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Effect of Instructional Module on Nursing Pitfalls Related To the Management of Children Having Lumbar Puncture

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Abstract: Meningitis could be fatal or a cause serious of long-lasting side effects. It is imperative that pediatric nurses have the knowledge and training related to lumbar puncture to ensure a positive experience for children. **Aim:** To assess effect of instructional module on nursing pitfalls related to the management of children having lumbar puncture. **Design**: A quasi-experimental design. This study was conducted at Shebin El-Kom Fever Hospital. A convenient sample of seventy nurses working at the previously mentioned setting and all hospitalized children with meningitis who had lumbar puncture procedures. **Instruments: Instrument one:** knowledge about meningitis, lumbar puncture, and its nursing care for children structured interviewing questionnaire. **Instrument two**: Nurses practices observational checklist **Results**, Nurses had higher level of knowledge on posttest (30.41 ± 2.32), and follow-up (22.32 ±5.79.) than pretest (10.50 ±2.83.).Also, they had fewer nursing pitfalls related to lumbar puncture on posttest (0.33 ± 0.50), follow-up test (2.93 ±1.57) than pretest (4.29 ±0.85). **Conclusion**: It was concluded that nurses who received instructional module had higher level of knowledge as well as nursing practices regarding lumbar puncture for children with meningitis on post –test than pre- test. Also, they had fewer nursing pitfalls related to lumbar puncture procedure on posttest rather than on the pre& follow-up tests. **Recommendations**: A continuous on- service training program for nurses regarding the management of meningitis in children is required.

Keywords*: Instructional module, Meningitis, Lumbar Puncture, Nursing pitfalls*

Introduction

Meningitis is a serious health problem caused by a variety of pathogenic organisms (viral, bacterial, or fungal infection). It affects the central nervous system (CVS). The infection may spread through the bloodstream or through the ears, nasopharynx, cranial injury, or congenital meningeal abnormalities (Afzal et al., 2019). Morbidity is present in more than 5% of pediatric cases (Swanson, 2020).

Meningitis is associated with significant morbidity and mortality, particularly in children, whose morbidity and mortality remain high. More than 1.2 million cases of bacterial meningitis are expected to occur each year around the world.

Meningitis is common in newborns and can result in a variety of acute and severe problems as well as long-term impairments. Early detection of meningitis in children is critical for lowering mortality and improving outcomes (George et al., 2018).

A diagnostic sample of cerebrospinal fluid is obtained via lumbar puncture, which is a well-established clinical practice (CSF). Clinical experience and touch of the patient's spinal anatomy are required to advance a thin, flexible needle into the spinal canal through narrow spaces between lumbar bony structures without seeing the location of the needle tip or its direction while interpreting the tactile feedback from penetrated tissues. It's frequently used to get information about the cerebrospinal fluid. It is most commonly used to rule out illnesses including benign intracranial hypertension, subarachnoid hemorrhage, bacterial meningitis, and multiple sclerosis. To acquire indirect measurements of intracranial pressure, lumbar puncture is required (Sievänen et al., 2021).

Pediatric nurses are important part of children's care and are in charge of detecting early signs and symptoms of infection. Nurses play a critical role in the prevention and treatment of meningitis by observing, diagnosing, and employing infection control techniques. They should be trained in the control and management of meningitis through regular training programs to strengthen their knowledge and practical abilities. Kafal & Bayoumi (2019).

monitoring and documenting vital signs, measuring the Glasgow Coma Scale and paying specific attention to the motor response, notifying the on-call doctor if it falls, assessing the child's mental health, and providing psychosocial assistance if the child is conscious. For venous drainage from the brain, raise the head of the bed to 30 degrees with a straight neck. Ensure that the youngster gets access to fluids and drugs via an IV line. Antibiotics should be taken as directed.

Although lumbar puncture (spinal tap) is generally considered safe, there are certain hazards associated with it. These are some of them: Headache caused by lumbar puncture A lumbar puncture can cause a headache in up to a quarter of children. Back discomfort or soreness following surgery It's possible that the pain will travel down the back of the child’s legs. Bleeding might happen near the puncture site or in the epidural area on rare occasions (Mayo Clinic, 2022).

