Effect of aTraining Program about Developmental Supportive Care on the knowledge of Pediatric Nurses inNeonatal Intensive Care Units

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ABSTRACT

Background: Developmentally supportive care is a comprehensive nursing approach that aims to make the neonatal intensive care unit (NICU) environment resemble the intrauterine setting as closely as possible, in order to support physiological stability and promote optimal growth and development of preterm infants. **Aim:** This study aimed to evaluate the effectiveness of a training program on enhancing pediatric nurses' knowledge regarding developmental supportive care in NICU**s. Subjects and Method: Design:** A quasi-experimental design with one-group pretest–posttest design was utilized. **Setting:** The study was conducted in the NICUs of Kafr Saad Hospital and El-Azhar University Hospital, Egypt. **Subjects:** A convenience sampling consisting of all available nurses (50 nurses) working at neonatal intensive care units at the above-mentioned study settings, regardless of their experiences, level of education, position, and age, were included in the study. **Tools:** A structured questionnaire was used for gathering data. **Results:** ″A significant improvement was observed post-program, with 70% of nurses achieving satisfactory knowledge compared to none before the intervention ($p < 0.001$)."**Conclusion:** The training program was effective in significantly enhancing NICU nurses' knowledge regarding developmental supportive care. **Recommendation:** Continuous training programs on developmental supportive care are recommended for nurses working in NICUs to sustain and advance knowledge levels.

Keywords: Developmental Supportive Care; Neonatal intensive care unit, Pediatric nurses; Training program.

INTRODUCTION

Neonatal intensive care unit (NICU) provides essential medical treatment and care for preterm and critically ill newborns (Schmid, 2024). Neonate admitted at NICU are highly vulnerable and dependent, requiring care specifically tailored to their unique needs. Unlike the intrauterine environment, the extrauterine setting does not adequately support normal growth and development (Mohamed, Abd Al-Moniem, Abou Khalaa & Ali, 2023). Although the NICU is often life-saving, it can also expose infants to risks and stressors that may cause harm (Braun et al., 2020).

Globally, approximately one in every ten births—about 15 million annually—occurs prematurely, according to the World Health Organization (WHO) (Mohammed, Khamis & Sabry, 2024). In Egypt, preterm births account for 8.2% of all deliveries (Riad, Ouda, Hegazy & Ismail, 2023). Advances in neonatal care over recent decades have greatly improved survival rates; however, these achievements often come with significant physical, emotional, and financial burdens, as premature infants may require prolonged NICU stays (Jones, 2024).

Developmentally supportive care (DSC) is an individualized, integrated nursing approach designed to create an environment in the NICU that closely resembles intrauterine conditions. It supports parent–infant attachment while maintaining physiological stability and promoting optimal growth and development of preterm infants (Lee & Cho, 2023). DSC practices aim to reduce the stress associated with the NICU environment by integrating interventions that involve healthcare providers and families. Such interventions include the regulation of sensory stimuli, stress, and pain management, and strategies that enhance family participation, all of which contribute to the infant's overall growth and development (Filippa et al., 2021; Lee, Park & Cho, 2022).

Among the core components of developmental care is clustered care, which involves grouping multiple nursing procedures together rather than performing them separately over time. This approach reduces disturbances, thereby promoting longer

periods of rest and supporting better physiological stability. Benefits include improved respiratory outcomes, reduced stress responses, and increased infant comfort (Hendy, Alsharkawy & El-Nagger, 2022; Charan, Kalia & Josh, 2024).

Another key intervention is kangaroo mother care (KMC), first introduced in 1978 by Edgar Rey in Bogotá, Colombia, as a substitute to incubator care for low birth weight infants (Al-Shehri & Binmanee, 2021). Designed to reduce NICU overcrowding and infant mortality, KMC emphasizes prolonged skin-to-skin contact, emotional bonding, frequent breastfeeding, and earlier hospital discharge (Gomes et al., 2020; Cañadas, Perales, Martínez, Belmonte & Carreño, 2022). Evidence shows that KMC lowers maternal stress, anxiety, and depression while promoting infant physiological stability (Landry, Kumaran, Tyebkhan, Levesque & Spinella, 2022). Moreover, this close physical relationship significantly influences the child's physical, psychological, and cognitive development with lifelong benefits (Kucukoglu, Ozdemir & Ozcan, 2020; Shrestha, 2021).

Nesting is another developmental care strategy, involving the use of padded supports or fabric rolls shaped in "U" or "O" forms to simulate the intrauterine environment (Rohmah, Saputri & Bahari, 2020). This practice encourages a flexed, contained posture, stabilizes positioning, and aligns the head and body. Nesting enhances muscle tone, neurobehavioral organization, and overall developmental outcomes for preterm infants (Tang et al., 2023).

The role of nurses is crucial for ensuring successful treatment outcomes and supporting the neurodevelopment of premature infants. Among NICU nurses, professional competence has the greatest influence on the quality of developmental care practices. High levels of professional ability, combined with optimism and motivation, significantly enhance nurses' performance in this specialized field (Suryandari, Arief & Utami, 2021).

