

Effect of Implementing Educational Strategies on Nurses' Performance Regarding Cardiac Catheterization for Children with Congenital Heart Disease

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Abstract

Background: Congenital heart disease in children is the most common major congenital anomaly that is required to be treated by cardiac catheterization which stands out as a reasonable tool to diagnose and treat children of various heart diseases. **The aim of the study** was to evaluate the effect of implementing educational strategies on nurses' performance regarding cardiac catheterization for children with congenital heart disease. **Research design:** Quasi-experimental research design was used . **Subjects and setting:** Convenience sampling of nurses (50nurses) from Cardiac Intensive Care Unit and Cardiac catheterization Unit at Tanta Educational International Hospital. **Two tools were used to collect data: Tool I:** Structured interview for nurses regarding their knowledge of congenital heart diseases and cardiac catheterization. **Tool II:** An Observational checklist for nurses' practices. **Results** demonstrated that Three quarters of nurses had poor knowledge and majority of them had unsatisfactory level of practice before implementation of the educational strategies, while immediately and after one month total scores of nurses` knowledge and practice were improved with a statistical significant differences . **The study concluded that: The** finding of the present study revealed there was significant improvement of nurses' knowledge and practices after implementing of educational strategies. **The study recommended** that Continues in-service training programs for all nurses should be conducted in order to improve, update and refresh their knowledge and practices regarding cardiac catheterization for children with congenital heart disease.

Key words: Cardiac Catheterization, Children, Congenital Heart Disease, Educational Strategies, Nurses` Performance

Introduction

Congenital Heart Disease in pediatric children is life threatening disorders that affect the child health and family, about 1 in 120 newborns born each year in the United States has a congenital heart diseases. Congenital heart defects are structural problems with the heart that are present at birth. They result when a problem occurs during heart development soon after conception; it has to occur during the first 8 to 12 weeks of gestation (Salma.2018). Congenital heart disease is caused by pre-natal environmental hazards as well as hereditary reasons, most of the time, the real cause of heart abnormality is unknown. More than 32,000 newborn each year with some forms of heart defect (Powell-Wiley., et al. 2021).

Incidence of Congenital heart disease among Egyptian children was found to be 5:6/1000 live births (staff, 2023). These children are often diagnosed in the first year of life and childhood (Garg., et al.2013). The birth prevalence of congenital heart disease varies among studies worldwide and is mostly reported between 8 and 12 per 1000. With a prevalence of 9 per 1000, approximately 1.35 million newborns are born with Congenital Heart Disease every year globally" (Powell-Wiley., et al. 2021)

The etiology of congenital heart disease in children is not fully understood in more than 90% of cases. However, certain factors are associated with a higher prevalence of these defects, including prenatal influences such as maternal rubella infection during pregnancy, maternal alcoholism, advanced maternal age (over 40 years), and maternal insulin-dependent diabetes. The increasing prevalence of congenital heart defects is likely attributed to advancements in diagnostic capabilities and improvements in overall survival rates. (Hockenberry, Wilson

& Rodgers, 2021: Marwali, Purnama & Roebiono, 2021)

Congenital heart defects are divided into acyanotic and cyanotic types. Acyanotic defects encompass conditions such as coarctation of the aorta, patent ductus arteriosus, and ventricular septal defect. (Haas & Kleideiter 2015) Typical cyanotic defects include Tetralogy of Fallot and transposition of the great vessels. Tetralogy of Fallot consists of four abnormalities: pulmonic stenosis, a ventricular septal defect, right ventricular hypertrophy, and an aorta that overrides the ventricular septal defect. (Cooper& Gosnell (2014); Gatzoulis, Webb & Daubeney. 2010).

Diagnosing congenital heart disease in children involves various tests such as blood pressure measurement, fetal echocardiogram, electrocardiogram (ECG), echocardiogram, pulse oximetry, and chest X-ray. An abnormal blood flow through the vessels can produce a heart murmur, which is detected using a stethoscope to examine heart defects. Additionally, cardiac catheterization is used to diagnose congenital heart disease. (Sun, Liu, Lu, & Zhang, 2015).

