

The Effect of Nasogastric Tube Feeding Educational Interventions on Critical Care Nurses' Knowledge and Performance

Inayat F.Elsayed*1, Amal R. Reyad2, Hala A. Abdelrahman3,

Marwa M. Mahmoud4, Nahed A. Kandeel5

*1 Nurse Specialist, Mansoura University Students' Hospital

e-mail Marianelmenawy@yahoo.com

2 Professor of Anaesthesia and Intensive Care, Faculty of Medicine, Mansoura University

3, 4 Lecturer, Critical Care and Emergency Nursing, Faculty of Nursing, Mansoura University

hawk_hawk3@yahoo.com halaabdelrahma@yahoo.com

5 Professor of Critical Care and Emergency Nursing, Faculty of Nursing, Mansoura University, Egypt Nahed_Kandeel2000@yahoo.com

Abstract

Background: Critically ill patients have complex nutritional needs to meet the metabolic response to critical illness. The nutritional support for critically ill patients is an important determinant of their survival and recovery. Critical care nurses are the primary ones responsible for feeding the patients in intensive care units. Therefore, their knowledge and performance are important for providing adequate nutritional support for their patients and prevent malnutrition complications. **Aim:** The current study aimed to assess the effect of nasogastric tube feeding educational interventions on critical care nurses' knowledge and performance. **Method:** A quasi-experimental one-group with pre and post-test design was used with a convenience sample of 60 critical care nurses working in four intensive care units affiliated with a university hospital in Egypt. The data were collected by using two tools: 'nasogastric tube feeding knowledge questionnaire' and 'nasogastric tube feeding observation checklist'. **Results:** Statistically significant differences were noted in the total mean scores of nurses' knowledge and performance of nasogastric tube feeding before and after the educational interventions. Improvement of participant nurses' knowledge and performance was markedly noted one month after education, however, a decline in knowledge and performance was evident after three months. **Conclusion and Recommendations:** Educational interventions can improve nurses' knowledge and performance of nasogastric tube feeding, and this will be positively reflected on patients' outcomes. Therefore, we recommend organizing continuous educational activities for critical care nurses to keep them up-to-date and competent. **Keywords:** Nasogastric Tube Feeding, Educational Interventions, Critical Care Nurses, Knowledge, Performance.

Introduction

Critical illness is a life-threatening condition that can lead to significant morbidity or mortality (Bennett, Robertson & Al-Haddad, 2016). It is usually associated with a hypermetabolic state related to the stimulation of many catabolic hormones (Ndahimana & Kim, 2018). This can contribute to changes in energy expenditure, increase in blood glucose level, a decline in muscle function, and psychological and behavioral disorders (Preiser, Ichai, Orban & Groeneveld 2014). Hence, critically ill patients have complex nutritional needs to meet the metabolic response to critical illness and are at high risk for malnutrition (McClave, Martindale, Rice & Heyland, 2014). The optimal nutritional support for critically ill patients is an important determinant of their survival of critical illness and recovery (Bear et al., 2017; Ndahimana & Kim, 2018).

It has been reported that the prevalence of malnutrition on hospital admission was 31% and before discharge was 36% (van Vliet, Gomes-Neto, de Jong, Jager-Wittenaar & Navis, 2020). Additionally, Kirkland, Kashiwagi, Brantley, Scheurer, and Varkey (2013), estimated that nearly 50% of patients are malnourished on admission and other patients develop malnutrition during hospitalization. In the intensive care unit (ICU), despite the nasogastric tube (NGT) feeding is a common practice, many patients remain undernourished or malnourished which is associated with poor clinical outcome (Marshall & West, 2006; Stewart, 2014). A prospective study conducted by Kim and Choi-Kwon (2011) on enteral feeding (EF) in the ICU reported that 75% of the patients were severely malnourished at admission

and the nutritional status worsened markedly during the ICU stay.

According to the literature, the critically ill patient may develop malnutrition due to the nature of the critical illness, hypermetabolic states, and stressors of the ICU (Shahin, Mohamed, & Sayed, 2012). Malnutrition is a clinical condition that affects multiple patient groups and can have a significant impact on clinical outcomes (Barker, Gout & Crowe, 2011; Stewart, 2014). It is usually associated with many complications such as infection, pressure ulcers, impaired wound healing (Kim, Stotts, Froelicher, Engler, & Porter 2012), disease severity, high morbidity and mortality, longer hospital stays, and increased health care costs (Correia & Waitzberg, 2003; Kim et al., 2012).

