it is intended to measure. Factorability of items was evaluated by Bartlett's test of sphericity to test relationships among variables, and the Kaiser–Meyer–Olkin (KMO) measure evaluated sampling adequacy to determine whether partial correlations among variables were small. The following table discussed the validity result.

	Questionnaire	Knowledge assessment interview questionnaire.	Lumber puncture observational Checklist
1	KMO Test	0.887	0.795
	Interpretation	Marvelous adequate Sampling for validity	
2	Bartlett's test of sphericity	0.000**	0.000**
	Interpretation	Interrelationship among variables is present	

Reliability

The tools' reliability was examined using internal consistency and tested to determine the extent to which the tools' items are inter-correlated with each other. Internal consistency is measured by two methods. The first one is Cronbach's alpha coefficient, which is one of the most popular reliability statistics for measuring internal consistency. The second is the split-half reliability, which is calculated by averagely dividing questions based on the parity of item numbers. Then a Pearson's r or Spearman's rho correlation is run between the two halves of the instrument. The following table discussed reliability results:

	Questionnaire	No of items	Alph Cronbach test	Split-half
1	Knowledge assessment interview questionnaire.	59	0.994	0.921
2	Lumber puncture observational Checklist	13	0.960	0.966
	Interpretation (Both)	Confirming excellent the internal consistency		

Ethical considerations

A research proposal was approved by the Ethical Committee in the Faculty of Nursing, Helwan University. The study was followed common ethical principles in clinical research. Prior to data collection, informed oral consent from each participant in the study was obtained. Each participant was informed about the purpose of the study and its significance. They were assured that anonymity and confidentiality would be guaranteed and that they had the right to withdraw from the study at any time without giving any reason. Ethics, values, culture, and beliefs were respected.

Pilot study

It was carried out on 10% of the studied nurses (5 nurses) of a total sample size of 50. The aim of the pilot study was to determine the clarity, applicability, and efficiency of the tools. It also aims to ensure that the study tools are simple, relevant, and feasible. In addition, it helps in the estimation of the time needed to collect data and determine the obstacles. Accordingly, minor modifications were made to the study tools.

Field work (Procedure)

- Permission to conduct the study was obtained from the hospital's responsible authorities after an explanation of the study's aim.
- Data was collected by the researchers for approximately eight months, starting in December 2021 and ending in July 2022.
- The study was carried out in four phases; assessment, planning, implementation, and evaluation.

Phase I: Assessment phase

During this phase, the researchers collected data from the studied nurses. It began with the nurses' personal characteristics and knowledge assessment interview questionnaire. Each nurse spent about 30-40 minutes completing the tools.

The researchers also observed the nurses being studied in order to collect data about their roles pre, during, and after lumbar puncture procedure using an observational checklist **(Tool III).** It was filled in by the researchers (pre-test). Each nurse was observed pre-procedure, during the procedure, and post-procedure three times and the mean (±SD) of these observations was estimated to assess the nurse's practices. The average time needed for the completion of each observational checklist was about 45–60 minutes. The data that was obtained during this phase was considered the basis for the educational instruction program (pre-test).

Phase II: **Planning phase**

The educational instruction program was designed based on the analysis of the actual studied nurses' needs in the assessment phase. The content was written in simple Arabic, consistent with the related literature. It was designed to improve nurses' knowledge and practices regarding the care of patients with meningitis according to their level of understanding.

Construction of the educational instruction program

The educational instruction program was developed by the researchers based on the previous assessment of nurses' knowledge and practices, available resources, and reviews of relevant literature guided by **Misra et al. (2020) and Kamal et al. (2019), Abdulmowla et al., (2017) and Lavery & Whitaker (2018),**aiming to improve their knowledge and promote practices. It was written in a simple Arabic language.

The following steps were followed to develop the program:

1. **Stating the program general and specific objectives.**

General objective of the program

The overall objective of the developed program was to evaluate the effect of an educational instruction program regarding the care of patients with meningitis on nurses' performance at critical care units and general medical departments at Helwan Fever Hospital .

Specific objective of the program: by the end of the program; studied nurses were able **to (1) knowledge and understanding skills (a)** Identify composition of central nervous system and of peripheral nervous system, layers meninges and function of the brain, **(b)** Define acute, chronic meningitis, and non-infectious meningitis, **(c)** list causes and types of infectious and non-infectious meningitis, **(d)** Enumerate the hallmark symptoms of bacterial, fungal, and viral types of meningitis, in addition to non-infectious meningitis, **(e)** List the side effects of a meningitis vaccine and the disappearance time of side effects, **(f)** Enumerate the method of transmission of meningitis through the body, **(g)** Indications and contraindications of lumbar puncture, **(h)** Summarize the treatment of meningitis, **(i)** Discuss initially the diet, method of food cooking, avoided food in the recovery phase, **(j)** Recognize universal precautions with acute meningitis patient **(k)** List most common complications**. Intellectual skills: (a)** Design a nursing care plan for managing hyperthermia, acute pain, and disturbed sensory perception **(a)** Demonstrate the lumber puncture procedure & precautions. **General and transferable skills**: **(a)** Communicate effectively with teamwork **(b)** Protect patient rights.

2. **Planning the program:** the content of the program was arranged into theoretical and practical part including five teaching sessions in addition to preliminary one.

