https://doi.org/10.48047/AFJBS.6.7.2024.4415-4427

African Journal of Biological Sciences

Journal homepage: http://www.afjbs.com

Research Paper Open Access

Upgrading Nurses' Performance Regarding Early Ambulation and Health Outcomes of Children with Congenital Heart Defects Following Cardiac Catheterization

Afaf Sayed Taha[(*a)], Seham Mohammed Elmwafie[(b)], Shereen Said Gouda[(c)], Safaa Salah Ismail[(d)]

a) Assistant Lecturer of Pediatric Nursing - Faculty of Nursing, Beni Suef University, Egypt,
b) Professor of Pediatric Nursing - Faculty of Nursing, Beni Suef University, Egypt,
c) Lecturer of pediatric Nursing - Faculty of Nursing, Beni Suef University, Egypt.
d) Professor of Pediatric Nursing & Dean of the Faculty of Nursing - Faculty of Nursing, Helwan University, Egypt

***Corresponding author: Afaf Sayed Taha Ahmed**

Email: afafsayed@nursing.bsu.edu.eg

Article History

Volume 6, Issue 7. 2024

Received: 15 June 2024

Accepted: 31 July 2024

doi: 10.48047/AFJBS.6.7.2024.4415-4427

Abstract:

Background: Early ambulation is a effective and safe intervention to reduce complications of immobility for pediatrics post-cardiac catheterization. **Aim:** The research evaluated the effect of upgrading nurses' performance regarding early ambulation and health outcomes of pediatrics with congenital heart defects following cardiac catheterization. **Research design:** A quasi-experiment. **Setting:** At the cardiology unit at Beni-Suef University Hospital. **Subjects:** included a convenient sample of thirty nurses and a purposeful sample of fifty children before and after the program**. Tools:** Four tools were used to gather data: an Arabic interview questionnaire to assess the study participants' understanding of early ambulation, an observational checklist to assess the nurses' early ambulation practices, and a 5-point Likert scale of attitudes. **Results:** Compared to pre- and post-program implementation, there was a significant improvement in overall knowledge, practice, and attitude, as indicated by the following percentages: (26.6% to 83.3%), (16.6% to 76.7%), and (10.0% to 80.0%), respectively. Furthermore, compared to the preprogrammed, the educational program improved the health outcomes for children with congenital heart defects after cardiac catheterization. **In conclusion**, introducing an educational program improved children's health outcomes and nurses' knowledge, practice, and attitude. **Recommendation:** It is suggested that nurses be more aware of the advantages of early ambulation following cardiac catheterization and how to prevent complications by providing in-service training sessions.

Keywords:*Congenital heart defects; cardiac catheterization; early ambulation; children's outcomes*

INTRODUCTION

Congenital heart disease (CHD) is an abnormality of the heart and large vessels, commonly encountered in the pediatric population. CHD can be categorized into cyanotic and noncyanotic lesions. The elevated availability of pediatric echocardiograms (Echo) and expertise in managing CHD children operationally and percutaneously have improved children's outcomes (**Ottaviani & Buja, 2022).**

Further, children with CHD are surviving because of improved medical care and recent developments in diagnosis, therapy, and surgery. During the past twenty years, open heart surgery, medication, and cardiac catheterization have been treatment approaches (**O'Byrne et al., 2020).**

Early ambulation is a nursing intervention that increases physical activity, maintains or improves bodily function autonomy during surgical procedures or recovery from illness, and prevents immobility complications **(Baqal & Mahmood, 2022).** Because cardiology is a specialized and complex field, providing high-quality nursing care to children in these units requires professional nursing knowledge and skills. Early ambulation after CC has recently become an exciting and engaging subject for nurses; it is a nursing task that is commonly performed in critical care. Therefore, early ambulation for cardiac procedures for pediatric has an essential role for critical care nurses **(Bulut &Calik, 2020).**

SIGNIFICANCE

Cardiac catheterization (CC) is a huge event that is accepted as a stressful procedure for children and families. The global prevalence of CHDs accounting 9.410/1000. It represented a potential increase over fifteen prior years (***Liu et al., 2019).*** At the national level, Egypt saw 796 cases (79.2%) of cyanotic CHD and 209 cases (20.8%) of cyanotic CHD ***(Al-Fahham & Ali, 2021).*** CC nursing care standards are a significant concern for all healthcare teams in achieving high-quality care for pediatric patients and helping minimize post-CC complications.