Enteral feeding is a useful and well-tolerated approach for patients with normal gastrointestinal function but unable to ingest adequate nutrients through the oral route (Ojo Keaveney, Wang & Feng, 2019). It is more preferable to other feeding methods in the ICU as it enhances patients' immunity and survival, and is less expensive (Das, Patra, & Pradhan, 2015). The NGT is commonly used for critically ill patients for feeding and gastric decompression (Williams & Leslie 2004). Critical care nurses have a significant role in the delivery and management of EF and maintaining patient's optimal nutritional status (Das, et al., 2015; Morphet, Clarke & Bloomer, 2016). They are accountable for NGT insertion, ensuring its appropriate placement, giving the feeding, and monitoring its associated complications (Xu, Huang, Lin, Zheng, & Zhu, 2020). They can also identify susceptible

patients for malnutrition, assess nutritional adequacy, and implement nursing interventions to prevent and manage malnutrition (Sauer, Alish, Strausbaugh, West & Quatrara, 2016; Stewart, 2014).

Some studies investigated nurses' knowledge and/or practice related to EF of critically ill patients and reported marked variability. A recent study conducted by Kunwar and Koirala (2019) found that more than half of the nurses had an unsatisfactory level of knowledge and practice concerning NGT feeding. Das et al. (2015) found that 44% of the nurses had above-average knowledge about EF for critically ill patients and 44% had below-average knowledge. Mula, Ncama, and Maluwa (2014) reported variations in nurses' knowledge that ranged from adequate knowledge in many aspects of care to lacked knowledge in some other aspects. Marshall and West (2006) conducted a survey study to investigate the EF practices of 376 critical care nurses and reported a greater discrepancy in nurses' practice which may lead to underfeeding of critically ill patients. In her Doctoral study, Marshall (2008) found that nurses depend greatly on the verbal testimony of others for their clinical practice rather than access to guidelines and evidence-based practice which may cause inconsistency in their knowledge and clinical practice. She highlighted the need for developing strategies for promoting the transfer of knowledge into clinical practice and integrating such strategies into undergraduate nursing education.

Since critical care nurses are responsible for the delivery and management of NGT feeding in the ICU, their knowledge and practice concerning this procedure are important to

accomplish these tasks safely and competently (Gill, 2019). Yet, nursing interventions related to NGT feeding is based upon nurses' own judgment rather than the best available evidence (Williams & Leslie 2004). Few studies were conducted in Egypt to address nurses' knowledge and/or practice concerning NGT feeding. These studies reported inadequate nurses' knowledge and incompetent practice (Abdullah, Mohammed, Ismail, 2014; Bedier, EL-Ata, Shehab, 2016; Metwaly, E. Mohammed, Mohammed, 2013; Mohammed, Mahmoud, Sleem & Shehab, 2017; Shahin, et al., 2012). These findings highlighted the need for enhancing nurses' knowledge and practice to ensure optimal nutritional support for critically ill patients. Hence, this study was carried out to address this issue.

Aim of the study

This study aimed to assess the effect of NGT feeding educational interventions on critical care nurses' knowledge and performance.

Research hypothesis

To fulfill the aim of the study, we hypothesized that critical care nurses' knowledge and performance mean scores will be improved after the implementation of NGT feeding educational interventions compared to their mean scores pre-interventions.

Method

Research Design

This study has a quasi-experimental, one group, pretest-posttest design. This type of design is mainly used to estimate the effect of an intervention on some outcomes without randomization (Polit, & Beck, 2018).

Setting

This study was conducted in four ICUs affiliated with a university hospital

in Egypt including Neurological ICU (5 beds), Cardiothoracic ICU (4 beds), Neurosurgery ICU (5 beds), and Surgical ICU (9 beds). These units are well prepared with the technology required for the management of critically ill patients. The nurse-patient ratio in the selected units is nearly 1:2 in morning shifts and 1:3 in afternoon shifts.

