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Effect of Preterm' Healing Environment Program for Nurses on their Knowledge and Related Practices

*[1]Assist. Lecturer Samar Gamal Selim, [2]Prof. Azza Abd Elmoghny Attia, [3]Assist. Prof. Manal Farouk Mohamed

[1,3]Pediatric Nursing Department, Faculty of Nursing, Suez Canal University, [2]Cairo University

*[1]**Corresponding author:** Samar Gamal Selim M.Sc., Department of Pediatric Nursing, Faculty of Nursing, Suez Canal University, Ismailia, Egypt.

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Abstract: **Background: Nurses must have the necessary knowledge, competent practices regarding creating healing environment for preterm in neonatal intensive care unit to reduce stress and promote better outcomes. Aim: Evaluate the effect of preterm' healing environment program for nurses on their knowledge and related practices. Design: One group pretest-posttest quasi-experimental research design was adopted. Sample: A convenient sample of forty nurses who were providing care for preterm neonates. Tools: A structured interview questionnaire and observational checklist. Results: Nurses' knowledge about methods of reducing noise, light and visual stimuli, effects of exposure of preterm neonates to noise and benefits of reducing light levels improved in post-test. All nurses do not put ear muffs for preterm neonate either before or after teaching program, less than two thirds, three fifths and more than half of nurses were set alarms and phone to lowest level, keep nursing and medical rounds away from neonate incubator, and wear quiet shoes and move softly in post-test. After the program most of nurses reducing the light level, using eye cover and offer non-nutritive sucking with non-oral feeding. More than three quarters and most of nurses corrected the practices related to close the incubator doors softly and do not place things above. More than half of the nurses and more do the practices related to application of kangaroo care. Three quarters of nurses start containment before painful procedures. Also clustering of care, nesting and developmentally supported positions were improved with highly statistically significant differences. Conclusion: Healing environment program had positive effect on improvement of nurses' knowledge and practices related. Recommendation: Ensure regular on job training programs for nurses about preterm' healing environment to update their knowledge and practices.**

Keywords: **Healing environment, knowledge, neonates, nurses, practices, preterm, program.**

1. INTRODUCTION

Neonatal intensive care unit (NICU) is a highly stressful setting with various environmental stressors. These environmental stressors may cause adverse effects on the immature nervous system and cause disruption in the preterm neonate's development and function of the brain which affect negatively on the subsequent stages of growth and neurodevelopmental milestones. Admittance of the preterm neonates to the NICU means being exposed to a series of stressful and painful stimuli for which they are not prepared such as loud sound, intense light and frequent invasive and unpleasant procedures **(Faez et al., 2022).**

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Healing environment is an essential component of developmental supportive care (DSC) which is an environment that supports the preterm neonates' appropriate growth and development while minimizing their pain and stress caused during their NICU stay by trying to make the NICU environment mimic the intrauterine environment. The changes in the environment have come in the form of reduction in lighting, sound, decreasing noxious stimuli such as odors and overcrowding, and eliminate all inappropriate or unnecessary sources of stimulation **(Sanz-Segura et al., 2020).**

Neonatal nurses play an important role in creating healing environment by reducing noise to make NICU auditory environment more developmentally friendly. Maintaining recommended sound levels (<45 dB) in the NICU may increase physiologic stability, improve growth, improve more natural neurosensory maturation and fewer speech and language difficulties as well as reduction in the number of apneas, reduction of ventilation days which reduces the length of hospital stay. Also, improves the sleep cycle, lengthens the peaceful sleep, avoid increases in intracranial pressure and episodes of hypoxemia and lead to normal development of language, attention and perception **(Lee & Cho, 2023).**

A review article titled "Noise in neonatal intensive care units: a short review" conducted by **Alberto et al. (2018)** revealed that neonatal nurses had lack of expertise in noise prevention area, and that they would benefit by becoming involved in an educational program based on prevention of sound stimulation of preterm neonates and indicated that a major strategic to reduce noise is to change the behavior of health professionals. A well-structured training program also seems to be a low cost measure to start the noise reduction process in the NICU.

