

Effect of Educational Program Regarding Arterial Blood Gases Interpretation on Nurses' Performance and Self-efficacy

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Abstract

Background: Arterial blood gas (ABG) interpretation represents the gold standard method for diagnosis and managing patient oxygenation status and acid-base balance. **Aim** of the study was to evaluate the effect of educational program regarding arterial blood gases interpretation on nurses' performance and self-efficacy. **Research design:** Quasi- Experimental research design (pre and post test). **Settings:** The study was conducted in general Intensive Care Unit (ICU) and Chest Care Unit at Benha University Hospital, Qalyubia Governorate, Egypt. **Subjects:** A convenient sample of all available nurses in ICU and Chest Care Unit, (90) nurses from both sexes and agreed to participate in the study. **Tools of data collection, Tool (I):** Nurses' self-administered questionnaire. **Tool (II):** Nurses' practice observational checklist regarding arterial blood gases interpretation. **Tool (III):** Arterial puncture Self-efficacy Scale(APSES). **Results:** 91.7% of studied nurses had unsatisfactory level of total knowledge about arterial blood gas interpretation preprogram implementation to be significantly improved during immediate and post three months periods of program implementation among (88.5% & 84.2%, respectively). While 93.7% of studied nurses had incompetent level of practice regarding the arterial blood gases interpretation preprogram implementation to be significantly improved during immediate and post three months periods of program implementation among (62.1% & 56.8%, respectively). 64.4% of studied nurses had moderate confidence level regarding the practice of arterial blood sampling preprogram implementation to be significantly improved during immediate and post three months periods of program implementation among (86.3% & 83.2%, respectively). **Conclusion:** Educational program effectively improved nurses' knowledge, practice and self-efficacy regarding arterial blood gases interpretation. **Recommendation:** Ongoing educational and training programs for nurses about arterial blood gases interpretation and further study is needed about arterial blood gases interpretation with larger sample size to evaluate its effect on nurses' performance and patients' outcomes.

Key words: Educational Program, Arterial Blood Gases Interpretation, Nurses' Performance, Self-efficacy

Introduction

Arterial blood gases sampling (ABGs) and its analysis has become one of the most important laboratory investigations that are frequently ordered in clinical settings. ABGs is a simple blood test which is performed through puncturing an artery with a thin needle and heparinized syringe to draw a

small amount of blood (approximately, 1ml) from the radial artery at the wrist which is the most usual site, but the femoral artery in the groin and other sites can be used as well. Moreover, blood can also be drawn from an arterial catheter to obtain frequent blood gas measurements (*Karunarathna et al., 2024*).

Arterial blood gases (ABG) analysis helps to measure the oxygen tension (PaO₂), carbon dioxide tension (PaCO₂), acidity (pH), oxyhemoglobin saturation (SaO₂), and bicarbonate (HCO₃⁻) concentration in arterial blood. Some blood gas analyzers also measure carboxyhemoglobin and hemoglobin levels. Such information is important when caring for patients with critical illness such as respiratory and metabolic diseases. Therefore, Arterial blood gases analysis (ABG) is the very common procedure performed in Intensive care unit that help healthcare providers to interpret conditions that affect the respiratory system, circulatory system and metabolic processes (*Nafees et al., 2024*)

Interpretation of ABG results requires understanding of normal ranges for each parameter and their relationships to each other. Deviations from the normal ranges can indicate various respiratory and metabolic disorders. Healthcare professionals, including doctors, nurses, and respiratory therapists, use ABG analysis to tailor treatment plans, adjust ventilator settings, and monitor the progress of patient's condition (*Yee et al., 2022*).

Nurses are playing crucial role in early detection of patients at high risk for acid-base imbalance in critical care units. The nurse is involved in the medications administration, oxygen therapy and mechanical ventilation if indicated. In extreme circumstances in which therapeutic compensation is required, the nurse should be knowledgeable about potential risks of these therapy and able to monitor administration rates and therapeutic responses carefully (*Achanti & Szerlip, 2023*).

Self-efficacy is described as individuals' belief in their ability to succeed in a specific task or accomplish a specific goal. In nursing, self-efficacy is an important aspect of nursing practice that can impact patient outcomes, job satisfaction, level of stress and overall performance (*Lin et al., 2024*). Nurses with high self-efficacy tend to be more resilient in the face of challenging situations and cope with stress more effectively, as they believe in their ability to handle stressful situations. On the other hand, nurses with low self-efficacy may experience more stress, job dissatisfaction, less likely to take on leadership roles and may have more difficulty adapting to changes in the healthcare system (*Lartey et al., 2022*).

Significance of the study

Nurses are essential members of the healthcare team to manage arterial blood gases and clinical staff to receive its results. Understanding the significance of these results and knowing when to seek medical help, can improve the quality of patient care. Nurses' responsibilities range from proper sample collection and interpretation, decision-making, ongoing monitoring, and patient education. Effective collaboration and communication among nurses and other healthcare professionals are essential for optimal patient care (*Mohammed et al., 2024*).

Arterial blood gas (ABG) analysis represents the gold standard method for diagnosis and managing patient oxygenation status and acid-base balance. The usefulness of this diagnostic tool is dependent on being able to correctly interpret the results. Arterial blood gas interpretation is best approached systematically and leads to an understanding severity of abnormalities,

whether the abnormalities are acute or chronic and if the primary disorder is metabolic or respiratory in origin (*Lee, ۲۰۲۵*).

Nurses comprehensive understanding of acid-base balance, along with their skills in medication administration, oxygen therapy, and mechanical ventilation, ensures that patients receive timely and effective care. Moreover, nurses are well-equipped to monitor therapeutic responses and potential risks associated with these interventions, especially in extreme cases that require complex compensation strategies. Therefore, educating the staff nurses regarding ABGs interpretation helps them to develop and refine their existing skill and knowledge, which lead to improvement in quality of care (*Kulvi, ۲۰۲۳*).

