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IMPACT OF AN INSTRUCTIONAL PROGRAM ON DEVELOPMENTAL SUPPORTIVE CARE FOR ENHANCING PEDIATRIC NURSES' PERFORMANCE IN NEONATAL INTENSIVE CARE UNITS

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Abstract

Background: Developmentally supportive care is an integrated nursing practice that ensuring that the neonatal intensive care unit environment is as similar to the intrauterine environment as possible to maintain the physiological stability and optimal growth and development of preterm infants. **Aim:** the study aims to evaluate the impact of instructural program about developmental supportive care for enhancing pediatric nurses' performance in neonatal intensive care units. **Subjects and Method: Design:** A quasi-experimental design was used, with one group employed to conduct the study. **Setting:** The study was conducted in neonatal intensive care units at Kafr Saad hospital and El- Azhar university hospital, Egypt. **Subjects:** A purposive sample consisting of all available nurses working at neonatal intensive care units at the above-mentioned study settings (50), **Tools:** A structured questionnaire, divided into three parts; personal data of studied nurses, assessment of pediatric nurses' knowledge regarding developmental supportive care in NICU and, observational checklist of nurses' practices about the developmental supportive care for neonates. **Results:** All nurses exhibited unsatisfactory knowledge levels Preprogram; while a significant improvement was observed post program implementation**.** Regarding total practice of developmental supportive care; a significant increase from 0% pre-program to 36% at the follow-up stage was observed in positioning, as well as for total practice of massage and touch; there was a significant increase from 0% pre-program to 76% post-program and 20% at follow-up. As for total practices of nurses regarding developmental supportive care in the neonatal intensive care unit, there was a significant increase in adequate practice from 0% pre-program to 8% post-program. **Conclusion:** The training program about developmental supportive care was effective in improving nurses' performance. **Recommendation:** Continuous training about developmental supportive care for nurses working in neonatal intensive care units is recommended.

Keywords: Instructural Program; Developmental Supportive Care; Pediatric Nurses; Performance; Neonatal Intensive Care Unit.

INTRODUCTION

The intensive care unit provides essential care management for preterm infants and sick newborns (Schmid, 2024). Neonates in the Neonatal Intensive Care Units (NICUs) are extremely vulnerable and dependent, requiring care tailored to meet specific needs and unique concerns.

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The extrauterine environment does not support normal growth and development of neonates (Mohamed, Abd Al-Moniem, Abou Khalaa, & Ali, 2023). Neonatal intensive care units can be lifesaving, but they also can cause harm (Braun et al., 2020).

According to the WHO, it is estimated that one in every ten births worldwide, or approximately 15 million children, are born prematurely each year (Mohammed, Khamis & Sabry, 2024). In Egypt, the percentage of preterm births was 8.2% of all deliveries (Riad, Ouda, Hegazy& Ismail, 2023). The management of premature infants has advanced significantly over the past decades because of a multitude of technological advances. This progress comes with great physical, emotional, and financial costs because premature infants spend many weeks and months in the neonatal intensive care unit (Jones, 2024).

Developmentally supportive care (DSC) is an individual and integrated nursing practice that supports the attachment between parents and their babies, in addition to ensuring that the NICU environment is as similar to the intrauterine environment as possible to maintain the physiological stability and optimal growth and development of preterm infants (Lee & Cho, 2023).

Developmental care practices aim to minimize the stress of the NICU environment so that it is as much like the intrauterine environment as possible, and provides individual and integrated interventions with the help of health professionals and the premature babies' families through specific interventions, which may include control of external sensory stimuli, pain, stress management, and increased family involvement in the preterm infants' care for the optimal growth and development of premature babies (Filippa et al., 2021; Lee, Park & Cho, 2022).

Developmental care includes Clustered care, which represents clustering nursing care procedures, and several routine practices performed together instead of spacing them out over time. The main goal of clustering care is to allow the premature infant to rest for longer periods (Hendy, Alsharkawy & El-Nagger ,2022). This approach leads to more efficient management of respiratory needs, reduced stress responses and increased comfort through longer rest periods with fewer disruptions (Charan, Kalia & Josh,2024).

Kangaroo mother care (KMC) was first introduced in 1978 by Edgar Rey as an alternative neonatal care to incubators for low birth weight (LBW) in Bogota in Colombia (Al-Shehri & Binmanee, 2021). Also, in order to reduce overcrowding and mortality of premature newborns in the neonatal care unit, improving care through skin-to-skin contact and greater effective bonding (Gomes et al., 2020). The World Health Organization (WHO) has defined KMC as early, continuous, and prolonged skin-to-skin contact between the mother and the newborn, with the fathers involved as kangaroo care providers, as well as frequent and exclusive breastfeeding and early discharge from the hospital (Cañadas, Perales, Martínez, Belmonte & Carreño, 2022).