A study entitled "Effectiveness of nurses' training program about neuroprotective developmental care for premature neonates on their knowledge and practices in neonatal intensive care unit" conducted at the NICU at Mansoura University Children's Hospital revealed that level of nurses' knowledge about healing environment was generally improved immediately and one month after the training program with statistically significant differences **(Elarousy et al., 2020)**.

Also, for creating healing environment in NICU, neonatal nurses should play a crucial role in implementing light reduction strategies because NICU tend to be bright, constantly lightened by florescent lighting which is in contrast to the developmentally appropriate dark intrauterine environment and have negative effects on the growth and development of preterm neonates; these measures include ensuring complete darkness for the infant during sleep and maintaining low light levels at other times to support alertness. It is also important to ensure that any lighting directed toward the infant's face is indirect **(Young, 2020).**

As regards to visual stimuli in NICU, nurses should choose with care the objects which are in the infant's visual field in or near the incubator and crib. Placing photographs of parents and siblings in visual range 19–22 cm. in en face position because the human face is the most appropriate visual stimulation in early infancy. Other aspects of visual developmental supportive care include; avoiding the placement of visual stimuli, such as toys and pictures with contrasting colors. Additionally, initiating eye contact and maintaining a gentle, warm facial expression are important practices **(Hockenberry et al., 2021).**

Significance of the study:

The effects of the NICU environment on the preterm neonates' brain during critical developmental periods are thought to be responsible for numerous adverse outcomes. The brain and sensory systems are still immature and are affected by the constant stimuli such as high stimulations of light, noise and sleep disturbances **(Elarousy et al., 2020)**.

Preterm neonates admitted to NICU are more vulnerable for developing problems such as cognitive impairment, motor deficits, poor academic performance and behavioral disorders such as attention-deficit-hyperactive disorders, anxiety and emotional disorders. In addition to many medical sequalae such as chronic lung diseases, intraventricular hemorrhage, retinopathy of prematurity and cerebral palsy compared to those infants born full-term. Therefore, it is essential that a healing environment is created in NICU with background neurosensory stimulation kept at a level that prevents these adverse outcomes **(Salins et al., 2023).**

Creating healing environment in NICU for improving the growth and neurodevelopment of preterm neonates require that neonatal nurses must acquire the basic knowledge, competent practices which are gained through attending training programs that are important for improving their skills and experiences **(Hendy et al., 2023)**.

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Not all neonatal nurses provide full healing environment for preterm neonates. This is due to the lack of their understanding and knowledge regarding the implementation of healing environment in the NICU room. In this case, the solution that can be offered to increase nurses' knowledge and practices is the provision of education. Unfortunately, previous studies only evaluated the level of nurses' knowledge and practices without providing interventions to increase knowledge and practices in carrying out healing environment as a component of developmental care in NICU (**Syamsu et al., 2022)**.

Despite the numerous benefits of creating healing environment for preterm neonates, the application of this model of care can be challenging. One of the main challenges is the requirement that neonatal nurses possess competent practices and knowledge regarding healing environment for its successful implementation in NICU. However, the availability of healing environment programs for providing nurses with such skills is limited **(Hendy et al., 2024).** Therefore, the current study hoped to add an evidence-based practice research aims to enhance the body of knowledge about preterm' healing environment in pediatric nursing and improve the quality of nurses' practices for maximizing outcomes for preterm neonates and their families**.**

The aim of the study

The aim of the present study was to evaluate the effect of preterm' healing environment program for nurses on their knowledge and related practices.

Hypotheses:

- Nurses' knowledge about healing environment will be improved after program implementation than before.
- Nurses will have competent practices regarding healing environment after program implementation than before.

2. SUBJECTS AND METHODS

Design

A quasi-experimental research design (one-group pretest-posttest design) was utilized in the current study.

Setting

The current study was carried out at the NICU of Suez Canal University Hospitals.

Subjects

A convenient sample of 40 nurses regardless of their age, level of education or their years of experience in NICU, who were providing care for preterm neonates in the above mentioned setting over 6 months period of data collection were comprised the sample of the current study.