A. **Theoretical part included:**
 ▪ **Knowledge regarding to anatomy and function of nervous system** such as composition of central nervous system, composition of peripheral nervous system**,** composition of layers meninges and function of the brain.
 ▪ **Knowledge regarding definitions, causes, types, and clinical manifestations** such as those related to defining acute meningitis, chronic meningitis, non-infectious meningitis, severity of meningitis, causes of infectious meningitis and non-infectious

meningitis, type of meningitis, seasonal timing of viral meningitis, the hallmark symptoms of bacterial meningitis, the most common bacterial types, the most common fungal types, the most common viral types, non-infectious meningitis**,** onset of bacterial meningitis, and early warning sign.

- **Knowledge regarding vaccination,** such as the side effects of a meningitis vaccine**,** the disappearance time of side effects**,** several types of vaccines, and people at risk of meningococcal disease.

- **Knowledge regarding modes of transmission and diagnosis,** such as the methods of transmission of meningitis through the body, the method of transmission of viral and bacterial meningitis, contagious types of meningitis, the incubation period.**,** labs, the contraindication of lumbar puncture, and the main diagnostic tool in defining bacterial meningitis.

- **Knowledge regarding management such as** medical treatment related to (treatment of chronic meningitis, bacterial meningitis, viral meningitis), diet related to composition of healthy diet, water intake, initially the diet of the patient, method of food cooking, avoided food in the recovery phase, recommended food in the recovery phase, citrus Juices) and nursing management related to (managing the following nursing diagnosis as ineffective tissue perfusion, hyperthermia, and acute pain).

- **Complications** such as most common complications, off balance effect and blotch skin effect, hemodynamic effect, a stiff neck, light sensitivity effect.

B. Practical part: It included nursing role pre, during and after lumber puncture procedure.

3. **Learning environment:** the program was conducted in nurse's room related to the critical care units and general medical departments at Helwan Fever Hospital.

4. **Teaching methods:** different teaching and learning strategies were used, including lectures and discussions using audiovisual aids such as a PowerPoint presentation and a booklet. Moreover, videos and posters about acute meningitis and the lumber puncture procedure were used for illustration.

5. **Arranging the subgroup:** The total sample was divided into ten subgroups, with five nurses in each session for better understanding.

Phase III: Implementation phase

During this phase the program was implemented for the ten subgroups of the nurses, all groups were exposed to five sessions every session took 45 minutes ,10 minutes for revision, 30 for discussion and 5 minutes for summary. In addition to the preliminary session. Preliminary session: in this session the researchers met the participants and explained the objective, content and method of program evaluation. **Theoretical part** contained **Session (1)** included: knowledge regarding to anatomy and function of nervous system, definitions, causes, types and clinical manifestations and people at risk. **Session (2)** included: knowledge regarding to vaccination, mode of transmission, diagnosis and complications **Session (3)** included medical treatment, and nursing management. **Practical part contained Session (4)** included: nursing role pre, during and post lumber puncture procedure. **Session (5)** included re-demonstration the same nursing role pre, during and post lumber puncture procedure and summarizing all knowledge sessions. Group discussion was encouraged with continuous feedback to ensure understanding and achievement of the stated objective of the program. An open channel of communication was established between the researchers and studied nurses to answer any question and reinforce the gained information and correct action. In the last session the researchers summarized and emphasized the important point.

Phase IV: Evaluation phase

The evaluation of educational instruction program was carried out immediately after the end of the

program using the pre-posttest; **tool two** (Knowledge assessment interview questionnaire) and **tool three** (Lumber puncture observation checklist) and after 3 months for follow-up in order to test the effectiveness of the educational instruction program on nurse's knowledge and practices.

Administrative design

Prior conducting the study, the necessary official approvals were obtained from the director of Helwan Fever Hospital and heads of medical departments and critical care units, official letters were issued to them from the Faculty of Nursing , Helwan University explaining the aim of the study.

Statistical design

- Data entry and analysis were performed using SPSS statistical package version 25. Categorical variables were expressed as number and percentage while continuous variables were expressed as (mean ±SD). Chi-Square (x2) was used to test the association between row and column variable of qualitative data.
- ANOVA test was used to compare mean in normally distributed quantitative variables in more than two groups. Pearson correlation was done to measure correlation between quantitative variables.
- For all tests, a two-tailed p-value ≤ 0.05 was considered statistically significant, P-value ≤ 0.01 was considered highly statistically significant. While p-value> 0.05 was considered not significant.
- Eta square (η2) is used to measure the effect size. The referential framework for identifying the effect size. As when Eta-square value = 0.01 to < 0.06, the effect is considered weak, when it = 0.06 to < 0.14, the effect is considered medium and when it ≥ 0.14 the effect is large.

Results:

Table (1): shows that 48% of studied nurses' age was ranged between ≥ 20 ≤ 30 years old, with a mean age of **32.34 ± 7.60**. Considering gender, **(96%)** of them were female, with a male to female ratio is **24:1**. Furthermore, 72% were married, 42%

held technical certificates, 52% of studied nurses had ≥ 10 years of experience in the field of nursing and 52% had worked in an ICU and 86% had not attended training courses.