During kangaroo care (KC), a baby is positioned in skin-to-skin contact with the mother's (or father's) chest for varying periods. KC is widely practiced across the world and has been shown to reduce maternal stress, anxiety, and depression (Landry, Kumaran,

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Tyebkhan, Levesque & Spinella., 2022). This relationship between the mother and infant deeply affects the child's physical, psychological, and intellectual development and continues to be effective throughout life (Kucukoglu, Ozdemir & Ozcan., 2020; Shrestha, 2022).

Nesting is the use of tools shaped like a condition in the mother's womb, made of linen and can be adjusted to the length of the baby's body. This tool is placed as a protector of the baby's position, maintaining changes in the baby's position caused by gravity (Rohmah, Saputri, Bahari, 2020). The nest resembles the maternal uterus by a cloth rolled in a "U" or "O" shape, which favored a more flexed posture for total containment of the baby's movements from head to foot and facilitated alignment of head to the body, thus improving neurobehavioral and muscle development of preterm infants (Tang et al., 2023).

The role of the nurse is very important for the success of the neurodevelopment of premature infants. The professional ability had the most decisive impact on developmental care practice in neonatal intensive care unit nurses. High professional ability, a strong sense of optimism and motivation have a positive impact on the professional performance of nurses (Suryandari, Arief & Utami, 2021)

A neonatal nurse is a professional with special training, skills, and knowledge in the care of neonates and their families. The progress of science and technology in neonatal intensive care units (NICUs) has contributed to the increased survival of neonates (Riad et al., 2023). Neonatal intensive care unit nurses spend the longest time with premature infants while providing nursing care during their hospitalization. Therefore, neonatal intensive care unit nurses are responsible for actively advocating and providing developmental positioning to premature infants, acquiring the professional skills required to positively induce the developmental potential of premature infants, and applying that expertise to nursing practice (Yun & Kim., 2022).

Significance of the Study

In Egypt, the percentage of preterm infants' deliveries was 8.2% of all deliveries (Kunswa & Bayoumi, 2018). Preterm infants in NICUs are exposed to numerous stressors, including painful stimuli, disruption of sleep, excessive noise and light levels, frequent handling associated with medical or nursing procedures, and maternal separation and disrupted parenting (Mousa, Khalil, Mohamed, & Mohamed, 2021).

Symington and Pinelli (2002) have documented nurses' lack of knowledge and practices regarding developmental supportive care (Sathish et al., 2019). So, the neonatal intensive care nurse should be equipped with the recent evidence in newborn care and should be alerted to provide developmental supportive care in an NICU setting (Ahmed & Mohammed, 2019). Moreover, there have been few previously reported studies evaluating individualized developmental supportive care in the NICU context (Mohammed, Khamis, & Sabry (2018). A practical training program should be provided to nurses to promote confidence in implementing developmental care for pre-term infants (Park & Kim, 2019).

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AIM OF THE STUDY

The study aims to evaluate the effect of a training program about developmental supportive care on pediatric nurses' performance in neonatal intensive care units. This will be done through the following objectives:

1. Assess knowledge of the pediatric nurse about developmental supportive care at neonatal intensive care units.
2. Assess pediatric nurses' practices about developmental supportive care at neonatal intensive care units.
3. Design the instructural developmental supportive care program.
4. Implement the instructural developmental supportive care program.
5. Evaluate the effect of the instructural developmental supportive care program on nurses' performance

SUBJECTS AND METHOD

Study Design

Quasi-experimental design included one group was used to conduct the study.

Study Setting

This study was carried out in neonatal intensive care units at Kafr Saad hospital and El-Azhar University hospital**.**

Study Subjects

A purposive sample consisted of all available nurses working at NICUs at the above-mentioned study settings (50 nurses), regardless of their experiences, level of education, position, or age, were included in the study.

Tool of data collection

Data was collected through the use of the following tool

A structured questionnaire, divided into three parts:

Part (1): This part covered personal data of studied nurses as nurses' which include 6 items: age, gender**,** nursing qualification, social status, years of experience, and training programs attended in the field of developmental supportive care.

Part (2): It was adapted by the researchers from Toso, Viera, Valter, Delatore, and Barreto (2015) and Halder, Bera, and Banerjee (2015), to assess the knowledge of pediatric nurses regarding developmental supportive care in NICUs. Questions were in the form of multiple choice.

Answers were checked with the model answer. It includes knowledge about developmental supportive care as: Definition of developmental care(5)**,** The extent of familiarity to the concept of developmental supportive care(3), Sources of information

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about developmental supportive care(6), Numbers of developmental supportive care skills used per shift(2), Types of developmental care known in the neonatal intensive care unit(11), Applied developmental supportive care in neonatal intensive care unit(11), Positive effect of developmental supportive care on neonates(7), Exposing to obstacles during implementation of developmental supportive care(2), Obstacles during implementation of developmental supportive care(7), Support the implementation of developmental supportive care from the unit(2), Methods of supporting developmental care from the unit(6), Ability to provide developmental supportive care for neonates(2), The extent of confidence for providing developmental supportive care for neonates (4), Interesting in additional education or training on developmental care practices(3), kangaroo care it include main question about: meaning of kangaroo care(4), technique of kangaroo care (8).