Aim of the study:

The study aimed to evaluate the effect of educational program regarding arterial blood gases interpretation on nurses' performance and self-efficacy.

Research hypotheses:

H^۱: Nurses' knowledge score regarding arterial blood gases interpretation could be significantly higher after implementation of educational program than before.

H^۲: Nurses' practice score regarding arterial blood gases interpretation could be significantly higher after implementation of educational program than before.

H^۳: Nurses' self-efficacy score regarding arterial blood gases interpretation could be significantly higher after implementation of educational program than before.

H^۴: There will be significant correlation

between nurses' performance and self-efficacy regarding arterial blood gases interpretation after implementation of educational program than before.

Subject and Methods

Research design:

A quasi- experimental research design (pre and post test) was utilized to achieve the aim of the study.

Study settings:

The study was carried out in general Intensive Care Unit (ICU) and Chest Care Unit at Benha University Hospital, Qalyubia Governorate, Egypt.

Subjects:

A convenient sample of all available nurses in ICU (۸۰) and Chest Care Unit (۹۰) nurses, total number of nurses was (۱۷۰) from both sexes who were working in these settings during the time of data collection and agreed to participate in the study.

Tools for data collection

Tool (I): Nurses' self-administered questionnaire :

This tool used to assess nurses' knowledge regarding arterial blood gases and its interpretation. It designed by the researcher based on a thorough review of recent relevant literature and scientific references (*Bayomi & Taha, ۲۰۲۲*), (*Ibrahim et al., ۲۰۲۱*) & (*Abd Elkader et al., ۲۰۲۰*) . It consisted of two parts:

Part one: Nurses' personal data such as: age, gender, educational qualifications, years of experience in hospital , years of experience in ICU, training courses, number of courses and last date of courses. It contained (۸) questions.

Part two: Nurses' knowledge regarding arterial blood gases and its interpretation. This part contained (56) multiple choice questions designed by the researcher. It includes general knowledge about:

Scoring system: The score distributed as: one mark for each correct answer and zero for wrong answer, The total score of knowledge was (56) marks. The knowledge scores were converted into a percentage and categorized as follows:

- More than or equal 80% of total score (45 marks or more) considered satisfactory level of knowledge.
- Below 80% of total score (Less than 45 marks) considered unsatisfactory level of knowledge.

Tool (II): Nurses' practice observational checklist :

This tool adapted from (*Curtis et al., 2022*) , (*Johnson, 2022*), & (*Thomas, 2020*) and modified by the researcher after reviewing recent relevant literatures and scientific references to assess nurses' practices regarding arterial blood gases and its interpretation. It included the following:

Scoring system: The scores distributed as: one mark for each step correctly done, and zero for incorrectly done & not done, the total practice scores were (180) marks.

These scores were converted into a percentage and categorized as follows:

- Practices scores, more than or equal 80% of total score (144 marks or more) considered adequate level of practice.
- Practices scores, below 80% of total score (less than 144 marks) considered inadequate level of practice.

Tool (III): Arterial Puncture Self-Efficacy Scale (APSES):

This tool adapted from (*Guleria et al., 2022*) & (*Hernandez-Padilla et al., 2016*) which consists of 22 items and aimed to assess nurses' self-efficacy regarding arterial blood gases and its interpretation .

Scoring System of nurses' self-efficacy scale: All items in the arterial puncture self-efficacy scale were scored on a four points Likert Rating Scale whereas 1 mean not confident, 2 mean somewhat confident, 3 mean quite confident and 4 mean highly confident. The total score of all items was ranged from 1 to 88 grades.

Educational booklet regarding arterial blood gases and its interpretation: It was developed by the researcher after reviewing literature and scientific references based on nurses' needs (*Mohammed & Abdullatif, 2022*) & (*Ibrahem et al., 2021*) and aimed to improve nurses' knowledge and practice regarding arterial blood gases and its interpretation.

Method:

I- Administrative design:

Official permission to conduct the study was obtained from the hospital director, nurse supervisor and head nurse of ICU at Benha University Hospital by the submission of a formal letter from the dean of the faculty of nursing at Benha University.

Ethical considerations:

- Oral and written consent was obtained from the studied nurses in order to participate in the study.
- The aim of the study was explained to all nurses, and they were reassured that all information will be confidential, and it will be used only for their benefit and for the research purpose.
- The studied nurses are also informed that they are allowed to choose to participate or not in the study and they have the

right to withdraw from the study at any time without any reason giving.

- The research tools will not cause any harm for participants
- Permission to carry out the study from responsible authorities in the faculty of nursing at Benha University and hospital administration personnel.

II-Preparatory phase:

This phase included reviewing of literature on various aspects of this study to develop the appropriate tools for data collection according to supervisors' guidance and experts' opinions. During this phase, the researcher also visited the study setting to be acquainted with the personnel and the setting.

Tools Validity

The tools were reviewed by a panel of five experts from medical surgical nursing field at faculty of nursing, Benha University. Jury involved two professors and three assistant professors of medical surgical nursing to test the relevance, clarity of tools' content, comprehension, understanding and applicability of the questions. The consensus among experts regarding the tools was between 98% to 100% for most items, then all required modifications were done consequently, and the final form of the tools was used for data collection.

Reliability

The researcher used test – retest – methods to test the internal consistency of the tools, by administration of the same tools to the same subjects under similar condition on two different occasions. Testing the reliability of the tools through **Cronbach alpha**. Tool reliability for self-administered questionnaire that used to assess nurses' knowledge was 0.974. Tool reliability for nurses' practice observational

checklist that used to assess nurses' practice was 0.949 & 0.970 for nurses' Self-efficacy.