Nursing pitfalls are not exclusive to medication error, and they do not always involve prescription problems. Most nursing errors are caused by issues connected to the healthcare system, primarily management and environmental factors. Nurses should be encouraged to report not only significant but also near misses and innocuous errors, and a culture of safe error reporting should be promoted. Nursing pitfalls should be thoroughly investigated to determine the underlying reasons so that effective error-prevention techniques may be developed (Eltaybani et al., 2018).

Nurses are more likely to report pitfalls when they feel safe, yet there is a need for an internationally recognized language to identify and analyze nursing pitfalls. Improving the health-care system, particularly the administrative and environmental components, may minimize the incidence and severity of nursing pitfalls (Eltaybani et al., 2018).

Significance of the Study:

Every year, one to two million cases of bacterial meningitis are predicted to occur worldwide, resulting in 180,000

fatalities in children aged one to 59 months by 2020. Meningitis is a serious pediatric nursing issue that requires prompt diagnosis, prevention, and management (UNICEF, 2020). The number of children who died in Egypt in 2017 reached 119. The number of infected children under the age of fifteen years with meningitis in 2019 has reached 184. As a result of lumbar puncture (LP), considerable morbidity and mortality rates may occur (Ministry of Health, 2019).

Operational Definitions

Instructional module: It defined as the method used by investigator to provide or design instructional activities that guide the study nurses in independently achieving the objectives of study. It define as instructional activities that allows nurses up to date knowledge and skills for effectively performance of lumbar puncture procedure through apply module about definition, clinical manifestation, causes, lumbar puncture and nursing intervention.

Nursing pitfalls: It defined as an action which is inaccurate or incorrect. Or an unsuspected difficulty, problem , or error that nurses may fall into in lumbar puncture procedure to cause patient harm and that the harm was likely to be negligible or minor for children with meningitis. Determining errors enable investigator to identify weak points on nurses performance during procedure for increase nurses s' procedural competence.

Aim

The aim of this study was to:

To assess effect of instructional module on nursing pitfalls related to the management of children having lumbar puncture.

Research Hypotheses:

1) Nurses who receive the instructional module will have a higher level of knowledge as well as nursing practices regarding lumbar puncture for children with meningitis on post-test than on pre-test.

2) Nurses who receive the instructional module will have fewer nursing pitfalls related to lumbar puncture on post-test than on pre-test.

Methods

This section describes research design, setting, sampling technique, data collection instruments, data collection procedure, pilot study, and data analysis.

Research Design:

A quasi-experimental (pre/posttest) research design was utilized.

Research Setting:

This study was conducted at Shebin El-Kom Fever Hospital in Menoufia Governorate in Egypt.

Sample:-

- A convenient sample of seventy nurses employed at the previously mentioned setting.
- All hospitalized children with meningitis who had lumbar puncture procedure throughout the period of data collection were included in the study

Data collection instruments:

Two instruments were used to collect data in order to meet the study's goal.

- **Instrument one:** A structured interviewing questionnaire was developed by the researcher to evaluate nurses' knowledge of meningitis, lumbar puncture, and nursing care for children with meningitis during lumbar puncture. It is divided into two parts, as follows:
  - **Part 1: Characteristics of studied nurses:** Age, education level, gender, years of experience, and participation in past training

programs or workshops related to meningitis in children.

- **Part 2: Nurses' Knowledge about Meningitis:** It includes thirteen open end questions to assess nurses' knowledge about meningitis. Lumbar puncture procedure: It contains ten open end questions to assess nurses' knowledge about lumbar puncture procedure and nurses' knowledge about nursing performance for children with meningitis and lumbar puncture: it includes ten open end questions to assess nurses' knowledge about nursing care.

  The scoring system for this part is: A question was scored as the following, each point of the "correct" answer scored by one score, and zero point to the "incorrect" answer. Total score (100%) of questions were collected and accordingly scores of nurses' knowledge were categorized as follows: **High knowledge**: More than 75% of total score. **Average knowledge:** from 50- 75% of total score. **Poor Knowledge:** less than 50% of total score.

- **Instrument two**: Observational Checklist: It was developed by the researchers guided by Celik, et al., (2019). It consists of two parts:

  - **Part 1: Characteristics of studied children:** It includes age, gender, residence, season of admission, obligatory vaccination, duration of illness, and clinical picture on admission.
  - **Part 2: Nursing Practice Observational Checklist:** To assess nurse's practices before, during, and after lumbar puncture procedure.