Table (2): Regarding to level of knowledge, there was a highly statistically significant difference between total mean score of knowledge regarding care of patients with meningitis during pre /post and 3 months follow up after implementation of educational instruction program (p-value = 0.000).

Figure (1): Illustrates that, during the post-test phase, the studied nurses gained a satisfactory level of knowledge (92%) followed by the phase of follow-up test (90%) as compared with the phase of pre-test (34%). In addition to presence of difference between observed and expected values with a significant statistical difference at χ2=53.7, P=0.000.

Table (3): Regarding to total level of practices in relation to pre-care phase, it denotes that, during the post-test phase, the studied nurses gained a competent level (98%) followed by the phase of follow-up test (94%) as compared with the phase of pre-test (32%). Moreover, there was a highly statistically significant difference between total mean score of practices regarding lumbar puncture in relation to pre-care phase during pre, post & three months follow up among the studied nurses at P = 0.000.

Table (4): Reveals that, during the post-test phase, the studied nurses gained a competent level of practices (96%) followed by the phase of follow-up test (94%) as compared with the phase of pre-test (34%). Moreover, there was a highly statistically significant difference between total mean score of practices regarding lumbar puncture in relation to ongoing-care phase during pre, post & three months follow up among the studied nurses at P = 0.000.

Table (5): Regarding to total practices during the post-test phase, it shows that the studied nurses gained a competent level of practice (96%) followed by the phase of follow-up test (94%) as compared

with the phase of pre-test (32%). Moreover, there was a highly statistically significant difference between total mean score of practices regarding lumbar puncture procedure in relation to post-care phase during pre, post & three months follow up among the studied nurses at P = 0.000.

Figure (2): Displays that, during the post-test phase, the studied nurses gained a competent level of practices (96%) followed by the phase of follow-up test (94%) as compared with the phase of pre-test (32%). In addition to presence of difference between observed and expected values with a significant statistical difference at $\chi 2=68.8$, P=0.000.

Table (6): Reveals that educational instruction program regarding care of patients with meningitis had positive large effect size on total knowledge and practices regarding lumber puncture procedure during pre, post & three months follow up among the studied nurses at $\eta 2= 0.478$, & 0.547 respectively. Therefore, this provides enough evidence to support research hypothesis.

Table (7): Shows that there was a highly statistically significant difference between personal characteristics (age, gender, marital status, qualification, experience & working department) and the cumulative total of knowledge regarding care of patients with meningitis among the studied nurses, at P = ≤ 0.01.

Table (8): Clarifies that there was a highly statistically significant difference between personal characteristics (age, gender, marital status, qualification & working department) and the cumulative total of practices regarding care of patients with meningitis among the studied nurses, at P = ≤ 0.01.

Figure (3): Represents that, there was a highly statistically significant positive correlation between of total knowledge and practices regarding care of patients with meningitis during pre, post & three months follow up among the studied nurses at (r= 0.926 and P= 0.000).

**Table (1): Frequency distribution of the personal characteristics among the studied nurses (n=50)**

Items		No.	%
Age (year)	$\geq 20 \leq 30$	24	48.0
	$\geq 31 \leq 40$	18	36.0
	$\geq 41 \leq 50$	8	16.0
	Mean± SD	**± 7.60**	**٣٢,٣٤**
Gender	Male	48	96.0
	Female	2	4.0
	Male to female ratio	**24:1**	
Marital status	**Single**	**14**	**28.0**
	Married	**36**	**72.0**
	Male to female ratio	**0.4:1**	
Educational level	Bachelor	12	24.0
	Technical nursing institute	21	42.0
	Diploma nurse	17	34.0
Years of experience in the field of nursing	< 5	11	22.0
	5 < 10	13	26.0
	≥ 10	26	52.0
	Mean± SD	**10.0 ± 4.28**	
Working department	ICU	26	52.0
	General medical departments	24	48.0
Attended training courses	Yes	7	14.0
	No	43	86.0

Table (2): Comparison between level of knowledge regarding care of patients with meningitis during pre, post & three months follow up among the studied nurses (n=50)

Items	Pre				Post				3 months follow up				F-test	P-Value
	Satisfactory		Un-satisfactory		Satisfactory		Un-satisfactory		Satisfactory		Un-satisfactory			
	F	%	F	%	F	%	F	%	F	%	F	%		
▪ Anatomy and function of nervous system	7	14.0	43	86.0	43	86.0	7	14.0	41	82.0	9	18.0	63.0	0.000**
▪ Definitions	19	38.0	31	62.0	48	96.0	2	4.0	47	94.0	3	6.0	42.3	0.000**
▪ Causes &types	17	34.0	33	66.0	47	94.0	3	6.0	46	92.0	4	8.0	40.3	0.000**
▪ Clinical manifestations	20	40.0	30	60.0	49	98.0	1	2.0	48	96.0	2	4.0	48.3	0.000**
▪ Mode of transmissions	19	38.0	31	62.0	47	94.0	3	6.0	46	92.0	4	8.0	34.1	0.000**
▪ Diagnosis	27	54.0	23	46.0	49	98.0	1	2.0	49	98.0	1	2.0	27.5	0.000**
▪ General management	17	34.0	33	66.0	47	94.0	3	6.0	46	92.0	4	8.0	47.6	0.000**
▪ Treatment	24	48.0	26	52.0	48	96.0	2	4.0	47	94.0	3	6.0	46.9	0.000**
▪ Nutrition	13	26.0	37	74.0	47	94.0	3	6.0	45	90.0	5	10.0	66.6	0.000**
▪ Vaccination	13	26.0	37	74.0	46	92.0	4	8.0	45	90.0	5	10.0	66.1	0.000**
▪ Complications	14	28.0	36	72.0	48	96.0	2	4.0	47	94.0	3	6.0	77.2	0.000**
▪ Nursing management	5	10.0	45	90.0	46	92.0	4	8.0	45	90.0	5	10.0	112	0.000**
▪ Total	**17**	**34.0**	**33**	**66.0**	**46**	**92.0**	**4**	**8.0**	45	90.0	5	10.0	67.2	**0.000****

