

Improving Pediatric Critical Care Nurses' Knowledge and Practices Regarding Restraint Application and Children's Outcomes

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Abstract

Background: Critically ill children often connected with many tubes and lines. Physical restraint routinely implemented in critical care unit to reduce child's self-injury and improve safety. Therefore, the current study conducted to improve pediatric critical care nurses' knowledge and practice regarding restraint application and children's outcomes. **Subjects and Method: Design:** A quasi-experimental non-randomized intervention design pre-posttest one-group was utilized. **Subjects:** A convenience sample of 43 nurses working in Pediatric Intensive Care Units (PICUs) at Mansoura University Children's Hospital (MUCH) affiliated to Mansoura University, Egypt was recruited in the present study. **Results:** The current study showed that nurses take the decision of restrain without parents' permission or participation. Sedation is the alternative to physical restrain in PICUs as reported by nurses. The most common health problem among children is respiratory problem and the prevalence of restraint related complications reduced post intervention phase compared to baseline data. In addition, there is an improvement in the total level of knowledge. Reported and observed practices post intervention also, were improved as compared to pre intervention with statistically significant differences. **Conclusion:** The current study concluded that, the training program application is the best approach to improve knowledge and practices regarding using of physical restraint and reducing restraint related complications among children. **Recommendation:** Documentation system that includes physical and chemical restraint assessment and evaluation and restraint related complication documentation is mandatory.

Keywords: Pediatric Critical Care Nurses, Children's Outcomes, Knowledge, Practice, Restraint Application.

Introduction

Critically ill children are suffering from serious illness and they are under the effect of sedation that can aggregate the delirium and agitation state. Many invasive diagnostic and treatment procedure and equipment is attached to critically ill children that keep the risk of self-endanger increase. Therefore, nurses often implement physical restraint for the safety of patient. Physical restraints (PR) are common practices in the acute care settings, frequently used as nursing intervention for children in many countries. ⁽¹⁾ The purposes of physical restraints are to prevent adverse events, especially those related to falls and accidental removal of medical and treatment devices. ⁽²⁾ Physical restraint used as a part of a holistic intervention plan; this plan should be established and accepted by the medical team with the consultation of the caregivers and with the consent of a guardian. Physical restraint should not be used for nurses' availability or to overcome deficiency of adequate staff support and supervision. It should be used only for the safety of the pediatric patients or others. ⁽³⁾ All

children have physiologic and psychological needs to be mobile or move. Prolonged immobility of children may affect the physiologic functioning of the body in other way, such as: influencing respiratory volume, peripheral circulation, lack of motor development and sensory contact with the others. Therefore, pediatric critical care nurses should evaluate the necessity to restraint application and identify any alternatives to gain the child's cooperation. Physical restraint often applied by nurses to children in their care for different reasons such as immobilization, safe administration of treatments or medications, needle-related procedures and to prevent interference with tubes or dressings. ^(4,5) The Joint Commission on Accreditation of Healthcare Organizations (JCAHO) defines physical restraint as “the use of physical for the purpose of adjusting the actions of the pediatric patient, without the permission of the patient.” ⁽⁶⁾ According to the American Psychiatric Nurses Association, physical restraint is defined as “Any manual method,

physical or mechanical method, material or equipment that arrest or reduce the ability of the patient to move his or her arms, legs, body or head freely.” It also, defined as “the use of restraint as a constraint to control the children’s behavior or limit the children freedom of movement and is not a standard treatment the child condition”.^(7,8) There are many types of physical restraint usually used with children such as mummy restraint and modified mummy restraints (swaddle). Also, jacket restraint, elbow restraint, arm and leg restraint-splints, extremity restraint (clove hitch restraint), crib and crib with dome, mittens, abdominal binders, and bed cradle/ bed with side rail restraints.^(9,10) These types used to control unexpected behaviour by children and to ensure their safety.⁽¹¹⁾ In acute care units, the prevalence of restraint application is between 7% and 87%. There are no relevant nursing guidelines for physical restraint use has been published in Pediatric Intensive Care Units (PICUs). Therefore, there is a deficiency of nurses’ practice standard for physical restraint use among acute care setting in the hospitals.^(12,13)