    The scoring system for this part is: Each step of observational checklist was scored as follow: 2 for adequately done, 1for inadequately done and 0 for not done. Nurses who more than 75% had had satisfactory level while nurses who obtained less than 75% had unsatisfactory level.

Validity:

For validity assurance purpose, instruments were submitted to a jury of five specialists (two professors and one assistant professor in Pediatric Nursing Department and one professor and another assistant professor in Pediatrics Department). To modify any required items of the instruments. All required modifications were done.

Reliability

Determination of the instrument's reliability. The test-retest approach was used among ten participants separated by two weeks. The questionnaire's items were examined to see how closely they were related to one another. Between the two scores, Cronhbach's alpha was determined. It was 0.78, indicating that the instruments

Ethics Consideration.

- Approval of the Scientific Ethical Research Committee of Faculty of Nursing, Menoufia University was obtained.
- An official written approval was obtained from nurses and care givers of children after assuring them that they have the freedom to withdraw at any time, and a formal written agreement was obtained.
- Nurses and children in the study were informed that their data would be kept private and that their anonymity would be protected.

Pilot study

A pilot study was conducted on seven nurses (10 percent of the total number of nurses studied) to assess the clarity of the instruments used after they were developed and before they were used to collect data to test the applicability,

practicability, consistency, clarity, and feasibility of the study instruments and to estimate the time required for data collection. The instruments did not require any modifications, thus the pilot research was included in the whole sample.

Procedure:

1- A written permission: An official permission to carry out the study was obtained from director of the setting after submitting an official letter from the Dean of the Faculty of Nursing, Menoufia University to the director of the previously mentioned hospital and explaining the purpose of the study and method of data collection.

2- At the beginning of the study, the researcher introduced herself for nurses who participated in the study and explained the purpose and outcomes of study. Data was collected for a period of 7 months starting from January to July 2021

- **a)** Assessment of a nurse's knowledge about meningitis lumbar procedure, and nursing care were done. It took 20 minutes to complete and fill the questionnaire instrument by the researcher (pretest)
- **b)** Assessment of nursing practices before, during, and after lumbar puncture was done. It took 40 minutes to complete Instrument two (pretest)
- **c)** Then, instructional module health education sessions were provided by the researcher to all nurses working in the previously mentioned setting. Studied nurses were divided into fourteen groups. Each group contained 5 nurses.

3- Instructional module was given in three health education sessions. First session was theoretical session. It took 45 minutes related to meningitis such as definition, signs and symptoms, diagnosis, prevention, management, complications and nursing role.

4- There were two practical sessions: Each session lasted around 45 minutes. First session contained vital signs, correct position, fluid intake and output before, during and after procedure, and offering prescribed medication. Second session was about all nursing care provided to children before, during and after lumber puncture. Oral presentations and group discussion were done. Demonstrations/re-demonstration, role play, feedback, and explanatory booklet were provided.

5- Immediate post –test was done to re-assess nurses' knowledge (instrument one) and practices (instrument two) following the conducted sessions. (instrument two)

6- A follow-up test was done 2 months later to reevaluate nurses knowledge and practices using the same the same data collection instruments.

Statistical Analysis:

Data was entered and analyzed by using SPSS (Statistical Package for Social Science) statistical package 22 version on IBM compatible computer. Graphics were done using Excel program.

Quantitative data were presented by mean (X) and standard deviation (SD). It was analyzed using student ttest and ANOVA test. Qualitative data were presented in the form of frequency distribution tables, number and percentage. It was analyzed by Friedman Test. A statistical significant difference was considered if $P<.05$. A highly statistical significant difference was considered if $P<.01$.

RESULTS

Table 1: Shows distribution of the studied nurses according to their characteristics. Mean age of studied nurses was 27.91±4.21. Also more than half of them (58.6%) had technical nursing institute, 44.2% had 3 to less than 5 years of experience in pediatric nursing. Most of them (80%) didn't attended training programs in the field of infectious diseases or meningitis.

Table 2: Demonstrated mean and standard deviation of nurses' knowledge about meningitis, lumbar puncture, and nursing care about lumbar puncture procedure on pre, post and follow-up tests. It was found that there were highly statistically significant differences between pre, post and follow-up tests nurses' knowledge about meningitis, lumbar puncture, nursing care for lumbar puncture (P<0.01).