*Significant p ≤ 0.05   **Highly significant p ≤ 0.01   F: ANOVA Test

Figure (1): Comparison between total level of knowledge regarding care of patients with meningitis during pre, post & three months follow up among the studied nurses
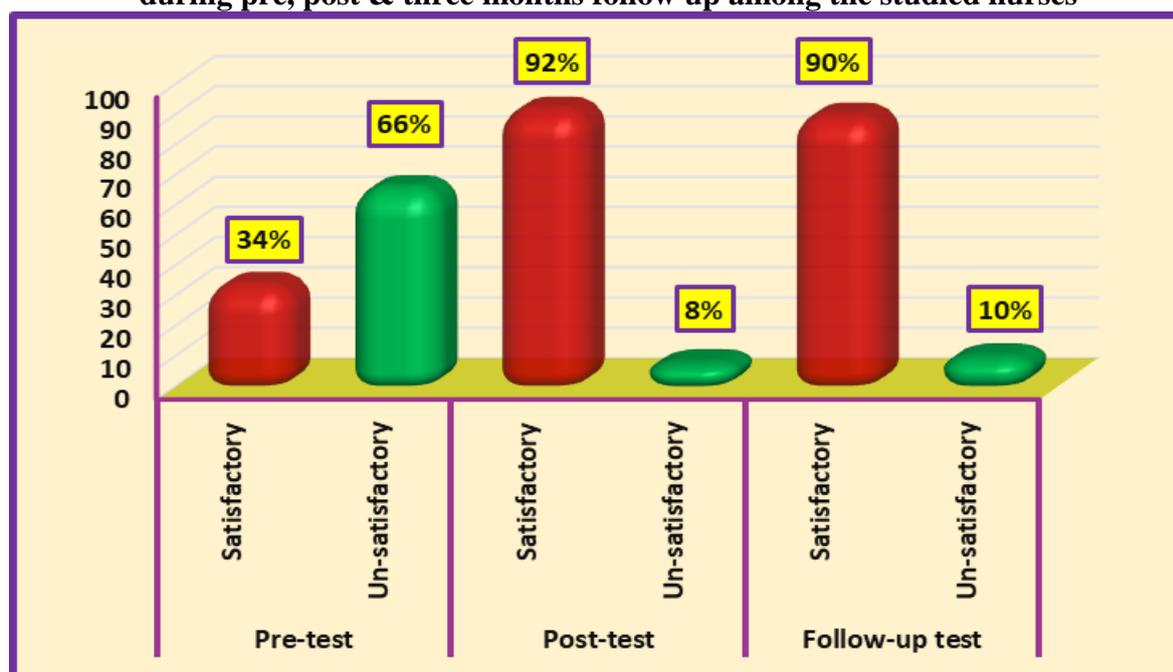
$\chi2=53. 7, P=0.000$

Table (3): Comparison between level of practices regarding lumbar puncture procedure in relation to pre-care phase during pre, post & three months follow up among the studied nurses (n=50)

Pre procedure phase	Pre- test				Post- test				3 months follow up				F test	P value
	Competent		Incompetent		Competent		Incompetent		Competent		Incompetent			
	N	%	N	%	N	%	N	%	N	%	N	%		
Pre procedure														
▪ Explain the procedure	5	10.0	45.0	90.0	47	94.0	3	6.0	45	90.0	5	10.0	139	0.000**
▪ Hand washing	12	24.0	38	76.0	48	96.0	2	4.0	47	94.0	3	6.0	89.1	0.000**
▪ Maintain the privacy	45	90.0	5	10.0	50	100.0	0	0.0	48	96.0	2	4.0	2.9	0.058*
▪ prepare the equipment	16	32.0	34	68.0	49	98.0	1	2.0	47	94.0	3	6.0	68.5	0.000**
Total	**16**	**32.0**	**34**	**68.0**	**49**	**98.0**	**1**	**2.0**	**47**	**94.0**	**3**	**6.0**	**104**	**0.000****

NS: > 0.05   *Significant p ≤ 0.05   **Highly significant p ≤ 0.01   F: ANOVA Test

Table (4): Comparison between level of practices regarding lumbar puncture procedure in relation to ongoing-care phase during pre, post & three months follow up among the studied nurses (n=50)