Subjects

The study involved a convenience sample of critical care nurses (60 nurses) working in the above-mentioned ICUs who had at least one year of work experience in the study setting, were involved in providing patient care and accepted to take part in this investigation.

Data Collection Tools

The data were collected by using two tools:

Tool I: Nasogastric Tube Feeding Knowledge Questionnaire for Critical Care Nurses

This tool was developed by the principal investigator (PI) after reviewing relevant literature. It aimed to assess critical care nurses' knowledge regarding NGT feeding pre and post the educational sessions. It comprises of two parts:

Part 1: Critical Care Nurses' Demographic Characteristics

This part covered the demographic characteristics of the participant nurses including age, gender, marital status, educational level, years of work experience, and attended previous training programs regarding NGT feeding.

Part 11: Nasogastric Tube Feeding Knowledge Questionnaire

This part was developed based upon relevant literature (AL Kalaldehy, Watson & Hayter, 2015; Bourgauly, Ipe, Weaver, Swartz, O'Dea, 2007; Shahin et al., 2012). It included 30 multiple-choice

questions (MCQs) about NGT feeding. It aimed to assess critical care nurses' knowledge about NGT insertion, feeding, and care pre and post the educational intervention. The questionnaire covered 7 areas including general information regarding NGT feeding (4 questions), preparation for NGT insertion (2 questions), NGT insertion (1 question), assessment before feeding (1 question), preparation for feeding (2 questions), implementation of feeding (3 questions) and post-feeding care (3 questions).

The correct answer was given one mark and the wrong answer was given a zero. A score of less than 85% was considered an unsatisfactory level of knowledge while a score of more than 85% was considered a satisfactory level of knowledge.

Tool II: Nasogastric Tube Feeding Observation Checklist

This tool was developed by the researcher based on relevant literature (Babapour et al., 2016; Bedier, 2016; Shahin et al., 2012) to assess critical care nurses' performance of NGT feeding. Nursing interventions were categorized under five main domains including assessment, preparation, implementation, post-care, and documentation.

In the observation checklist, the interventions were ranked on a three-point scale from 0 to 2 (done correctly = 2, done incorrectly = 1, and not done = 0). Also, the total scores were calculated and converted into percent. The scores of less than 85% were considered an unsatisfactory level of practice, and the scores of more than 85% were considered a satisfactory level of practice.

Validity and Reliability

The content validity of tools was assessed by a panel of seven experts

from the fields of Critical Care and Emergency Nursing, the Anesthesia and Intensive Care Medicine. The tools were revised for applicability, relevancy, clarity, and comprehensiveness, and modifications were made accordingly. The knowledge questionnaire was translated into the Arabic language, and the back-translation technique was used to ensure the validity of the translation. The reliability of tools was measured by Cronbach's alpha test and the value was 0.817 for tool I and 0.912 for tool II which reflects reliable tools.

Pilot Study

A pilot study was carried out on 10% of the participants before starting the data collection to test the feasibility and applicability of the tools and to make necessary modifications before conducting the main study. This group was not included in the study sample.

Ethical Considerations

Ethical approval was granted from the local Research Ethics Committee. Informed consent was obtained from the eligible nurses who accepted to participate in the study. They were informed about the details of the study including the aim, educational interventions, the time schedule, and the benefits and risks of participation. They were assured that their participation is voluntary and that they had the right to withdraw from the study at any time without penalty. They were also assured about the confidentiality of their personal information. It was emphasized to them that their knowledge and performance scores would not be included in their annual evaluation.

Data Collection Process

This study was conducted between January and May 2018. Before commencing the study, permission to carry out this investigation was gained

from the authority of the selected university hospital and the ICUs. The PI communicated with the eligible nurses, informed them about the details of the study, and invited them to participate. The questionnaire sheet (pretest) was distributed to all nurses who accepted to take part in the study. Nurses required between 30 and 40 minutes to complete the questionnaire. The PI collected the questionnaire sheets back.

Nurses' performance of the NGT feeding was observed by the PI in the morning shifts. Based on nurses' pretest knowledge and practice scores, areas of inadequate knowledge, and incompetent practice were determined. Then, the PI prepared the NGT feeding educational guide based on the current evidence-based practice. The guide included both theoretical materials and NGT feeding clinical procedures.