Table 3: illustrated mean and standard deviation of nurses' pitfalls before, during and after lumbar puncture on pre, post- test and follow-up tests. It revealed that there were highly statistically significant differences between nurses' pitfalls on pre, post and follow up tests as (P <.01).

Figure 1: Levels of Nurses Knowledge about meningitis on pre, post and follow- up Tests. It showed that nurses had higher level of knowledge about meningitis on post and follow-ups test than pretest.

Figure 2: Showed levels of nurses' performance of lumbar puncture on pre, post and follow -up tests, it revealed that all studied nurses had unsatisfactory performance level. on pre-test, but 100% and 68.6% have satisfactory performance level on post and follow-up tests respectively. So that there was a highly statistically significant differences between nurses performance on pre, post and follow - up tests (P<0.01).

Figure 3: Showed Pearson correlation between total score of nurses' knowledge and total Performance, it showed that there was highly statistically significant positive correlation between total knowledge and total practice as P value (<0.01).

Table (1): Distribution of Studied Nurses according to their Characteristics (No: 70).

Items	No	%
Age in years		
• From 20 to less than 25	24	34.3
• From 25 to less than 30	24	34.3
• From 30 to less than 35	15	21.4
• from 35 to less than 40	7	10.0
Mean ± SD	27.91±4.21	
Qualification		
• Bachelor of Nursing	26	37.1
• Technical Nursing Institute	41	58.6
• Nursing Diploma	3	4.3
Sex		
• Male	16	22.9
• Female	54	77.1
Years of experience in pediatric nursing		
• Less than two years	27	38.6
• From 3 to less than 5 years old	31	44.2
• From 5 to less than 7 years	6	8.6
• 7 years and over	6	8.6
Have you attended any training programs in the field of infectious diseases or meningitis		
• Yes	14	20
• No	56	80
If yes how many courses did you take and the name of the course		
• Meningitis and infection control	7	10

Table (2): Mean Score of Nurses' Knowledge about Meningitis, Lumbar Puncture, and Nursing Care about Lumbar Puncture Procedure on pre, post and follow-up Tests.

Items	Pre- test X±SD	Posttest X±SD	Follow-up test X±SD	P- value
Meningitis	4.90 ±2.83	12.16 ± 1.67	11.24 ±1.52	.000**
Lumbar puncture	3.69 ± 3.21	6.48 ± 1.60	5.42 ± 5.40	.000**
Nursing Care about the Lumbar Puncture Procedure	1.91 ±1.92	9.60±1.31	5.66 ±3.43	.000
Total Score of Nurses' Knowledge	10.50 ±2.83	30.41 ± 2.32	22.32 ±5.79	.000**

