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Effect of Designed Eye Care Protocol on Nurses' Knowledge and Practices Regarding Prevention of Ocular Surface Disorders among Sedated and Intubated Children at Pediatric Intensive Care Unit

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Abstract Sedated and intubated children have impaired ocular protective mechanisms putting them at risk for ocular surface disease with potential vision loss. So, rapid intervention with targeted treatment is essential to avoid vision-threatening complications. This study aimed to evaluate the effect of designed eye care protocol on nurses' knowledge and practice regarding the prevention of ocular surface disorder among sedated and intubated children at pediatric intensive care units. Research design: A quasi-experimental design was used. Settings: This study was conducted at the pediatric intensive care units in Benha university hospital and Benha Specialized Pediatric Hospital. Sample: A Convenient sample of nurses (n=75) and a purposive sample of sedated and intubated children (n=62). Tools of data collection: Three tools were used; a structured interviewing questionnaire sheet, an observational checklist, and eye health status assessment sheet. Results: there was a significant improvement in nurses' knowledge and practice post-designed eye care protocol implementation. Moreover, the results revealed that the majority of children in the study group had no ocular surface disorders and less than three-quarters of them had absent conjunctival edema post-designed eye care protocol implementation. Conclusion: The implementation of the designed eye care protocol proved to be effective in improving nurses' knowledge and their practices, with a positive impact on sedated and intubated children. Recommendations: Provide continuous educational programs and training courses for nurses working at pediatric intensive care units about eye care to improve their performance.

Keywords: *designed eye care protocol, nurses' knowledge and practices, ocular surface disorder, children, pediatric intensive care unit*

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1. Introduction

The ocular surface represents a finely regulated system that allows the protection of the eye. It represents the interface between the functioning eye and the environment, and it is a finely regulated complex system that provides anatomic, physiological, and immunologic protection of the eye [1].

Ocular surface disease in the Pediatric Intensive Care Unit (PICU) is a significant problem in intubated children due to altered eye protective mechanics, leading to exposure of the eye surface and dry eye. So, eye care should be part of the care provided to children during admission to intensive care units [2].

The ocular surface is normally protected by the ability to produce tears, blinking reflex, and eyelid closure. All of these mechanisms can be disrupted in the intensive care population, increasing the risk of developing ocular surface disease especially those who are sedated and intubated [3].

The health of the front surface of the eye, particularly the cornea (the clear front window of the eye) depends on the ability to produce tears, to blink, and to close the eyes with rest or sleep. These can be impaired at the intensive care unit (ICU) whether by disease (e.g. facial oedema, reduced conscious level, peripheral or central neurological injury) or treatments (e.g. the drying effects of gas flows from CPAP or oxygen masks). In particular muscle relaxants reduce the tonic contraction of the orbicularis muscle around the eye which normally keeps the lids

closed, and sedation reduces blink rate and impairs the blink reflex. Whatever the cause, this risk is higher in those mechanically ventilated, due to greater length of stay, use of sedative drugs and the effects of positive pressure ventilation [4].

The eye is a multifaceted organ and is susceptible to injury and infection. This vulnerability is amplified in children in PICUs who are already critically ill. The risk of these children developing ocular complications is increased because of impaired consciousness, sedation and ventilation, sepsis and incomplete eyelid closure. So that, eye care is a fundamental aspect that should not be neglected in sedated and intubated children [5].

Children in PICU are often sedated and mechanically ventilated. This can mean that eyelid closure, the blink reflex and tear production are impaired. Without meticulous eye care, the risk of ocular surface disorders increased and can lead to potential vision loss. Corneal damage may start as early as 48 hours after admission to ICU. Correctly performed eye care prevents the majority of corneal problems encountered in the intensive care unit. Common ocular surface disorders in PICU includes corneal abrasion, exposure keratopathy, chemosis and microbial conjunctivitis/keratitis [6].

Ocular complications that occur in children admitted to the ICU range from a mild conjunctival infection to severe corneal injury such as corneal ulcers and even corneal perforation followed by permanent eye damage. Among these, the most ocular complications identified in the intensive care unit were contact keratopathy, chemosis (conjunctival swelling) and microbial keratitis. Also, the prevalence of corneal ulcers in the ICU is estimated at 22-33% and lagophthalmos occurs in 75% of these patients [7].

Nurse play a vital role, not only delivery of eye care and treatment, but rather assessment and diagnosis of eye disorders related to infection and can prevent complications if well trained and utilize right knowledge. Unfortunately, nurses' backgrounds regarding knowledge, even practice, toward eye care remains to be performed based on individual beliefs and tradition and documentation oftentimes unsatisfactory and poor [8].

Eye care for sedated and intubated children is an essential nursing skill. So, nurses need to be able to carry out a baseline assessment of the eye as part of a holistic child assessment and deliver essential care including eye cleansing [9]. As PICU patients' natural eye protective mechanisms are diminished, nurses has an important role in maintaining a healthy eye surface and preventing complications as, good eye hygiene, application of artificial tear drops, lubricating eye ointment., moisture chambers (polyethylene covers) to relieve dry eye symptoms, Polyacrylamide gel dressings and prophylactic antibiotic ointments. So, nurses must practice effectively and in accordance with the best available evidence [5].

1.1. Significance of the Study

The eye care is often seen as a minor problem, which represent low priority in comparison to other intervention and sometimes nurses provide eye care based on their personal opinions rather than standards. This can lead to ophthalmic complication [10]. Sedated intensive care children have impaired ocular protective mechanisms putting them at risk for ocular surface disease with potential vision loss [11].

Corneal damage may start as early as 48 hours after admission to ICU. Correctly performed eye care prevents the majority of corneal problems encountered in the intensive care unit [12]. Therefore, this study has been conducted in order to evaluate the effect of designed eye care protocol on nurses' performance regarding prevention of ocular surface disorder.