Benefits of kangaroo care (9), barriers of kangaroo care(7), complications of applying kangaroo care(6). meaning of developmental positioning (3), its technique (6), benefits of applying developmental positioning (7), barriers of applying developmental positioning (9), complications of applying developmental positioning (5). Meaning of non-nutritive sucking (3), techniques of non-nutritive sucking (7), benefits of applying non-nutritive sucking (7), barriers of applying non-nutritive sucking (6), complications of non-nutritive sucking (5).

Meaning of clustered care (6), techniques of cluster (7), benefits of cluster care (10), barriers to applying cluster care (7), complications of cluster care (5). Meaning of swaddling (3), techniques of swaddling (9), benefits of swaddling (6), barriers to applying swaddling (10), complications of applying swaddling (5).

Mechanisms of massage therapy (4)**,** Duration of massage for newborns (3), Benefits of massage for newborns (5), Complications of massage for newborn (3), Contraindications for massage for newborns (5). Meaning of nesting (6), techniques for applying nesting (4), benefits of applying nesting (10), complications of applying nesting (4), barriers for applying nesting (5). Sources of sounds, noises, and lights (7), techniques for reducing noises and lights (7), benefits of reducing sounds and lights (6), barriers to reducing sounds and lights (7), complications of reducing sounds and lights (6).

Scoring System

Scoring System of Nurses' knowledge

The studied nurses' answers were compared with model key answers, where **(2)** scores were given for a completely correct answer, **(1)** for an incomplete correct answer, and **(0)** for do not know the answer. The total score was calculated by summing up to (**313**) converted into a percent score. Nurses' total level of knowledge has been classified as follows: unsatisfactory knowledge for nurses who got scores less than **75% (< 267),** satisfactory knowledge for nurses who got scores **75%** or more **(≥ 267**).

Part (3): **Observational Checklist of Nurses practices of the Developmental Supportive Care for Neonates:** It was adapted by the researchers from Toso, Viera,

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Valter, Delatore, and Barreto (2015) and Halder, Bera, and Banerjee (2015) to assess practices of nurses regarding developmental supportive care in NICU as: Kangaroo care (39), Position of neonate (17), Massage/touch,(43) reducing noise, (8) The clustering care activities (1) reducing noise, (8) and Reducing light (7).

Scoring System of Nurses 'Practice

According to the practices of nurses, the steps of practices checked as done and not done, **(2)** scores were given for done, and **(0)** was given for not done. The total score was (**123**) it was calculated by summing up and converted into a percent score. Nurses' total level of practice has been classified as follows; inadequate practices for nurses who got scores less than **85% (<105),** adequate practice for nurses who got scores **85%** and more (**≥105**).

Pilot Study

A pilot study was undertaken after the development and validation of the study tool and before starting the data collection phase. It was carried out on a sample of about 10% of the main study sample.

The purposes of the pilot study were to test the applicability, clarity, and feasibility of the study tools, and it served to estimate the time needed to complete the form. It also helped to find out any obstacles and problems that might interfere with data collection. Based on the findings of the pilot study, certain modifications of the tools were made, and hence, the pilot nurses (**5** nurses) were not included in the main study sample.

Fieldwork

This fieldwork was achieved through assessment, planning, Implementation, and evaluation phases.

Assessment Phase

This phase involved the preparation of the tool and the assessment of the nurses' performance about developmental Supportive Care for Neonates, specifically in neonatal intensive care units. The researcher visited the study settings, met with the eligible nurses, explained to them the study aims and procedures, and invited them to participate.

After obtaining nurses' consent, the researcher started the interview using the first tool. This was conducted individually and privately in the study setting according to the policy of the place, where the researcher asked the nurses questions and recorded their answers on the form. For the assessment of practices, the researcher used the observational checklist, observing the nurses during their work and noting every action they performed concerning developmental supportive care.

This was done discreetly to ensure an accurate reflection of their practices. It took approximately 45 to 60 minutes. The researchers visited the study setting twice per week and met 2-3 nurses per day. This assessment phase lasted for 3 months from the first of May 2024 to the end of July 2024. The data collected constituted a pretest for baseline

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comparisons. It also served in preparing the intervention program based on identified needs.

Planning Phase

The researchers started to develop the intervention program using the baseline information gathered in the assessment phase. Hence, the program was designed based on the identified needs and demands of the respondents, and in light of the most recent literature. It was written in simple Arabic language. The program general aim was to improve nurses' knowledge and practices on developmental supportive care in neonatal intensive care units.

Implementation Phase

The implementation of the program was carried out in neonatal intensive care units at two hospitals affiliated to the Damietta governorate. The program was administered in four sessions (Characteristics of the studied nurses, general knowledge of nurses about developmental supportive care, cluster care), (swaddling, kangaroo care, developmental positioning), (non- nutritive care, nesting, massage and touch, light and noise), (practice such as position, reducing noise and light, massage and touch, clustering of nursery care activities) the duration of each session lasting from 45 to 60 minutes.