Participants were divided into small groups according to their availability in the shift. The educational interventions were arranged during morning shifts from 10 am – 10.45 am at the nurse station in the ICU. Each participant nurse was given a copy of the NGT feeding educational guide. It involved an orientation session and three sessions covered all educational interventions. In the orientation session, the participants were given an overview of the study aim, the procedure, and the sessions' planned schedule. The educational sessions were repeated three times per week for one month to allow the participants to attend the suitable sessions for their work schedule.

In general, each nurse attended three educational sessions. Different teaching methods were used including lectures, discussions, and colored pictures. For the clinical part, a demonstration and re-demonstration of

the procedures were used. The participants were allowed to ask questions and seek clarifications as needed. Nurses' knowledge and performance were evaluated in three phases including pre the educational interventions, and then one month and three months after education.

Statistical Analysis

Data were analyzed using IBM-SPSS software version 25.0. (Armonk, NY: IBM Corp.). Qualitative data were presented as frequencies and percent, and compared using the Chi-square test (Fisher's exact test). Quantitative data were expressed as mean ± standard deviation (SD). The ANOVA test was utilized to differentiate between repeated measures. Pairwise comparisons were performed to detect significant differences throughout the phases of the study. The test calculates F value, p-value, and partial eta square (η^2) which is a measure of the effect size. Results

were considered statistically significant if $p \leq 0.05$.

Results

Nurses' Knowledge Regarding NGT Feeding

Table1 Describes participant nurses'socio-demographic characteristics. It showed that the majority of the nurses (81.7%) were aged between 21-30 years, were females (85%) and slightly more than half of them (53.3%) were married. Regarding the educational level, 38.3% had a secondary nursing school certificate and 36.7% had a Bachelor's Degree in Nursing. The results also illustrated that 40% of the nurses had more than 10 years of work experience in the ICU and 33.3% had less than 2 years of work experience in the ICU. Additionally, the vast majority of nurses (93.3%) reported that they didn't attend any training programs concerning NGT feeding.

Table 1 Participant Nurses' Socio-demographic Characteristics

Variables	N (60)	%
Age		
< 20 years	1	1.7%
21-30 years	49	81.7%
31-40 years	8	13.3%
>40 years	2	3.3%
Gender		
Male	9	15%
Female	51	85%
Marital status		
Single	28	46.7%
Married	32	53.3%
Educational level		
Bachelor Degree in Nursing	22	36.7%
Technical Institute of Nursing	15	25%
Secondary Nursing School	23	38.3%
Years of work experience in ICU		
< 2 years	20	33.3%
2-5 years	6	10%
6-10 years	10	16.7%
>10 years	24	40%
Attendance of training programs/workshops regarding nasogastric feeding		
No	56	93.3%

Data are presented as numbers (N) and frequencies (%)

Table 2 describes the participants' total mean knowledge scores throughout the phases of the study. It showed highly

Table 2 Total Mean Knowledge Scores of Participant Nurses Throughout the Phases of the Study

	Before education	After 1 month	After 3 months
Mean ± SD	19.5±2.8	25.3±2.1	23.9±2.1
Pairwise comparison	A	B	C
F	121.988		
P-value	<0.001		
Partial Eta squared	0.674		

F: Fisher Snedecor Distribution $P \leq 0.05$ Partial Eta Squared: a measure of effect size □: mean, SD: standard deviation

Comparisons of column proportions are presented as capital letters (A, B, C: Similar letters = no significant difference and Different letters = significant difference).

Table 3 Participant Nurses' General Knowledge About Nasogastric Feeding Throughout the Phases of the Study

NGT Feeding	Frequency and Percentage (N=60)		
	Before education	After 1 month	After 3 months
Definition	60 (100%) A	60 (100%) A	60 (100%) A
Indications	58 (96.6%) A	60 (100%) A	60 (100%) A
Benefits	60 (100%) A	60 (100%) A	60 (100%) A
Contraindication	58 (96.6%) A	60 (100%) A	60 (100%) A

Table 4 illustrated statistically significant differences ($P = < 0.0005$) in nurses' knowledge about the patient's preparation and NGT insertion