Due to the importance of eye care for children in PICU, it is necessary for nurses to use accurate methods in eye care for these children. Despite the different methods of eye care, PICU nurses need to have a proper evaluation of the performance and effectiveness of eye care methods. Therefore, the implementation of a comprehensive, complete and accurate care protocol can be one of the most effective methods of eye care in the PICU [7].

1.2. Aim of the Study

The aim of this study was to evaluate the effect of designed eye care protocol on nurses' performance regarding prevention of ocular surface disorder among in sedated and intubated children at pediatric intensive care unit through:

1. Assessing nurses' knowledge and practice regarding eye care for sedated and intubated children.
2. Designing and implementing eye care protocol for nurses who provide care to sedated and intubated children based on the nurses' actual needs.
3. Evaluating the effect of designed eye care protocol intervention on nurses' performance.
4. Evaluating the effect of improved nurses' knowledge and practice on reducing the occurrence of ocular surface disorder for sedated and intubated children.

1.3. Research Hypothesis

1. The level of nurses' knowledge and practice will be improved after implementing designed eye care protocol.
2. There will be a significant relationship between the nurses' knowledge, practice and their personal characteristics.
3. Sedated and intubated children in the study group who receive care after implementing designed eye care protocol will have less risk for ocular surface disorder than those in control group who receive a routine hospital care.

2. Subjects and Methods

2.1. Research Design

A quasi-experimental design was utilized to attain of the present study.

2.2. Research Settings

This study was conducted in pediatric intensive care unit (PICU) at Benha university hospital and Benha

Specialized Pediatric Hospital affiliated to the ministry of health and population. PICU at Benha university hospital is found in the fourth floor which contains four rooms, the first room comprises five beds, the second room comprises four beds, the third room comprise two beds and the fourth room (isolation room) comprises only one bed; while PICU at Benha Specialized Pediatric Hospital is found in the third floor in surgical building and comprises three rooms; the 1st room comprises ten beds, 2nd room contain two beds and the 3rd room (isolation room) comprises one bed.

2.3. Subjects

- A convenience sample of all available nurses (75) who are working at the previously mentioned study settings were included in this study (35) nurse from Benha University Hospital and (40) nurse from Benha Specialized Pediatric Hospital, regardless their educational level and years of experiences.
- A purposive sample of sedated and intubated children (n=62) were included from the previously mentioned settings. Those children were divided equally into 2 constructed groups; study group (n=31) who receive care after implementing of designed eye care protocol and control group (n=31) who receive a routine hospital care.

Inclusion criteria:

Admission to the PICU and intubated with mechanical ventilation for less than 48 hours.

Exclusion criteria:

1. Children who had previous ocular surface disorders.
2. Children who had significant eye trauma, and those meeting criteria for brain death.
3. Children who had prior ocular surgery; who had refractive errors, and/or who are taking topical medication.

A total of 62 child recruited in the current study. They randomly allocated into two groups: group (1) study group included (31) child receiving nursing care based on eye care protocol, and group (2) control group included (31) child receiving only routine nursing care.

Technique: The control group firstly assessed before implementation of designed eye care protocol. This technique applied to avoid and reduce bias during data collection. Additionally, study group related intervention and assessment applied after one week implementation of designed eye care protocol.

2.4. Tools of Data Collection

The following three tools were used to collect data relevant to the current study.

2.4.1. Tool I

It was designed by the researchers in the light of related studies and researches [13,14]. It was prepared in an Arabic language and composed of three parts:

Part I: concerned with the characteristics of studied nurses such as age, gender, academic qualifications, years of experiences, and attendance of previous training courses related to eye care for sedated and intubated children.

Part II: Personal characteristics and medical data of the studied children such as; age, gender and medical diagnosis.

Part III: Nurses' knowledge regarding ocular surface disorders: It encompassed (18) multiple-choice questions such as; description of eye structure and function (2 questions), definition of Ocular Surface Disorder (OSD) (1 question), eye protective barriers of ocular surface (1 question), assessment of OSD in sedated and intubated children (1 question), risk factors for OSD in sedated and intubated children (1question), diagnosis-established technique (1 question), assessment of eye lid closure and grading of lagophthalmos, management of OSD (2 questions) methods of prevention of OSD (3 questions), Ocular surface complications (3 questions), nursing role regarding eye care for sedated and intubated children (3 questions).

Part IV: Nurses' knowledge regarding eye care for sedated and intubated children: It encompassed (21) multiple-choice questions such as; eye assessment methods (2 questions), the key objective of eye care (1 question), eye problems in sedated and intubated children (2 questions), signs of eye infection (1 question), physical examination of eye (2 question), the best time for beginning eye care (1 question), how often should a child be assessed regarding the protective mechanisms of the eye(1 question), risk factors for incomplete lid closure(1 question), the best eye care plan(3 questions), most effective method for preventing corneal abrasion (1 question), methods for closure of the eyelids and the right direction for applying adhesive tape on eyelids for closing the eyes (3 question), a potential risk factor for ophthalmic complication (1 question), the most important criterion in assessing ophthalmic complication(2 questions).

Scoring system for nurses' knowledge:

The scoring system for nurses' knowledge was evaluated upon fulfillment of the interviewing questionnaire as the nurses' knowledge checked with a model key answer. Therefore, correct answer scored (1), and incorrect or do not know answer scored (0). The total score ranged from 0-29 (29 questions ×1). Nurses' total knowledge was classified into ≥75% was considered a good level of knowledge, a score 60>75% was considered an average level of knowledge, while those who obtained a score <60% was considered a poor level of knowledge.

2.4.2. Tool II

Eye care checklist: It was adapted from [9,15,16,17,18] to assess nurses' practice towards designed eye care protocol for preventing ocular surface disorders. It includes 8 main items and the total steps were 55 steps including; a baseline assessment of the eye (9 steps), essential eye care (17 steps), instilling eye medication; in case of administer eye drops (9 steps), in case of administer ointment (5 steps), maintain eye closure (8 steps), additional eye care for incomplete eyelid closure (5 steps) lubrication to prevents drying of the ocular surface (3 steps).