Ongoing-care phase	Pre- test				Post- test				3 months follow up				F test	P value
	Competent		Incompetent		competent		Incompetent		Competent		Incompetent			
	N	%	N	%	N	%	N	%	N	%	N	%		
During procedure														
▪ Put the patient in suitable position on one side at the edge of the bed with the thigh and legs are flexed.	12	24.0	38	76.0	48	96.0	2	4.0	47	94.0	3	6.0	89.1	0.000**
▪ The nurse assists the patient to maintain the position.	7	14.0	43	86.0	47	94.0	3	6.0	45	90.0	5	10.0	111	0.000**
▪ Encourage the patient to relax	16	32.0	34	68.0	50	100.0	0	0.0	48	96.0	2	4.0	83.6	0.000**
▪ Cleaning the site	19	38.0	31	62.0	48	96.0	2	4.0	47	94.0	3	6.0	48.2	0.000**
▪ Injection the local anesthetic agent and then insert needle to subarachnoid space.	46	92.0	4	8.0	49	98.0	1	2.0	48	96.0	2	4.0	1.0	0.355
▪ Specimen of CSF is collected in test tube then dressing.	17	34.0	33	66.0	48	96.0	2	4.0	47	94.0	3	6.0	57.1	0.000**
Total	**17**	**34.0**	**33**	**66.0**	**48**	**96.0**	**2**	**4.0**	**47**	**94.0**	**3**	**6.0**	**83.7**	**0.000****

NS: > 0.05   *Significant p ≤ 0.05   **Highly significant p ≤ 0.01   F: ANOVA Test

Table (5): Comparison between level of practices regarding lumbar puncture procedure in relation to post-care phase during pre, post & three months follow up among the studied nurses (n=50)

| Post-care phase	Pre- test				Post- test				3 months follow up				F test	P value
	Competent		Incompetent		competent		Incompetent		competent		Incompetent			
	N	%	N	%	N	%	N	%	N	%	N	%		
Post procedure														
▪ Instruct the patient to lie in prone position to reduce leak of CSF and observe any complication if occurred	12	24.0	38	76.0	48	96.0	2	4.0	46	92.0	4	8.0	81.7	0.000**
▪ Encourage increased fluid intake prevent post procedure headache	16	32.0	34	68.0	48	96.0	2	4.0	47	94.0	3	6.0	62.3	0.000**
▪ Post care measures	17	34.0	33	66.0	49	98.0	1	2.0	47	94.0	3	6.0	62.8	0.000**
Total	**16**	**32.0**	**34**	**68.0**	**48**	**96.0**	**2**	**4.0**	**47**	**94.0**	**3**	**6.0**	**75.8**	**0.000****

NS: > 0.05   *Significant p ≤ 0.05   **Highly significant p ≤ 0.01   F: ANOVA Test

Figure (2): Percentage distribution of total level of practices regarding lumber puncture procedure during pre, post & three months follow up among the studied nurses (n=50)
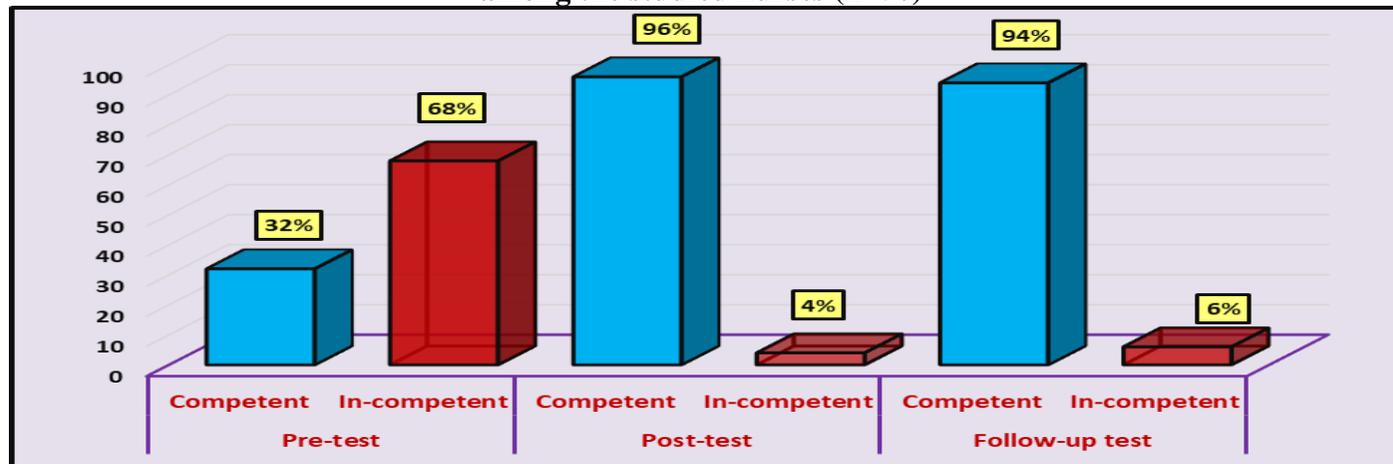
χ2=68.8, P=0.000

Table (6): Effect size and η2 of educational instruction program regarding care of patients with meningitis on total knowledge and practices during pre, post & three months follow up among the studied nurses (n=50)