Tools of the study: Two tools were utilized for data collection as the following:

Tool I: A structured Interview Questionnaire:

It was designed by the researcher after extensive review of related literature and then translated into simple Arabic language to assess nurses' personal characteristics and knowledge about healing environment pre, post and follow-up the implementation of the program. It comprised of the following two parts:

Part (I): Personal characteristics of the nurses including age, gender, level of education, years of experiences in NICU, previous attendance of workshops or training programs about healing environment for preterm neonates.

Part (II): Questions to assess nurses' knowledge about healing environment for preterm neonates **(Hansen et al., 2022).**

Section 1: Include definition, characteristics of preterm neonates, physiological handicaps and long-term complications of prematurity and universal precautions to protect preterm neonates from infection in the NICU.

- **Section 2:** Include questions regarding healing environment through reducing noise, light and vision.

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Scoring system :

The total number of questions that assessed the nurses' knowledge in the structured interview questionnaire was scored as follow; each complete correct answer was given two scores, incomplete correct answer was given one score, while incorrect answer or don't know was given zero score, the scores were summed up and then converted into percent.

The total percent of nurses' knowledge was categorized as follows:

- Unsatisfactory (less than 60%)
- Satisfactory levels classified as follow:
- Good = 60% to less than 75%
- Very good = 75% to less than 85%
- Excellent = 85% or more

Tool II: Observational Checklist of nurses' practices:

It was adapted from **Carroll et al. (2022)**, some questions were added and some modified, items were putted in a form of a checklist by the researcher. The observational checklist comprised of 18 steps to assess the nurses' practices regarding healing environment (reducing noise, light and vision at NICU).

Scoring system:

The total number of steps in the observational checklist is 18 steps. Each step that was done completely and correctly was given one score and zero score for each step that was not done or was incorrectly done. The total practice' scores were 18 score; the scores were summed up and then converted into percent scores. Nurses' practices were considered to be competent if the nurse total score of practices percent was 70% or more and incompetent if the practices percent was less than 70%.

Validity of the study tools:

The study tools (tool I and tool II) were subjected to a jury of 3 experts in pediatric nursing and medicine to test the content validity of items, determine whether the included items are comprehensive, understandable, applicable, clear and suitable to achieve the aim of the study and according to their opinions minor modifications were done.

Reliability of the study tools:

Internal consistency of tool I (part II) and tool II was tested using Cronbach's alpha coefficient test and its value was (0.893) for knowledge items, (0.902) for nurses' practices items of the observational checklist.

Pilot study

A pilot study was carried out after formulating the study tools and before starting data collection. It was conducted on 10% of the study sample that equal (4) nurses. It was carried out to evaluate the clarity and applicability of the study tools and to estimate the time needed to fulfill the tools and for program application. Based on the results of the pilot study, the necessary modifications were done namely, ambiguous items were omitted, other items were modified according to the nurses' response and the final form was developed. The sample of the pilot study was included in the study sample.

Field Work

Data collection was carried out through three phases: interviewing and assessment phase, implementation phase and evaluation phase. The actual field work was carried out over a period of 6 months .

The total program sessions were five; one session for pretest, the next two sessions used for implementing the preterm' healing environment program, then one session for immediate posttest, and the last session was for follow-up that carried out after 2 months of program implementation.

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A- Interviewing and assessment phase:

The researcher interviewed the nurses who were providing care for preterm neonates on an individual basis in the nursing room at the NICU of the study setting. The researcher introduced herself to the nurse, explained the aim of the study and its expected outcomes and written consent was taken from each nurse .

The first session devoted to the pretest phase. In the first session, the structured interview questionnaire of nurses' knowledge was filled by the researcher through interview with each nurse individually; the average time needed to fill this tool was about 30 minutes period. Also, the observational checklist was filled by the researcher by observing the nurse' practices regarding healing environment items during providing care for preterm neonates over a course of an entire work' shift at the NICU.