The sample of nurses was divided into 16 groups, each including 2-3 members. At the beginning of the first session of the program, the attendants were oriented towards the program objectives, contents, and procedures. The program was implemented per week during a period of three months from the first of October 2024 to the end of December 2024.

The intervention program was presented in a clear and concise form, following the principles of adult learning, focusing on interactive learning and active participation. It was implemented using different teaching methods such as short lectures, group discussion, demonstration of practices and re-demonstration. In addition, different audiovisual materials were used as pictures, videos, and hand out to facilitate the teaching of each topic.

Evaluation Phase

The effectiveness of the program was based on assessing the improvement in nurses' knowledge, and observed practices. This was achieved through comparing the pretest with posttest immediately done after the implementation of the program and one month later from February to the end of March 2025.

Ethical Considerations

The study was approved by the scientific research ethical committee of the faculty of nursing, Port Said University, before starting the study. The purpose and procedures of the study were explained clearly and simply to every nurse to obtain their informed consent to participate in the study.

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The researcher also informed them about their rights to refuse or withdraw at any time without giving a reason and with no consequences on their care. They were assured that any information obtained would be Confidential and used only for the study. The study maneuvers could not harm the participants. Professional help and advice were provided as needed.

Statistical Analysis

Data entry and statistical analysis were done using SPSS 20.0 statistical software package. Cronbach's alpha coefficient was calculated to assess the reliability of the developed tools through their internal consistency. Qualitative categorical variables were compared using the chi-square test.

Pearson correlation test was used for the assessment of the inter-relationships among quantitative variables. To identify the difference between pre- and post-intervention in the same group, used paired sample t test. Statistical significance was considered at p-value <0.05.

RESULTS

Table 1: Percentage distribution of the studied nurses according to their characteristics (n= 50)

Nurses' characteristics	n	%
Age/years:		
- < 25	14	28.0
- 25 < 30	18	**36.0**
- 30 < 35	13	26.0
- 35 < 40	5	10.0
Mean ± SD	27.8±5.5	
Min- max	19 – 39	
Range	20	
Gender		
- Male	0	0.0
- Female	50	**100.0**
Social status:		
- Single	15	30.0
- Married	35	**70.0**
Level of education:		
- B.SC	4	8.0
- Technical institute of nursing	36	**72.0**
- Diploma	10	20.0
Years of experience:		
- < 5	23	**46.0**
- 5 < 10	12	24.0
- ≥ 10	15	30.0
Training courses in developmental supportive care:		
- Yes	0	0.0
- No	50	**100.0**

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Table (1) Showed the percentage distribution of the studied nurses according to their characteristics, it was observed that all studied nurses were female **(100%)**, more than one third of them were between the ages of 25 and less than 30 years **(36. %)**.

Moreover, less than three quarter of them were married **(70.0%)**, less than half of the studied nurses had less than five years of experience (**46.0 %)**. and less than three quarters of studied nurses were graduate from technical institute of nursing (**72.0%**).

All of the studied nurses had no previous training courses in developmental supportive care **(100%)**

Table 2: Percentage distribution of the studied nurses regarding their total knowledge about developmental supportive care in NICU throughout the program phases (n=50)

Total knowledge of nurses about developmental supportive care in NICU	preprogram		Post program		Follow up	
	Satisfactory	Unsatisfactory	Satisfactory	Unsatisfactory	Satisfactory	Unsatisfactory
	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
General knowledge of nurses about developmental supportive care.	2(4.0)	**48(96.0)**	**50(100.0)**	0(0.0)	**46(92.0)**	4(8.0)
cluster care.	0(0.0)	**50(100.0)**	**31(62.0)**	19(38.0)	1(2.0)	**49(98.0)**
swaddling.	0(0.0)	**50(100.0)**	**50(100.0)**	0(0.0)	24(48.0)	**26(52.0)**
kangaroo care.	0(0.0)	**50(100.0)**	**30(60.0)**	20(40.0)	3(6.0)	**47(94.0)**
developmental positioning.	0(0.0)	**50(100.0)**	**37(74.0)**	13(26.0)	**29(58.0)**	21(42.0)
non-nutritive sucking.	0(0.0)	**50(100.0)**	**48(96.0)**	2(4.0)	21(42.0)	**29(58.0)**
nesting.	0(0.0)	**50(100.0)**	**29(58.0)**	21(42.0)	12(24.0)	**38(76.0)**
massage.	0(0.0)	**50(100.0)**	**50(100.0)**	0(0.0)	**50(100.0)**	0(0.0)
reducing noise and lights.	0(0.0)	**50(100.0)**	**32(64.0)**	18(36.0)	8(16.0)	**42(84.0)**
Total knowledge of nurses about developmental supportive care.	0(0.0)	**50(100.0)**	**35(70.0)**	15(30.0)	11(22.0)	**39(78.0)**

Table (2) reveals a dramatic transformation in nurses' level of knowledge regarding developmental supportive care in NICU, from nearly 0% pre-program in developmental positioning and massage to 74% and 100% respectively, post-program, and 58%, 100% at the follow-up phase of the program, respectively.