Congenital heart defects differ in severity, symptoms, and complications, often influenced by the infant's or child's age and the defect's size. Various treatment strategies are crucial to ensure optimal care for children with congenital heart disease. These strategies include open-heart surgery, medical treatment, and cardiac catheterization. (Jiang., et al. 2023; Sobhy, et al, 2017)

Cardiac catheterization is an invasive procedure in which a small flexible catheter is inserted through a vein or artery, usually the femoral vein, into the heart for diagnostic and therapeutic

purposes. It is usually done with angiography as radiopaque contrast media is injected through the catheter and visualization of the blood flow is seen on fluoroscopic monitors (Lee, et al. 2016 ; Marwali, Purnama & Roebiono, 2021)

Numerous catheters are available for heart catheterization, varying in kind, type, and size. These catheters are categorized into two main groups: diagnostic catheters and interventional catheters.(Castaldi, Marchioro & Donolato, 2022). Therapeutic cardiac catheterization procedures are used as an alternative to open-heart surgery (Cavalcante, Brunori, Lopes, Silva & Herdman 2015).

Nursing care for a child undergoing cardiac catheterization is essential for the early detection of complications, thereby reducing mortality and morbidity rates. Pre-procedural care involves ensuring adequate perfusion, reducing fear and anxiety, obtaining the child's medical history, monitoring vital signs, administering intravenous fluids and medications as prescribed, and preventing injury to the child. (Martin, 2022)

Post cardiac catheterization care include assess child's pain, assessing nasogastric tube is in site, providing child with oxygen therapy, checking intake and output chart, skin care, and wound dressing (Peterson & Evangelista, 2017).

Moreover, providing high-quality nursing care to children in Cardiac Intensive Care Units necessitates advanced professional knowledge and practical skills due to the specific and complex nature of the care required.. (Martin. 2022).

The incidence of major complications during diagnostic cardiac catheterization procedures is typically less than 1%, with a mortality rate of 0.05% for these procedures. The complication rate for any given child is influenced by multiple factors, including

child demographics, vascular anatomy, comorbid conditions, clinical presentation, the specific procedure performed, and the operator's experience. Complications can vary in severity, ranging from minor issues such as discomfort at the catheterization site to severe outcomes, including death (Mand & Baradhi, 2018).

Significance of the Study:

Congenital heart disease in children constitute 28% of common major congenital anomaly that required to be treated by cardiac catheterization which stands out as a reasonable tool to diagnose and treat children of various heart diseases (Bakker, et al. 2019). It is regarded as a safe invasive procedure, however, like any invasive procedures it has some risks and complications that may happen throughout the procedure steps. The prevalence of vascular complications due it in children is found to be 7.3% while death rate is 0.2% (Pishgoo, Shahmoradi & Asadian. 2017). Therefore, children who undergo this procedure require care from a dedicated team to maximize the treatment benefits and minimize associated risks. Nurses equipped with sufficient knowledge and skills can promptly identify complications, take critical actions swiftly, and improve child's outcomes (Lee., et al. 2016).

Aim of the study:

To evaluate the effect of implementing educational strategies on nurses' performance regarding cardiac catheterization for children with congenital heart disease

Research Hypotheses:

- 1- Nurses knowledge is expected to be improved after implementing educational strategies regarding cardiac catheterization for children with congenital heart disease..
- 2-Nurses practice is anticipated to improve

after implementing educational strategies regarding cardiac catheterization for children with congenital heart disease

Subjects and method:

Design: Aquasi-experimental research design was used.

Setting: The study was conducted on nurses in Cardiac Intensive Care Unit and Cardiac catheterization Unit at Tanta Educational International Hospital.

Subjects: The convenience sampling of pediatric nurses (50 nurses) who were employed at the previously mentioned setting

Tools of data collection:

Tool (I): A Structured interview of pediatric Nurses' knowledge regarding cardiac catheterization for children with congenital heart disease. It was created by the researcher to assess nurses knowledge. It comprised of two parts:

Part(1):Socio-demographic characteristics of studied nurses as age , gender, level of education, years of experience, attendance of previous training program regarding care of children with cardiac catheterization.