B- Implementation phase

The total number of nurses was divided into 8 groups according to their work schedule, 5 nurses/ group. At the beginning of the DSC' sessions the researcher distributed the program' booklet for each nurse. The second session was theoretical session included introduction about healing environment program and an overview about prematurity. The third session was theoretical included illustration the meaning of healing environment by controlling external stimuli (visual, auditory and visibility stimuli) and methods of applying it in NICU. Then the researcher answered any questions, summarized each session for nurses and asked them for feedback and to illustrate any queries .

C- Evaluation phase

Session four and five were concerned with evaluating nurses' knowledge and practices immediately post program implementation and after two months for follow-up respectively by using all previously mentioned tools.

Ethical consideration:

Final approval was obtained from the Research Ethical Committee in the Faculty of Nursing, Suez Canal University. The researcher explained the aim and the nature of the study to the nurses for gaining their cooperation; written consent was obtained from each nurse to participate in the study after informing them about their voluntary participation and about their right to withdraw at any time from the study. The topic of this study did not touch religious, ethical, moral and cultural issues among participants, nurses were assured that all gathered data were confidential and used only for the purpose of the study.

Statistical analysis

Data were organized, revised, tabulated and analyzed using statistical package of social science program, (SPSS package version 20). Continuous data were normally distributed and were expressed in mean and standard deviation. Categorical data were expressed in number and percentages. Chi-square test was used for comparison of variables with categorical data. Statistically significant difference detected when $p<0.05$.

3. RESULTS

Table (1) reveals that, less than half (45%) of nurses were less than 25 years old with $\bar{x}\pm SD = 27.4 \pm 5.1$, the vast majority of nurses (95%) were females. Less than two thirds of nurses (65%) were graduated from technical nursing institute, while the minority of them (10%) had nursing bachelor degree. Regarding to their years of experiences in NICU, more than two thirds of nurses (70%) had less than 10 years of experience, while the minority of them (10%) had more than 20 years of experience with $\bar{x}\pm SD = 8.10 \pm 6.64$. Four fifths of nurses (80%) did not attend previous programs or workshops about healing environment.

Table (2) shows that, vast majority, most and less than two thirds of nurses (95%, 85% and 65% respectively) answered incorrectly regarding methods of reducing visual stimuli, methods of reducing light and effect of exposure of preterm neonates to noise in pretest, improved in posttest to most and majority of nurses (85% and 90% respectively) answered correctly and the improvement still observed in follow- up regarding all items with highly statistically significant differences.

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Table (3) reveals that, all of nurses (100%) did not put ear muffs during excessive noisy procedures in pretest, posttest and follow-up with no statistically significant difference. Vast majority, majority and most of nurses (95%, 92.5% and 87.5% respectively) did not set alarms and phone at the lowest safe level, did not move medical and nursing ward rounds away from the bedside, did not wear quiet shoes only, move softly and gently in pretest, improved in posttest to less than two thirds, three fifths and more than half of nurses (65%, 60% and 57.5% respectively) were doing these practices, and in follow-up, two fifths and more of nurses (40% and 45% respectively) were doing these practices also.

Three quarters of nurses (75%) did not close incubator doors softly and were placing things on the top of the incubator in pretest, improved in posttest to more than three quarters and most of nurses (77.5% and 85% respectively) corrected these practices and the improvement still observed in follow-up. Highly statistically significant improvements were noticed in all items of nursing practices.

Table (4) shows that, vast majority and most of nurses (95% and 87.5% respectively) did not use nurses' hand during focused lighting medical procedures/ examinations to cover the eye, did not use of available natural lighting, did not make sure that all lighting that falls on the infant's face is indirect and did not cover the incubator in pretest, improved in posttest as more than half, less than three quarters and more than three fifths of nurses (57.5%, 72.5% and 62.5% respectively) were doing these practices in posttest. More than half and less of nurses (52.5% and 45% respectively) did not reduce light levels generally in the NICU and did not use eye cover in pretest, improved in posttest as most of nurses (82.5%) were reducing light levels generally in the NICU and using eye cover and the improvement still observed in follow-up. Statistically significant differences were detected.