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Although another marked improvement in level of knowledge related to cluster care, swaddling, kangaroo care, non-nutritive sucking, nesting and reducing noise and light from 0% Preprogram to 62%, 100%, 60%, 96%, 58%, 64 % respectively post program, however, the follow-up phase indicates a significant decay in knowledge retention, with satisfactory scores dropping back to 2%, 48%, 6%, 42%, 24% and 16 % of program implementation respectively.

Table 3: Difference between the studied nurses' total knowledge about developmental supportive care in NICU throughout the program phases (n=50)

Total knowledge of nurses about developmental supportive care in NICU	Pre/ Post program				Pre/ Follow up program			
	Pre Mean±SD	Post Mean±SD	t	Sig	Pre Mean±SD	Follow up Mean±SD	t	Sig
General knowledge of nurses about developmental supportive care.	3.8±.29	11±.85	20.6	**.000**	3.8±.29	9.7±.11	18.2	**.000**
cluster care.	0.2±.05	7.9±.21	34.15	**.000**	0.2±.05	5.7±.12	48.4	**.000**
swaddling.	.40±.18	8.9±.12	37.2	**.000**	.40±.18	6.5±.10	31.3	**.000**
kangaroo care.	0.1±.05	7.6±.27	26.5	**.000**	0.1±.05	5.6±.08	60.6	**.000**
developmental positioning.	.44±.09	7.8±.21	28.9	**.000**	.44±.09	6.6±.13	39.7	**.000**
non-nutritive sucking.	3.5±.17	8.7±.17	17.5	**.000**	3.5±.17	6.5±.10	13.8	**.000**
nesting.	1.6±.23	7.3±.24	17.4	**.000**	1.6±.23	5.9±.11	18.7	**.000**
massage.	1.1±.10	9.5±.09	52.9	**.000**	1.1±.10	8.9±.12	50.6	**.000**
reducing noise and lights.	4.7±.07	7.7±.23	13.2	**.000**	4.7±.07	5.6±.10	6.9	**.000**
Total knowledge	15.8±.66	76.4±1.2	34.8	**.000**	15.8±.66	62.6±.77	52.7	**.000**

t- paired sample t test Significant level ($p < 0.05$)

Table (3) demonstrates a clear and statistically significant impact of the developmental supportive care training on NICU nurses' total knowledge.

Immediately post-program, nurses' knowledge means scores rose dramatically from 15.8 ± 6.66 to 76.4 ± 1.2 with a statistically significant difference ($p < 0.000$) and declined to $62.6 \pm .77$ at the follow-up phase ($p < 0.00$).

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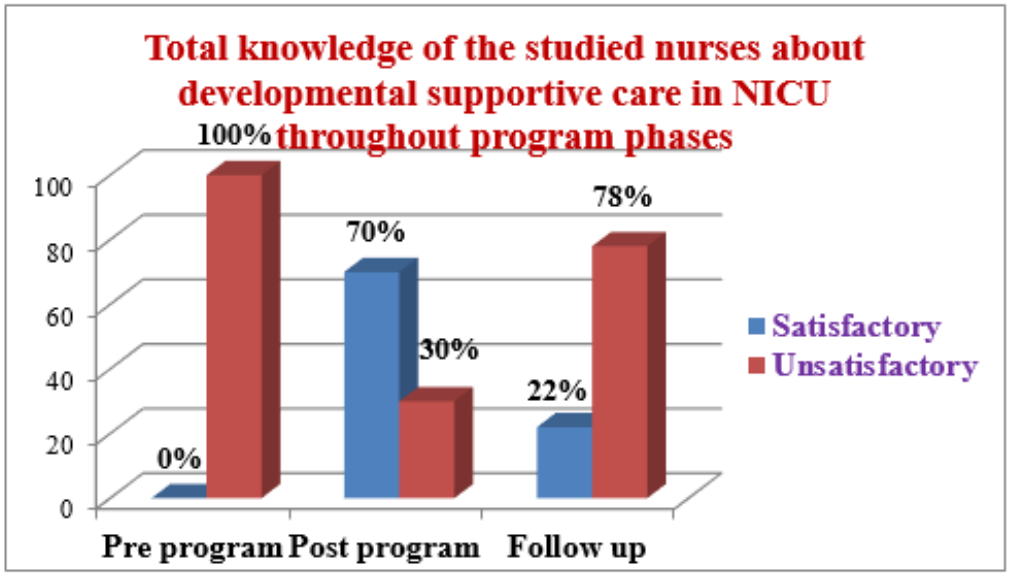

Figure 1: Percentage distribution of the studied nurses regarding their total knowledge about developmental supportive care in NICU throughout program phases (n=50)

This figure illustrates the impact of an educational program on nurses' knowledge of developmental supportive care in NICU over three distinct phases: pre-program, post-program, and follow-up. Preprogram, all nurses exhibited unsatisfactory knowledge levels. Post program, a significant improvement was observed, as 70% of nurses achieved satisfactory knowledge. At the follow-up stage, the satisfactory knowledge decreased to 22%, with a sharp increase in the proportion of unsatisfactory knowledge to 78% compared to results of post program.