Few researches on nursing care, particularly early ambulation of children following cardiac catheterization, have yet to be done in Egypt. The current study assessed the impact of improving nurses' performance on early ambulation and the health outcomes of pediatric with congenital heart defects following cardiac catheterization. The current study's findings will help enhance nurses' understanding of caring for children following cardiac catheterization. This research carries two benefits for nurses in the CC specialty and pediatrics performing CC. Moreover, it provides evidence-based data for post-CC care, which helps anticipate and prevent post-CC complications while minimizing hospital resource utilization.

METHODOLOGY

Design: A quasi-experimental research.

Setting: At the cardiology unit of an Upper Egypt University Hospital.

Subjects:

A convenient sample of 30 nurses employed at the previously stated setting. A purposive sample of 50 pre- and 50 post-program children with congenital cardiac defects who were admitted to the cardiology unit for the duration of the study.

Children criteria:

Both sexes, aged 18 months to six years and free from other mental or physical diseases and subjected to either diagnostic or interventional cardiac catheterization with an average bleeding profile.

Nurse's criteria:

Registered nurses employed full-time in the cardiology unit accepted the invitation to participate in the research and were available at the time of gathering data. Before the start of the study, nurses should have been working for at least six months in the cardiology unit.

Tools for collecting the data:

Data was collected using the four tools:

1st tool: Designed Interviewing Questionnaire Sheet:

The researcher developed it after reviewing relevant literature to assess nurses' understanding of early ambulation. It is written in Arabic and is divided into the following sections:

Part I: Characteristics of the nurses who have cared for children post cardiac catheterizations, which include age, sex, education, experience, position, and received formal training on early ambulation.

Part II: Assessing the nurses' knowledge of early ambulation, which encompasses three primary areas of knowledge; the first section was about congenital heart defects, including definition, causes, symptoms, types, investigations, complications, treatment, and prevention. The second section was about cardiac catheterization, including definitions, indications for diagnostic and therapeutic catheters, the most common site of insertion, benefits, types, contraindications, complications, and interventional procedures (tests) done during cardiac catheterization. The third section was knowledge about early ambulation as definition, time, number of times of evaluation during early ambulation, criteria for initiating early ambulation, types of exercise, levels of activity performed, benefits, contraindications, criteria for termination of early ambulation, barriers, complications of immobility and facilitators to implement early ambulation.

2nd tool: Nurses' Practice toward Early Ambulation (Observational Checklist)

The assessment of nurses' practices regarding early ambulation was adapted from **(Abouheiba et al., 2015; Reese & Bandy, 2023).** The practices included monitoring vital signs, removing the sheath, observing the insertion of the catheter, assessing skin color and temperature, applying manual pressure to the catheter site, changing positions, and performing lower extremity exercises such as ante flexion and dorsiflexion of the foot and abduction, adduction, and circumduction of the hip joint.

3rd tool: Nurses' Attitude toward Early Ambulation

It was adapted from **(Lin et al., 2020; Dweekat, 2020)** Using a 5-point Likert scale of 1-5 to evaluate nurses' attitudes toward early ambulation. This tool contained (17) items that reflected the nurses' attitude regarding early ambulation

4th tool: Child Health Outcome Sheet:

This tool was recruited from **(Abouheiba et al., 2015)** and modified by the researcher, written in English. It encompassed:

Part I: Socio-demographic and clinical data assessment sheet:

The researcher used the tool to obtain data about the social profiles, children's medical history before they entered the cardiac catheterization lab, and data from the cardiac catheterization lab. It contained the following data:

1- Socio-demographic data such as birth order, residence, gender, and child age.

2-The medical history of the children before they enter the cardiac catheterization lab, including diagnosis, medication prescription, family history of congenital heart defects, previous invasive cardiac procedure, and previous hospitalization, was gathered.

3-Pre-cardiac catheterization nursing assessment of children's health parameters, such as weight, vital signs, oxygen saturation, and lab investigations, was recorded.

4- Data obtained from the cardiac catheterization lab as the purpose of catheterization, access site of cardiac catheterization, type of anesthesia used, time consumed to gain vascular access, duration of the fluoroscopic study, sheath size, catheter size, and total duration of the procedure.

Part II: Post cardiac catheterization nursing assessment sheet:

The researcher used this tool to obtain data about the health parameters of children following cardiac catheterization. It included the following data:

Vital signs, Access site assessment, Fluid intake and output, Patient medication, Peripheral pulses: femoral, posterior tibial, and pedal pulses, Capillary refill time, and perfusion of both lower limbs.

Ethical Considerations:

On February 13, 2022, the Ethical Scientific Research Committee of the Faculty of Nursing at Helwan University granted ethical approval for this study under reference approval number 28.