Numerous research reported the adverse effects of physical restraints, the prolonged use of physical restraints in children care can result in a range of seriously negative consequences, both physical and psychosocial. The physical complications include exacerbation of the patient’s condition, skin laceration, muscle wasting, nerve damage, bone destruction, increased infection rates, pressure ulcers and even death by strangulation. Moreover, the psychosocial complications contain deterioration in social function, increased excitement, and other emotional reactions, including anger, depression, and embarrassment.⁽¹¹⁾

Research in restraint application at PICU suggests a wide range of clinical practices among nurses. Therefore, an abundant number of registered policies and guidelines used to reduce high diversity of physical restraints in patients especially in children admitted to PICU.⁽¹⁴⁾ Reducing physical restraints applications in the PICU is an important indicator of nursing care quality. So, nursing education plays a fundamental role to prepare competent nurses to

identify patients' needs and based on their needs modify the environment to provide most applicable health care services in the light of the best research evidence. ⁽¹⁵⁾

Currently, physical restraint application in acute care setting is a provocative practice. Therefore, nursing staff play a vital role in the management process concerning physical restraint application in PICUs. According to Joint Commission on Accreditation of Health Care Organization, many health care organizations start to focus on hospitals' considerations to reduce PR application and monitoring process for restrained children. Additionally, PR is considered an arguable procedure; due to moral and legitimate issue considerations, that affects the independence and self-respect of patients. ^(16,17) In addition, PR includes severe safety concerns for nurses and children. Therefore, increase nurses' mindfulness about physical restraint use and complications help to establish nurses' clinical reasoning process. Most nurses have a conflict about the necessity of application of

physical restraint and the patients' autonomy. ⁽¹⁸⁾

However, the nurses' knowledge and intentions towards using physical restraint are critical factors that contribute to implement this procedure. In PICUs, physical restraint still implemented despite standards of care and clinical protocols for physical restraint usage. In addition, studies have concluded that the nurses' knowledge about the proper use of PR was unsatisfactory, and other studies showed that nurses have mixed feelings about physical restraint usage. ^(19,20)

The best approach to advance knowledge and practices regarding the use of physical restraint is through educational interventions program in the PICUs. ^(21- 23) It is necessary to implement an effective educational program on physical restraints use in PICUs to improve nurses' practice and to increase pediatric patient safety. ⁽²⁴⁾ Therefore, the present study conducted to improve pediatric critical care nurses' knowledge and practice regarding restraint application and children's outcomes.

Significance of the study

Physical restraint is an intervention that is used to reduce the risk of treatment interference and abrupt discontinuation of medical device used for monitoring, diagnosing, and treating children. It used to prevent critically ill children from harming themselves and others. There is a lack of research that focus on ongoing training in the proper and safe use of physical restraints especially in PICUs. (25,26) Commitment to children and pediatric nurses' safety is a top priority for health care organizations. Since nurses' knowledge and practice play a significant role in physical restraint application. It was important to develop an educational training program for pediatric critical care nurses on safe application, reassessment, and documentation to physical restraint use. Therefore, the current study was carried out to improve pediatric critical care nurses' knowledge and practice regarding restraint application and children's outcomes.

Aim of the study

This study aims to improve pediatric critical care nurses' knowledge and

practice regarding restraint application and children's outcomes.

Hypotheses

H₁: Pediatric critical care nurses' knowledge and practice regarding restraint application are expected to be improved after implementation of the training program.

H₂: Children's outcomes are expected to be improved after implementation of the training program.

Subject and Methods

Study design:

A quasi-experimental design was used in the current study.

Setting:

This study was conducted in Pediatric Intensive Care Units (PICUs) at Mansoura University Children's Hospital (MUCH) affiliated to Mansoura University, Egypt. The MUCH has many department and ICUs. Medical PICU is available for all pediatric patients with different critical medical condition. The capacity of PICU is nine beds separated by curtains and equipped with monitors and

ventilators. Nurses to children ratio were 2:1 in the morning shift and 1: 2 in the afternoon and evening shift.