Table 4: Percentage distribution of the studied nurses regarding their total practices about developmental supportive care in NICU throughout program phases (n=50)

Total practice	Preprogram		Post program		Follow up		P1	P2
	Adequate	Inadequate	Adequate	Inadequate	Adequate	Inadequate	X^2 P-value	X^2 P-value
	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)		
kangaroo care in	0(0.0)	**50(100.0)**	0(0.0)	**50(100.0)**	0(0.0)	**50(100.0)**	—	—
Developmental positioning	0(0.0)	**50(100.0)**	17(34.0)	**33(66.0)**	18(36.0)	**32(64.0)**	X^2=2.61 P=.956	X^2=28.3 **P=.008**
Reducing noise.	0(0.0)	**50(100.0)**	12(24.0)	**38(76.0)**	9(18.0)	**41(82.0)**	X^2=.658 P=.417	X^2=.521 P=.771
Reducing light and vision.	0(0.0)	**50(100.0)**	11(22.0)	**39(78.0)**	17(34.0)	**33(66.0)**	—	—
Massage and touch.	0(0.0)	**50(100.0)**	**38(76.0)**	12(24.0)	10(20.0)	**40(80.0)**	X^2=100.6 **P=.000**	X^2=10.7 **P=.048**
Cluster nursery activities.	**50(100.)**	0(0.0)	**49(98.0)**	1(2.0)	**50(100.0)**	0(0.0)	—	—
Total practices	0(0.0)	**50(100.0)**	4(8.0)	**46(92.0)**	2(4.0)	**48(96.0)**	X^2=20.2 **P=.050**	X^2=2.73 P=.169

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Table (4) revealed that the total adequate practice of pediatric nurses regarding developmental positioning in NICU had a significant increase from 0% pre-program to 36% at follow-up. Total practice regarding massage and touch, there was a significant increase in adequate practice from 0% pre-program to 76% post-program and 20% at follow-up phases (P=.000 and P=.048) respectively. As for total practices of nurses regarding developmental supportive care in NICU, there was a significant increase in adequate practice of pediatric nurses from 0% pre-program to 8% post-program with statistically significant (P=.050).

Table 5: Difference between the studied nurses' total practices about developmental supportive care in NICU throughout program phases (n=50)

Total practices	Pre/ Post program				Pre/ Follow up program			
	Pre Mean±SD	Post Mean±SD	t	Sig	Pre Mean±SD	Follow up Mean±SD	t	Sig
kangaroo care.	0.0±0.0	0.0±0.0	—	—	0.0±0.0	0.0±0.0	—	—
developmental positioning.	9.9±0.02	26.7±0.6	26.7	**.000**	9.9±0.02	25.5±0.7	21.5	**.000**
reducing noise.	0.3±0.2	9.9±0.5	17.1	**.000**	0.3±0.2	9.2±0.5	16.5	**.000**
reducing light and vision.	7.0±0.0	8.5±0.4	3.71	**.001**	7.0±0.0	9.3±0.5	5.02	**.000**
Massage and touch.	14.4±0.5	78.8±1.3	53.8	**.000**	14.4±0.5	63.5±1.4	34.8	**.000**
Cluster nursery activities.	2.0±0.0	1.9±0.02	1.0	.322	2.0±0.0	2.0±0.0	—	—
Total practices	33.7±0.6	100.3±1.4	67.4	**.000**	33.7±0.6	100.1±1.7	41.1	**.000**

t- paired sample t test Significant level (p< 0.05)

Table (5) revealed that there was a significant increase in the total mean score of Nurses' practices regarding developmental positioning in NICU from 9.9±0.02 pre-program to 26.7±0.6 post-program, then to 25.5±0.7 at follow-up phases (0.000), while for Nurses' practices regarding reducing noise, there was a significant increase from 0.3±0.2to 9.9±0.5then to 9.2±0.5 (0.000).

Also, there was a significant increase in the total score of Nurses' practices regarding reducing light and vision from 7.0±0.0 pre-program to 8.5±0.4 post-program, then to 9.3±0.5 at follow-up phases (P=0.001 and 0.000, respectively).

Total practices of nurses regarding developmental supportive care in NICU increased from 33.7±0.6 to 100.3±1.4 post program, then 100.1±1.7 at follow-up phases (P=0.000).