Table 4 Participant Nurses' Knowledge About NGT Insertion Throughout the Phases of the Study

Steps of NGT insertion procedure	Frequency and Percentage (N=60)			P-value
	Before education	After 1 month	After 3 months	
Preparation				
Prepare the patient	29 (48.3%) A	53 (88.3%) B	44 (73.3%) C	<0.0005
Prepare equipment	59 (98.3%) A	60 (100%) A	60 (100%) A	-----
Implementation				
Nursing care when resistance occurs during NGT insertion	5 (8.3%) A	51 (85%) B	26 (43.3%) C	<0.0005

statistically significant differences ($P = 0.001$) between the three knowledge scores throughout the study phases (after 1 month > after 3 months > pre the educational interventions).

Table 3 revealed that there were no statistically significant differences in all items of nurses' knowledge regarding NGT feeding general information throughout the phases of the study as the pairwise comparison showed similar letters.

throughout the three phases of the study. No statistically significant differences were noted concerning the preparation of required equipment.

According to **table 5**, statistically significant differences ($p < 0.0005$) were noted in nurses' knowledge pre and post-implementation of the educational interventions (one month and 3 months) regarding the preparation and implementation of feeding, checking the

placement of NGT, and nasal and mouth care post-feeding. However, there were no statically significant differences in nurses' knowledge concerning checking the amount of residual volume or positioning after feeding.

Table 5 Participant Nurses' Knowledge About NGT Feeding Procedure Throughout the Phases of the Study

Steps of NGT feeding procedure	Frequency and Percentage (N=60)			P-value
	Before education	After 1 month	After 3 months	
Assessment				
Check amount of gastric residual volume (GRV)	49 (81.7%) A	59 (98.3%) A	59 (98.3%) A	-----
Preparation				
Prepare the formula	26 (43.3%) A	58 (96.7%) B	58 (96.7%) B	<0.0005
Elevate HOB 30-45°	44 (73.3%) A	60 (100%) B	60 (100%) B	<0.0005
Implementation				
Time to initiate feeding	41 (68.3%) A	60 (100%) B	60 (100%) B	<0.0005
Hold feeding if GRV ≥ 500	38 (63.3%) A	60 (100%) B	60 (100%) B	<0.0005
Give medication via NGT	41 (68.3%) A	59 (98.3%) B	59 (98.3%) B	<0.0005
Post NGT feeding care				
Check the placement of NGT	31 (51.7%) A	57 (95%) B	57 (95%) B	<0.0005
Keep the patient in sitting position after feeding	51 (85%) A	60 (100%) A	60 (100%) A	-----
Nasal and mouth care	15 (25%) A	45 (75%) B	45 (75%) B	<0.0005

Participant Nurses' Performance of NGT Feeding

Table 6 showed statistically significant differences in nurses' total

mean performance scores ($P = 0.001$) throughout the three phases of the study (after 1 month > after 3 months > pre the educational interventions).

Table 6 Total Mean Performance Scores of Participant Nurses throughout the Phases of the Study

	Before education	After 1 month	After 3 months
Mean ± SD	138.8± 16.9	203.5±9.3	187.8±11.7
Pairwise comparison	A	B	C
F	449.15		
P-value	<0.001		
Partial Eta squared	0.884		

Table 7 showed statistically significant differences in nurses' assessment of patient's daily urine, glucose, acetone, and albumin, and preparation for NGT insertion after one and three months of the training ($P < 0.0005$). A significant difference was also noted in nurses' performance of

post-insertion care as the practice improved one month after the training but declined 3 months post-training ($P < 0.0005$). However, no statistically significant differences were detected in nurses' assessment of abdominal bowel sound or the insertion of the NGT.