Figure (1): Levels of Nurses Knowledge on Pre, Post and Follow- Up Tests

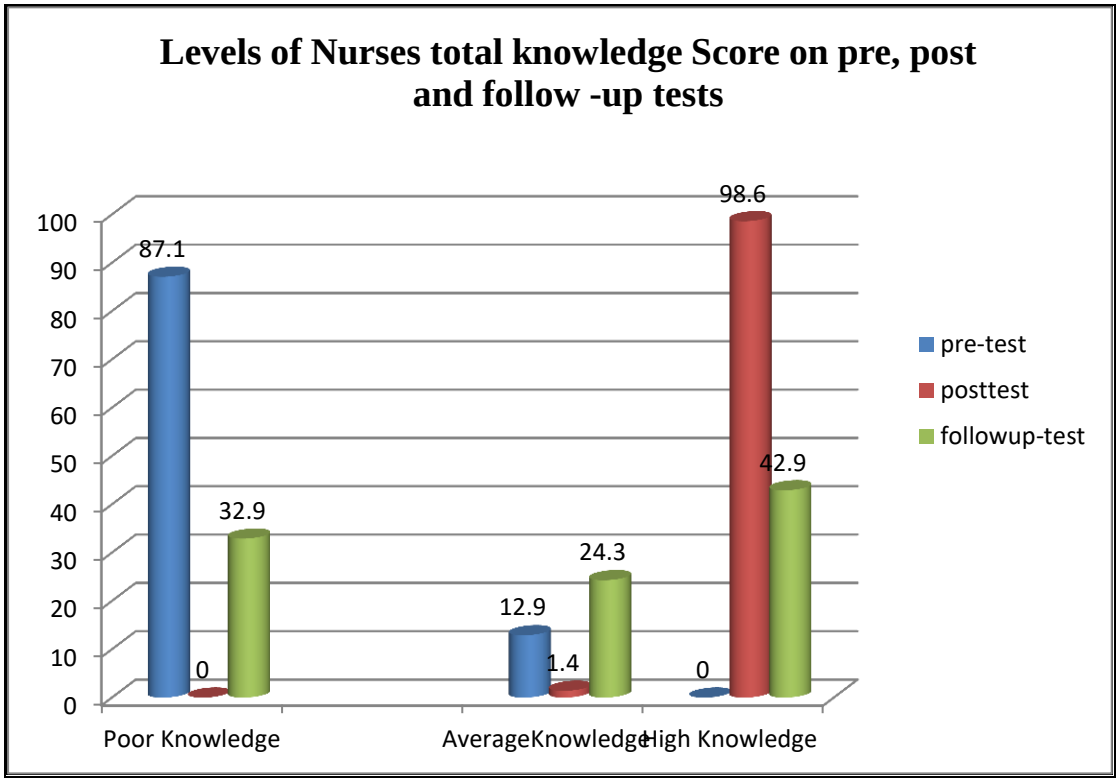


Figure (2): Levels of Nurses' Performance of Lumbar Puncture on pre, post and follow- up Tests (No: 70).

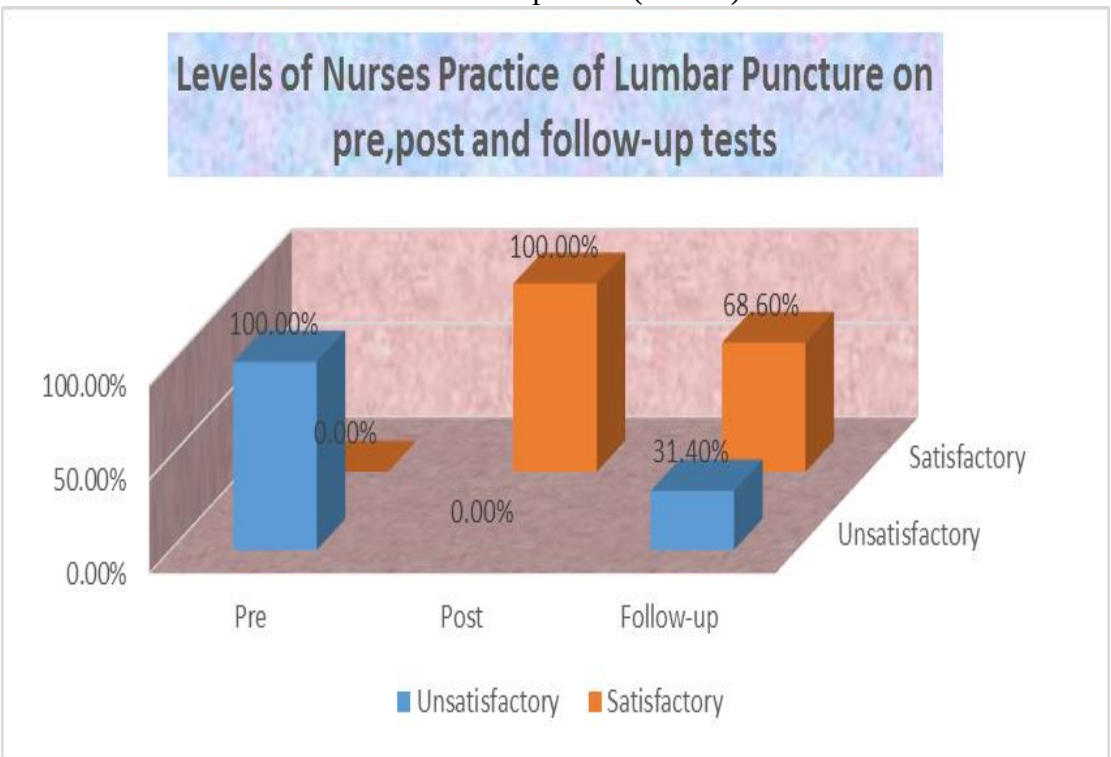
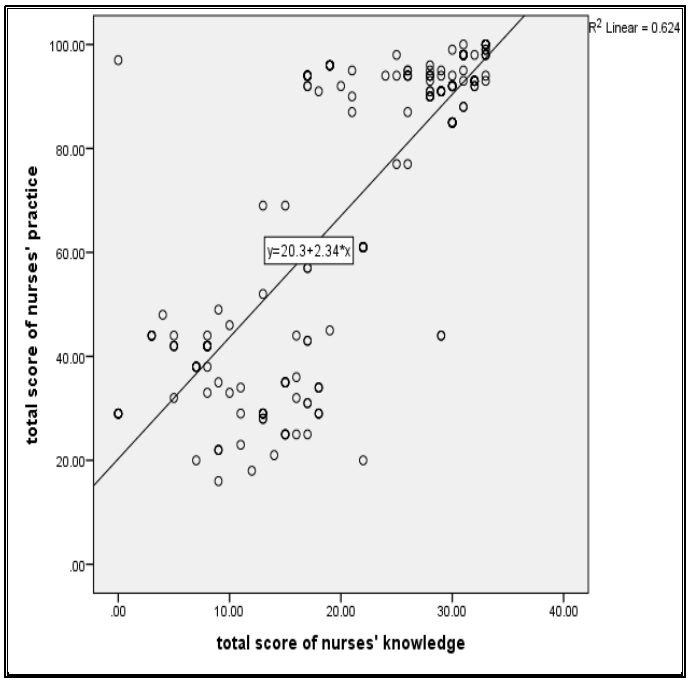