Scoring system for nurses' practice:

A score of (one) for done and a score of (zero) for not done. Total scores converted into percent scores, where the score of ≥ 80% considered competent and a score < 80% considered incompetent.

2.4.3. Tool III

Ocular surface disorders and ophthalmic complication assessment sheet**.** It consisted of two parts; **part I:** Grading of lid position scored as 0=no exposure, 2= grade I (lids apposed), 3=grade II (conjunctiva of the eye visible), 3=grade III (Cornea visible).

Part II: Assessment of ocular surface disorders scored as 0=None, 1=Corneal abrasion, 2=Keratopathy, 3= Chemosis, 4= Corneal injury.

Part III: Assessment of ophthalmic complication, included conjunctival odema. Graded as 0= Absent, 1= Conjunctival Infection, 2= Conjunctival odema without dellen formation, 3= Conjunctival odema with dellen formation.

Children in the control group were exposed to the routine care. While children in the study group assessed after implementing the designed eye care protocol for nurses, and then eye assessment was carried out by the researchers utilizing tool III.

2.5. Preparatory Phase

The researchers reviewed the local and international related literature to cover the various aspect of the study and develop relevant tools for data collection and designing the content of the eye care bundle by using books, evidence-based articles, periodicals, and magazines of line reference. This period extended from the beginning of June 2021 to the end of July 2021.

2.6. Tools Validity and Reliability

Tools validity was tested through a jury of three experts in the field of pediatric nursing to test the tools clarity, simplicity, comprehensiveness, relevance and applicability. Modifications were done accordingly based on their judgment. Testing reliability of all items of the tools was done by using Cronbach's alpha test. It was 0.789 for knowledge and 0.871 for practice. This phase took one month August 2021.

2.7. Ethical Considerations

According to the Faculty of Nursing Ethical Research Committee, the researchers got permission from the hospital managers and the supervisors of PICUs through the submission of an official letter. All participants were assured that participation in the study was voluntary; each nurse was informed about the purpose, benefits and nature of the study and each nurse had the right to withdraw from the study at any time without any rationale, then oral consent obtained from them. Confidentiality and anonymity of each subject was assured through coding of all data and all information has taken was protected.

2.8. Pilot Study

A pilot study was carried out on 10% of the total sample size (approximately 8 nurses) over a period of one month (September 2021) to test clarity of the data collection tools, feasibility, objectivity and time needed for each data collection tool. Based on the results of the pilot study some modifications were done as; omission and addition of some items. The pilot study subjects were excluded from the actual study sample.

2.9. Field Work

The actual field work was carried out from the beginning of October 2021 to the end of March 2022. The researchers were available at the previously mentioned setting by rotation three days/week (Saturday, Tuesday and Wednesday) in the pediatric intensive care unit in the morning shift to collect the data by using previously mentioned data collection tools.

2.9.1. Assessment Phase

At the beginning, the researchers interview each nurse, introduced themselves to each participant included in the study, explained the aim of the study, duration, and activities and took an oral consent to participate in the study prior data collection. Then, each nurse asked to fill the structured interviewing questionnaire sheet individually to collect baseline data and to assess nurses' learning needs; (Tool I). The average time needed for the completion of each interview for nurses was between 15 – 25 minutes. After that, the researchers fill children medical assessment record; this took 10-15 minutes. After that, the researchers observed each nurses' practice during demonstrating eye care for sedated and intubated children during their shift to assess their practice according to designed eye care protocol (Tool II). The average time needed for completion of each direct observation was between 20-30 minutes. Meanwhile, the researchers started to assess children eye condition for risk of ocular surface disorder and ophthalmic complication and grading of eye lid position (Tool III) in 7^{th} day (when ocular surface disorders expected)

2.9.2. Planning Phase

The eye care protocol was designed by the researchers after an extensive review of related literatures and the needs identified in the assessment phase. An Arabic booklet concerning eye care protocol was prepared and given to nurses.

The general objective of the designed eye care protocol was to update studied nurses' knowledge and improving their practice regarding eye care for sedated and intubated children.

Specific objectives:

At the end of designed eye care protocol each studied nurse should be able to:

- Describe the eye structure.
- Enumerate function of the eye.
- Mention eye protective mechanics
- Define ocular surface disorder.
- Illustrate importance of eye protective barriers of ocular surface.
- Understand the methods of assessing OSD in sedated and intubated children.
- Explain the methods of assessing eye lid closure and grading of lagophthalmos
- Mention the factors leading to incomplete eyelid closure.
- Mention risk factors for OSD in sedated and intubated children.
- Explain management of OSD.

- Discuss preventive measures of OSD.
- List eye problems in sedated and intubated children.
- Discuss the best eye care plan.
- List methods for closure of the eyelids.
- Mention the most important criterion in assessing ophthalmic complication.
- Demonstrate steps of eye care.
- Apply eye medication.

2.9.3. Implementation Phase

The implementation phase was achieved through six sessions (2 sessions for theory and 4 sessions for practice). A time schedule suitable for nurses was developed to conduct the sessions includes; date, place, topic, time and duration of each session. The training sessions consisted of two parts, the theoretical part and the practical part cover the items of eye care protocol. It was difficult to take all nurses at the same time; thus they were divided into 8 groups of about 9-10 nurses in each session.

The duration of theory sessions 30-35 minutes for each session and practical sessions ranged between 45 to 60 minutes for three days/week. At the beginning of each session, the researchers started by a summary about what was given through the previous session and objectives of the new one, taking into consideration using simple and clear language to suit the nurses. Different teaching methods were used including small group discussion, flip charts, brain storming, role-playing, demonstration, and re-demonstration. The teaching aids used were videos, and Power Point presentation.