Part (2) : Nurses' knowledge assessment sheet regarding cardiac catheterization for children with congenital heart disease: It was designed to collect nurses' knowledge of educational strategies.(Desai.,etal., 2019, Vozzella, et al. 2023):-

a- Nurses' knowledge regarding congenital heart disease definition, predisposing factors, types, clinical manifestation, complications, and management of complications.

b-Nurse knowledge regarding cardiac catheterization as definition, indications, nursing management of children with cardiac catheterization, complications and instruction discharge plan about daily activities and follow up care.

Scoring system as follow:

Correct and complete answers were scored (2) correct and incomplete answers were scored

(1) and incorrect answers and did not know were scored zero.

The total score level of knowledge was calculated by (18 questions \times 2=36)

Which was categorized as follows:

-High level of knowledge \geq 80%. (44-52)

-Moderate level of knowledge 70 % - <85%. (36-43)

-Low level of knowledge <70%. (0-35)

Tool II: Nurses' practices observational checklist. (Hockenberry., et al. 2021, Salma. 2020, Kligman., et al. 2020)

It was adapted by the researcher following a reviewing of relevant literature to assess nurses' practices before, immediately and one month after implementation of the educational strategies regarding cardiac catheterization for children with congenital heart disease. It included the following:

Part(1) Nurses` practices pre-cardiac catheterization: it included the following; Monitoring vital signs, and physical examination, checking child from head to toe in a systematic manner, in addition to measurement of weight, height, body mass index, fluid balance (intake and output) oxygen saturation, administration of intravenous fluids and medications as ordered

Part (2): Nurses` practices post cardiac catheterization: Nurse assesses physical status and routine management for child with cardiac catheterization by giving oxygen therapy if needed, monitoring intake and output through intake and output chart, skin care, assess puncture site characteristics through changing wound dressing and prepared the child for discharge through giving health education to the parents or caregivers that include nutritional needed, exercise and follow up plan.

Scoring system for nurse's practice as follow:

-Done correctly and completely were scored as (1).

-Done incorrect or not done at all were scored as (0).

The total score level of practice was calculated and classified as follow:

-Satisfactory practice $\geq 80\%$

-Unsatisfactory practice $< 80\%$

Method:

The study was conducted through the following steps

1-Official permission was obtained from Faculty of Nursing, Tanta University and directed to the administrators responsible for cardiac Intensive Care Unit and Cardiac Catheterization Unit of Tanta Educational International Hospital to obtain their approval and cooperation to conduct this study

2-Ethical Scientific Researcher Committee gave its ethical approval with ethical code (54- 4- 2022).

a) Nurses were notified of the study's purpose before providing their informed consent for inclusion in the research study. Privacy and confidentiality for the nurses was assured.

b) There was no harm or injury to the nurses as a result of the study.

c) Nurses had the right to leave the study at any time.

d) The aim of study was explained to the studied nurses before conducting the study.

3-Tools development: Two tools were utilized in the study:-

Tool I, II were designed after reviewing of relative literature to assess nurses` knowledge and practice.

4-Content validity: - Prior to initiating the research, both tools were tested for content and construct validity by five experts in nursing field to verify that the data was accurate and pertinent. Content validity index were 98%. Recommendation from expertise was done

5-Reliability: - The reliability of the tools (I

and II) was evaluated using Cronbach's alpha, which was 0.891.

6- A pilot study involving 10% of nurses from previously setting was conducted in order to assess the viability and intelligibility of the tools. The essential change was made.

7 -Application of the current study done taking the subsequent steps:

I. Assessment phase:-

The researcher reviewed recent related literature regarding cardiac catheterization for children with congenital heart disease strategies and expertise in order to implement it to assess the children who meets the inclusive and exclusive criteria of this study and to assess nurses' knowledge regarding cardiac catheterization and congenital heart diseases which include the following :-

1-Preparation of the content:

The researcher developed an educational Arabic booklet based on nurses' needs and data from the assessment phase, using recent relevant literatures available locally and internationally (books and magazines).