Intervention

The implementation phase was achieved through 7 sessions for each group. The researcher was available twice weekly at the cardiology unit in the previously mentioned settings. Each group took two weeks (4 days) for the theoretical part, practical part, and evaluation. The first and second days were for the theoretical part of the intervention, the first day the following week for the practical part of the application, and the second day the following week for the nurse's evaluation. The total sessions were 7 (4 and 3 for knowledge and practice, respectively). Such sessions lasted 70 hours (40 hours for theory- 30 hours for practice). The participants were categorized into ten categories, each with three subjects. The implementation and evaluation period were achieved through six months from the start of April 2023 to the end of September 2023).

Statistical analysis:

SPSS version 25 was used for data entry and processing. McNemar's Test evaluated the difference between qualitative variables when data was paired, dichotomous, and non-parametric. A marginal Homogeneity test was used. Chi-square (x^2) and Fisher exact tests were used to evaluate the relationship between the independent categorical parameters. Spearmen correlation coefficient evaluated the strength and direction of correlation between the two parameters.

RESULTS

Table (1): Studied nurses' socio-demographic characteristics (N=30).

Characteristics	No	%
Age (in years)		
<25 years	6	20.0
25-30 years	21	70.0
>30 years	3	10.0
Mean ±SD	**26.9 ±2.21**	
Gender		
Male	10	33.3
Female	20	66.7
Education		
Nursing diploma	4	13.4
Nursing institute	13	43.3
Bachelor of Nursing	12	40.0
Postgraduate	1	3.3
Other	0	0.0
Current position		
Head nurse	0	0.0
Supervisor	1	3.3
Nurse	29	96.7
Experience years		
Less than five years	9	30.0
5- 10 years	19	63.3
>ten years	2	6.7
Mean ±SD	**6.41±2.25**	
Attending training courses		
Yes	0	0.0
No	30	100.0

Table (1) displays that 70.0% of the subjects were in the 25-30 age group, with a mean of 26.9 ±2.21 years old, and 66.7% were females. Also, 43.3% graduated from nursing institutes, 40.0% had bachelor's degrees, and 96.7% were staff nurses. Additionally, 63.3% had 5-10 years of experience, with a mean of 6.41±2.25 years, and 100.0% did not attend training courses.

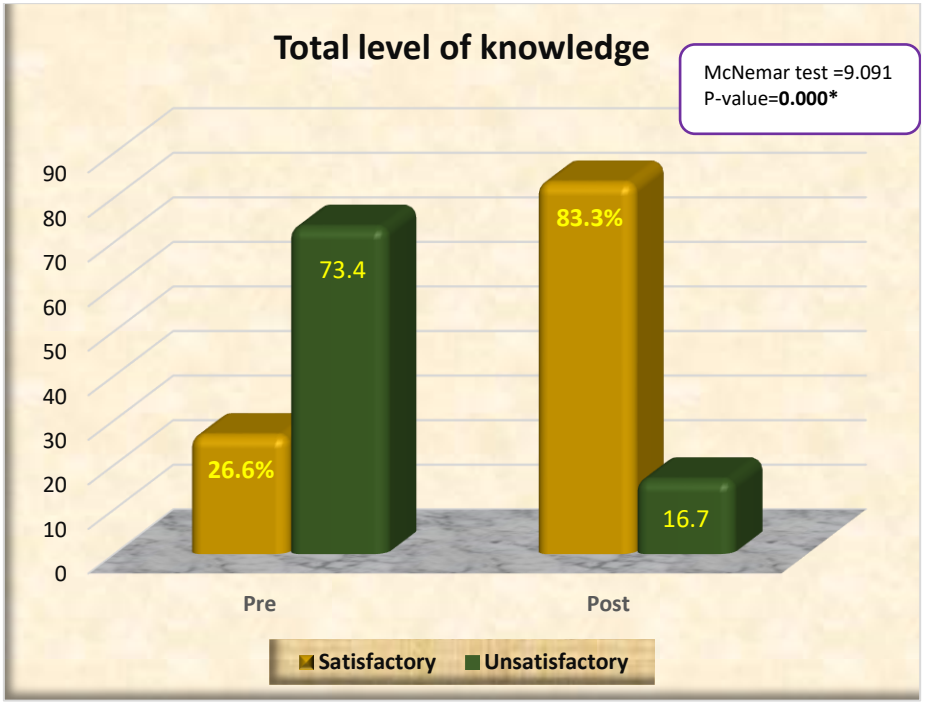

Figure (1): Frequency of the nurses based on total level of knowledge pre and post-program implementation (N=30).

Figure (1) illustrates that 26.6% of the nurses had a satisfactory knowledge preprogram, which improved to 83.3% post-program, respectively. A significant variation was found between preprogram and post-program adoption regarding the total level of knowledge at a P-value of 0.000.