Furthermore, the researchers used **flashcards** as a teaching method. It is a small note cards used for improving the nurses' memory through practiced information retrieval. Flashcards are two-sided, with the title on one side and the information about the title on the other and include names, vocabulary, concepts, and procedures. Also, flashcards increase nurses' self-confidence, develop good and effective communication, enhance creativity and encourage active recall [19].

The researchers also use **electronic automatic reminder device** in the PICU; it is considered a very effective method. Electronic automatic reminder is a spoken message that reminds nurses to do eye care. Reminders repeat every particular time as a researchers mark them. The most important aspect of a reminder is having it delivered when the nurse can do eye care for sedated and intubated children. Reminders keep nurses most important priorities top of mind, even if they forget the time of eye care. First, the researchers install it on the computer found at PICU, then, click on sign up. To sign up, one researcher provides a full name, email address, and password. From there, follow the instructions to start using Remind, adjust time for reminding the nurses for practicing eye care for sedated and intubated children. The researcher can change time of reminder as needed and can set reminders to go off at a certain time. Select the date to schedule the new event from the calendar. Also, the researcher use written reminder and paste the time of eye care on the wall.

An open channel of communication was established between the researcher and nurses through mobile and personal meetings in the departments for any questions, missed information, and reinforcement of knowledge and practices all through the study period.

2.9.4. Evaluation Phase

After the completion of the protocol contents; the nurses' knowledge and their practice were evaluated immediately after implementing eye care protocol, the post tests were administered by using same pretest tools. Additionally, the researchers asked nurses to apply eye care protocol on children (study group) and evaluate their eye condition for risk of ocular surface disorder using (tool III).

2.10. Statistical Analysis of Data

The collected data were categorized, analyzed and tabulated using the SPSS computer program Version 21. Numerical data were expressed as mean and standard deviation. Qualitative data were expressed as frequency and percentage. A comparison between qualitative variables carried out by using a parametric Chi-square test. Correlation among variables was done using Pearson correlation coefficient. A statistically significant difference was considered at p-value < 0.05, a highly statistically significant difference was considered at p-value ≤ 0.001 and no statistically significant difference was considered at p-value > 0.05.

3. Results

Table 1 shows the nurses' characteristics; it was observed that, the mean age of the studied nurses was 29.95±4.93years and the majority (88%) of them were females. In relation to nurses' academic qualifications less han half (45.3%) of them had a technical institute of nursing. Additionally, it was noticed that, more than two fifth (42.7%) of nurses had an experience from 5 to more than 8 years. Moreover, all (100%) of them not attended any previous training courses about eye care for sedated and intubated children.

Table 2 shows children's personal characteristics, it was observed that, the mean age of the studied children was 7.75±1.83& 8.21±1.26 in study group and control group respectively. In relation to gender it observed that less than two thirds (61.3%) of children were males in study group and more than half (54.8%) were females in control group. Additionally, it was noticed that, 35.5% & 48.4% had pneumonia in study group and control group respectively.

Table 3 reveals nurses' total knowledge regarding ocular surface disorder and eye care pre and post designed eye care protocol. It was found that, less than two thirds (65.3%) of studied nurses' had good knowledge post designed eye care protocol implementation compared to 14.7% pre designed eye care protocol implementation. Also, there was a statistical significant difference pre and post designed eye care protocol at p value ($P<0.05$).

Table 4 reveals nurses' practice regarding prevention of ocular surface disorder pre and post designed eye care protocol. It was observed that, the majority of the studied nurses had competent practice post designed eye care protocol implementation in all items. Also, there was a highly statistical significant difference pre and post designed eye care protocol implementation in all items at p-value ($P<0.001$).

Table 1. Distribution of the studied nurses according to their personal characteristics (n=75)

Nurses' characteristics	No.	%
Age in years		
20->25	34	45.3
25->30	25	33.3
30-≥35	16	21.4
Mean ±SD	29.95±4.93	
Gender		
Male	9	12.0
Female	66	88.0
Academic qualifications		
Diploma of secondary nursing school	28	37.3
Technical Institute of nursing	34	45.3
Bachelor in nursing science	13	17.4
Years of experience at PICU		
Less than two years	5	6.7
2->5	22	29.3
5->8	32	42.7
≥ 8 years	16	21.3
Nurses' previous training course about eye care for sedated and intubated children		
Yes	0	0.0
No	75	100.0

Table 2. Percentage distribution of the studied children according to their personal characteristics (n=62)

Children's personal characteristics	Study group (no=31)		Control group (no=31)	
	No	%	No	%
Age in years				
< 1 year	8	25.8	10	32.3
1-> 5	12	38.7	14	45.2
5-> 10	8	25.8	6	19.3
≥ 12	3	9.7	1	3.2
$\bar{x}$±SD	7.75±1.83		8.21±1.26	
Gender				
Male	19	61.3	14	45.2
Female	12	38.7	17	54.8
Medical diagnosis				
Internal bleeding	3	9.7	0	0.0
Pneumonia	11	35.5	15	48.4
Cardiac disorders	3	9.7	2	6.4
Neurological disorders	6	19.3	4	12.9
Respiratory failure	8	25.8	10	32.3

Table 3. Percentage distribution of the studied nurses' total knowledge regarding ocular surface disorder and eye care pre and post designed eye care protocol (n=75)

Items	Pre (n=75)		Post (n=75)		X^2	P-value
	No	%	No	%		
Total knowledge level					37.361	P<0.05*
Good (≥75 %)	11	14.7	49	65.3		
Average (60 >75%)	25	33.3	20	26.7		
Poor (<60%)	39	52.0	6	8.0		

*Astatistical significant difference at p-value <0.05.