Subjects:

The current study involved two groups (nurses and children) as follow:

A convenience sampling of 43 nurses working in the previously mentioned study setting. Nurses from both genders, with different ages, educational background, and years of experience were involved in the present study.

A convenience sampling of 40 children from both gender who were admitted to the previously mentioned study setting and exposed to physical restraint application were involved in the current study.

Tools:

Three tools were used in the current study namely. The tools were developed by the researchers in the guidance of the following references. ⁽²⁷⁻²⁹⁾

Tool I: Pediatric Critical Care Nurses' Knowledge and Reported Practice Regarding Restraint Application

A structured questionnaire sheet was used to determine PICU nurses'

knowledge regarding to restraint and reported practice related to restraint application. The questionnaire includes three parts as follow:

Part (1): comprise of demographic characteristics of the nurses such as age, gender, educational background, and years of experience.

Part (2): includes 10 statements about ethical and legal issues of restraint application, indication, purposes, complication, who should order the restraint. The response to the questions either with "true, false or I do not know".

Part (3): comprises of 14 items to judge nurses' reported practice regarding use of PR. This division covers questions related to the use of alternative measures before the application of restraints, physician's order before restraint application, parents' permission of restraint application. Furthermore, concerns in nursing care for children immediately before and during restraint application, observation every 2 hours, recording of restraint data, follow up for detection of restraint complications and assessment of the need for restraint removal. The correct answer of the

nurses scored (1), incorrect answer or I do not know scored (zero).

Scoring system:

The scoring system utilized for the total knowledge and reported practice adopted from ⁽²⁹⁾ as follow:

High level of knowledge 75% and more.

Average level of knowledge 70% to less than 75%.

Poor level of knowledge less than 70%.

Tool II: Restraint Application Checklist

This tool includes 25 steps. Including checking physician order, assess the need for restraint, select the best type of restraint, apply the restraint in the correct technique that allow the child to move freely without defeating the idea of the restraint. In addition, assessment and observation criteria during restraint application and documentation of the restraint in the child file including skin condition under restrain, causes for removal and time for restraint application.

Correct and complete step scored (1). While, incorrect or not done step scored zero. The scoring system for nurses' practice as the follow: the nurses

considered had competent practice if the score is 75% and greater, while incompetent practice calculated when the score less than 75%.

Tool III: Restraint Complication Assessment Sheet

It was developed by the researcher to gather information about children bio socio demographic data including medical condition. It was consisted of two parts as follow:

Part (1): Children bio-socio demographic data including age in years, gender, diagnosis.

Part (2): this part includes assessment of restraint type, assessment of restraint related complication (cyanosis, coldness of the restrained part, edema, skin ulceration), assessment of agitation and anxiety level.

Method:

Validity and reliability:

Data collection tools were reviewed by a panel of five professionals from pediatric and critical care nursing at Mansoura University. No significant modification on the tools based on their opinions was done. Tools' reliability was

done using Alpha Cronbach's coefficient test, which was ($\alpha = 0.81$) for the tool I, while it was ($\alpha = 0.89$) for tool II.

Pilot Study:

A pilot study was conducted on four nurses (10% of the total sample) to check the precision, practicability, applicability, and objectivity of the data collection tool. No modification required and the pilot study nurses were included in the study sample.

Ethical consideration:

Ethical endorsement from Ethical Research Committee of Faculty of Nursing, Mansoura University was obtained. An authorized agreement from the administrator of Hospitals and the heads of the departments in which the study was conducted was taken. The aim of the study was explained to the nurses and the mothers of children and they were informed that their participation in the study is considered. They also assured that their participation in this study is voluntary, so, they have the right to reject participation and to withdraw at any time from the study without any penalties, and their data was

confidential and used only for research publications.

Fieldwork:

Data collection:

Data collection of this study was carried out over a six month period that started from 1st of October 2020 to the end of March 2021. Data collection was conducted through three phases (assessment phase, implementation, and evaluation phase).