- It covered theoretical knowledge about congenital heart disease and cardiac catheterization, as well as practical nursing procedures regarding care of children with congenital heart disease undergoing cardiac catheterization.

Preparation of the educational strategies sessions;

The goal of educational strategies was to improve knowledge and practices of nurses regarding cardiac catheterization and congenital heart disease.

Educational strategies included 6 sessions for The total number of nurses was (50 nurses)

- Studied nurses were divided into 10 subgroups each subgroup consist of 5 nurses.

II-Implementation phase:

-The educational strategies program was conducted by the researcher through six sessions:

- The first session: Focused on the goal of the educational strategies and provided the nurses with basic knowledge about congenital heart disease.
- The second session: provided all nurses with knowledge regarding cardiac catheterization
- The third session: provided all nurses with knowledge regarding discharge instruction plan about daily activities and follow up care.
- The fourth session: Focused on providing the nurses working cardiac catheterization unit with the proper and needed practical skills regarding cardiac catheterization for children with congenital heart diseases as physical examination and teaching techniques of vital signs and measurement procedures, and oxygen saturation.
- The fifth session, Focused on nurses practice regarding fluid balance(intake and output), administration of intravenous fluids procedure or blood if needed and medications as ordered
- The sixth session: **Focused on** practices of skin care, wound dressing procedure, oxygen therapy procedure if needed, monitoring intake and output and prepared the child for discharge through nutritional needed, exercise and follow up plan

Statistical analysis:

The SPSS statistical computer application, version 26, was used to arrange, tabulate, and statistically analyze the data that had been gathered. The range, mean, and standard deviation were computed for the quantitative data. To compare qualitative data, the Chi-square test (χ^2) was employed. The paired samples t-test was utilized to compare the means of two variables within a group. The analysis of variance (ANOVA). R, the correlation coefficient between Pearson and

Spearman, was used to assess the correlation between the variables.

-Correlation between variables was evaluated using Pearson's correlation coefficient (r). Significance was adopted at $p < 0.05$ for interpretation of results of tests of significance.

-In order to evaluate the findings of the significance tests (*), a significance level of $P < 0.05$ was used. The findings of tests of significance were also interpreted using a highly significant at $P < 0.01$ (**). (White E. 2019).

Results:

Table (1): Illustrates that 70% of the studied nurses were in the age group $30 \leq 40$ years with mean age 33.74 ± 4.71 years and 50% of the studied nurses graduated from health technical institute. Also 62% of the studied nurses were from urban areas and 52% of them were married. Regarding attendance of training strategies, 68% of the studied nurses didn't attend training strategies related to care of children undergoing cardiac catheterization. As regards years of experience, 60% of the studied nurses have $10 \leq 20$ years of experience

Figure (1): Displays that the majority Of total nurses` knowledge before, immediately and one month after implementation of educational strategies with $X^2 = 33.319$, P value < 0.001 , $X^2 = 12.482$, P value $= 0.001$, $X^2 = 37.50$, P value < 0.001 respectively. **Table (2)** Illustrate that, highly statistically significant difference related to nurses' practice for children's anthropometrical measurements (height, weight, and body mass index) before, immediate, and one month after implementation of educational strategies with $X^2 = 66.174$, P < 0.001 , $X^2 = 60.482$, P < 0.001 , $X^2 = 47.311$, P < 0.001 respectively.

Table (3): Signify that highly statistically significant difference related to nurses' practice for children's physiological measurements (blood pressure, temperature, apical pulse and respiratory rate) before, immediate, and one month after implementation of educational strategies with $X^2 = 44.531$, $P < 0.001$, $X^2 = 55.866$, $P < 0.001$, $X^2 = 43.120$, $P < 0.001$, $X^2 = 23.035$, $P < 0.001$ respectively.

Table (4): Shows that, highly statistical significantly differences in total nurses' practice before, immediately and one month after implementation of educational strategies with $X^2 = 79.567$, $P \text{ value} < 0.001$ of $P \text{ value} 0.000$.