Table 4. Percentage distribution of the studied nurses' practice regarding prevention of ocular surface disorder pre and post designed eye care protocol (n=75)

Practice items	Pre (n=75)				Post (n=75)				X^2	P-value
	Competent practice		Incompetent practice		Competent practice		Incompetent practice			
	No	%	No	%	No	%	No	%		
Key elements of practice										
A baseline assessment of the eye and eye lid integrity	15	20.0	60	80.0	61	81.3	14	18.7	45.532	0.000**
Essential eye care	19	25.3	56	74.7	63	84.0	12	16.0	43.951	0.000**
Instilling eye medication	17	22.7	58	77.3	68	90.7	7	9.3	47.992	0.000**
Maintain eye closure	13	17.3	62	82.7	60	80.0	15	20.0	42.417	0.000**
Additional eye care in incomplete eyelid closure	10	13.3	65	86.7	63	84.0	12	16.0	47.620	0.000**
Lubrication to prevents drying of the ocular surface	9	12.0	66	88.0	66	88.0	9	12.0	47.998	0.000**
Total	**14**	**18.6**	**61**	**81.4**	**63**	**84.0**	**12**	**16.0**	49.759	0.000**

Table 5. Percentage distribution of the studied nurses' total practice regarding prevention of ocular surface disorder pre and post designed eye care protocol (n=75)

Items	Pre designed eye care protocol (n=75)		Post designed eye care protocol (n=75)		X^2	P-value
	No	%	No	%		
Total practice level					49.759	0.000**
Competent practice (≥ 85)	14	18.6	63	84.0		
Incompetent practice (< 85)	61	81.4	12	16.0		

**A highly statistical significant at P value P<0.001.

Table 6. Relation between nurses' total knowledge scores and their personal characteristics pre and post designed eye care protocol (n=75)

The total score of nurses' knowledge and their characteristics	Pre designed eye care protocol (n=75)						Post designed eye care protocol (n=75)						X^2	P-Value
	Good (n=11)		Average (n=25)		Poor (n=39)		Good (n=49)		Average (n=20)		Poor (n=6)			
	No	%	No	%	No	%	No	%	No	%	No	%		
Age/ Years:														
20->25	0	0.0	8	32.0	26	66.7	19	38.8	10	50.0	5	83.3	36.2	P<0.05*
25->30	4	36.4	11	44.0	10	25.6	16	32.6	8	40.0	1	16.7		
30-≥35	7	63.6	6	24.0	3	7.7	14	28.6	2	10.0	0	0.0		
Gender														
Male	2	18.2	4	16.0	3	7.7	3	6.1	5	25.0	1	16.7	24.9	P>0.05
Female	9	81.8	21	84.0	36	92.3	46	93.9	15	75.0	5	83.3		
Academic qualifications														
Diploma of secondary nursing school	2	18.2	4	16.0	22	56.4	11	22.5	13	65.0	4	66.7	32.5	P<0.05*
Technical Institute of nursing	3	27.3	14	56.0	17	43.6	25	51.0	7	35.0	2	33.3		
Bachelor in nursing science	6	54.5	7	28.0	0	0.0	13	26.5	0	0.0	0	0.0		
Years of experience at PICU														
Less than two years	0	0.0	0	0.0	5	12.8	0	0.0	3	15.0	2	33.3	34.7	P<0.05*
2->5	1	9.1	8	32.0	13	33.3	13	26.5	6	30.0	3	50.0		
5->8	4	36.4	10	40.0	18	46.2	20	40.8	11	55.0	1	16.7		
≥ 8 years	6	54.5	7	28.0	3	7.7	16	32.7	0	0.0	0	0.0		

*A statistical significant at P value P<0.05, no statistical significant at P-value P>0.05.

Table 5 displays nurses' total practice regarding prevention of ocular surface disorder pre and post designed eye care protocol. It was found that, the majority (84.0%) of the studied nurses had competent practice post designed eye care protocol compared to only 18.6% pre designed eye care protocol. Also, there were highly statistical significant differences at p value (P<0.001).

Table 6 indicates that, there were a statistical significant relation between nurses' total knowledge scores and their ages, academic qualifications and years of experiences pre and post designed eye care protocol.

Table 7 demonstrates that, there were a statistical significant relation between nurses' total practice scores and their personal characteristics pre and post designed eye care protocol.

Table 8 indicates that, there was a positive correlation between the total knowledge score, and their total practice score pre and post designed eye care protocol.

Table 7. Relation between nurses' total practice scores and their personal characteristics pre and post designed eye care protocol (n=75)

The total score of nurses' practices and their characteristics	Pre designed eye care protocol (n=75)				Post designed eye care protocol (n=75)				X^2	P-value
	Competent (n=14)		Incompetent (n=61)		Competent (n=63)		Incompetent (n=12)			
	No	%	No	%	No	%	No	%		
Age/ Years										
20->25	0	0.0	34	55.8	23	36.5	11	91.7	37.41	P<0.05*
25->30	4	28.6	21	34.4	24	38.1	1	8.3		
30-≥35	10	71.4	6	9.8	16	25.4	0	0.0		
Gender										
Male	0	0.0	9	14.7	5	7.9	4	33.3	30.64	P<0.05*
Female	14	100.0	52	85.3	58	92.1	8	66.7		
Academic qualifications										
Diploma of secondary nursing school	2	14.3	26	42.7	21	33.3	7	58.3	33.68	P<0.05*
Technical Institute of nursing	5	35.7	29	47.5	29	46.0	5	41.7		
Bachelor of nursing science	7	50.0	6	9.8	13	20.7	0	0.0		
Years of experience at PICU										
Less than two years	0	0.0	5	8.2	2	3.2	3	25.0	35.12	P<0.05*
2->5	2	14.3	20	32.8	20	31.7	2	16.7		
5->8	3	21.4	29	47.5	25	39.7	7	58.3		
≥ 8 years	9	64.3	7	11.5	16	25.4	0	0.0		

*A statistical significant at P-value P<0.05.