Table (5) illustrates that, all of nurses (100%) did not place strongly contrasting images in preterm neonate' view and did not save stimulating toys for the time when the infant be strong enough to enjoy them in pretest, posttest and follow-up with no statistically significant differences. More than three quarters of nurses (77.5%) did not always maintain a gentle warm facial expression in pretest, improved in posttest and follow-up to three quarters and half of nurses (75% and 50% respectively) were doing this practice with highly statistically significant difference.

Table (6) shows that four fifths of nurses (80%) had incompetent practices regarding healing environment in pretest, improved in posttest and follow-up to be competent among most and less than three quarters of nurses (82,5% and 70% respectively) with highly statistically significant differences.

4. DISCUSSION

Creating healing environment for the preterm neonates to minimize stress and provides a developmentally appropriate sensory experience for promoting neurobehavioral organization and developing infant's self-regulatory skills is of a paramount importance, which required that neonatal nurses possess the requisite knowledge and practices to facilitate implementation of healing environment which mitigate the potential negative impacts of the NICU environment on short- and long-term outcomes of preterm neonates **(Maria et al., 2021).**

Regarding nurses' knowledge about healing environment in NICU, the current study results illustrated that vast majority, most and less than two thirds of nurses respectively, answered incorrectly regarding methods of reducing visual stimuli, methods of reducing light and effect of exposure of preterm neonates to noise in pretest, improved in posttest to most and majority of nurses respectively answered correctly and the improvement still observed in follow- up regarding all items of healing environment with highly statistically significant differences.

These results were in the same line with **Hendy et al. (2024)** in a study about "Impact of on-the-job training on nurses' performance in creating a healing environment and clustered nursing care for premature" who indicated a significant improvement in the nurses' knowledge about healing environment including components of healing environment and ways of control extensive light and noise at NICU following the intervention with a highly statistically significant differences between pre-and post-intervention.

While, the current study results were in contrary with the results of the study carried out by **Syamsu et al. (2022)** titled "The seven points of developmental care for preterm neonates: nurses' knowledge and attitudes in the NICU room" which was

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conducted in Indonesia and showed that there was no significant increase in nurses' knowledge regarding healing environment before and after education.

From the researcher point of view, the current study findings may be due to unavailability of instructions within the NICU explaining the concept of healing environment and workload that may hinder nurses from updating their knowledge. While, improvement in nurses' knowledge after the program may be attributed to feeling of interest from nurses toward the program, and the attention given to them during the instructional sessions.

The previous study results prove the first hypothesis of the study titled "Nurses' knowledge about healing environment will be improved after program implementation than before ".

In relation to nurses' practices regarding reducing noise at NICU, the present study results revealed that all nurses did not put ear muffs for preterm neonates during excessive noisy procedures in pretest, posttest and follow-up. These findings were inconsistent with a study titled "Developmental care of premature newborns: a success story from evidence-based research" carried out by **Philomene et al. (2022)** who recommend that implementation of proper noise control guidelines in NICU is needed, which should include putting ear muffs for preterm neonates during excessive noisy procedures, closing doors to external noise sources and lowering of voices to create a calm acoustic environment, especially during the night.

The current study results clarified that vast majority of nurses did not set alarms and phone at the lowest safe level, in pretest, improved in posttest to less than two thirds of nurses and two fifths in follow-up were doing this practice also with highly statistically significant differences. These results were in accordance with **Henawy et al. (2021)** in a study titled " Effect of developmental supportive care training program on nurses' practice regarding behavioral response of premature neonates" who clarified that concerning setting alarms and phones at the lowest safe level, the most of nurses did not perform it before the program application, improved to more than half and half of nurses respectively do this practice immediately after the application of the program and three months later with statistically significant differences.