Pilot study

A pilot study was carried out on 10% of the studied subjects (10 nurses) in order to test the clarity and applicability of the tools and determine the time needed for filling it. According to the results of pilot study there was no modification, so the nurses involved in pilot study were included in the study.

Fieldwork

The process of data collection was performed over a period of nine months from beginning of July ,2024 to the end of March ,2025. The researcher visited ICU and chest care unit three days/week (Sunday, Wednesday and Thursday) in the morning and afternoon shifts to collect data. It carried out through four phases:

I- Assessment phase:

The researcher interviewed the available nurses in additional teaching room at ICU and in nurses' room in chest care unit then the researcher assesses nurses' knowledge through self-administered questionnaire (**Tool I**) which given to each nurse to fill it and time required for completion of the questionnaire was ranged from 20- 30 minutes.

Then the researcher assesses nurses' practical skills through observational checklist (**Tool II**) which is done at time of arterial blood gases sampling and interpretation of results once appears, the time needed to complete the checklist ranged between 30-35 minutes.

Also, the researcher assesses self-efficacy

using nurses' self-efficacy scale (**Tool III**) that given to each nurse to fill it and time required for completion of the scale was ranged from ٢٠- ٢٥ minutes.

This assessment (pretest) gives more insight about the current nurses' knowledge, practice and self-efficacy level to help detecting knowledge, practice and self-efficacy deficits.

II-Planning phase:

The educational booklet developed by the researcher according to nurses' needs and deficiencies in their performance. It was written in simple Arabic language and reviewed by the supervisors, and the validity was done by a panel of five experts from medical surgical nursing field.

Teaching methods were prepared e.g. discussion, demonstration, redemonstration and teaching materials as booklet , PowerPoint presentation and videos that helped in covering theoretical and practical information.

III-Implementation phase:

-All available nurses in the intensive care unit and chest care unit during the time of data collection and agreed to participate in this study was recruited into the study.

- The researcher gave the educational booklet to nurses immediately post assessment phase. The educational booklet was written in a simple Arabic language and supplemented by pictures and illustrations to help the nurse understanding of the content.

- Total number of the studied nurses was ٩٥ nurses; they were divided into ١٠ groups. Each group contained ٩-١٠ nurses in every session. The researcher was attended three

days/week in the morning and afternoon shift and met every group through four sessions: Two sessions for theory part and two sessions for practices. Each session ranged between ٤٥-٦٠ minutes, including the period of discussion.

- An orientation to the educational booklet and its process were presented. Each session started with a brief summary about what had been given through the previous session, then the objectives of the new topics, taking into consideration the use of simple language to suite the level of all nurses' education.

The sessions were presented as the following:

- **Session one:** (introductory session) it included explanation of reasons and importance of designed educational booklet, explanation of arterial blood gases test, indications and contraindications for arterial blood gases test, complications resulting from taking an arterial blood sample and factors that affect accuracy of arterial blood gases results.
- **Session two:** included an explanation about normal rates of arterial blood gases results, metabolic acid - base disorders, respiratory acid - base disorders.
- **Session three:** Demonstration role of the nurse before, during and after drawing an arterial blood gases sample from radial artery, brachial artery, femoral artery and arterial line.
- **Session four:** concerned with steps of interpretation of arterial blood gases results with some examples.

Discussion, motivation and reinforcement during the sessions were used to enhance learning. At the end of each session the researcher allowed nurses to ask questions to correct any misunderstanding.

Also, at the time end of each session the nurse's question were answered and discussed to correct any misunderstanding and the researcher received notes from the nurses and thanked them for their cooperation. Then asked them about their opinion on the educational program and their benefits from the subject and distributed the questionnaire for post test.

IV-Evaluation phase:

This phase aimed to evaluate the effect of educational program regarding arterial blood gases and its interpretation on nurses' knowledge, practice and self- efficacy. It implemented through two phases;

Phase I: Immediately post program implementation using Tool I (part II), Tool II and Tool III.

Phase II: Post three months of program implementation using the same tools.

Statistical analysis

Results were collected, statistically analyzed by personal Computer using Statistical Package of Social Science (SPSS) (version 20). Qualitative data was presented as a number and percent. Furthermore, quantitative data was described as mean or standard deviation, as appropriate. Chi-square test was used to examine the difference and relation between qualitative variables during different periods. For quantitative data, paired t test for comparing between two different periods within one group. Comparison between two groups

was done using student t-test and anova test for comparison between more than two groups. Pearson method was used to test correlation between numerical variables.

Statistical significance was considered as the following:

- P value < 0.001 highly statistically significant relation.
- P value < 0.05 statistically significant relation.
- P value > 0.05 no statistically significant relation.

Results:

Table (1): Percentage distribution of studied nurses according to their personal data which reveals that the age of 66.8% of the studied nurses was <30 years with a mean age of 29.49 ± 0.71 years. Concerning gender, 94.7% of the studied nurses were females. As for educational level, 47.4% of the studied nurses had nursing technical institute. 87.4 % of them had 1- ∞ years of experience in hospital, moreover 91.6 % had ∞ years of working experience in ICU and 44.2% of nurses reported attending training courses on arterial blood gases interpretation, where as 64.3% of them had one course.

Table (2): Difference between total mean of nurses' knowledge about arterial blood gas testing and interpreting its results which reveals that there was a highly statistically significant differences regarding total mean of nurses' knowledge between pre and post program implementation periods, in term of improvement in knowledge score. Where, complications of arterial blood sample and factors that affect the accuracy of its results was of the highest percent of mean knowledge score post 3 months period of program implementation constituting 92.7%

accompanied by role of nurse in drawing ABGs which represent 92.6%.