Table (3): Mean and Standard Deviation of Nurses' Pitfalls before, during and after Lumbar Puncture on pre, post- test and follow-up tests (No: 70).

Items	Pre- test X±SD	Posttest X±SD	Follow-up test X±SD	P- value
Before Lumbar Puncture	4.29 ±0.85	0.33 ± 0.50	2.93 ±1.57	.000**
General Guidelines for Diagnostic Tests before Lumbar Puncture	6.17 ± 2.21	0.014± 0.12	0.900 ± 1.81	.000**
Tray Set-up before Lumbar Puncture	2.20 ±1.16	.0300 ± 0.55	0.96 ±1.37	.000
During Lumbar Puncture	3.84 ±1.85	0.214 ±0.41	1.83 ±2.71	
After Lumbar Puncture	3.31 ±2.25	0.60 ± 0.81	3.11 ±3.61	.000**

NB: **: Mean highly statistical significance: P value (<0.001)

Figure (3): Pearson Correlation between Total score of Nurses' Knowledge and Total Performance.



DISCUSSION

Meningitis has an effect on a child's ability to survive and avoid injury. Lumbar puncture is a painless invasive diagnostic procedure that involves removing cerebrospinal fluid for investigation and measuring the pressure of the fluid. Nurses must be knowledgeable, talented, and competent in order to provide high-quality of care for children. Furthermore, every child wishes to be cared for by qualified nurses who will treat them with respect, safety, and comfort (Obiero et al., 2021).

As a result, the current study hypothesized that nurses who receive the instructional module will have a higher level of knowledge as well as nursing practices regarding lumbar puncture for children with meningitis on post-test than on pre-test. The results of the current study demonstrated that nurses who received the nursing intervention had higher level of knowledge about lumbar puncture on post and follow-ups test than pretest. These results were consistent with ," Niemantsverdriet et

al., (2020) who conducted a study entitled "Techniques, contraindications, and consequences of cerebral spinal fluid collection techniques," which indicated that after educational intervention, the majority of investigated nurses had accurate information regarding lumbar puncture. From researcher' perspective, it could be interpreted as the provision of knowledge of instructional module was in a simple way. Also, the use of suitable media for clarification, and the guidance offered during application of the module enhanced the process of learning. Thus, this improvement points to the effectiveness of the instructional module, on nurses' acquisition of knowledge.

The results of the current study illustrated that nurses who received the nursing intervention had higher level of knowledge about meningitis and lumbar puncture on post and follow-ups test than pretest. This finding was consistent with Temsah et al. (2021), who found a statistically significant difference in post-educational knowledge and self-reported intended practice in a study entitled "Effect of lumbar puncture instructional film on parental knowledge and self-reported intended practice."