The present study results illustrated that majority of nurses did not move medical and nursing ward rounds away from the bedside in pretest, improved in posttest to three fifths of nurses were doing these practices, and in follow-up, two fifths of nurses were doing these practices also. These findings were in the same line with **Lenzi et al. (2023)** in a review article titled "Improving the quality of the acoustic environment in neonatal intensive care units: a review of scientific literature and technological solutions" who clarified that nurses are naturally considered as the main source for human induced sound nuisance because of their constant presence and continuous activities within the NICU and that lack of nurses' education regarding the impact of medical or nursing ward rounds and human activity on the overall sound level might increase the noise and its harmful effects on preterm neonates in NICU.

Current study results clarified that most of nurses did not wear quiet shoes only, move softly and gently in pretest, improved in posttest and follow-up to more than half and more than two fifths of nurses respectively were doing this practice, with highly statistically significant differences. These findings were in agreement with **Henawy et al. (2021)** who showed that there were statistically significant improvements in nurses' performance for reducing noise such as wearing quiet shoes and move softly and gently.

The present study results revealed that three quarters of nurses did not close incubator doors softly in pretest, improved in posttest to more than three quarters of nurses corrected this practice and the improvement still observed in follow-up with highly statistically significant differences. These results were in agreement with **Mohammed et al. (2018)** in a study entitled **"**Effect of preterm neonates' developmental supportive care program on nurses' performance" who noticed a significant change in nurses' practice of closing the incubator doors softly immediately after the program application and three months later. Additionally, these results were supported by **Incekar and Balci, (2017)** who studied "The effect of training on noise reduction in neonatal intensive care units" and reported that, noise significantly decreased after the training provided for healthcare professionals of the NICU within the scope of the study.

The current study results revealed that three quarters of nurses were placing things on the top of the incubator in pretest, improved in posttest to most of nurses corrected these practice and the improvement still observed in follow-up with highly statistically significant differences. These results agreed with **Mohammed et al. (2018)** who revealed that before starting the program, it was clear that more than two thirds of nurses were placing objects on top of incubator, improved among

nearly three quarters of nurses corrected this practice immediately after the program application, with statistical significant differences.

From the researcher point of view, the slight decrease in nurses' noise reduction practices in the follow-up phase in the current study could be justified by lack of legislation regarding noise in NICU, lack of supervision. Nurses required to be reminded of noise reduction strategies by placing instruction posters inside the NICU.

On studying nurses' practices regarding reducing light at NICU, the study results revealed that most of nurses did not cover the incubator in pretest, improved in posttest as less than three quarters of nurses were doing this practice in posttest with highly statistically significant differences. These results agreed with **Abdel Hamid et al. (2021)** who studied "Effect of light and noise on physiological parameters in a sample of preterm neonates in the neonatal intensive care of Cairo university teaching hospital" and recommended that all incubators should be equipped with acoustical foam inside and covered shield outside to minimize the exposure to sound and light as much as possible. Furthermore, the staff members of NICU should take different courses about healing environment to minimize environmental stimuli in NICU.

The current study results clarified that vast majority of nurses did not use nurses' hand during focused lighting medical procedures to cover the eye of preterm neonates in pretest, improved in posttest as more than half were doing this practice with highly statistically significant differences. This improvement in nurses' performance in posttest was disagreed with **Mohammed et al. (2018)** who reported that none of the nurses used their hand during focused lighting medical examinations to cover the eye before the program, immediately after the application of the program and three months later with no statistically significant differences.

The results of current study revealed that, more than half and less of nurses respectively did not reduce light levels generally in NICU and did not use eye cover for preterm neonates in pretest, improved in posttest as most of nurses were reducing light levels generally in the NICU and using eye cover for preterm neonates, and the improvement still observed in follow-up with statistically significant differences.

These results agreed with **Khawash and Banerjee, (2018)** in a review article titled "Training of NICU staff in early developmental care of newborn-a perspective from India" who recommend that preterm neonates need to be exposed to rhythmic low-level ambient lights to allow the circadian rhythm which facilitates the sleep cycle and that reducing light levels generally in the NICU, using eye cover and avoid exposure to direct bright light should be implemented by all neonatal nurses to maintain the ideal NICU environment for supporting brain growth.