Table (5): The table clears that there was a positive significant correlation between nurses' knowledge and practice before, immediate, and one month after implementation of educational strategies after the implementation of routine teaching methods, with $r (0.097, 0.317)$ and $P (0.426, 0.508)$, respectively.

Table (6) Illustrated that a positive significant correlation between age, educational level and years of experience with their knowledge and practice before, immediate, and one month after implementation of educational strategies.

Table (1): Percentage distribution of the studied nurses regarding their socio demographic characteristics

Socio-demographic characteristics	(n=50)	
	No	%
Age (years)		
20≤30	15	30.0
30≤40	35	70.0
Mean ±SD	33.74± 4.71	
Educational level		
Secondary Nursing School	8	16.0
Health Technical Institute	25	50.0
Bachelor of Nursing Science	12	24.0
Postgraduate Diploma	5	10.0
Residence		
Rural	19	38.0
Urban	31	62.0
Marital status		
Single	14	28.0
Married	26	52.0
Widowed	2	4.0
Divorced	8	16.0
Attendance of cardiac catheterization training		
Yes	16	32.0
No	34	68.0
Years of experiences		
≤4	1	2.0
4<10	19	38.0
10≤20	30	60.0
Mean ±SD	11.8±4.54	

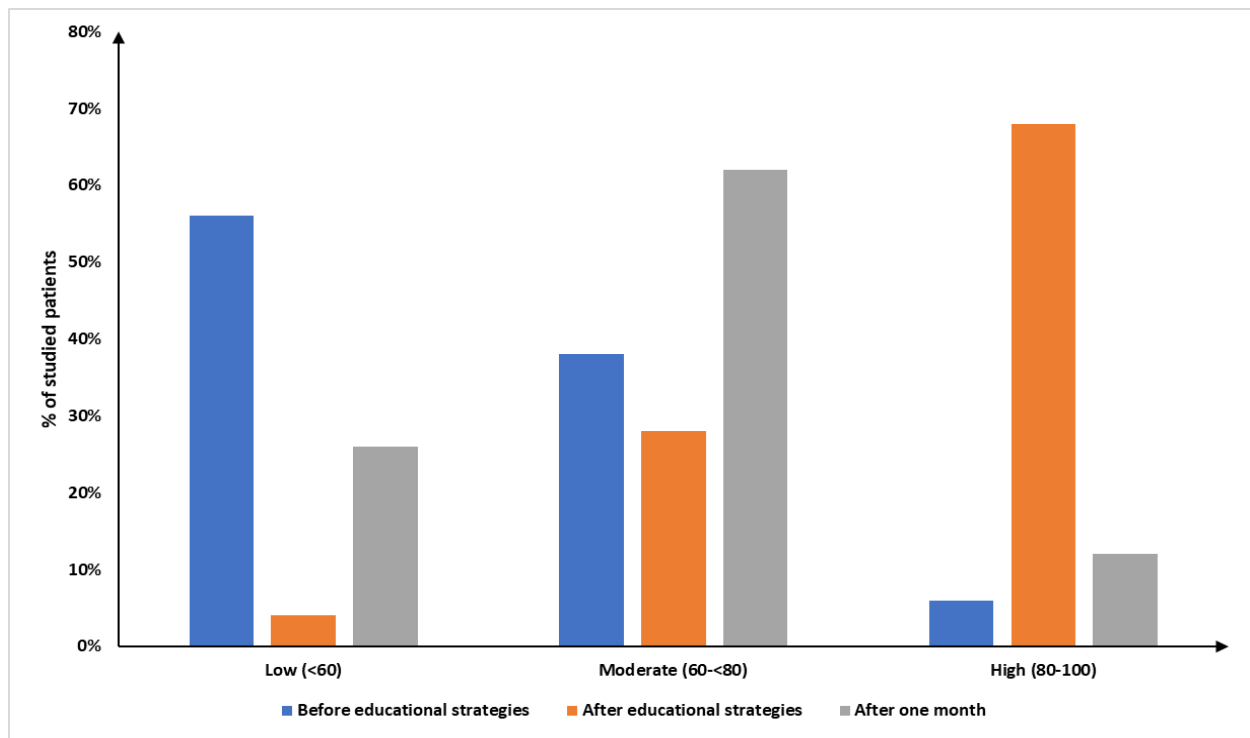


Figure (1): Total nurses` knowledge regarding to congenital heart disease and cardiac Catheterization

Table (2): Nurses` practice level related to anthropometrical measurements for children with congenital heart disease.