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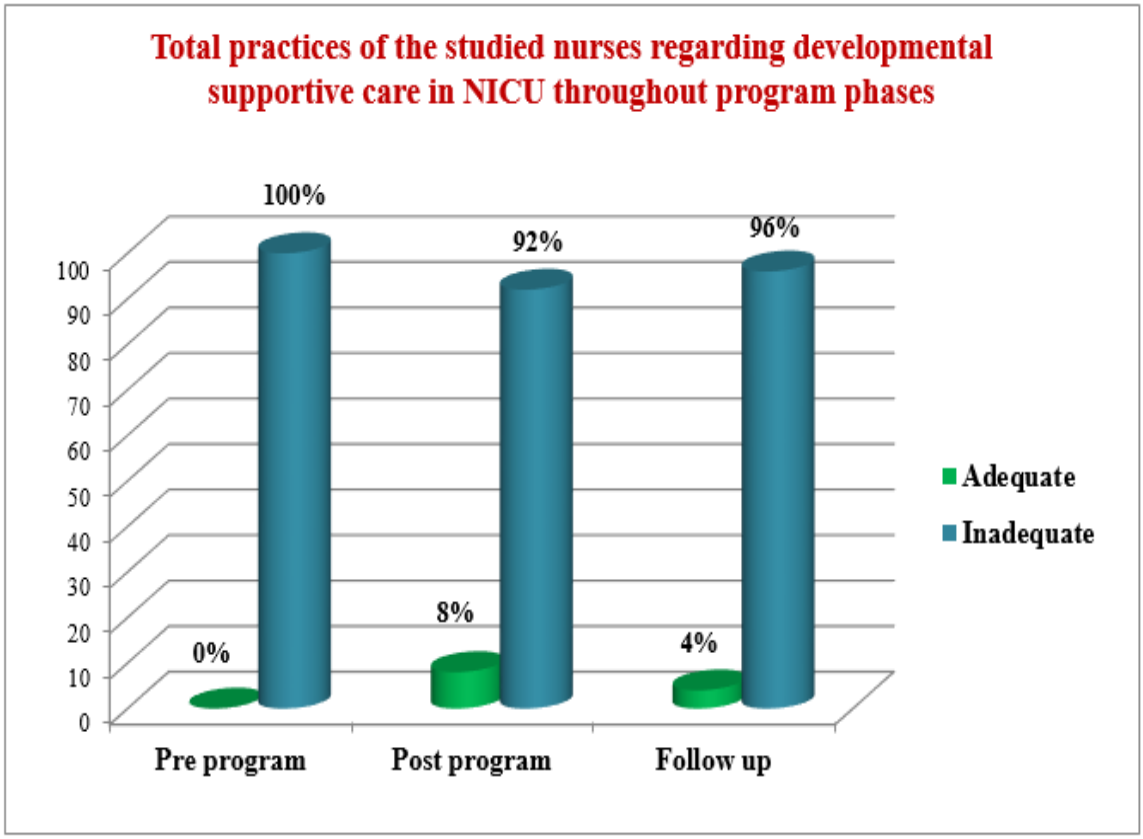

Figure 2: Percentage distribution of the studied nurses regarding their total practices about developmental supportive care in NICU throughout program phases (n=50)

Figure (1) shows the increase in total adequate practice of nurses about developmental supportive care in NICU from 0% pre-program to 8% post-program, and then declined to 4% in the follow-up phase.

Table 6: Correlation between Nurses' total score of knowledge and their total practices developmental supportive care in NICU throughout program phases (n=50)

Nurses' total score of knowledge about developmental supportive care in NICU	Nurses' total practices regarding developmental supportive care in NICU					
	Pre program		Post program		Follow up	
	r	p-value	r	p-value	r	p-value
Pre program	.454**	**.001**	-.175	.132	.219	.127
Post program	.128	.375	.281*	**.048**	-.180	.211
Follow up	-.175	.225	.075	.606	.087	.546

r- pearson correlation coefficient Significant level (p< 0.05)

Table (6) shows that there was a significant direct positive correlation between pre-Nurses' total score of knowledge and their pre total practices developmental supportive

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care in NICU and also there was a significant direct positive correlation between post Nurses' total score of knowledge and their post total practices developmental supportive care in NICU.

DISCUSSION

Regarding the studied nurses' total knowledge, the present study revealed that immediately post-program, mean knowledge scores rose dramatically from 15.8 ± 6.66 to 76.4 ± 1.2 ($p < 0.001$). However, while scores at follow-up (62.6 ± 7.7) remained elevated, the decline from post-test represents a significant knowledge attrition ($p < 0.001$).

This pointed the effectiveness of the educational program since contents of educational program were based on the identified needs and priorities of the nurses, the simplicity of the language and avoiding scientific sophisticated terms. During the follow-up phase, there was a slight decrease in the nurses' total knowledge. This is normal issue because information is easy to forget, that's way nurses need continuing education and training.

This study was parallel to the Egyptian study conducted by **Selim et al., (2024)** in entitled study "Effect of Developmental Supportive Care Program for Preterm Neonates on Nurses' Performance", who found that most of nurses had unsatisfactory total score of knowledge in pretest, improved to most and less than two thirds of nurses had satisfactory (excellent total score) of knowledge in posttest and follow-up respectively. The total mean score of nurses' knowledge 104, in pretest was x ±SD= 31,5 ±9,8, improved in posttest and follow-up to x ±SD= 96.4 ±7.5 and 90.2 ±15.7 respectively. The differences were highly statistically significant.