Figure (1): Difference between nurses' total knowledge level regarding basic concepts of arterial blood gases testing and interpreting its results which shows that there was statistically significant difference in total knowledge level between pre and post program implementation periods. Where, 91.6% of studied nurses had unsatisfactory levels of total knowledge about arterial blood gas testing and interpreting its results preprogram implementation, while they had satisfactory knowledge level during immediate and post three months periods of program implementation among (88.4% & 84.2%, respectively).

Table (2): Difference between total mean of nurses' practice regarding arterial blood gases sampling and interpretation its result pre and post periods of implementing the educational program which clarifies that, that there was a highly statistically significant differences regarding nurses' total mean of practice between pre and post program implementation periods, in term of improvement in practice score. Where, nurses' practice of arterial blood gases interpretation was of the highest percent of mean practice score post 3 months period of program implementation constituting 90.9%.

Figure (2): Difference between nurses' total practice level regarding the arterial blood sampling pre and post periods of implementing the educational program which illustrates that, there was statistically significant difference in total practice level between pre and post program implementation periods. Where, 93.7% of studied nurses had incompetent level of practice regarding the arterial blood sampling preprogram implementation, while they had a competent level during

immediate and post three months periods of program implementation among (62.1% & 66.8%, respectively).

Figure (3): Difference between nurses' total self-efficacy level of arterial puncture pre and post implementing the educational program. Illustrates that there was statistically significant difference in total self-efficacy level between pre and post program implementation periods. Where, 67.4% of studied nurses had moderate confidence level regarding the practice of arterial blood sampling preprogram implementation, while they had a high confidence level during immediate and post three months periods of program implementation among (86.3% & 83.2%, respectively).

Table (3): Correlation between total knowledge, practice, and self-efficacy among the studied nurses pre and post periods of implementing educational program which clarifies that, that there was a positive and significant correlation between total nurses' knowledge with their total practice and self-efficacy regarding blood gases interpretation immediate and post 3 months periods of program implementation with p-value of ($< 0.05^*$). Whereas there was no significant correlation between self-efficacy with practice preprogram implementation with p-value of (> 0.05).

Table (1): Percentage distribution of studied nurses according to their personal data (n = 90).

Nurses' personal data	No.	%
Age / years		
< 30	54	60.0
30 - < 40	30	33.3
≥ 40	6	6.7
Mean ± SD	39.49 ± 0.71	
Gender		
Male	24	26.7
Female	66	73.3
Educational level		
Secondary diploma in nursing	8	8.9
Nursing Technical institute	40	44.4
Health Technical institute	3	3.3
Bachelor of Nursing	24	26.7
Post graduate studies	15	16.7
Years of Experience working in hospital		
< 1 year	4	4.4
1 - < 5 years	83	91.1
5 - < 10 years	3	3.3
Mean ± SD	4.21 ± 0.58	
Years of Experience working in ICU		
< 5 years	87	96.7
5 - < 10 years	3	3.3
Attending previous training courses for arterial blood gases interpretation		
Yes	42	46.7
No	48	53.3
If yes, number of training courses		(n= 42)
One course	27	64.3
Two courses	9	21.4
Three courses	4	9.5
More than 3 courses	2	4.8
The last period of taking training courses		
< 6 months	37	88.1
≥ 6 months	5	11.9
Mean ± SD	0.23 ± 0.29	

Table (٢): Difference between total mean of nurses' knowledge about arterial blood gas testing and interpreting its results(n=٩٥).

Total nurses' knowledge	Max score	Knowledge (pre educational program) n= ٩٥	Knowledge (immediately post educational program) n= ٩٥	Knowledge (post ٣ months of educational program) n= ٩٥	% of mean post ٣ months of educational program	Paired t test P value (١)	Paired t test P value (٢)
		$\bar{x} \pm SD$	$\bar{x} \pm SD$	$\bar{x} \pm SD$			
Arterial blood gas testing	٨	٥.٣٠ ± ١.٢٢	٧.٣٣ ± ٠.٨٣	٧.١٣ ± ٠.٩٠	٨٩.١%	-١٥.٥٢٦ <٠.٠٠١*	-١٤.٩٩١ <٠.٠٠١**
Indications and contraindications for arterial blood gas test	٤	٢.٧٤ ± ١.٢٧	٣.٧٥ ± ٠.٤٩	٣.٦٦ ± ٠.٦٢	٩١.٥%	-٩.٠٦٤ <٠.٠٠١*	-٩.٤٨٠ <٠.٠٠١**
Complications of arterial blood sample and factors that affect the accuracy of its results	٤	٢.٥٤ ± ١.٥١	٣.٨٠ ± ٠.٥١	٣.٧١ ± ٠.٦٤	٩٢.٧%	-٨.٠٩٣ <٠.٠٠١*	-٧.٧٤٤ <٠.٠٠١**
Normal rates of arterial blood gas analysis results	١٤	٩.٥٠ ± ٢.٧٧	١٣.٢٧ ± ١.٠٥	١٢.٩٤ ± ١.٤٠	٩٢.٤%	-١٣.٦٤٧ <٠.٠٠١*	-١٢.٧٢٥ <٠.٠٠١**
Acid base balance	٦	٢.٨٣ ± ١.٦٤	٥.٤٢ ± ٠.٨٧	٥.٢٦ ± ١.٠٤	٨٧.٦%	-١٥.٦٩٨ <٠.٠٠١*	-١٤.٥٥٣ <٠.٠٠١**
Metabolic (acid - base) disorder	١١	٥.١٨ ± ٢.٣٩	١٠.٣٦ ± ٠.٨٩	٩.٩٣ ± ١.٥٠	٩٠.٢%	-١٩.٨٨١ <٠.٠٠١*	-١٩.٤٨٨ <٠.٠٠١**
Respiratory disorder (acid - base)	٨	٣.٨١ ± ١.٨٣	٧.٤٨ ± ٠.٨٢	٧.٢٨ ± ١.١٧	٩١.٠%	-٢٠.٤٩٦ <٠.٠٠١*	-١٨.٥٩٣ <٠.٠٠١**
Role of nurse in drawing ABGs	٨	٤.٧٦ ± ٢.٠٦	٧.٦٥ ± ٠.٧٥	٧.٤١ ± ٠.٩٢	٩٢.٦%	-١٣.٩١٤ <٠.٠٠١*	-١٢.٥٤٩ <٠.٠٠١**
Interpreting results of ABGs	١٣	٦.١٤ ± ٣.٣٩	١١.٩٥ ± ١.١١	١١.٥٥ ± ١.٨٦	٨٨.٨%	-١٦.٥٩٦ <٠.٠٠١*	-١٤.٨٤٠ <٠.٠٠١**