Nurses` practices	(n=50)												X ²	P
	Before educational strategies				Immediate after educational strategies				After one month					
	Satisfactory practice		Unsatisfactory practice		Satisfactory practice		Unsatisfactory practice		Satisfactory practice		Unsatisfactory practice			
	No	%	No	%	No	%	No	%	No	%	No	%		
Height	0	0.0	50	100.0	40	80.0	10	20.00	23	46.0	27	54.0	66.174	<0.001*
Weight	1	2.0	49	98.0	36	72.0	14	28.00	33	66.0	17	34.0	60.482	<0.001*
Body mass index	2	4.0	48	96.0	34	68.0	16	32.00	28	56.0	22	44.0	47.311	<0.001*

*: Statically significantly difference at (P value <0.05)

Table (3): Total level scores of the studied nurses` practices regarding physiological measurements for children with congenital heart disease.

Nurses` practice	(n=50)												X ²	P
	Before educational strategies				Immediate after educational strategies				After one month					
	Satisfactory practice		Unsatisfactory practice		Satisfactory practice		Unsatisfactory practice		Satisfactory practice		Unsatisfactory practice			
	No	%	No	%	No	%	No	%	No	%	No	%		
Blood pressure	3	6.0	47	94.0	35	70.0	15	30.0	26	52.0	24	48.0	44.531	<0.001*
Temperature	11	22.0	39	78.0	44	88.0	6	12.0	40	80.0	10	20.0	55.866	<0.001*
Apical pulse	1	2.0	49	98.0	32	64.0	18	36.0	22	44.0	28	56.0	43.120	<0.001*
Respiratory rate	9	18.0	41	82.0	32	64.0	18	36.0	26	52.0	24	48.0	23.035	<0.001*

*: Statically significantly difference at (P value <0.05)

Table (4): Total levels of nurses` practice regarding care of children undergoing cardiac catheterization.

Nurses` practice	(n=50)						X ²	P
	Before educational strategies		Immediate after educational strategies		After one month			
	No	%	No	%	No	%		
Unsatisfactory (<80%)	38	76.0	1	2.0	5	10.0	79.567	<0.001*
Satisfactory (80-100%)	12	24.0	49	98.0	45	90.0		

*: Statically significantly difference at (P value <0.05).

Table (5): Correlation between total scores of nurses' knowledge and practice for children with cardiac catheterization

Variables	Correlation between knowledge and practice (n=50)					
Knowledge	Before		Immediate after strategies		After one month Strategies	
	r	p	r	P	R	P
Practice	0.335	0.017*	0.610	<0.001*	0.532	<0.001*

r=Correlation Coefficient

Significant (P < 0.05)**Table (6): Correlation between total scores of nurses' knowledge, practices and their Socio-demographic characteristics**

Socio-demographic characteristics	Total knowledge scores (n=50)						Total practice scores (n=50)					
	Before		Immediate after strategies		After one month Strategies		Before		Immediate after Strategies		After one month strategies	
	r	P	r	p	R	P	r	P	R	P	r	P
Age	0.363	0.009*	0.489	<0.001*	0.537	<0.001*	0.395	0.004*	0.607	<0.001*	0.561	<0.001*
Educational level	0.559	<0.001*	0.439	0.001*	0.532	<0.001*	0.386	0.006*	0.753	<0.001*	0.565	<0.001*
Years of experience	0.347	0.013*	0.431	0.002*	0.474	<0.001*	0.316	0.025*	0.477	<0.001*	0.477	<0.001*

r=Correlation Coefficient

Significant (P < 0.05)

Discussion

Cardiac catheterization remains widely recognized as the preferred method for assessing hemodynamics in children affected by congenital and acquired heart diseases, and it is increasingly used as a therapeutic intervention for a broadening spectrum of conditions (**Rosenzweig et al., 2022**). The risk of morbidity and mortality during cardiac catheterization is linked to the cardiac operating room, with reported rates of major adverse events ranging between 10% and 11% (**O'Byrne et al., 2020**).