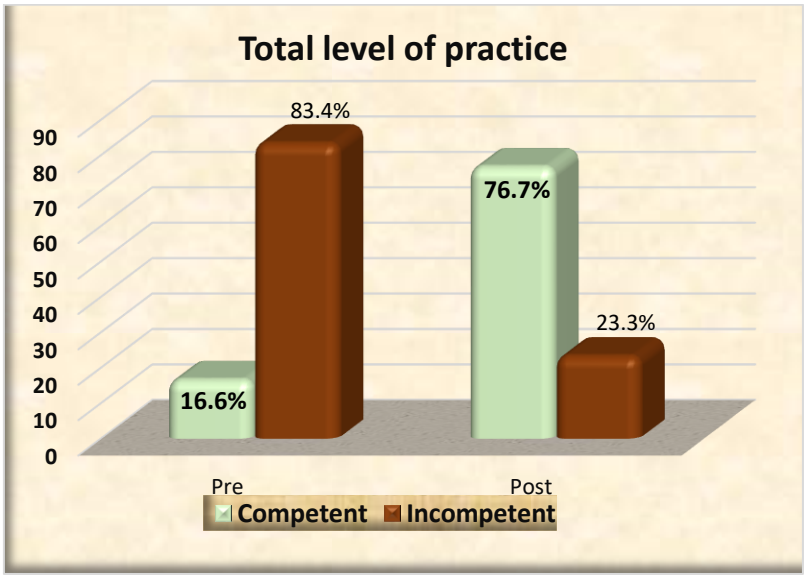

Figure (2): Frequency of the participants based on total practice pre and post implementation (N=30).

Figure (2) illustrates that 16.6% of the subjects had a competent practice preprogram, which improved to 76.7% post-program application. Also, a considerable variation was found between preprogram and post-program regarding the total level of practice, at a P-value of 0.000.

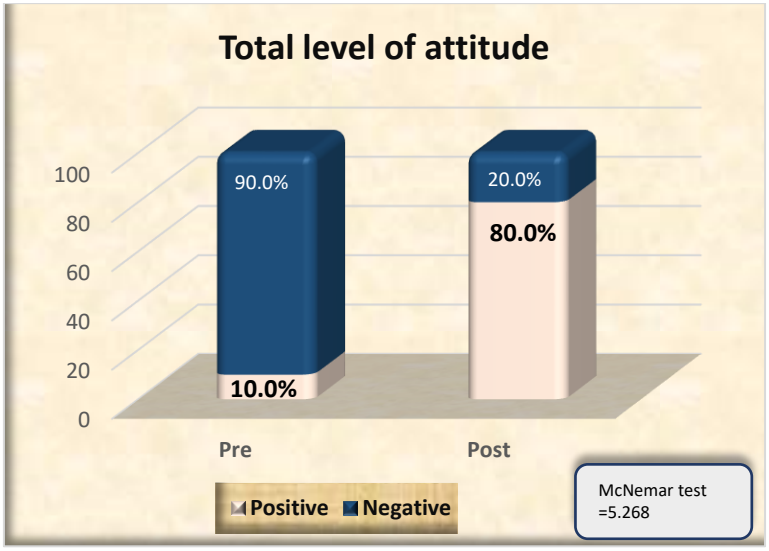

Figure (3): Frequency of nurses based on total attitude pre- and post implementation (N=30).

Figure (3) displays that 10.0% of the nurses had a positive attitude preprogram, that improved to 80.0% following implementation. Also, a marked difference was determined between preprogram and post-program regarding the total level of attitude at a P-value of 0.000.

Table (2): Correlation between total knowledge, practice, and attitude pre and post-program (N=30).

Variables (Total level)	Pre /post	Knowledge		Practice	
		R	P	r	P
Practice	Preprogram	0.551	**0.030* (S)**		
	Post-program	0.692	**0.034* (S)**		
Attitude	Preprogram	0.461	**0.037* (S)**	0.418	**0.041* (S)**
	Post-program	0.621	**0.015* (S)**	0.835	**0.010* (S)**

***P-value ≤ 0.05= Significant (S)**

Table (2) demonstrates a significant positive relationship between total knowledge and practice at P= 0.030 and 0.034 preprogram and post-program implementation, respectively. In preprogram and post-program, a considerable positive correlation was observed between total knowledge and attitude (P-value= 0.037 and 0.015). Additionally, a potential positive relationship was found between total level of practice and total level of attitude at P-value= 0.041 and 0.010 preprogram and post-program, respectively.

Table (3): Correlation between time of ambulation oral intake and output pre and post-program.