Figure (١): Difference between nurses' total knowledge level regarding basic concepts of arterial blood gases testing and interpreting its results (n=٩٥).

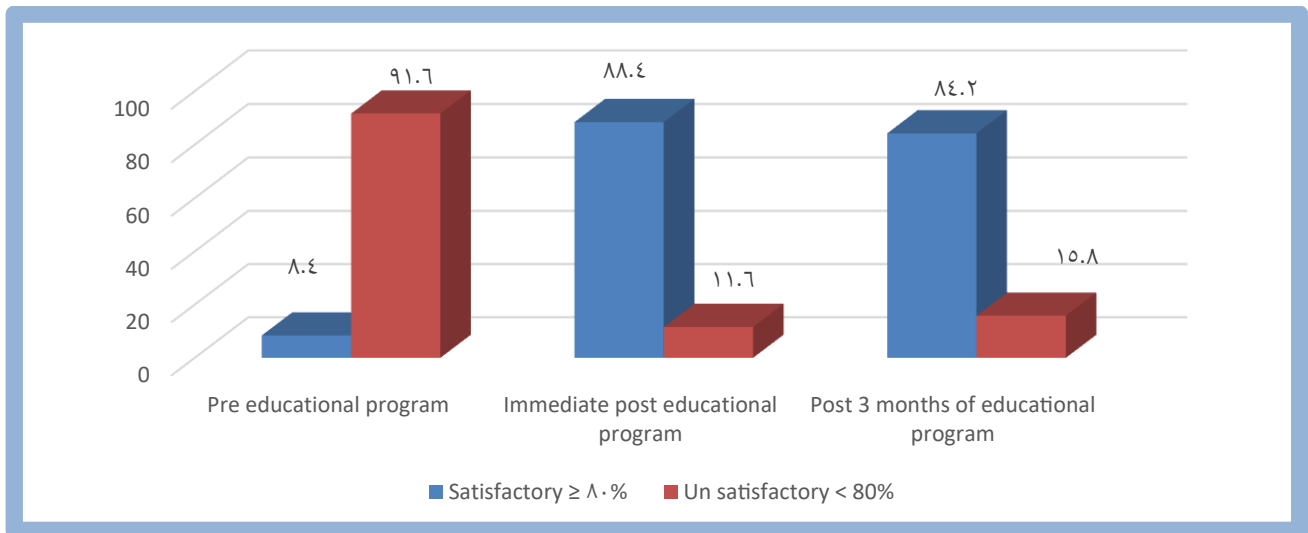


Table (3): Difference between total mean of nurses' practice regarding arterial blood gases sampling and interpretation its result pre and post periods of implementing the educational program (n=90).

Total nurses' practice	Max score	Practice (pre educational program) n= 90	Practice (immediately post educational program) n= 90	Practice (post 3 months of educational program) n= 90	% of mean post 3 months of educational program	Paired t test P value (1)	Paired t test P value (2)
		$\bar{x} \pm SD$	$\bar{x} \pm SD$	$\bar{x} \pm SD$			
Nurses' practice of arterial blood sampling via radial artery	47	23.42 ± 4.27	32.40 ± 4.94	32.13 ± 4.80	68.3%	-18.209 <0.001**	-17.766 <0.001*
Nurses' practice of arterial blood sampling via brachial artery	39	19.23 ± 4.08	30.01 ± 4.04	29.02 ± 4.00	70.6%	-21.491 <0.001**	-20.761 <0.001*
Nurses' practice of arterial blood sampling via femoral artery	39	19.42 ± 3.20	34.61 ± 6.96	33.97 ± 6.86	87.1%	-29.394 <0.001**	-27.819 <0.001*
Nurses' practice of arterial blood sampling via arterial line	38	19.98 ± 3.01	34.01 ± 0.82	33.72 ± 0.78	88.7%	-30.137 <0.001**	-33.670 <0.001*
Nurses' practice of arterial blood gases interpretation	22	3.22 ± 0.23	21.30 ± 3.16	21.11 ± 3.10	90.9%	-30.707 <0.001**	-30.299 <0.001*

Figure (Y): Difference between nurses' total practice level regarding the arterial blood sampling pre and post periods of implementing the educational program (n=90).