Assessment phase:

An explanation about the aim and nature of the study were discussed with the head nurse and nurses in the PICU. Throughout this phase, the investigators measured nurses' knowledge and practice about restraint application using tool I. Then, each nurse was given a code number to be used as an identifier throughout the study. The investigators conducted direct observation to appraise nurses' practical level. The researcher observed each nurse throughout different shifts, on an average 3 hours a day- 3 days a week for one-month using tool II, the researcher was filling out the observational checklists and was

documented nurses' practices regarding to restraint application. The researchers collect data related to the children and recorded the complication developed for children related to restraint application using tool III.

Implementation phase:

The researcher developed and implemented training program for the study nurses. The program included two sessions "one practical and one theory session". The program delivered throughout one month, every week including two sessions, and every session lasts about thirty to forty-five minutes. The nurses assigned to groups five nurses in each group. The session timing was between morning and afternoon shift or during morning shift after giving the routine care to the critically ill children.

The theoretical sessions focused on definition of restraint, purpose, indication, types, complication, ethical and legal issue related to restraint, alternative to restraint application, parents' approval and consent for restraint application and nursing assessment care for children before,

during and after restraint application. Practical session concentrated on the application and demonstration of different types of restraint and the needed data for documentation in nurses' notes related to restraint. Every practical session was carried out during the shift work. Nurses divided into small groups (for each five nurses); practical sessions were done in the nurses' working area to facilitate the training. Enough time was given for discussions, clarifications, and any questions regarding the practical skills. Many teaching methods was used in each session included demonstration and return demonstration, displaying simple training videos for practical skills and power point presentation with pictures used in theoretical part.

Evaluation phase:

Nurses' knowledge and practice were appraised pre and immediately post after implementation of the training program using the previously mentioned study tools. Evaluation of the condition of the studied children regarding occurrence of restraint complication were also done

after the implementation of training program using tool III.

Data Analysis:

Collected data was prepared, reviewed, tabulated, and analyzed using the number and percentage distribution. Data analysis was done using Statistical Package for Social Sciences (SPSS Inc., Chicago, IL, USA), version 20 for Windows. Categorical variables described using number and percent. Continuous variables presented as mean \pm SD (standard deviation). The following statistical test used Paired sample t test, Wilcoxon signed-rank test and Spearman and Pearson correlation (r) performed to measure the strength and the way of relationship among the main study variables. All tests done at a level of significance (P-value) equal or less than 0.05 considered statistically significant.

Results

Table (1) shows that, most of the studied nurses (67.4%) were in the age group of 30 years old with a mean age of (35.27 \pm 5.37) years. With regard to years of experience, it was observed that, more than half of the study nurses (53.5%) had

15 or more years of experience in the ICUs. An identical percentage (44.2%) of the nurses' diploma and bachelor's degree of nursing and a minority of them (11.6%) had technical institute of nursing.

Table (2) illustrates that approximately one third of children (32.5%) in the age group of six years or more. In addition, 37.5% of children diagnosed with respiratory problem. Moreover, nearly half (57.5%) of children were boys.

Table (3) shows nurses knowledge about application of physical restraints for children pre and post implementation of educational sessions. It was found that there is either significant or highly significant improvement of nurses' knowledge post training program implementation in all items related to knowledge about application of physical restraints for children except the item that mentioned that child restraints increase the stay hospital length of p (≤ 0.005 and ≤ 0.001).

Table (4) reveals reported practice of the studied nurses' pre and post implementation of training program. It

shows that nurses' practices improved regarding decision taken for restraints application for children; the most common type of restraints used in PICU, age group most commonly implement restraints, obtain parent approval to use restraint and documentation of the restrain in the child's medical records. There were statistically significant differences in nurses' practice with P value (≤ 0.001) all through two assessments.

Table (5) demonstrates the prevalence of restrain complication among critically ill children pre and post intervention. It is obvious that approximately one third of children (30%) had skin ulcers and injury in pre intervention and the minority of them (15%) had no complication compared to more than half of them (60%) who did not have any complication from the restraint in post intervention with statistically significant difference ($P = 0.017$).