In addition, this finding was matching with Kalaf, (2020), who performed a study named "Nurses' Performance in Neonatal Meningitis Care: Effect of an Educational Program," It was found that after the program was implemented, the majority of the investigated sample had a solid understanding of meningitis. Also, findings of this study were in line with Mahmoud and Abd-ElSadik (2019), who found that the total mean score of nurses' knowledge improved after providing health education related to clinical pathway in a study entitled "Effect of Clinical Pathway Regarding Promoting Quality Nursing Care of Children with Meningitis Exposed to Invasive Procedures.". From the researcher's point of view, the instructional module could be provided in a clear manner. Also, the utilization of appropriate media for clarification, as well as the coaching provided during module implementation, aided the learning process. As a result, this improvement demonstrates the usefulness of the instructional module in assisting nurses in their knowledge acquisition.

Concerning nurses' practice during lumbar puncture procedure, the findings of the current study revealed that more than half of the studied nurses had adequately practice regarding correct position of child during lumbar puncture. This finding was agreed with Dunaway, Skeens & Stevens, (2021), who mentioned in a study entitled "Emergency nurses' guide to neonatal Lumbar punctures" that the nurse kept correct position of neonates during lumbar puncture procedure. This indicates that trained pediatric nurses can act as patient advocator to reduce complications after LP procedure. From the researcher's perspectives, this might be due to nurses' recognition of benefits and complication of child position during lumbar puncture after instructional module attendance.

For nurses' practices prior to lumbar puncture, the findings revealed that more than half of nurses did not wash their hands before the procedure. In a study entitled "Use Of An Error-Focused Checklist to Identify Incompetence in Lumbar Puncture Performances," Pugh et al. (2019) discovered that the majority of nurses did not wash their hands. According to the researchers, this could be due to work overload that nurses face in the governmental hospitals. Also, they

needed more training before performing the procedure. This could be due to a lack of lumbar puncture in-service training programs, procedural manuals, regulations, guidelines, and procedure. All of which should be available in the workplace.

In relation to nurses' performance during lumbar puncture procedure, the current study found that more than half of nurses had satisfactory practice related to correct positioning of children during the procedure. Dunaway, Skeens, & Stevens, (2021), stated in a research entitled "Emergency nurses' guidance to neonatal Lumbar punctures" that nurses maintained the correct position of the neonate during the procedure. To reduce difficulties after the LP surgery, competent pediatric nurses must engage as child advocates. This could be related to nurses' identification of the benefits and complications of child position during lumbar puncture after attending an instructional module

The current study discovered that nurses who received the nursing intervention had higher level of knowledge about lumbar puncture on post and follow-ups test than pretest. The findings are consistent with Ahmed et al. (2019) in their study "Effect of an Educational Program on Nurses' Knowledge and Practice Regarding Defibrillation and Cardioversion," which found that nurses' knowledge and performance were poor prior the educational program. This could be due to lack of Arabic nursing textbooks or their incorrect use.

As a result, the current study hypothesized that nurses who received the instructional module will have fewer nursing pitfalls related to lumbar puncture on post-test than on pre-test. The results of the current study demonstrated that nurses who received the nursing intervention had higher level of nurses' practices pitfalls related to lumbar puncture on pretest than post and follow-ups test. Jissir & Hassan (2019) observed that after implementing the programs, nurses' skills improved statistically considerably when compared to pre- and post-test. This could be attributed to the fact that post-test errors were uncommon among nurses because they learnt information and skills from the teaching materials.

Regarding Pearson correlation between total score of nurses' knowledge and total performance, the current study showed that there was a highly statistically significant positive correlation between total knowledge and total practice. This finding agreed with Mohammad & Moghazy (2019) who conducted a study, entitled "An Educational Bundle to Secure Nursing Competency toward Safe Blood Transfusion. They clarified that there was a positive statistically significant correlation between total nurses' knowledge and practice on post-intervention of the educational bundle as well as between their total post practices.

CONCLUSION

Based on the findings of the current study, it was concluded that nurses who received instructional module had higher levels of knowledge as well as nursing practices regarding lumbar puncture for children with meningitis on post –test than pre- test. Also, they had fewer nursing pitfalls related to lumbar puncture procedure on posttest rather than on the pre and follow-up tests.

RECOMMENDATIONS

In the light of the study findings, the following recommendations are suggested.

Continuous job training programs must be provided for nurses regarding management of meningitis in children.

Pediatric nurses should update their knowledge and performance through continued nursing education, training, and frequently attending seminars and conferences based on their needs assessment

Further studies are needed to assess the impact of application of educational module on the quality of nurses' intervention provided to children during lumbar puncture.

Further studies are recommended on larger sample size and different settings to permit more generalization of the study results.

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