Nurses play a critical role in early detection or prevention of cardiac catheterization problems through maintaining patient's safety, continuous monitoring of patients, following established infection control recommendations and upholding aseptic practices during the installation of cardiac catheters (**Labrague, 2024**).

The nurses who can spot issues early are best positioned to take decisive action and enhance pediatric outcomes. Therefore, lowering the mortality and morbidity rates for children undergoing cardiac catheterization may be possible for nurses with experience in patient care during Cardiac catheterization (**Qiu, 2024**).

High quality nursing care for children in cardiac intensive care units demands professional nursing knowledge and practical skills, due to its specificity and complexity (**Vozzella & Hehman, 2023**).

Therefore, the current study was conducted to assess the effect of implementing educational strategies on nurses' performance regarding cardiac catheterization for children with congenital heart disease.

Regarding educational level of the studied nurses, the present finding revealed that half

of them graduated from technical institute of nursing while the least of them had post graduate diploma. The educational level of nurses is a critical factor that directly affects the quality of care provided to children, especially those with congenital heart disease undergoing cardiac catheterization, as these children are frequently in critical condition and require advanced, specialized care (**Vozzella & Hehman, 2023**).

Abdelaziz et al. (2023) who were align with current study, these findings revealed that most of the nurses in the study graduated from a technical institute of nursing, and one-quarter of them had never attended training courses related to cardiac catheterization.

Regarding the attendance training program related to care of children undergoing cardiac catheterization, The results of the current study revealed that slightly more than two thirds of the studied nurses didn't attend the training program cardiac catheterization care for children with congenital heart disease

From the researcher point of view, it might be due to the shortage of nurses in cardiac catheterization unit and work overload that prevent them from attendance of training program. These findings correspondent to **Mohamed, Fathy & Mahmoud, (2023)** who found that most of the studied nurses didn't attend previous training courses related to cardiac catheterization.

Ali, Fadl, Adel, Mahmoud & Abdelaziz, (2023) were disagreed with these findings, as he stated that three quarters of them attend previous training program pediatric patient safety post cardiac catheterization .

Concerning the acquisition of knowledge about congenital heart disease and cardiac catheterization, the result of the current study revealed that there was an improvement in

the total level of nurse's knowledge immediately and one month after the implementation of intervention compared to nurses level before the implementation of intervention.

The result of current study revealed that more than half of studied nurses had low level of knowledge score before implementation of educational strategies.

From the researcher point of view, it may be due to lack of orientation programs before their work, absence of their inspiration in refreshing their knowledge, work overload in cardiac catheterization unit. the lack of in-service educational program cardiac catheterization, no accurate sources for acquiring knowledge , the lack of training courses and lack of availability of manual booklets about caring of child after cardiac catheterization.

Ali et al. (2023) were in the same line with the current study, they reported that more than half of studied nurses had poor knowledge scores about Cardiac Catheterization before the implementation of educational guidelines.

On the opposite immediately after educational strategies implementation, nurses` knowledge improved and most of them obtained high Scores. It might be due to the effectiveness of implementing the content of educational strategies which was developed based on nurses` needs, its clarity and simplicity, and using of audiovisual aids, in enhancing their knowledge through availability the booklet about how to deal with child undergoing cardiac catheterization.

Aburaghif and Hassan (2016) who were in accordance with the current finding, they illustrated that there were highly significant

differences between the two periods (pre and post-tests) of study sample in all domains of (nurses' information about cardiac catheterization and its complication. Also, **El-Sol and Badawy (2017)** were in accordance with the current study. They showed that total knowledge of nurses significantly increased after the application of teaching module.

Furthermore, one month after the implementation of teaching strategies and follow up, there was slightly decline in nurses` knowledge and near to two third had moderate level scores in all items of knowledge. From the researcher view, this might be due to forgetting and decreasing of knowledge with the time factor.