Table 8. Correlation between total knowledge score and total practice score of the studied nurses pre and post designed eye care protocol (n=75)

Variables	Pearson correlation coefficient			
	Total knowledge score			
	Pre designed eye care protocol (n=75)		Post designed eye care protocol (n=75)	
	R	P	R	P
Total practice score	.495	.000**	.637	.000**

** Correlation is significant at the 0.01 level.

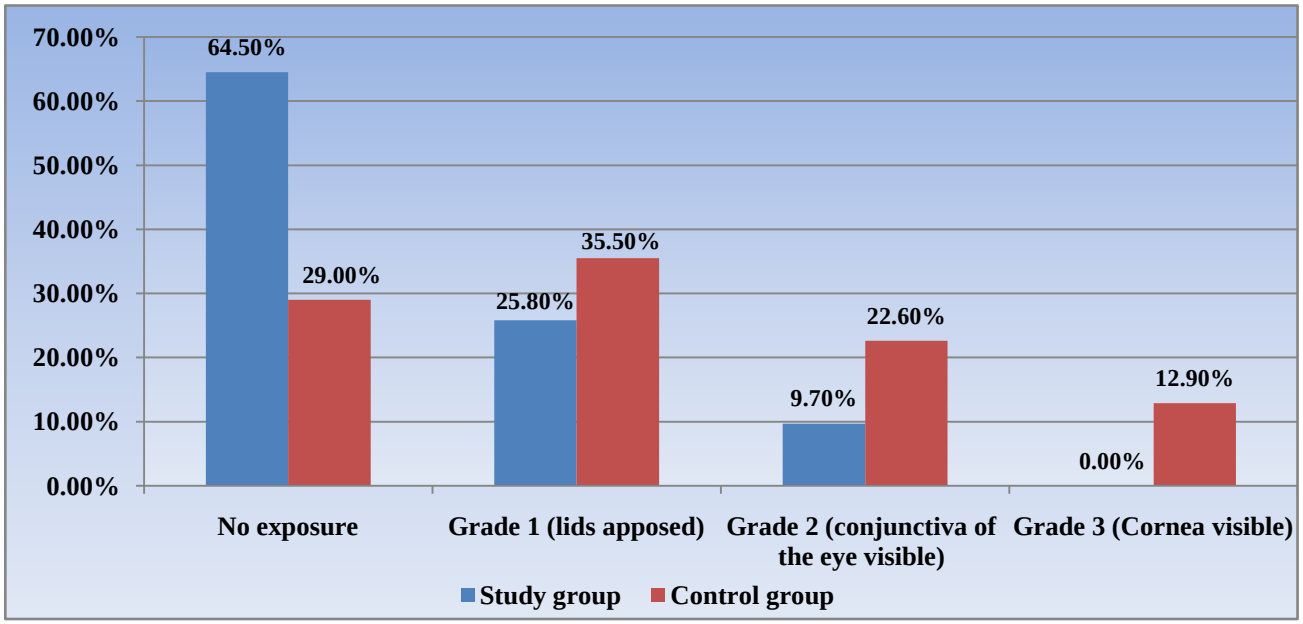

Figure 1. Percentage distribution of the studied children regarding grading of lid position in study and control group (n=62)

Figure 1 illustrates distribution of the studied children regarding grading of lid position in study and control group. It was found that, nearly two thirds (64.5 %) of children in study group had no exposure of the eye compared to less than one third (29.0%) in control group. Also, nearly one quarter (25.8%) in study group had grade I of lid position compared to more than one third (35.5%) in control group.

Figure 2 shows distribution of the studied children regarding ocular surface disorders in study and control group. It was found that, the majority (84.9%) of children in study group had no ocular surface disorders. while, less than half (45.1%) of control group had keratopathy.

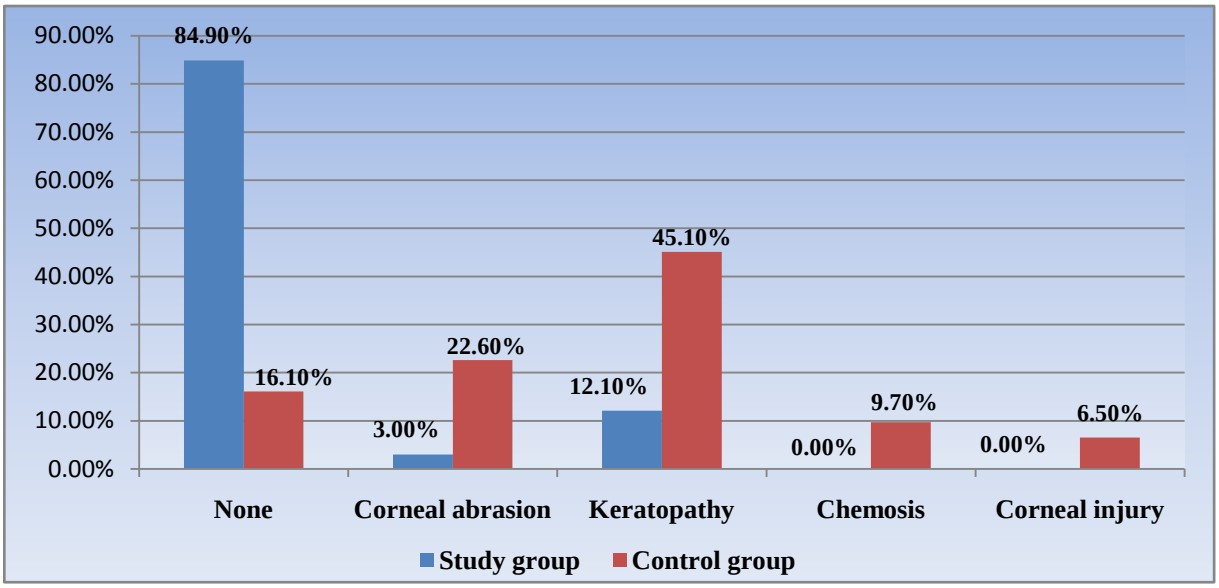

Figure 2. Percentage distribution of the studied children regarding ocular surface disorders in study and control group (n=62)