Table 7 Participant Nurses' Performance of NGT Insertion Throughout the Phases of the Study

NGT insertion section	Frequency and Percentage (N=60)			P-value
	Before education	After 1 month	After 3 months	
Assessment				
Assess abdominal bowel sound	57 (95%) A	60 (100%) A	60 (100%) A	-----
Assess the patency of nostrils	0 (0%) A	55 (91.7%) B	26 (43.3%) C	<0.0005
Assess patient's daily for urine, glucose, acetone, and albumin.	0 (0%) A	59 (98.3%) B	59 (98.3%) B	<0.0005
Preparation				
Wash hands	7 (11.7%) A	60 (100%) B	60 (100%) B	<0.0005
Maintain privacy	1 (1.7%) A	60 (100%) B	60 (100%) B	<0.0005
Implementation				
Estimate the proper length of the tube	58 (96.7%) A	60 (100%) A	60 (100%) A	-----
Position curved edge of the tube downward	60 (100%) A	60 (100%) A	60 (100%) A	-----
Insert NGT gently	60 (100%) A	60 (100%) A	60 (100%) A	-----
Post NGT insertion care				
Perform nasal care	7 (11.7%) A	55 (91.7%) B	22 (36.7%) C	<0.0005
Document time of NGT insertion	11 (18.3%) A	60 (100%) B	24 (40%) C	<0.0005

According to table 8, there were statistically significant differences ($P < 0.0005$) in nurses' performance of NGT feeding one month after the training as the practice was improved. However, nurses' performance of some steps was declined after three months, such as checking the NGT placement, giving the prescribed formula, and flushing the NGT. No statistically significant differences were noted concerning checking the GRV or

positioning the patient as preparation for feeding throughout the three phases of the study.

Statistically significant differences ($P < 0.0005$) were also noted regarding nurses' documentation of the time of checking GRV, giving medication, and any untoward problems. However, no significant differences were observed in nurses' documentation of the time of feeding during the three phases of the study

Table 8 Participant Nurses' Performance of NGT Feeding Throughout the Phases of the Study

NGT feeding domains	Frequency and Percentage (N=60)			P-value
	Before training	After 1 month	After 3 months	
Assessment				
Check NGT placement	6 (10%) A	59 (98.3%) B	22 (36.7%) C	<0.0005
Check GRV	54 (90%) A	57 (95%) A	57 (95%) A	-----
Assess bowel sounds	10 (16.7%) A	55 (91.7%) B	55 (91.7%) B	<0.0005
Preparation				
Explain the procedure to patient	6 (10%) A	60 (100%) B	60 (100%) B	<0.0005
Maintain patient's privacy	10 (16.7%) A	60 (100%) B	60 (100%) B	<0.0005
Put the patient in sitting position	56 (93.3%) A	55 (91.7%) A	55 (91.7%) A	-----
Implementation				
Give the prescribed formula	4 (6.7%) A	57 (95%) B	26 (43.3%) C	<0.0005
Flush NGT with 20-30 ml water	2 (3.3%) A	56 (93.3%) B	26 (43.3%) C	<0.0005
Hold NGT feeding if GRVs >500ml	40 (66.3%) A	59 (98.3%) B	59 (98.3%) B	<0.0005
Post feeding care				
Elevated HOB at 30-45 degree for 30 min	34 (56.7%) A	60 (100%) B	60 (100%) B	<0.0005
Provide oral hygiene every 2-4 hours	1 (1.7%) A	50 (83.3%) B	50 (83.3%) B	<0.0005
Documentation				
Time of feeding	60 (100%) A	60 (100%) A	60 (100%) A	-----
Time to check GRVs	8 (13.3%) A	53 (88.3%) B	53 (88.3%) B	<0.0005
Time to give medication via NGT	18 (30%) A	58 (96.7%) B	58 (96.7%) B	<0.0005
Any problem arises	7 (11.7%) A	53 (88.3%) B	60 (100%) B	<0.0005

Discussion

Critical care nurses are the primary ones responsible for the delivery of NGT feeding for critically ill patients. Hence, their knowledge and practice are significant for ensuring the delivery of adequate nutritional support for their patients. This study aimed to assess the effect of NGT feeding educational interventions on critical care nurses' knowledge and performance. The study involved a sample of sixty participant nurses. Most of them were young females and their ages ranged from 21 to 30 years. Despite the increasing number of males who select nursing as a career, yet nursing continues to be a female dominant profession in Egypt. The young age of the participants could be due to the appointment of novice critical care nurses in the selected ICUs. This finding is consistent with other similar studies which illustrated that the majority of the participant nurses were less than

thirty years old (El-Meanawi, 2017; Al-Hawaly, Ibrahim & Qalawa, 2016).