Concerning nurses' practices regarding reducing visual stimuli at NICU, the current study results revealed that all of nurses did not place strongly contrasting images in preterm neonate' view and did not save stimulating toys for the time when the infant be strong enough to enjoy them in pretest, posttest and follow-up with no statistically significant differences. These results was in the same line with **Hockenberry et al. (2021)** who recommended that staff nurses needs to carefully consider the impact of visual stimuli on preterm neonates and avoid leaving visual stimuli such as high-contrast images, stimulating toys in their direct line of sight as they cannot escape from it, which can evoke an obligatory staring response.

In relation to differences in nurses' total level of practice regarding healing environment between pretest, posttest and follow-up, the current study results illustrated that four fifths of nurses had incompetent practices regarding healing environment in pretest, improved in posttest to be competent among most of nurses and the improvement still noticed in follow-up with highly statistically significant differences.

These findings were agreed with **Hendy et al. (2024)** who revealed that before the intervention, most of the nurses exhibited incompetent practice regarding healing environment. However, after the intervention, the majority of nurses became competent in these areas with highly statistically significant differences. The previous study results prove the second hypothesis of the study titled "Nurses will be competent in practices regarding healing environment after program implementation than before".

5. CONCLUSION

Healing environment program had a positive effect on improvement of nurses' knowledge and practices with highly statistically significant differences.

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6. RECOMMENDATIONS

- Ensure regular on job training programs for nurses about healing environment for preterm neonates to update their knowledge and practices.

Table (1): Percentage distribution of nurses according to their personal characteristics (n=40)

tems	N	%
Age (Years)		
< 25	18	**45.0**
25 – 30	12	30.0
>30	10	25.0
x̄±SD	**27.4 ±5.1**	
Gender		
Male	2	5.0
Female	38	**95.0**
Level of Education		
Secondary nursing school	10	25.0
Technical nursing institute	26	**65.0**
Nursing bachelor degree	4	**10.0**
Years of experiences in NICU		
<10	28	**70.0**
10 – 20	8	20.0
> 20	4	**10.0**
x̄±SD	**8.10 ±6.64**	
Attendance of previous programs or workshops about DSC		
Yes	8	20.0
No	32	**80.0**

Table (2): Comparison of nurses' knowledge regarding healing environment in NICU between pre, post and follow-up the application of the program (n=40)

Items	Pre-test						Post-test						Follow-up						X^2	p-value
	Incorrect answer		Incomplete correct answer		Complete correct answer		Incorrect answer		Incomplete correct answer		Complete correct answer		Incorrect answer		Incomplete correct answer		Complete correct answer			
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%		
Methods of reducing noise	4	10.0	20	**50.0**	16	40.0	1	2.5	2	5.0	37	92.5	1	2.5	4	10.0	35	87.5	34.621	<0.001**
Effect of exposure of preterm neonates to noise	26	**65.0**	10	25.0	4	10.0	2	5.0	4	10.0	34	**85.0**	3	7.5	6	15.0	31	**77.5**	62.217	<0.001**
Methods of reducing light	34	**85.0**	0	0.0	6	15.0	4	10.0	0	0.0	36	**90.0**	6	15.0	0	0.0	34	**85.0**	60.574	<0.001**
Benefits of reducing light levels	24	60.0	0	0.0	16	40.0	2	5.0	0	0.0	38	95.0	5	12.5	0	0.0	35	87.5	37.144	<0.001**
Methods of reducing visual stimuli	38	**95.0**	0	0.0	2	5.0	6	15.0	0	0.0	34	**85.0**	10	25.0	0	0.0	30	**75.0**	61.414	<0.001**

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Table (3): Comparison of nurses' practices regarding reducing noise at NICU between pre, post and follow-up the application of the program (n=40)