Table (6) total score of the studied nurses' knowledge, reported and

observed practice about restraint application for children in PICU. It is obvious that there is an improvement in the total mean knowledge scores post implementation as compared to pre implementation ($8.51 \pm 1.05 - 3.95 \pm 2.22$) respectively. In addition, the same table documents an apparent increase in the subtotal mean reported practice score post implementation as compared to pre implementation ($22.39 \pm 0.49 - 13.79 \pm 6.59$ respectively. (11.93 ± 3.76 and 22.11 ± 2.63).

Table (7) correlation between the total studied nurses' knowledge and their practice regarding implementation of physical restraint for children in PICU. The table reflected positive statistically significant correlation between the nurses' knowledge and total studied nurses' reported and observed practice, ($r/p = -0.919^*/0.001 - 0.306/0.046$) respectively post implementation.

Table (1): Distribution of the studied Nurses according to their demographic characteristics (n=43)

Variables		No (43)	%
Age	20-<30ys	8	18.6
	30-<40ys	29	67.4
	≥40ys	6	14
	Mean ±SD	35.27±5.37	
Qualification	Diploma of nursing	19	44.2
	Technical institute of nursing	5	11.6
	Bachelor's degree of nursing	19	44.2
Years of experience	< 5 years	4	9.3
	5 - < 10 years	7	16.3
	10- <15 years	9	20.9
	≥15 years	23	53.5

Table (2): Characteristics of studied children (n= 40)

Variables	No (40)	%
Age		
Less than 1 year	11	27.5
1-3 years	9	22.5
3-6 years	7	17.5
More than 6 years	13	32.5
Gender		
Boys	23	57.5
Girls	17	42.5
Diagnosis		
Respiratory problem	15	37.5
Neurological problem	10	25
Cardiac problem	5	12.5
Medical problem	10	25

Table (3): Nurses knowledge about restraints application for children in PICU pre and post training program implementation (n=43)

Knowledge' items	Pre-implementation (43)						Post-implementation (43)				Test of significance	
	Yes		No		I don't know		Yes		No		Z	P-value
	No	%	No	%	No	%	No	%	No	%		
Its legal and important to use restraints to protect the child from injury	39	90.7	4	9.3	0	0	43	100	0	0	2.00	0.046*
The mother has the right to know the restrain cause and to refuse restraints	20	46.5	22	51.2	1	2.3	43	100	0	0	4.79	≤0.001**
Physician orders is necessary to apply or remove the child restraints	20	46.5	21	48.8	2	4.7	43	100	0	0	4.79	≤0.001**
The restraint should be used when nobody observes the child	14	32.6	29	67.4	0	0	41	95.3	2	4.7	5.19	≤0.001**
Sedative children should be restrained	11	25.6	32	74.4	0	0	43	100	0	0	3.31	≤0.001**
Child restraint prevent falling from the bed and decrease injury	30	69.8	13	30.2	0	0	41	95.3	2	4.7	2.84	0.005*
Child restraints increase the mortality rate in the hospital	1	2.3	36	83.7	6	14	9	20.9	34	79.1	2.53	0.011*
Child restraints increase the hospital length of stay	40	93	3	7	0	0	4	9.3	39	90.7	2.00	0.046
Child restraints is not congruent with child rights	11	25.6	26	60.5	6	14	4	9.3	39	90.7	1.80	0.071
Child restraints safe for health care provider work	24	55.8	19	44.2	0	0	43	100	0	0	4.35	≤0.001**
Skin areas should be examined every 2 hours and position of the child should be changed	26	60.5	17	39.5	0	0	38	88.4	5	11.6	3.20	≤0.001**

* Significance at level $P < 0.05$ ** Significance at level $P < 0.001$

Table (4): Distribution of the studied nurses' reported practice regarding restraint application for children in PICU pre and post training program implementation (n=43)