Variables	Interval	Mean	SD	Range	F Test	P value	η	η2	Effect size
Total Knowledge	Pre-test	78.30	23.9	59-121	67.2	0.000***	0.691	0.478 ***	Large effect
	Post-test	115.2	13.6	59-121					
	Follow up	114.4	15.3	59-121					
	Total	102.67	25.01	59-121					
Total Practice	Pre-test	17.80	4.49	13-26	88.8	0.000***	0.740	0.547 ***	Large effect
	Post-test	25.58	1.91	15-26					
	Follow up	25.18	2.91	13-26					
	Total	22.85	4.85	13-26					

*Significant p ≤ 0.05   **Highly significant p ≤ 0.01   F: ANOVA Test

*Small effect size (.01)   **Medium effect size (.06)   ***Large effect size (.14)

Table (7): Relation between personal characteristics and cumulative total of knowledge regarding care of patients with meningitis among the studied nurses (n=50)

Personal Characteristics		Total knowledge $\overline{x} \pm SD$	Test	P-Value
Age (year)	▪ ≥ 20 ≤ 30 years old	302.1 ± 9.23	F= 137.3	0.000**
	▪ ≥ 31 ≤ 40 years old	349.8 ± 12.5		
	▪ ≥ 41 ≤ 50 years old	231.3 ± 35.6		
Gender	▪ Male	313.1 ± 35.9	T=5.02	0.000**
	▪ Female	184.0 ± 9.89		
Marital status	▪ Single	332.7 ± 63.2	T=2.6	0.011**
	▪ Married	298.3 ± 28.7		
Qualifications	▪ Bachelor	263.2 ± 35.0	F= 22.9	0.000**
	▪ Technical institute	308.0 ± 9.1		
	▪ Diploma nurse	342.1 ± 43.7		
Years of experience	▪ < 5	274.2 ± 23.9	F= 6.58	0.003**
	▪ 5 < 10	302.6 ± 2.78		
	▪ ≥ 10	324.9 ± 51.6		
Working department	▪ ICU	324.5 ± 51.7	T=3.0	0.004**
	▪ General medical ward	290.1 ± 21.9		
Attending training courses	▪ Yes	335.4 ± 69.8	T=1.84	0.072**
	▪ No	303.5 ± 36.9		

*Significant p ≤ 0.05   **Highly significant p ≤ 0.01

Table (8): Relation between personal characteristics and cumulative total of practices regarding care of patients with meningitis among studied nurses (n=50)

Personal Characteristics		Total practice $\overline{x} \pm$ SD	Test	P-Value
Age (year)	▪ $\geq 20 \leq 30$ years old	67.0 ± 0.204	F= 862.6	0.000^{**}
	▪ $\geq 31 \leq 40$ years old	75.0 ± 2.84		
	▪ $\geq 41 \leq 50$ years old	58.1 ± 10.7		
Gender	▪ Male	69.6 ± 5.17	T=5.0	0.000^{**}
	▪ Female	42.5 ± 2.12		
Marital status	▪ Single	72.0 ± 12.5	T=2.6	0.011^{**}
	▪ Married	67.1 ± 3.31		
Qualifications	▪ Bachelor	63.5 ± 7.1	F= 11.0	0.000^{**}
	▪ Technical institute	67.2 ± 0.71		
	▪ Diploma nurse	73.9 ± 8.7		
Years of experience	▪ < 5	66.27 ± 1.67	F= 1.57	0.217
	▪ $5 < 10$	67.00 ± 2.00		
	▪ ≥ 10	70.31 ± 9.96		
Working department	▪ ICU	70.3 ± 9.96	T=3.0	0.004^{**}
	▪ General medical ward	66.6 ± 1.16		
Attending training courses	▪ Yes	72.5 ± 13.9	T=1.84	0.072
	▪ No	67.9 ± 5.74		

*Significant $p \leq 0.05$ **Highly significant $p \leq 0.01$

Figure (3): Scatter dot correlation between of total knowledge and practices regarding care of patients with meningitis during pre, post & three months follow up among the studied nurses (n=50)
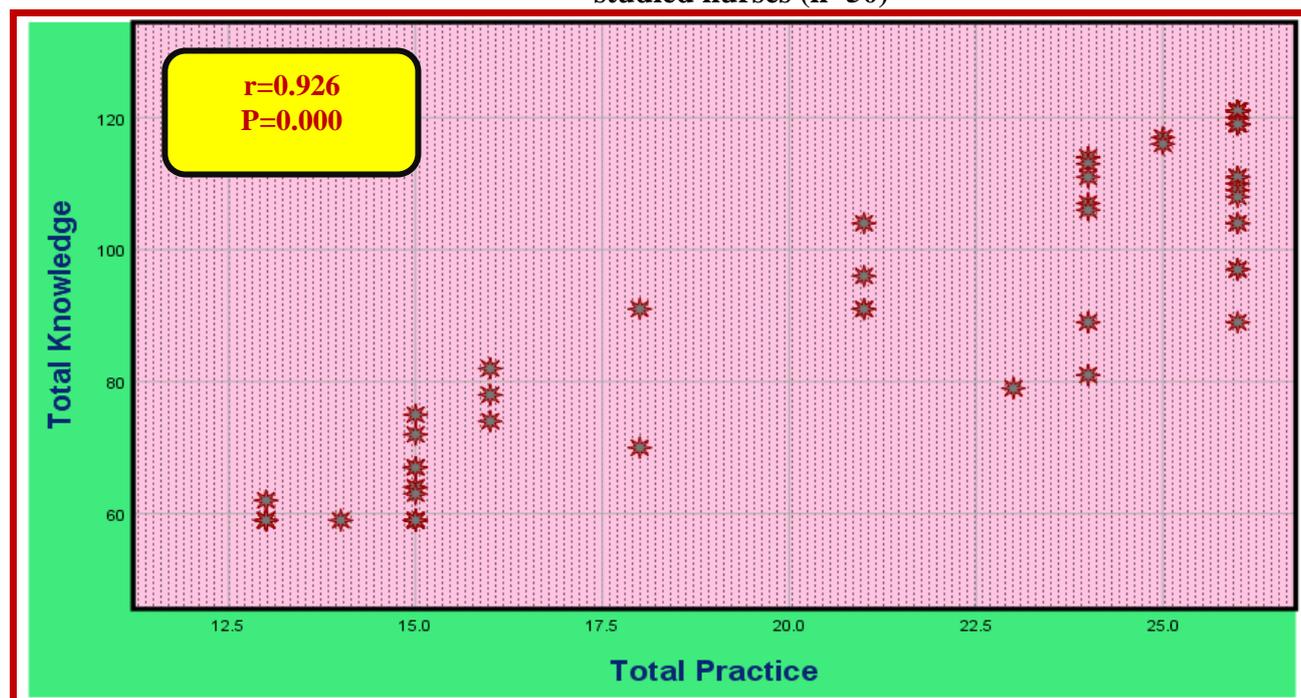
Discussion