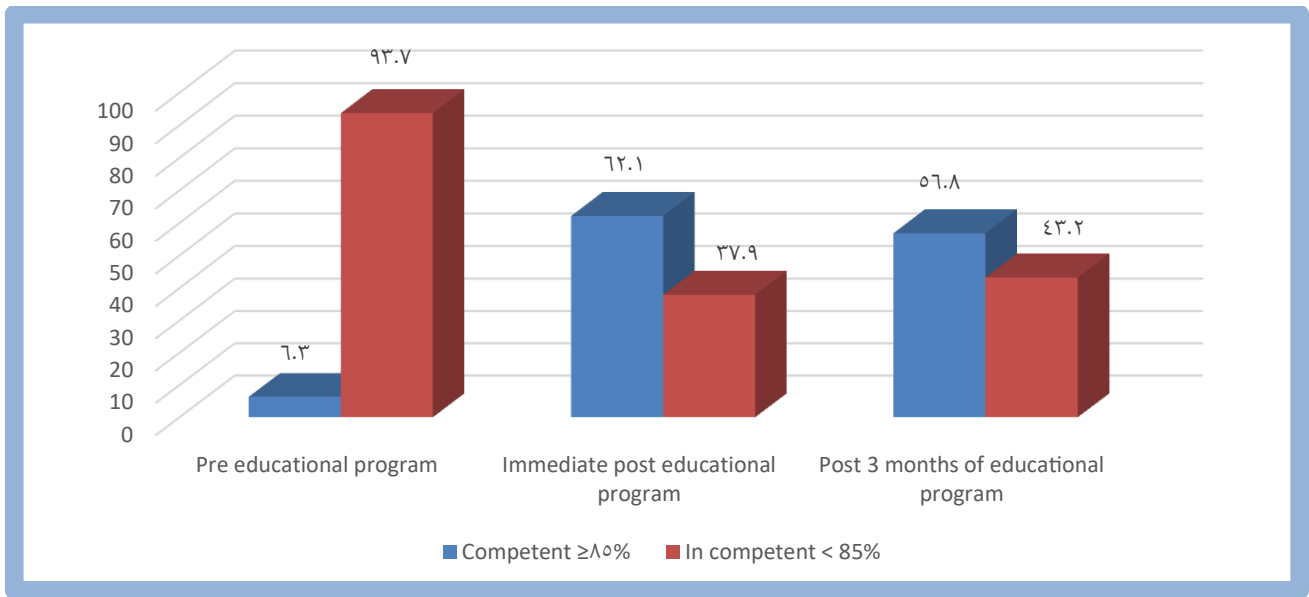


Figure (3): Difference between nurses' total self efficacy level of arterial puncture pre and post implementing the educational program (n=90)

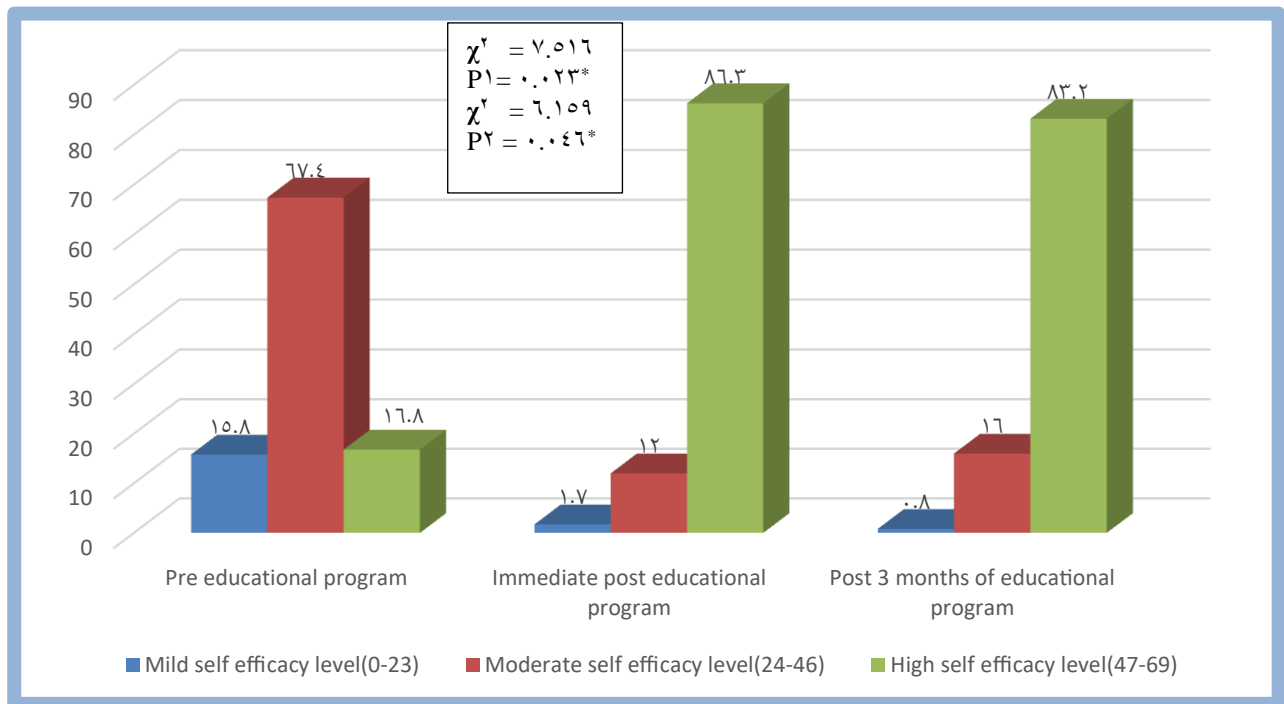


Table (4): Correlation between total knowledge, practice, and self-efficacy among the studied nurses pre and post periods of implementing educational program (n=90).