Practice' items	Pre-implementation		Post-implementation		Test of significance	
	No.	%	No.	%	Z	P-value
Application of the restraint for children in PICU						
Yes	25	58.1	43	100	4.24	≤0.001**
No	18	41.9	0	0		
Type of restraints used with the children in PICU						
Chemical restraint	23	53.5	0	0	4.79	≤0.001**
Physical	20	46.5	43	100		
The decision for restraints taken by						
Nurse	24	55.8	4	9.3	3.87	≤0.001**
Physician	19	44.2	39	90.7		
Supplies needed to apply the restraint						
Gauze	41	95.3	43	100	1.41	0.157
Bandages	2	4.7	0	0		
The most common type of restraints used in PICU						
Clove Hitch restraints	38	88.4	43	100	2.23	0.025
Mummy restraints	5	11.6	0	0		
Age group most commonly implement restraints are						
Infant and toddlers	15	34.9	0	0	4.14	≤0.001**
School age children	6	14	1	2.3		
All ages	22	51.2	42	97.7		
How many time you assess the child restraints site						
No assessment	6	13.95	0	0	1.80	0.071
Every 2 hours	32	74.4	39	90.7		
Every 4 hours	3	7	2	4.7		
Every 8 hours	2	4.7	2	4.7		
Obtain parent approval to use restraint						
No	16	37.2	4	9.3	5.38	≤0.001**
Oral approval	10	23.3	39	90.7		
Not applicable	17	39.5	0	0		
Documentation of the restrain in the child medical records						
Yes	11	25.6	39	90.7	5.29	≤0.001**
No	32	74.4	4	9.3		

* Significance at level $P < 0.05$ ** Significance at level $P < 0.001$

Table (5): Reported Complications of Physical Restrain Among Pediatric Critically Ill Children Pre and Post Training Program Implementation (n=40)

Variables	Pre-intervention (n=20)		Post-intervention (n=20)		Test of significance	
	No.	%	No.	%	X ²	P-value
No complication	3	15	12	60	8.133	0.017*
Skin ulcer and injuries	6	30	4	20		
Edema of the restrained Extremities	4	20	2	10		
Cyanosis of the restrained Extremities	4	20	0	0.0		
Increase anxiety and irritable	3	15	2	10		

Table (6): Total score of the studied nurses' knowledge and practice regarding restraint application for children in PICU pre and post training program implementation (n=43)

Total score	Pre-implementation		Post-implementation		Test of significance	
	No.	%	No.	%	t	P
Total knowledge score						
Poor	22	51.2	0	0	15.99	≤0.001**
Fair	20	46.5	4	9.3		
Good	1	2.3	39	90.7		
Mean ± SD	3.95±2.22		8.51±1.05			
Total reported practice score						
Poor	18	41.9	0	0	18.61	≤0.001**
Fair	22	51.2	4	9.3		
Good	3	7	39	90.7		
Mean ± SD	11.93±3.76		22.11±2.63			
Total observed practice score						
Incompetent practice	29	67.4	0	0	8.25	≤0.001**
Competent practice	14	32.6	43	100		
Mean ± SD	13.79±6.59		22.39±0.49			

* Significance at level P < 0.05

** Significance at level P < 0.001

Table (7): Correlation between the total studied Nurses’ knowledge and their practice regarding restraint application for children in PICU pre and post training program implementation (n=43)

Item	Pre-implementation		Post-implementation	
	<i>r</i>	<i>P</i>	<i>r</i>	<i>P</i>
The total studied Nurses’ knowledge				
Total studied Nurses’ reported practice	0.765	≤0.001	0.919	≤0.001
Total studied Nurses’ observed practice	0.421	0.005	0.306	0.046

* Significance at level $P < 0.05$

** Significance at level $P < 0.001$

Discussion

Pediatric Intensive Care Unit (PICU) is specialized area of nursing care for children with life-threatening conditions. Using physical restraint to prevent harm for critical ill children. Restraint application is an important nursing care in PICU that is usually associated with many adverse effects and raises many ethical and practical concerns. Therefore, in-service training program for pediatric critical care nurses about physical restraints in PICU is a necessary step to improve their knowledge, and practices. Therefore, the current study conducted to improve pediatric critical nurses' knowledge, practice, and to find out pediatric patient outcomes regarding restraint application. The current study showed that more than one third of studied children admitted to PICU with respiratory problem. This finding agreed with the study conducted by **Mohammed et al. (2016)** ⁽²⁶⁾ who revealed that nearly one third of the restrained children had respiratory disorders. This result interpreted in the fact that the primary causes of morbidity among children under six years is a respiratory problem and children are always in need for monitoring and assistive respiratory devices.