Meningitis is a disease whose morbi-mortality remains high, especially in third world countries. Because the nursing team are the frontline of care, nurses are the first group of professionals to contact patients with meningitis. The nurse develops a relevant contribution to the immediate recognition of signs and symptoms and in the quick accomplishment of appropriate interventions (**Moura et al., 2020).**

Part I: Personal characteristics of studied nurses.

The results of the current study revealed that nearly half of the studied nurses were between 20 and 30 years old, with a mean age of 32.34 ± 7.60. The majority of them were female, and more than two-thirds were married. Moreover, more than two fifths of the studied nurses had graduated from a technical nursing institute, slightly more than half had experience in the field of nursing more than 10 years, and the majority of them didn't attend any training courses.

This result was consistent with **Jissir and Hassan (2019)** whose study entitled "Effectiveness of an educational program on nurses' knowledge about nosocomial infection" and reported that more than half of participants were females, two fifth of them at age 20-29 years old, also more than one third was graduated from nursing institute, and more than half of them working from 1-9 year of experiences. In the same context **Abdelmowla et al., (2017)** in the study of **"** Lumbar puncture: nurses' knowledge, practice and patients' satisfaction with nursing care" revealed that the majority of sample were females and having more than 10 years of experience while the same study showed that majority of nurses were aged from 25 to 45 years.

Additionally, this result was congruent with **Mohammed et al., (2019):** who studied "Effect of teaching program regarding care for acute meningitis on nurses' performance at emergency unit" and showed that the more than two fifth of the nurses were graduated from the nursing

technical institute and more than half were married. Similarly, the current study come in the line with **(Elnageeb, 2018)** who studied " Assessment of nurse's knowledge regarding care of child with meningitis in Soba university hospital (2017 – 2018)" and reported that most of the studied sample had more than 3 years of experience and the majority of the studied sample were female. while the current study contraindicated with the same author in reporting that the majority had bachelor's degree. According to researchers' opinion; differences in results between studies could be due to differences of tools used for data collection and sitting at which the study was conducted.

Part II: Effect of educational instruction program on studied nurses' level of knowledge regarding care of patients with meningitis.

Regarding the total knowledge about care of patients with meningitis, the present study results showed that one third of studied nurses had satisfactory level of knowledge about meningitis pre-educational instruction program while most of studied nurses had satisfactory level of knowledge post and three months follow up educational instruction program. This could be due to lack of appropriate courses in the curricula of institutions and improvement could be due to effectiveness of the program.

The study results were supported by **Hussien et al, (2021)** who conducted a study at Minia Fever Hospital entitled "Effective of educational instruction of nurses knowledge regarding meningitis and universal precaution measures at selected department" and reported that, the most of study subjects had unsatisfactory level of knowledge about meningitis and less than fifth had a satisfactory level of knowledge preprogram implementation which improved to two thirds post program.

Likewise, **Kafl and Bayoumi, (2019**) in a study entitled " Nurses' performance towards care of neonatal meningitis: effect of an educational program " supported the previous finding as they mentioned that most of the studied

sample had poor knowledge about meningitis during their assessment which increased post educational program. Also, this result come in accordance with (**Oladele et al., 2020**) who studied "Tackling cryptococcal meningitis in Nigeria, one-step at a time; the impact of training" and reported that most of the studied sample had poor knowledge regarding meningitis before training program with a statistically significance difference between pre and post program.

The results of the current study revealed that there was a highly statistically significant difference between total mean score of knowledge regarding care of patients with meningitis during pre, post & three months follow up among the studied nurses. These results supported the research hypothesis (**H1**) which stated that; there will be a statistically significant difference between pre, post and follow-up nurses' knowledge after the educational instruction program. These results were in accordance with **Mohammed, et al., (2019)** who showed that total mean score of nurse's knowledge pre and post teaching program had significance difference about acute meningitis with P. value (< 0.001). From researcher' perspective, it could be interpreted as the provision of knowledge at educational instruction was in a simple way. Also, the use of suitable media for clarification, and the guidance offered during application of the program enhanced the process of learning. Thus, this improvement points to the effectiveness of the educational instruction program on nurses' acquisition of knowledge.