Also, This consistent with Iranian study by **Sankar, Marakkar, &Varghese (2022)** in entitled study "Effectiveness of Developmentally Supportive Education Program on Nursing Knowledge of Retinopathy of Prematurity in Neonatal Intensive Care Unit" who reported that Post-test knowledge score mean (SD) 14.53 (2.39) was significantly higher than the pre-test knowledge mean (SD) 9.00 (3.68), which showed that the educational program was effective in improving the nurses knowledge ($t32 = 10.09$, $p < 0.001$).

The current study illustrated that, there was a significant relation between total knowledge about developmental supportive care in neonatal intensive care unit and nurse's education and marital status post program and with years of experience at follow up stage where higher satisfactory knowledge is noticed for higher education and more years of experience. This because increased years of experience and higher education provide nurses with more knowledge about developmental supportive care.

This finding is consistent with chines study by **Zhong, Cai, Wang, Wu & Sun (2025)** in entitled study" The knowledge, attitude and practice of nurses on the posture management of premature infants: status quo and coping strategies "who reported that years of work experience and marital status and had accepted premature infants posture management training are the main influencing factors of neonatal nurses' knowledge, belief and practice in postural management of premature infants.

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On the same side, the study's results were in an agreement with Egyptian study by **Elarousy, Abd El Aziz, & Youssef (2020)** in entitled study" Effectiveness of Nurses' Training Program about Neuroprotective Developmental Care for Premature Neonates on their Knowledge and Practices in Neonatal Intensive Care Unit" , who found the majority of nurses had "poor" knowledge and "unsatisfactory" practices before the training program, compared with the statistical significant improvement immediately and one month after the training either in knowledge. Also, these results were congruent with **Mousa et al, (2021)** who stated that more than half of studied nurses had inadequate practice related developmental care. Furthermore, Egyptian study by **Hendy, Alsharkawy**, & **El-Nagger (2023)** in a study entitled " Nurses' Performance about Creating Healing Environment and Clustering Nursing Care for Premature Infants" who reported that the majority of studied nurses had incompetent practice about developmental care.

The finding of the present study demonstrated that, there was a significant direct positive correlation between pre-Nurses' total score of knowledge and their pre total practices developmental supportive care in neonatal intensive care unit and also there was a significant direct positive correlation between post Nurses' total score of knowledge and their post total practices developmental supportive care in neonatal intensive care unit. This might due to, the nurses perform the nursing skills according to the knowledge they have about them, which calls for further training due to its positive impact on the knowledge and nursing skills they provide to the newborn.

This result was similar to study conducted by **Rupashree(2023)** in entitled study" Nurses knowledge and practice regarding developmental supportive care"who reported that there was a strong positive relationship between the knowledge and practice scores of the nurses calculated through Spearman Rank correlation coefficient (R = 0.56) hence Null hypothesis was rejected.

The present study revealed that, there was a significant increase in total score of Nurses' practices regarding developmental positioning in neonatal intensive care unit from 9.9 preprogram With Pre-Mean±SD 9.9±0.02 to 26 post program with Post Mean±SD 26.7±0.6 to 25.5 at follow up With Mean±SD 25.5±0.7.

This finding was in line with Iranian study conducted by **Shahedi, Dehghani, &Salmani(2023)** in entitled study"Effects of Bedside Nurses' and Mothers' Training on the Positioning Score of Premature Infants Hospitalized in NICU: A Clinical Trial" who reported that There was a significant difference between the mean infants' positioning score before (5.59 ±2.82), one week (9.28 ±2.91), and one month after the intervention (9.86 ±2.64). According to total practices of nurses regarding developmental supportive care in NICU,The current study revealed that there was a significant increase in adequate practice after training program. The significant improvement after the training program may be contributed to the passion and commitments of the nurses toward their responsibilities and improving their practices when they have the chance to attend training to provide high quality of care for those fragile group of patients. These results go in the same way with Egyptian study by **Elarousy, Abd El Aziz, & Youssef (2020)** in entitled

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study" Effectiveness of Nurses' Training Program about Neuroprotective Developmental Care for Premature Neonates on their Knowledge and Practices in Neonatal Intensive Care Unit" who reported that the majority of nurses of the current study had "poor" knowledge and "unsatisfactory" practices before the training program, compared with the statistical significant improvement immediately and one month after the training either in knowledge.

Also, **Mousa et al, (2021)** who stated that more than half of studied nurses had inadequate practice related developmental care. Furthermore, Hendy **et al, (2023)** who reported that the majority of studied nurses had incompetent practice about developmental care.

CONCLUSION

The instructural program about developmental supportive care on pediatric nurses' performance in neonatal intensive care units was extremely effective in improving nurses' knowledge and practices especially post program implementation.

Recommendation

Continuous training for nurses working in the neonatal intensive care unit regarding developmental supportive care is recommended.

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