Regarding nurses' knowledge about application of physical restraints for children in PICU, the results of the present study showed that there is a statistically significant difference regarding nurses' knowledge post implementation to all items of the knowledge about application of physical restraints for children. Most of nurses know that it is legal and important to use restraints to protect the child from injury pre and posttest. These results were supported with **Chang et al. (2016)** ⁽³⁰⁾ who recommended that using PR was based on healthcare staff considerations and their expression of moral and ethnic values and related healthcare authority policies. Changing physical restraint implementation policy is a multidisciplinary team responsibility. Three quarters of nurses reported that restrain should not be applied to sedated children in the pretest. Higher dosage and frequency of sedative drug administration are most important reasons supporting the high level of non-restraint attained in PICU for sedated child.

There was statistically significant difference in relation to nurses' practice pre and post implementation of training program. In the present study regarding documentation of the restrain in the child

medical records, only one quarter of nurses reported that, they document the restraint in child's file in the pre implementation of training program compared to most of nurses' post implementation. This finding supported with **Moradimajd et al. (2015)** ⁽³¹⁾ their findings concluded that restraint standards implementation failure might be due to nurses' unfamiliarity with the standards, absence of documentation sheets, and supervisors' low sensitivity related to restraint use and recording. So, they recommended to educate nurses who are the first decision makers for using restraint and informing them with clinical guidelines are critical and judging the effects of education program on physicians and nurses' restraint use. Similarly, **Gu et al. (2019)** ⁽³²⁾ in their study concluded that using physical restraint in Chinese ICUs was higher than that reported in previous investigations. Incomplete documentations in the patients' nursing notes about physical restraint were obvious, so they recommended a need for physical restraint use standard guidelines and policies for in china hospital ICUs.

The collaboration of parents in restraint application for their children can minimize the feelings of guilt and the ethical dilemmas that nurses may experience ⁽³³⁾.

The current results showed that most of nurses did not take approval from parents to implement physical restraint. As similar, **Kısacık et al. (2020)** ⁽³⁴⁾, their results showed the ICU nurses act as independent decision-makers to use physical restraints due to commonly used PR in ICUs in Turkish hospitals for ensuring patient safety. However, they did not consider patient and family rights to obtain the order for using PR.

In the present study, the causes for applying physical restraints in PICU were to inhibit the child from disconnecting medical equipment and to protect them from falling out of bed. It was also evident that all nurses apply restraint to improve patient safety especially for mechanically ventilated pediatric patient with agitation even with sedation administration. This result is congruent with the study of **Younis and Ahmed (2017)** ⁽³⁵⁾ who mentioned that, most common explanations given by ICU nurses for applying PR were to preserve the patient's safety and confirm that treatment continued. This may be due to nurses are responsible for safeguarding children safety, recognize physical restraints as a simple solution to accomplish this common goal.

In current study two third of nurses reported their practiced during using physical restraint, child skin areas should be examined every 2 hours and change child position pre intervention but improved to most of them post intervention. Similarly, **Younis and Ahmed (2017)**⁽³⁵⁾ results showed that the majority of nurses after application of clinical guidelines, demonstrate the intervention correctly such as assessment of restraint limb, every 2 hours renewing PR orders, perform frequently range of motion exercises, assess skin color, limbs movement, sensation and peripheral circulation assessment and remove restraints for 30 minutes every two hours. These results reflect that, in-services training program content improve the nurses reported practice of physical restraint using.

Most of nurses' post intervention compared to three quarter in pre intervention in the current study disagreed about physical restrained increased risk to suffocation. The use of physical restraint increases the children risk to suffocation and strangulation. Consequently, training nursing staff to advance their knowledge and skills concerning physical restraint has become necessary. This goes in the line with **Perez et al. (2021)**⁽³⁷⁾ who concluded that new information proves nurses'

understanding of the possible harm caused by physical restraints and the way in which existing practices conducted by workplace customs and expectations rather than on critical thinking and decision-making.