Variables	Time of ambulation			
	Pre		Post	
	r	P	R	P
Oral intake	0.245	**0.027***	0.197	**0.023***
Output	0.315	**0.041***	0.267	**0.039***

r= Spearman correlation coefficient * P-value ≤ 0.05 **Significant**

Table (3) clarifies a significant positive relationship between time of ambulation and oral intake pre- and post-intervention, with P-values of 0.027 and 0.023, respectively. Also, a considerable positive relationship was found between the time of ambulation and urine output pre- and post-intervention (P-values of 0.041 and 0.039, respectively).

DISCUSSION

A congenital heart defect is the most frequent congenital disability, affecting almost one newborn in every 120-166 births (**Findley et al., 2024),** With advances in both palliative and corrective surgeries, the survival of children with CHD to adulthood has increased. Nevertheless, CHD is still the leading cause of death among children with congenital malformations (**Kiraly, 2022)**. Early ambulation is an efficient and safe approach to reduce the adverse impacts of bed rest and functional disabilities affecting children after cardiac catheterization. EA in children is shown to improve outcomes after cardiac catheterization. (**Cho et al., 2023).**

This research displayed that more than two-thirds of participants were in the age of 25-30 years with a mean of 26.9 ±2.21 years, and less than two-thirds had 5-10 years of experience with a mean of 6.41±2.25 years. This previous finding agrees with **Thabet et al. (2020),** whose study finding showed that they were 25-30 years with a mean of 27 ± 2.27 years and experience of five- ten years with a mean of 4.25 ± 7.18 years.

This result disagrees with the results of **Jabr et al. (2022),** who demonstrated that more than two-thirds of nurses were older than 30 years, with a range between 35 to 45 years and a mean of 33.78 ± 6.0, and more than fifty percentages had more than ten years of experience in a CC unit.

This work demonstrated that nearly two-thirds of the nurses studied were females. This may be due to a considerable portion of the nurses in Egypt are female. This result is in line with **Faried et al. (2023)** study, which stated that two-thirds were female; this may related to female predominance in the nursing profession and the recent inclusion of males in their nursing careers. This is inconsistent with **Mahmood et al. (2021),** who declared that their subjects were primarily males; nonetheless, they vary in age categories as most of them were between 25-29 years.

Concerning education of the nurses, the present research indicated that more than two-fifths of the sample had technical institute degrees in nursing, and two-fifths had bachelor's degrees in nursing. This may be a result of many bedside nurses in governmental hospitals are bored due to a shortage of staff nurses. Such findings were agreed with **Henedy & El-Sayad (2019),** who found most studied nurses had nursing technical institutes and bachelor's degrees.

The entire sample reported not attending any training courses regarding early ambulation of children with congenital heart defects following cardiac catheterization. This earlier result is consistent with that of **Omer (2020),** who discovered that most of the studied samples had no training sessions for pediatric cardiac catheterization.

The findings of this work on the overall nurses' knowledge confirm the hypotheses. A considerable variation between the evaluated nurses' overall knowledge prior to and immediately following the implementation of the educational intervention was observed. Less than one-third, less than one-fifth, and less than one-quarter had satisfactory knowledge preprogram regarding congenital heart defects, cardiac catheterization, and early ambulation, respectively, which improved to more than three quarters, less than three quarters, and the vast majority post-program implementation. According to the researcher, this outcome showed that nurses' educational programs successfully raised nurses' level of awareness.

These findings were consistent with **Rahane Williams (2023),** who found that most staff nurses lacked adequate knowledge of coronary angiogram care. The total pre-test knowledge displayed that many (65%) needed improvement. The total post-test knowledge demonstrated that the majority (98.33%) had adequate knowledge regarding coronary angiogram care.

A significant difference in the scores obtained before and after practice was observed after assessing the overall level of nurses' practices regarding the early ambulation of children after CC. Less than one-fifth of nurses had competent practice during pre-educational training; this number rose to more than three quarters after program implementation. These findings explained that the nurses needed to be trained in early ambulation of children following CC and had no protocols or information to improve their practices. However, following implementation of the program, there was a statistically remarkable improvement in the frequencyof nurses who scored competently.

Such results match the hypothesis that nurses with appropriate knowledge and practice can help restore cardiac pediatric patients. Similarly, **Ali &Ali (2019)** found a positive and considerable relationship between knowledge and practice post-implementation of educational training. The result is reinforced by research conducted by **Sania et al. (2022), and Taşdelen et al. (2024),** which revealed that 83.25% of nurses had adequate practice after implementation, compared to 66.7% who had inadequate practice during pre-educational training.

The current study found that regarding the nurses' overall attitude toward early ambulation of children after a CC, a minority of the nurses were positive prior to the program's implementation. However, this majority improved after it was implemented. Additionally, nurses' attitudes toward early ambulation both before and after the implementation of educational programs showed statistical improvements. It might be because the participants had negative attitudes or feelings regarding early ambulation before the program. It demonstrated that the educational programs for nurses were successful and effective in raising the attitude levels of nurses.