Items	Pre –test				Post –test				Follow – Up				X^2	p-value
	Not Done		Done		Not Done		Done		Not Done		Done			
	N	%	N	%	N	%	N	%	N	%	N	%		
Close incubator doors softly	30	**75.0**	10	25.0	9	22.5	31	**77.5**	18	45.0	22	55.0	22.256	<0.001**
Do not place anything on the top of the incubator	30	**75.0**	10	25.0	6	15.0	34	**85.0**	10	25.0	30	75.0	34.971	<0.001**
Set alarms and phone at the lowest safe level	38	**95.0**	2	5.0	14	35.0	26	**65.0**	24	60.0	16	**40.0**	31.292	<0.001**
Put ear muffs during excessive noisy procedures	40	**100.0**	0	0.0	40	**100.0**	0	0.0	40	**100.0**	0	0.0	0.000	1.000
Avoid tapping on or writing on incubators	22	55.0	18	45.0	3	7.5	37	92.5	10	25.0	30	75.0	22.346	<0.001**
Encourage staff and visitors to talk quietly	32	**80.0**	8	20.0	12	30.0	28	**70.0**	19	47.5	21	**52.5**	20.652	<0.001**
Move medical and nursing ward rounds away from the bedside	37	**92.5**	3	7.5	16	40.0	24	**60.0**	24	60.0	16	**40.0**	24.428	<0.001**
Wear quiet shoes only, move softly and gently	35	**87.5**	5	12.5	17	42.5	23	**57.5**	22	55.0	18	**45.0**	18.261	<0.001**

Table (4): Differences in nurses' practices regarding reducing light at NICU between pre, post and follow-up the application of the program (n=40)

Items	Pre-test				Post-test				Follow – Up				X^2	p-value
	Not Done		Done		Not Done		Done		Not Done		Done			
	N	%	N	%	N	%	N	%	N	%	N	%		
Use eye cover	18	**45.0**	22	55.0	7	17.5	33	**82.5**	9	22.5	31	77.5	8.454	0.015*
Use nurses' hand during focused lighting medical procedures/ examinations to cover the eye.	38	**95.0**	2	5.0	17	42.5	23	**57.5**	20	50.0	20	50.0	27.520	<0.001**
Reduce light levels generally in the NICU	21	**52.5**	19	47.5	7	17.5	33	**82.5**	13	32.5	27	67.5	10.966	0.004*
Make use of available natural lighting	35	**87.5**	5	12.5	11	27.5	29	**72.5**	15	37.5	25	62.5	33.076	<0.001**
Assure darkness for the infant during sleep and maintain low light levels	33	82.5	7	17.5	29	72.5	11	27.5	31	77.5	9	22.5	1.147	0.564
Make sure that all lighting that falls on the infant's face is indirect	35	**87.5**	5	12.5	15	37.5	25	**62.5**	20	50.0	20	50.0	22.286	<0.001**
Cover the incubator	35	**87.5**	5	12.5	11	27.5	29	**72.5**	33	82.5	7	17.5	39.420	<0.001**

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Table (5): Comparison of nurses' practices regarding reducing visual stimuli at NICU between pre, post and follow-up the application of the program (n=40)

Items	Pre-test				Post-test				Follow –Up				X^2	p-value
	Not Done		Done		Not Done		Done		Not Done		Done			
	N	%	N	%	N	%	N	%	N	%	N	%		
Do not place strongly contrasting images in preterm neonate' view	0	0.0	40	**100.0**	0	0.0	40	**100.0**	0	0.0	40	**100.0**	0.000	1.000
Save stimulating toys for the time when the infant be strong enough to enjoy them	40	**100.0**	0	0.0	40	**100.0**	0	0.0	40	**100.0**	0	0.0	0.000	1.000
Always maintain a gentle warm facial expression	31	**77.5**	9	22.5	10	25.0	30	**75.0**	20	50.0	20	**50.0**	22.073	<0.001**

Table (6): Differences in nurses' total level of practice regarding healing environment between pre, post and follow-up the application of the program (n=40)

Items	Pre-test				Post-test				Follow – Up				X^2	p-value
	Incompetent <70%		Competent >70%		Incompetent <70%		Competent >70%		Incompetent <70%		Competent >70%			
	N	%	N	%	N	%	N	%	N	%	N	%		
Healing Environment	32	**80.0**	8	20.0	7	17.5	33	**82.5**	12	30.0	28	**70.0**	35.805	<0.001**

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