Regarding nurses' qualifications, more than one-third of the participant nurses were holding a Bachelor's degree in nursing and had more than 10 years of work experience in the ICU. This is an interesting finding because there is a national trend in Egypt to appoint graduates of Faculties of Nursing in ICUs to enhance the quality of care provided for critically ill patients (Mohamed, Kandeel, Abosaeda & Ali, 2020). An investigation was conducted by Bedier et al. (2016) to assess the effect of the educational program on nurses' practice regarding caring for patients undergoing NGT feeding and reported that only 10% of the nurses had a Bachelor's degree in nursing. However, Özbaş and Baykara (2018) found that 55.8% of the nurses had a Bachelor's or Master's degree. Another study conducted by Morphet et al. (2016) to

explore Australian nurses' enteral nutrition knowledge and sources of information reported that most of the participants had completed a post-graduate qualification. This could be because continuous professional education for nurses is encouraged and supported in western countries.

The current study illustrated that the vast majority of the participants didn't attend any training programs or workshops related to NGT feeding. This could be attributed to the unavailability of regulations or policies to commit nurses to attend continuous in-service training programs to update their knowledge and skills. This finding supports the results of other studies which emphasized the importance of training programs in improving nurses' knowledge and practice, and consequently enhancing the quality of nursing care in ICUs (Ahmed & Mondal, 2014; F.Ahmed, Ahmed, Albitar, Ghoneim, 2018; Bedier, et al., 2016; El-Meanawi, 2017).

The findings of the current study showed a significant improvement in nurses' total mean knowledge and performance scores regarding NGT feeding one month following the educational interventions. These findings are harmonious with other investigations that implemented NGT educational programs in Egyptian hospitals and reported a significant enhancement in the participants' knowledge and practice post the training program (Ahmed, et al., 2018; Bedier, et al., 2016; El-Meanawi, 2017; Mohammed & Abdel Fattah, 2018; Shahin, et al., 2012).

Our results are also supported by other recent international studies. In Taiwan, Chang et al. (2015) implemented a systematic nursing educational intervention about NGT

feeding on 106 caregivers (experimental group) and provided routine education (educational pamphlet) to 127 caregivers (control group). Then the effect on caregivers and the incidence of feeding complications among patients were evaluated. The authors reported higher post-test knowledge and skills among the experimental group. In South Korea, Kim and Chang (2019) implemented an EF educational program on 205 nurses from nine ICUs in four hospitals. They illustrated that the participants' perception, knowledge, and practice around enteral nutrition meaningfully improved following the program. In Saudi Arabia, Bomozah (2020) highlighted the effectiveness of the NGT feeding educational interventions in enhancing the knowledge and performance of the studied nurses.

The findings of the current study exhibited that nurses' total mean knowledge and performance scores were declined 3 months after the educational interventions but it was better than pre-education scores. In general, retaining nurses' knowledge and performance within 3 to 6 months after training programs is well documented in the literature. Bedier, et al. (2016) reported significant improvement in the total scores of nurses' practices regarding caring of patients undergoing NGT feeding which declined 3 months and 6 months post the educational program. Similarly, Ragheb, N. El Sayed, El Sayed, and Metwally (2016) studied the effect of a training program on reducing nurses' medication errors in the ICU and noted enhancement in nurses' knowledge immediately after the program and a decline in their knowledge three months later. In light of these findings, NGT feeding refreshers are recommended for critical care nurses to keep them updated and competent.

Limitations

The study was conducted on a small group of critical care nurses from four ICUs in one hospital which limits the generalizability of the research findings. Furthermore, there were difficulties in following the educational interventions plan schedule due to participant nurses' heavy work in the ICU.

Conclusion and Recommendations

The study concludes that educational interventions are a useful strategy to improve critical care nurses' knowledge and performance of NGT feeding for critically ill patients. This study highlights the need for continuous in-service training programs for critical care nurses to keep them up-to-date and skilled. It is also important to evaluate nurses' performance of NGT feeding periodically to ensure that they follow the evidence-based practice. Future investigations are necessary to evaluate the effectiveness of NGT educational interventions on critically ill patients' clinical outcomes.

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The authors declared no potential conflicts of interest concerning the research, authorship, and/or publication of this article.

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