Such outcomes are agreed with those of **Hasballah et al. (2020)** in Assiut, who showed that less than one-quarter of nurses in the CC unit had a positive attitude toward patient safety, and more than three-quarters of participants had a negative attitude. This result was consistent with the findings by **Shondell et al. (2020),** which showed that 20.0% of the nurses had a positive attitude before the program implementation and that this percentage elevated to 83.0% after it, with a marked difference.

A remarkable positive association was observed between the pre-and post-implementation levels of nurses' overall knowledge, practice, and attitude. Moreover, a potential positive correlation was observed between the overall practice and attitude levels. The study's conclusions confirmed that nurses' knowledge of early ambulation had risen and that they had a more positive attitude toward it, both of which attributed to the program's efficacy. It emphasizes how crucial knowledge influences nurses' attitudes about early ambulation.

This result was in line with that by **Huang et al. (2021), Parveen et al. (2024), and Elfeky et al. (2023),** who reported a potential positive association between the overall knowledge, overall practice, and total attitude scores at the pre-and post-implementation phases of the program. The findings of the present work demonstrated a significant positive association between oral intake and urine output and the amount of time spent ambulation before and after the intervention. According to the researcher, early ambulating children performed better than late ambulating children regarding oral fluid consumption and urine output, suggesting that the educational program positively impacted children's health outcomes.

Morika et al. (2021), in their research done in Indonesia **and Zhang et al. (2024),** provided support for this finding. They discovered a considerable positive relationship between the time of ambulation, fluid intake, and urinary output. Specifically, they found that early ambulation is highly effective. Children ambulating three to four hours after CC consumed oral fluids, and they passed urine before children ambulating later.

Coincidently, **Chen et al. (2021)** in China proved that one- to three-hour ambulation following catheterization is safe and improves cases‘ comfort. It averts the requirement of arterial sealing devices and requires shorter catheterization lab recovery nurse-to-patient times, improving cost-effectiveness. Additionally,, early ambulation will increase subject turnover, possibly reducing waiting lists and positively affecting vascular access and peripheral pulses. This finding matched the hypnoses and indicated that educational programs effectively improved children's health outcomes.

CONCLUSION

Based on the findings of this research, nurses' knowledge, practices, and attitudes improved as soon as the early ambulation program for children with congenital heart defects was implemented. It was due to the program's immediate impact. Following the program's implementation, children's health outcomes notably improved.

FUTURE SCOPE

Further studies (including public and private sectors) should be held to investigate nurses’ knowledge, practice and attitude about early ambulation and the benefits of early ambulation for patients and health care organizations. Also, Replication of this research on a larger probability sample acquired from different geographical areas in Egypt for generalization.

RECOMMENDATIONS

According to this research, nurses' knowledge, attitudes, and practices regarding early ambulation should be periodically monitored. Programs for ongoing education and training are crucial to enhancing nurses' attitudes, behaviors, and knowledge regarding early ambulation and raising the standard of nursing care they offer to children.

LIMITATIONS

There is no limitation for this study.

CONFLICT OF INTEREST

The authors declare that they have no competing interests.

ACKNOWLEDGEMENT

The researchers express their gratitude to everyone who took part in the study.

The authors reported no conflicts of interest

REFERENCES

Al-Fahham, M. M., & Ali, Y. A. (2021). Pattern of congenital heart disease among Egyptian children: a 3-year retrospective study. The Egyptian Heart Journal, 73(1), 1-8. https://doi.org/10.1186/s43044-021-00133-0.

Abouheiba, M.G. M., Darwish, A. M., Elwalili, T. M., Abd-Elmohsen, A. M., Ibrahim, N. A., & Elsamman, G. A. (2015). Effect of early ambulation following cardiac catheterization on health parameters of children with congenital heart defects (Doctoral dissertation, University of Alexandria. Retrieved from http://srv3.eulc.edu.eg/eulc_v5/Libraries/Thesis/BrowseThesisPages.aspx?fn=PublicDrawThesis&BibID=12408046.

Ali, H. A. E., & Ali, M. M. (2019). Effect of designed teaching protocol regarding patients' safety after cardiac catheterization on nurses' performance and incidence of vascular complications. International Journal of Studies in Nursing, 4(1), 107. https://doi.org/10.20849/ijsn.v4i1.555.

Baqal, A., & Mahmood, F. (2022). Effect of Ice-Bag with Direct Pressure on Early Ambulation and Prevention of Urinary Retention, Low Back Pain, and Catheter Site Pain in Patients after Cardiac Catheterization. NeuroQuantology, 20(6), 8008. DOI:10.14704/nq.2022.20.6.NQ22796.