<i>r- p values</i>	Periods	<i>Total knowledge</i>		<i>Total practice</i>	
		r	p- value	r	p- value

<i>variable</i>					
Total practice	Pre	0.046	0.729 ^{n.s}	-	-
	Immediately post	0.306	<0.001 ^{**}	-	-
	Post 3 months	0.487	<0.001 ^{**}	-	-
Total self-efficacy	Pre	0.284	0.000 [*]	0.028	0.787 ^{n.s}
	Immediately post	0.320	0.011 [*]	0.287	0.000 [*]
	Post 3 months	0.404	<0.001 ^{**}	0.280	0.006 [*]

Discussion:

Arterial blood gases (ABG) analysis is a crucial skill for nurses to identify high risk patients with acid base imbalance in critical care units. Nurses' familiar with normal ABG values can quickly spot abnormal results. Identifying acid-base imbalance problems early which leads to improved patients care and can help to reduce morbidity and mortality. In extreme circumstances in which therapeutic compensation is required, the nurse should be knowledgeable about potential risks of therapy and able to carefully monitor administration rates and therapeutic responses (*Zaboli et al., ۲۰۲۵*).

ABG analysis is repeatedly used to assess critically ill patients' respiratory and metabolic status. Therefore, critical care nurses having an important role in patients' assessment, care and collecting ABG samples, interpreting and reporting results, recording deviations from normal and integration of these results into patients' care (*Ghimire et al., ۲۰۲۳*). So, this study aimed to evaluate the effect of educational program regarding arterial blood gases interpretation on nurses' performance and self-efficacy.

Regarding to age, the present study finding revealed that more than half of the studied nurses aged less than thirty years old with mean and standard deviation of (۲۹.۴۹ ± ۰.۶۱). **From the researcher's point of view**, this result might be due to the majority of staff were newly graduated and newly hired and tolerate the nature of the work in ICU units, critical care units usually need newly graduated staff because they have full of energy and enthusiasm. This finding is in the same line with *Vahedian-Azimi et al., (۲۰۲۱)* in their study entitled "Effect of the specific training course for competency in doing

arterial blood gas sampling in the intensive care unit" whose results more than two thirds of the studied nurses were females.

In regard to gender, the current study revealed that three quarter of nurses were females. **From the researcher's point of view**, these results may be because nursing is a female profession for a long time in Egypt as it appeared from nursing history. Additionally male nurses prefer to travel abroad or working in private hospitals for high salary outcome. This finding agreed with *Zaboli et al., (۲۰۲۵)* in their study entitled "Arterial Blood Gas Analysis and Clinical Decision-Making in Emergency and Intensive Care Unit Nurses: A Performance Evaluation" whose results revealed that most of the studied nurses in ICU were females. On the other hand, this finding disagreed with *Panwar, (۲۰۲۴)* in their study about "Effectiveness of Self-instructional Leaflet on knowledge regarding management of Arterial Blood Gas: A Pre-test–post-test Study, India" whose results revealed that more than half of the studied nurses were males.

Regarding educational level, the current study revealed that approximately two fifth of the studied nurses had technical institute of nursing. **From the researcher's point of view**, these results may be due to technical institute of nursing provide the community with large number of nurses and most bachelor nurses in the governmental hospitals are working as nursing supervisor or head nurse. this result is inconsistent with *Ibrahem et al., (۲۰۲۱)* in their study entitled "Arterial Blood Gases Interpretation: critical care nurses' knowledge and practices at a university hospital– Kafr-elsheikh Governorate, Egypt " whose results revealed that all studied samples had a bachelor degree.

In relation to years of experience in hospital, the current study results showed that majority of the studied nurses had experience less than five years. **From the researcher's point of view**, nurses had experience less than five years related to their age which was less than thirty years old. This finding is in the same line with *Maseeh et al.*, (2024) in their study entitled "Assess the knowledge regarding ABGs Analysis among Nurses" whose results revealed that majority of the studied nurses had experience less than five years.

Regarding years of experience in the intensive care unit, the current study results revealed that most of the studied nurses had experience less than five years. **From the researcher's point of view**, nurses had experience less than five years due to work stress, severity of patient condition and occupational hazards that facing nurses, all of these factors prevent nurses from continuing work in the critical care unit. This finding agreed with *Begum, et al.*, (2019) in their study entitled "Assess The effectiveness of structured teaching Program on knowledge of ABG Analysis Among Staff Nurses of ICU In Selected Private Hospitals of Guwahati" whose results revealed that majority of the studied nurses had one to five years of experience in ICU.

In relation to attendance of previous training courses about arterial blood gases interpretation, the present study finding displayed that only approximately two fifth of the studied nurses receive training courses regarding arterial blood gases interpretation. **From the researcher's point of view**, this may be due to work load in critical care units and training courses specific to arterial blood gases interpretation were not offered in the nursing in service training programs or in the

educational curriculums. This finding is in the same line with *Yadav*, (2022) in their study entitled "A Study to Assess the Structured Teaching Program on Knowledge about Arterial Blood Gas Analysis among the Staff Nurses Working in Critical Care Unit of Selected Hospital, Barabanki" whose results showed that three quarter of nurses didn't attend any training course related to ABG analysis.

Regarding to nurses' total mean of knowledge regarding arterial blood gas testing and interpreting its results, the present study revealed that there was a highly statistically significant differences regarding total mean of nurses' knowledge between pre and post program implementation periods, in term of improvement in knowledge score. **From the researcher's point of view**, this improvement might be related to effective role of designed training program for improving nurses' knowledge which included concise presentation in each session, using a simple language, clear educational methods and instructional media. This finding supported by *Panwar*, (2024) whose results revealed that there was a statistically significant difference between the mean scores (pre- and post-test knowledge scores) at $p=0.00$.

Also, this finding agreed with *Nafees et al*., (2024) in their study entitled "Effect of planned teaching program on the knowledge regarding Arterial Blood Gas Interpretation and selected nursing measures among staff nurses of selected hospitals of Moradabad, UP" whose results revealed that the mean post-test scores of knowledge overcoming the mean pre-test score of knowledge with statistically significant difference.