Part III: Effect of educational instruction program on studied nurses' level of practices regarding care of patients with meningitis.

Concerning level of studied nurses' practices regarding pre, during and post lumber puncture procedure; the present study results clarified that most of studied nurses gained a competent level post program implementation followed by the phase of follow-up test while only one third had competent level pre- program implementation. According to researchers' point

of view, this could ensure the success of the educational instruction program on the improvement of nurses' practices level which included continuous demonstration, re-demonstration, follow up and effective practical content in teaching & learning materials (booklet and videos), which was given to the studied nurses with continuous explanations, reinforcement and feedback.

These results were in accordance with **Jissir & Hassan (2019)** who observed that after implementing the programs, nurses' skills improved statistically when compared to pre-test. Similarly, **Abdelmowla et al.,** stated that majority of nurses had adequate level of practice post application of the nursing instructions brochure.

Moreover, there was a highly statistically significant difference between total mean score of practices regarding lumber puncture procedure during pre, post & three months follow up among the studied nurses. These results proved research hypothesis (**H1**) which stated that; there will be a statistically significant difference between pre, post and follow-up nurses' practices after the educational instruction program. These findings, were consistent with those of **Rahimi et al., (2018)** who 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 as compared with pre implementation.

The results of the present study clarified that educational instruction program had positive large effect size on total knowledge regarding care of patients with meningitis and total practices regarding lumber puncture procedure during pre, post & three months follow up among the studied nurses. This finding was consistent with the recent study by **Hamad et al., (2022)** about "Effect of instructional module on nursing pitfalls related to the management of children having lumbar puncture" who mentioned that nurses who

received the nursing intervention had higher level of knowledge about meningitis and lumbar puncture on post and follow up test than pretest.

In addition, this finding was in agreement with **Temsah et al., (2021),** in a study entitled " Effect of lumbar puncture educational video on parental knowledge and self-reported intended practice" and found a statistically significant difference in post-educational knowledge and self-reported intended practice. From researcher' point of view, 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. These results support the research hypothesis (**H2**).

Part IV: Relation / correlation between personal characteristics and studied nurses total knowledge and practices.

By studying the relation between total nurses' knowledge and practices and their personal characteristics, it was found that, there was a highly statistically significant difference between personal characteristics (age, gender, marital status, qualification, experience & working department) and the cumulative total of knowledge regarding care of patients with meningitis. These findings were compatible with **(Hussien et al., 2021)** who stated that there were highly statistically significant differences in knowledge and years of experiences. This may be related to that the nurse who had more years of experience was learn more skills and knowledge than those who had less years of experience.

Additionally, **Kafl, Bayoumi (2019)** illustrated a significant relationship between studied nurses' demographic characteristics (age, qualifications, years of experience & previous training about infection prevention) 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),** who reported that, there was a statistically significant relation between studied nurses' demographic characteristics and both their knowledge and practices levels regarding care of neonatal meningitis pre and post implementing the educational program.

In addition, these findings supported by **Hattab, Kadhim, and Abdulwahhab, (2021)** whose study entitled "Impact of years' experience upon nurses' knowledge and practice concerning infection control at Critical Care Units in Baghdad City" and mentioned that there was significant relationship between nurses' knowledge and their level of education, years of experience. While this result inconsistent with **(Elnageeb, 2018)** who stated that there was negative relation between years of experience and knowledge of nurses about nursing care.

On the light of the present study results, the findings revealed that, there was a high statistically significant positive correlation between total knowledge and practices regarding care of patients with meningitis during pre, post & three months follow up among the studied nurses at (r= 0.926 and P= 0.000). These results were similar to the study results of **(Feroze et al. 2017)** who found a positive relation between nurses' knowledge and practices.

In addition, the previous results were in accordance with **Abdelmowla et al., (2017)** who reported positive correlation between nurse knowledge and practice. This could be due to high level of nurses' knowledge reflected on their practices; knowledgeable nurses provide more accurate care. These results support the research research hypothesis (**H3**) which stated that there will be a positive correlation between nurse's knowledge and practices after implementation of educational instruction program.

Conclusion

Based on the study results, it is concluded that there was a highly statistically significant difference between total mean score of knowledge as well as practices during pre, post & three months follow up among the studied nurses. Additionally, there was a large effect size of an educational instruction program on nurses' knowledge and practices pre, post and follow-up after the educational instruction program. Moreover, there was a high statistically significant positive correlation between of total knowledge and practices regarding care of patients with meningitis among the studied nurses.

Recommendations

1. Educational guidelines, posters and pamphlets about meningitis should be available at each nursing stations in wards and encourage nurses to get use from them.
2. Periodical on-job training programs for nurses regarding management of meningitis.
3. Workshops and seminars should be organized to raise awareness of nurses regarding prevention and control of meningitis.
4. Further studies with larger number of nurses and different setting concerning management of meningitis is required for generalization of the study findings.

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