Bulut, H. K., & Calik, K. Y. (2020). Doctors and nurses' views on the participation of parents in invasive procedures of hospitalized children. J Pak Med Assoc, 70(2), 231-5. doi: 10.5455/JPMA.293926.

Chen, B., Xie, G., Lin, Y., Chen, L., Lin, Z., You, X., & Lin, W. (2021). A systematic review and meta-analysis of the effects of early mobilization therapy in patients after cardiac surgery. Medicine, 100(15), e25314. DOI: 10.1097/MD.0000000000025314.

Cho, E., Jang, M. R., Moon, J. R., Kim, M. J., Kim, Y. M., An, Y. J., & Song, J. (2023). Effects of time of bed rest on vascular complications after cardiac catheterization in pediatric patients with congenital heart disease: A randomized controlled trial. Heart & Lung, 60, 52-58. https://doi.org/10.1016/j.hrtlng.2023.02.023.

Dweekat, A. (2020). Introducing Early Mobility to Intensive Care Unit Nurses (Doctoral dissertation, Azusa Pacific University). Retrieved from https://www.proquest.com/openview/aca3e0e632d7f76708b2631a8b3393eb/1?pq-origsite=gscholar&cbl=18750&diss=y.

Elfeky, M.G.M., Mourad, G.M., Ismail, S.S., & Zaki, R.A. (2023). The effect of the psychoeducational program on coping patterns of mothers having children newly diagnosed with cancer. Helwan International Journal for Nursing Research and Practice, 2(2), 13–43. https://doi.org/10.21608/hijnrp.2023.225233.1082.

Faried A, A., Fadl AbdElkhalik, E., Adel M, I, B., Mahmoud, S, E., & Abdelaziz, M, F. (2023): Effect of Implementing Educational Guidelines on Cardiac Nurses' Performance regarding Patient Safety Post Cardiac Catheterization. Egyptian Journal of Health Care, 14(3), 619-632. https://dx.doi.org/10.21608/ejhc.2023.319128.

Findley, T. O., Crain, A. K., Mahajan, S., Deniwar, A., Davis, J., Solis Zavala, A. S., & Rodriguez-Buritica, D. (2024): Congenital heart defects and copy number variants

associated with neurodevelopmental impairment. American journal of medical genetics Part A, 188(1), 13-23. https://doi.org/10.1002/ajmg.a.62484

Hasballah, S. M., Shaor, O. A. E., Mohamed, M. A., & Mohamed, A. K. (2020). Assess Nurses' Knowledge and Attitude for Patient Safety in Cardiac Catheterization Unit. Assiut Scientific Nursing Journal, 7(19), 151–159. DOI: 10.21608/ASNJ.2019.74145.

Hendy, W. M., & El-Sayad, H. E. S. (2019). Nurses' knowledge and practice regarding patient safety Post Cardiac Catheterization. IOSR Journal of Nursing and Health Science, 8(3), 43-52. DOI: 10.9790/1959-0803074352.

Huang, L. S., Huang, Y., & Hu, J. (2021). Current practices of peripheral intravenous catheter fixation in pediatric patients and factors influencing pediatric nurses' knowledge, attitude and practice concerning peripheral intravenous catheter fixation: a cross-sectional study. BMC Nursing, 20, 1-9. https://doi.org/10.1186/s12912-021-00758-1.

Jabr, E. M., Taha, N. M., & Metwally, E. A. (2022). Nurses' Knowledge and Practice Regarding Care for Patients Undergoing Cardiac Catheterization. Zagazig Nursing Journal, 18(1), 1–15. https://doi.org/10.21608/znj.2022.216269.

Kiraly, L. (2022). Current outcomes and future trends in pediatric and congenital cardiac surgery: a narrative review. Pediatric Medicine, p. 5. Doi: 10.21037/pm-21–47.

Lin, F., Phelan, S., Chaboyer, W., & Mitchell, M. (2020). Early mobilization of ventilated patients in the intensive care unit: a survey of critical care clinicians in an Australian tertiary hospital. Australian Critical Care, 33(2), 130–136. https://doi.org/10.1016/j.aucc.2019.02.002

Liu, Y., Chen, S., Zühlke, L., Black, G. C., Choy, M. K., Li, N., & Keavney, B. D. (2019). Global birth prevalence of congenital heart defects 1970–2017: updated systematic review and meta-analysis of 260 studies. International journal of epidemiology, 48(2), 455-463. https://doi.org/10.1093/ije/dyz009.