In addition, this finding is in the same line with *Kulvi*, (2022) whose results revealed that mean of Post-test knowledge score was significantly higher than mean of pre-test knowledge score at 0.05 level of significance. Also, this finding agreed with *Pakkirisamy*, (2021) in their study entitled "Effectiveness of Planned Teaching Program on Knowledge regarding Arterial Blood Gas Analysis among Nurses in a Selected Hospital, Gwalior" whose results revealed that there was statistically significant at $P < 0.05$ regarding level of knowledge between pre-test and post-test.

Moreover, this finding is consistent with *Jasmi et al.*, (2022) whose results revealed that there was a statistically significant difference regarding level of knowledge between pre-test and post test which means that Nurse Led Education was effective.

Concerning total mean of nurses' practice regarding arterial blood gases sampling and interpretation its result, the present study revealed that there was a highly statistically significant differences regarding nurses' total mean of practice between pre and post program implementation periods, in term of improvement in practice score. **From the researcher's point of view**, these findings before program implementation may be due to poor skills, increased work load which may hinder the ability to train and improve their practice, While after the training program total practice improved due to availability of hand out and training that boosted nurses' confidence and leading to improved efficiency and accuracy in their work. Also, these findings reflect positive effect of the training program.

This finding is in the same line with *Mohammed et al.*, (2024) in their study

entitled "Effect of Educational Guidelines on Nurses' Performance Regarding Arterial Blood Gases Sampling and Interpretation at Mansoura University, Egypt" whose results showed that there was statistically significant increase in mean practice score pre and post educational guidelines implementation. Satisfactory practice frequency changed from less than half pre educational guidelines implementation to most of the study sample post educational guidelines implementation.

Also, this finding supported by *Bayomi & Taha*, (2022) in their study entitled "Effect of Self –Learning Package on Nurses' Knowledge and Practice Regarding Arterial Blood Gases Analysis for Critically Ill Patients at Zagazig University hospital, Egypt" whose results showed that there was statistically significant difference between pre/post, pre/follow-up, and pre/post/follow-up as regarding to total level of nurses practice with P value was 0.0001.

In addition, this finding agreed with *Upreti & Mishra*, (2022) whose results showed that there was statistically significant difference between mean pre-test practice score and post-test practice score at 0.05 level of significance.

Concerning nurses' total self-efficacy level regarding arterial blood gases and its interpretation, the present study revealed that there was a statistically significant difference between nurses' total self-efficacy score regarding arterial blood gases and its interpretation pre and post-program implementation at P value < 0.001 . **From the researcher's point of view**, the result prior to program implementation may be due to heavy workloads, lack of training and low institutional support which leading to nurses feel low confident in their abilities and

negatively affect their self-efficacy. Program implementation help to enhance self-efficacy and provide nurses with skills, knowledge and support which ultimately help boost their confidence and performance. This finding is consistent with the study by *Abd Elkader et al.*, (2020) in their study entitled "Effect of Applying Program Based Learning on Nurse's Performance and Self-efficacy Regarding Arterial Blood Puncture at Port Said University Hospital, Egypt" whose results showed A significant difference between levels of nurses' self-efficacy about arterial puncture after program implementation with p-value of 0.000. On the other hand, this finding is inconsistent with *Guleria et al.*, (2023) in their study entitled " A descriptive study to assess the knowledge and self-efficacy regarding ABG analysis and its Interpretations among Nursing Personnel working in selected hospitals of Ambala, Haryana " whose results showed that majority of studied nursing personnel have high level of self- efficacy regarding ABG analysis and its Interpretations.

Concerning correlation between total knowledge, practice, and self-efficacy among the studied nurses throughout phases of training program implementation, there was a positive and significant correlation between total nurses' knowledge with their total practice and self-efficacy regarding arterial blood gases sampling immediate and post 3 months periods of program implementation with p-value of ($< 0.05^*$). While there was not significant correlation between self-efficacy with practice preprogram implementation with p-value of (> 0.05). **From the researcher's point of view**, there was positive and significant correlation between total nurses' knowledge with their total practice and self-efficacy post program

implementation due to educational program was effective to enhance self-efficacy and provide nurses with skills, knowledge and support which ultimately help boost their confidence and performance. while there was not significant correlation between self-efficacy with practice pre program implementation because self-efficacy usually impacts practice after program implementation rather than before. This finding is in the same line with *Mohammed et al.*, (2024) whose results showed that there was a positive correlation between total score of knowledge and practice pre and post intervention program. This finding is also consistent with *Guleria et al.*, (2023) whose results revealed that coefficient of correlation between knowledge and self-efficacy is significant in nature. It shows that there is low positive correlation between the knowledge and self-efficacy.

Conclusion:

Educational program effectively improved nurses' knowledge, practice and self-efficacy regarding arterial blood gases interpretation where their knowledge were significantly more satisfactory after implementation of educational program than before, their practice were significantly more competent after implementation of educational program than before and their self-efficacy were significantly more confident after implementation of educational program than before.

Recommendations:

- 1- Encourage interdisciplinary collaboration among healthcare professionals to enrich their knowledge and practices regarding arterial blood gases sampling and its interpretation.

- ٢- Close supervision of nurses during performing their skills to determine areas of deficiency that needs corrective action.
- ٣- Orientation programs should be provided for new critical care nurses included knowledge about arterial blood gases sampling and its interpretation.
- ٤- Adoption of updated guidelines with health care administrators and practitioners regarding arterial blood gases sampling and its interpretation.
- ٥- Further study is needed about arterial blood gases sampling and interpretation on larger sample size to evaluate its effect on nurses' performance and patients' outcomes.
- ٦- Ongoing educational guidelines and training courses for nurses' regarding arterial blood gases sampling and its interpretation.

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