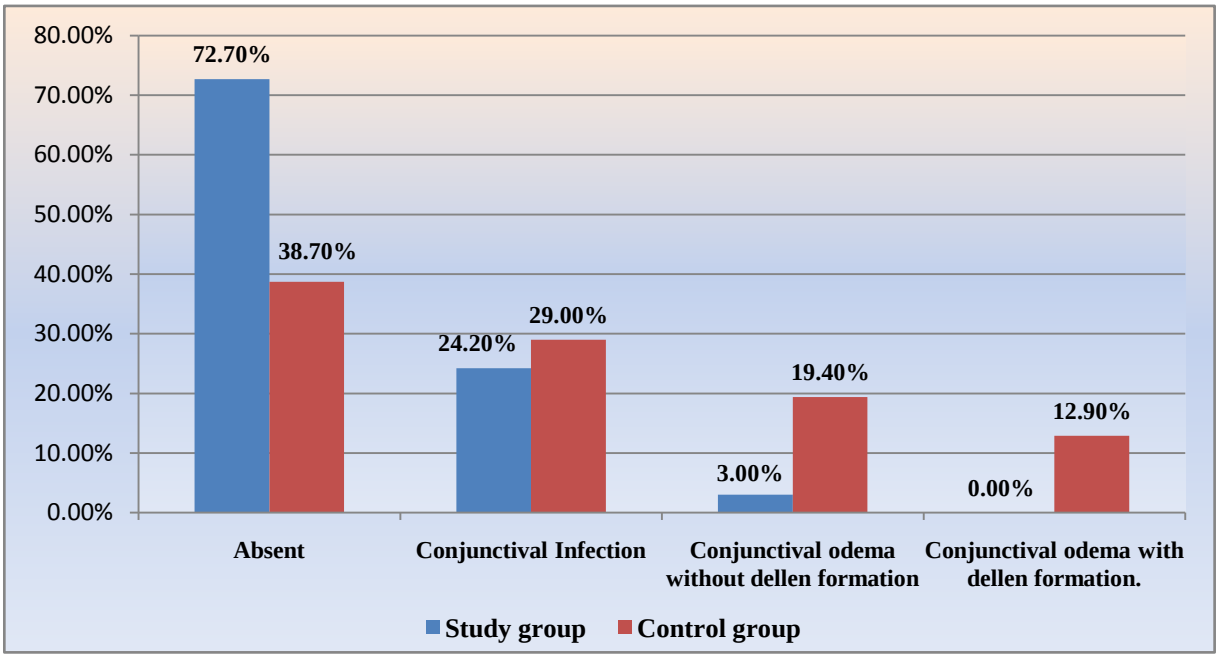

Figure 3. Percentage distribution of the studied children in the study and control group regarding conjunctival odema (n=62)

Figure 3 portrays distribution of the studied children in the study and control group regarding conjunctival odema. It was observed that, less than three quarters (72.7%) in study group had absent conjunctival odema. While, more than one quarter (29%) in control group had conjunctival infection.

4. Discussion

Eye care is recognized as a fundamental nursing procedure essential for critically ill children to eliminate ocular complications. However, neglecting of eye hygiene and eye protection in (PICUs) make them predisposing for the risk of ophthalmic adverse events. In response to technological innovations in in these setting critical care nurses' requiring many skills and abilities, which make constant changes in their work process [20].

Therefore, the aim of the present study was to evaluate the effect of designed eye care protocol on nurses' knowledge and practice regarding prevention of ocular surface disorder among sedated and intubated children at pediatric intensive care unit this aim was achieved throughout the study findings and the research hypotheses were accepted.

Regarding the characteristics of the studied nurses, the results of the present study revealed, that less than half of the studied nurses in the age group from 20 to less than 25 years with the mean age of the studied nurses was 29.95±4.93years. This can explained by the presence of newly graduate nurses in selected Pediatric Intensive Care Unit. This result supported with Mohamed et al., [21] in study about "Nurses Knowledge and Practice Regarding Care of Comatose Children at Pediatric Intensive Care Units" who found that 46.2% of the studied nurses in the age group from 20 to less than 25 years .

Regarding gender of studied nurses, the current study revealed that, majority of them were females. This result supported by [22] in a study about "Knowledge and practice patterns of Intensive Care Unit nurses towards eye care in Chhattisgarh state" who found that, three quarters (75%) of nurses were females. From the researchers' point of view, Although, the presence of males in nursing field has been gradually raising, they are remained a small percentage of the nursing population in Egypt.

In relation to nurses' academic qualifications the present study reflected that, less than half of them had a technical institute of nursing. Additionally, It was noticed that, more than two fifth of nurses had an experience from 5 to more than 8 years. In contrast with [21], who found that more than half of the studied nurses had finished their education in technical institute of nursing and 73.8% of the studied nurses had 1to less than 5 years of experience and 9.2% from 10 and more years of experience. From the researchers' point of view, years of experience in pediatric intensive care unit have a great effect on nurses' knowledge and compliance which result in improving optimal performance in all nursing aspects of their field.

According to nurses' attendance to training courses the current study revealed that, all of the studied nurses didn't attended training courses regarding eye care for sedated and intubated children. Therefore, the nurses need special PICU training in relation to eye care. This finding was supported by Jaafr, et al. [8], who studied" Nurses' knowledge based on evidence based practice toward eye care for intensive care units patients" and suggesting conducting training courses for nurses within continuous education in hospital is crucial to increase nurses' knowledge toward standard practices that can enhance the quality of care, reduce costs, and decrease work burnout.

Regarding the characteristics of the studied children, the results of the present study revealed that the mean age of the studied children was 7.75±1.83 & 8.21±1.26 in study group and control group respectively. This finding was disagree by the results of the study done by Fisler et al. [23], entitled "Characteristics and risk factors associated with critical illness in pediatric COVID-19" who found that age > 12 years is associated with PICU admission when compared to younger children

Regarding diagnosis of the studied children the present study revealed that, more than third of children in study group and less than half in control group had pneumonia. This finding supported with [24] in study about "Characteristics and risk factors of children requiring prolonged mechanical ventilation vs. non-prolonged mechanical ventilation in the PICU: A prospective single-center study" who found that the most common cause for connection to mechanical ventilation in studied children was acute lung disease.