Mahmood, H. J., Ibrahim, R. H., Hassan, E. T., & Abdulgani, M. F. (2021). Assessment of Nurses' Knowledge of Patient Care After Cardiac Catheterization in Mosul Hospitals. In 1st International Ninevah Conference on Medical Sciences (INCMS 2021) (pp. 181-184). Atlantis Press. https://doi.org/10.2991/ahsr.k.211012.030.

Morika, H. D., Sukma, D. M., Sari, P. M., Sandra, R., Sari, I. K., & Nur, S. A. (2021). Early Ambulation Lowering Pain Intensity Inpatient Post Heart Catheterization in the Intensive Care Unit (ICU) in Dr M. Damil Hospital, Padang, Indonesia. In 2nd Syedza Saintika International Conference on Nursing, Midwifery, Medical Laboratory Technology, Public Health, and Health Information Management (SeSICNiMPH, 2021) (pp. 253-257). Atlantis Press. https://doi.org/10.2991/ahsr.k.211026.048.

O'Byrne, M. L., Huang, J., Asztalos, I., Smith, C. L., Dori, Y., Gillespie, M. J., & Glatz, A. C. (2020). Pediatric/congenital cardiac catheterization quality: an analysis of existing metrics. Cardiovascular Interventions, 13(24), 2853-2864. https://doi.org/10.1016/j.jcin.2020.09.002.

Omer, Y. B. (2020). Quality of Pre-Cardiac Catheterization Nursing Care at Surgical Specialty Hospital-Cardiac Center in Erbil City. Erbil Journal of Nursing and Midwifery, 3(1), 75–81. https://doi.org/10.15218/ejnm.2020.09.

Ottaviani, G., & Buja, L. M. (2022). Congenital heart disease: pathology, natural history, and interventions. In *Cardiovascular pathology* (pp. 223-264). Academic Press. https://doi.org/10.1016/B978-0-12-822224-9.00011-6.

Parveen, S., Bashir, M., Akhtar, S., Perveen, S., & Ullah, S. (2024): Evaluation of Practices about Pediatrics Cardiac Catheterization among Nurses at District Head Quarter Hospital: Pediatrics Cardiac Catheterization Practices. NURSEARCHER (Journal of Nursing & Midwifery Sciences), 51-56. DOI: https://doi.org/10.54393/nrs.v4i01.80

Rahane, M. M., & Williams, M. P. (2023). A Pre-Experimental Study to Assess The Effectiveness of Planned Educational Program on The Knowledge and Practices Regarding Coronary Angiogram Care Among Staff Nurses at A Selected Hospitals. Journal of Clinical

Otorhinolaryngology, Head, and Neck Surgery Vol.: 27 Issue: 2, 2023. Retrieved from https://www.lcebyhkzz.cn//article/view/2023/02_2129.php.

Reese, N. B., & Bandy, W. D. (2023). Joint range of motion and muscle length testing-E-book (4ed.). India: Elsevier Health Sciences. Retrieved fromhttps://books.google.com.eg/books/about/Joint_Range_of_Motion_and_Muscle_Length.html?id=3eJOAQAAQBAJ&redir_esc=y.

Sania, S., Ali, S., & Ali, J. (2022). The Impact of Educational Training on Nurses to Improve Knowledge about Practices Regarding patient safety after Cardiac Catheterization: Educational Training on Nurses about Practices Regarding patient safety after Cardiac Catheterization. Pakistan Journal of Health Sciences, 140-144. https://doi.org/10.54393/pjhs.v3i06.303.

Shondell, L., Foli, K. J., & Erler, C. (2020). Effects of education on nurses' Knowledge and pain management attitudes in a postoperative cardiovascular unit. The Journal of Continuing Education in Nursing, 51(8), 377-383. https://doi.org/10.3928/00220124-20200716-08.

Thabet, O. F., Ghanem, H. M., Ahmed, A. A., & Abd-ElMouhsen, S. A. (2020). Effect of developing and implementing nursing care standards on outcome of patients undergoing cardiac catheterization. IOSR Journal of Nursing and Health Science (IOSR-JNHS), 8(01), 42-54. DOI: 10.9790/1959-0801054254.

Taşdelen, Y., Topan, A., & Şahin, Ö. Ö. (2024): Paediatric nurses' experiences of success and failure in first-time peripheral intravenous catheter insertion: A qualitative study. Journal of Pediatric Nursing, 75, 57-63. https://doi.org/10.1016/j.pedn.2023.12.002

Zhang, H., Sheng, Y., Yu, C., & Cheng, Q. (2024): Understanding the needs and perceptions of early mobilization for critically ill patients: A systematic review of qualitative studies. Intensive and Critical Care Nursing, 81, 103584. https://doi.org/10.1016/j.iccn.2023.103584