Monis (2017) who were in a harmony with the current results who confirmed that information can be easily forgotten if they are not refreshed periodically Similarly, **Ali and Ali (2019)** was in accordance with current study, they showed that nurses' level of knowledge was higher after the implementing of the designed teaching protocol post implementing the designed teaching protocol than pre implementation.

The current study revealed that most of the studied nurses had satisfactory level of practice regarding care of children undergoing cardiac catheterization immediately after implementation of educational strategies. From the researcher point of view, this might be due to the efficiency of strategies implementation in enhancing nurses` practice through demonstration of nursing skills about how to care for the child undergoing cardiac catheterization.

Sania, S., & J. (2022) were in same line with the current finding .They revealed that there

was a significant difference between nurses' level of practice after implementation of educational training.

While after one month of strategies implementation, there was a slight decline in nurses' practice.

From the researcher point of view,. This might be due to forgetting about the time factor and the need of nurses for repeating educational strategies periodically to maintain their satisfactory level of practice.

Shini S.& W. (2019) who congruent with the present finding. They found that after three months post- test of nursing care protocol, the scores of nurses' total practices were slightly reduced and most of nurses had satisfactory levels

Also **Elewa and Elkattan (2017)** who showed that nursing skills must improve through training and continuing education, this provides quality and effective health care to children.

Concerning correlation between the total nurses' knowledge, practice scores and their socio-demographic characteristics. It was cleared that there was a positive correlation between studied nurses' age, educational level and their knowledge and practice.

From the Researcher point of view, this finding may be since administrators of the unit were selecting them for the unit of cardiac catheterization due to their abilities to understand the tasks more efficiently.

Bakar et al. (2020) were agreed with the current study who confirmed that older nurses have less access to continuing professional development activities when compared to their knowledge. Also, **Abolwafa, H., & Mohamed (2019)** who agreement with the current findings, as they stated that the highest knowledge and

practice scores were found among nurses having bachelor degree in nursing science which provide them with more information.

Regarding correlation between total knowledge and total practices scores of studied nurses, the results of the current study revealed that there was statistically significant positive correlation between total knowledge scores and total practice scores before, immediately and one month after the implementation of educational nursing strategies about cardiac catheterization, This could be due to using of theoretical component which help in regulating nurses' practice as the nurse acquire new knowledge, developed skills that they were able to apply them perfectly during their practice. Therefore nurses' knowledge level was linked with their competency level of practice.

Mohamed et al. (2023) who illustrated that there was a significant improvement in nurses' healthy behaviors post intervention protocol. Furthermore, **Ghareeb & Abouelezz (2022)** illustrated that nurses' practice regarding the care of patients before cardiac catheterization significantly improved after coaching program.

Finally, it is revealed from the present study that there was an improvement of nursing staff knowledge and practice after educational strategies implementation in relation care of children with congenital heart disease undergoing cardiac catheterization. This may be due to the fact that successive educational sessions using different educational strategies and continuous evaluation improve nurse's knowledge as these strategies were planned and implemented according to their pre assessed needs. Furthermore, simplification of well-

presented information by suitable educational aids increases their interest and desire to acquire a lot of knowledge.

Conclusion

Based on the findings of the present study, it can be concluded that, there Was a statistically significant improvement in nurses' total knowledge and practices scores immediately, and one month after the implementing of educational strategies regarding cardiac catheterization for children with congenital heart disease. Also, there was a positive correlation between nurses' knowledge and practice before, immediately, and one month after the implementation of educational strategies.

Recommendations:

1. Continues in service training strategies should be conducted periodically and regularly for all nurses working in Cardiac Catheterization Units about implementation of educational strategies regarding cardiac catheterization for children with congenital heart disease.
2. Cardiac Catheterization Units must have a documented policy describing the standard nursing care that should each child receives in the unit.
3. Developing a system at Cardiac Catheterization Unit for evaluating nurses' performance regarding updated strategies in care of children undergoing cardiac catheterization.

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