Regarding grading of lid position in study and control group, this study revealed that, nearly two thirds in study group had no exposure of the eye compared to less than one third in control group and nearly one quarter in study group had grade I of lid position compared to more than one third in control group. This finding was contrast with [7] in study about "The effect of implementation of evidence-based eye care protocol for patients in the intensive care units on superficial eye disorders". Who reported that in terms of the criterion of eyelid closure the majority of patients (90.6 %) were grade I, and (9.4 %) patients were grade II.

Concerning to nurses' total knowledge about ocular surface disorder and eye care pre and post designed eye care protocol. It was found that, less than two thirds of studied nurses' had good knowledge post designed eye care protocol implementation compared to less than one fifth pre designed eye care protocol implementation. From the researchers' point of view, nurse's knowledge and practices regarding eye care of sedated and intubated children in pediatric ICU were not enough because there were lacks of training or educational protocols about eye care for sedated and intubated children in PICU. This finding was consistent with [25] in the study about "Development and validation of an eye care educational program for intensive care unit nurses" who found that the levels of eye care-related knowledge, awareness and practice were enhanced following the implementation of the educational program.

The current study revealed that, there was a statistical significant difference pre and post designed eye care protocol. This finding agree with [26] who conducted study about "Effect of eye care learning package for mechanically ventilated patients on critical care nurses' performance" who found that there was significant improvement in nurses' total knowledge regarding eye care for mechanically ventilated patients after learning package implementation.

Regarding to nurses' practice regarding ocular surface disorder and eye care pre and post designed eye care protocol. The finding of the present study revealed that, the majority of the studied nurses had competent practice post designed eye care protocol implementation in all items. Also, there was a highly statistical significant difference pre and post designed eye care protocol implementation in all items at p value ($P<0.001$). This finding agree with **[26]** who found that high percentage of studied nurses had adequate practice level in eye dropped, ophthalmic ointment, eye lid closed and the eye closed with gauze and tape horizontally post educational training implementation. This were consistent with [27,28] they reported that ophthalmic ointment, eye closed and eye lid taping was used and examined and became routine eye care method in ICU setting. From the view point of researchers, these findings indicate the effect of learning protocols about eye care sedated and intubated children in pediatric ICU.

Regarding nurses' total practice regarding prevention of ocular surface disorder pre and post designed eye care protocol the findings of this study revealed that, the majority of the studied nurses had competent practice post designed eye care protocol compared to only less than one fifth pre designed eye care protocol. The researcher point of view that finding was due to considering eye care is not lifesaving procedure among the majority health team members as well as no protocol of care is followed among the nurses in the pediatric intensive care unit. Also, there were highly statistical significant differences. This result supported by [26] who found that the nurses' total performance regarding eye care for MV patients before and after learning package. As shown there was highly statistical significant improvement in CCNs' total

performance regarding eye care for MV patients after learning package implementation. It is important to make the nurses in particular aware of the important of eye care protocol of sedated and intubated children in pediatric ICU to keep eye healthy and prevent ocular surface disorders.

As regards the relation between nurses' total knowledge scores and their personal characteristics pre and post designed eye care protocol the current study revealed that, there were a statistical significant relation between nurses' total knowledge scores and their ages, academic qualifications and years of experiences pre and post designed eye care protocol. This finding disagree with [29] who studied "Impact of a designed eye care protocol on nurses knowledge, practices and on eye health status of unconscious mechanically ventilated patients at north Palestine hospitals" and revealed that no statistical significant correlation at between total knowledge scores and age of participants nurses, experience of participant's nurses and educational level in the pre-test, post-test and 2 months following protocol application.

Relation between nurses' total practice scores and their personal characteristics pre and post designed eye care protocol this study demonstrates that, there were a statistical significant relation between nurses' total practice scores and their personal characteristics pre and post designed eye care protocol. Also, there was a positive correlation between the total knowledge score, and their total practice score pre and post designed eye care protocol. This finding was parallel to [26] who found that there was a positive statistical significant relation between nurses' knowledge, and practices with years of experience there was strong positive relationship between total knowledge score and total practice score pre learning package implementation. On the other hand, these findings were disagree with Khalil et al., [20] who reported no significant correlation between total knowledge score of the studied nurses about eye care and their performance. Regarding ocular surface disorders percentage in study and control group. The current study showed that, the majority of children in study group had no ocular surface disorders. while, less than half of control group had keratopathy. In relation to conjunctival odema the current study showed that, less than three quarters in study group had absent conjunctival odema. While, more than one quarter in control group had conjunctival infection. This result indicated that the eye care protocol was an effective instrument for improving eye care practices so decrease ocular surface disorder. This result was congruent with [30] who found that, the incidence of eye care improved from 19% to 96% after introducing an eye care protocol and adherence to the eye care protocol decreased abnormalities from 39% to 11%.

5. Conclusion

Based on the results of the present study, it can be concluded that, the implementation of designed eye care protocol proved to be effective in improving nurses' knowledge and their practices, with a positive impact on sedated and intubated children.

6. Recommendations

In the light of the findings of the current research, the following recommendations are suggested:

1. Provide continuous educational program and training courses for nurses working at pediatric intensive care units about eye care to improve their performance.
2. The availability of printed booklet about ocular surface disorder prevention and management will result in significantly better outcomes.
3. Emphasize multidisciplinary collaboration to reliably implement eye care protocol in an effort in pediatric intensive care units.
4. The importance of quality improvement and child safety collaboration available to care providers within pediatric critical care.

Conflicts of Interest

There are no conflicts of interest.

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