The current results revealed that approximately one third of children develop skin ulceration at the site of restrained limb and one fifth developed edema and cyanosis in the pre intervention. The prevalence of restraint related complication was reduced after training program implementation as represented in the current study result that approximately two thirds did not have complication and the difference was statistically significant. The results could be interpreted in the fact that the most common type of restraint used in PICUs is clove-hitch restraint and the nurses was applying the restraint without adding cotton under the gauze. In addition, fixation of the restraint in the side rails that allows friction between gauze and children skin and increase the risk of skin ulceration. The practice of nurses was advanced after application of training program that in turn decreasing the prevalence of restraint related complication in children. This result agreed with **Mohamed et al. (2016)**⁽²⁹⁾

who reported in his study that one third of studied children had extremities edema as a complication of physical restraint. This result could be interpreted as the proper implementation of PR endorses the excellence of nursing care for children and reduces their risk to physical complications. This study highlights the importance of modifying health care professionals' thoughts and concepts related to the PR use as a hospital strategy for childcare.

Additionally, in the study conducted by **Taha and Ali (2013)** ⁽²⁶⁾ their study concluded that relatively short-term in-service guidelines can significantly advance nurses' knowledge and practice regarding physical restraining of ICU patients, with successive decrease in the occurrence of related complications among these patients. These findings indicated that the nurses repeatedly use their knowledge and apply it to their daily practice, which helps recall and memorization. Similar to **Chang et al. (2016)** ⁽³⁰⁾ in their study concluded that in-service education for physical restraints improves relevant knowledge and techniques.

Educational interventions are the best method to improve knowledge, practice

regarding restraint application, and diminish their intention to implement physical restraint. Current findings showed increase in the total mean knowledge, reported and observed practice score in post intervention as compared to pre intervention with statistically significant difference. This result agreed with study conducted by **Mohamed et al. (2016)** ⁽²⁹⁾ who concluded that there was significantly improvement in nurses' knowledge and practice concerning to physical restraint application after implementation of physical restraint guidelines. In addition, **Chang et al. (2016)** ⁽³⁰⁾ concluded that in-service education significantly enhances the proper implementation of restraints by nursing staff and the implementation of physical restraint requires not only professional knowledge but also correct technique. Another study supported current results conducted by **Eskandari et al. (2018)** ⁽¹⁸⁾ and displayed a significant increase in the mean knowledge and practice score and a significant reduction in the mean intention score of nurses to physical restraint application after intervention. In addition, the same study highlighted that nurses' knowledge towards using physical restraint are important aspects that may contribute to this practice.

Moreover, Lee et al. (2021)⁽³⁸⁾ in their study findings showed that nurses had good restraint-related knowledge and practices, also reveals some areas of misunderstandings, and incompetent practices related to physical restraints. Many studies conducted by Kassew et al. (2020)⁽³⁹⁾ and Nasrate et al. (2017)⁽⁴⁰⁾ their study findings reflect that educational package can advance ICU nurses' knowledge and enhance their practice toward PR. Which positively effect on the excellence of nursing care conveyed to the patients and reducing the complications of malpractice regarding physical restraint. Finally, in-service training program about restraint achieved their goals in improving pediatric critical nurses' knowledge ad practice and patients' outcome.

Conclusion

In conclusion the current study delivers valued data to pediatric intensive care nurses, educationalists and policymakers to guide future practices and improve children' outcomes by highlighting the importance of education on PR performance and in the development of policies and guidelines. The training program has positive effect on improving nurses' knowledge and practices and more favorable outcomes as represented in the results. In addition, the prevalence of

restraint related complication decreased in the post intervention phase.

Recommendations

Family involvement in decision making in restraint application must be as a part of policy in PICU.

Documentation system that includes physical and chemical restraint assessment and evaluation and restraint related complications documentation is mandatory.

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