Neonatal nurses are professionals with specialized training, skills, and knowledge in caring for neonates and their families. Advances in science and technology have

improved neonatal survival rates in NICUs (Riad, Ouda, Hegazy & Ismail, 2023). Nurses in these units spend the most time with preterm infants during hospitalization, delivering both treatment and nursing care. Consequently, NICU nurses are not only responsible for direct clinical care but also for implementing developmental positioning strategies, acquiring and applying advanced knowledge and skills, and fostering the developmental potential of premature infants through specialized nursing practice (Yun & Kim, 2022).

Significance of the study:

According to Kunswa and Bayoumi (2018), the incidence of preterm birth in Egypt is estimated at 8.2% .Previous studies have reported nurses' insufficient knowledge of developmental supportive care (DSC) (Symington & Pinelli, 2002; Sathish et al., 2019). Therefore, NICU nurses should be equipped with up-to-date evidence in neonatal care and trained to implement DSC effectively (Ahmed & Mohammed, 2019). However, research on individualized DSC in NICUs remains limited (Mohammed, Khamis, & Sabry, 2018). To address this gap, evidence highlights the need for practical training programs to enhance nurses' competence and confidence in providing developmental care for preterm infants (Park & Kim, 2019).

AIM OF THE STUDY

This study aimed to evaluate the effectiveness of a training program on enhancing pediatric nurses' knowledge regarding developmental supportive care in NICU**s**

Objectives

1. Assess pediatric nurses' knowledge regarding developmental supportive care (DSC) DSC in neonatal intensive care units.
2. Design a training program for DSC.
3. Implement the DSC training program.
4. Evaluate the impact of the training program on pediatric nurses' knowledge in NICUs.

SUBJECTS AND METHOD

Technical Design:

The technical design included description of research design, setting, subjects and tools for data collection.

Study Design:

Quazi experimental design included one group was used to conduct the study (Pre and Posttest).

Study Setting:

This study was carried out in NICUs at Kafr Saad Hospital and El-Azhar University Hospital**.**

Study Subjects:

A convenience sampling included all available nurses (50 nurses) working in the NICUs of the mentioned settings. Participates were included regardless of their years of experiences, level of education, job position, or age.

Tool of data collection:

Data was collected through the use of the following tool:

Data were collected using a structured questionnaire developed by the researcher, drawing on previous studies by Toso, Viera, Valter, Delatore, and Barreto (2015) and Halder, Bera, and Banerjee (2015). The questionnaire was designed to assess nurses' knowledge regarding developmental supportive care (DSC) in NICUs. To ensure clarity and accessibility for nurses across different educational levels, it was written in simplified Arabic

Part (1): *Personal Data*

Collected information on nurses' age, gender, nursing qualification, social status, years of experience, and training programs attended in the field of DSC.

Part (2): *Nurses' Knowledge*

Adapted from **Toso, Viera, Valter, Delatore, & Barreto (2015)** and **Halder, Bera, & Banerjee (2015)** to assess the knowledge of pediatric nurses regarding DSC in NICUs. Questions were in the form of multiple choice. Answers were checked with the model answer. It includes knowledge about DSC as: Definition of developmental care(5)**,** The extent of familiarity to the concept of DSC (3), Sources of information about DSC (6), Numbers of developmental supportive care skills used per shift(2), Types of developmental care known in the NICU (11), Applied DSC in NICU (11), Positive effect of DSC on neonates(7), Exposing to obstacles during implementation of developmental supportive care(2), Obstacles during implementation of DSC (7), Support the implementation of developmental supportive care from the unit (2), Methods of supporting developmental care from the unit(6), Ability to provide DSC 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), and complications of reducing sounds and lights(6).

Scoring System:

Scoring system of nurses' knowledge:

The nurses' responses were compared against a model key. Each completely correct answer was assigned score of **2**, an incomplete correct answer received **1**, and an incorrect or "don't know" response was scored **0**. The total score was calculated by summing up to **313 points** and then converted into a percentage score. Knowledge levels were classified as follows:

- **Unsatisfactory knowledge**: < 75% (< 267 points).
- **Satisfactory knowledge**: ≥ 75% (≥ 267 points

Operational Design:

The operational design includes the preparatory phase, validity, reliability, ethical consideration, pilot study and field work.

Preparatory Phase:

The researcher reviewed local and international related literature using internet search, textbooks, and scientific journals. This helped in increasing acquaintance with the study topic and in the preparation of the data collection tools.

Tool Validity:

The tool of this study was revised for clarity, relevance, understanding and applicability by a panel of seven nursing and medical experts to assess the face and content validity of the study tool.

Tool Reliability:

The reliability of the structured interview questionnaire, was assessed through examining their internal consistency. very good level of reliability was shown as indicated below.

Name of tool	No. of Items	Cronbach's Alpha
Nurses' knowledge about developmental supportive care in NICU	55	0.86
Total questionnaire of nurses about developmental supportive care in NICU	170	0.83

Ethical considerations

Ethical approval for this research was granted by the Scientific Research Ethical Committee NUR(6/7/2025) (51) of the Faculty of Nursing, Port Said University, before any data collection commenced. Prospective participants were fully briefed on the study's objectives and processes. Informed consent was subsequently obtained. It was emphasized that participation was voluntary and that individuals could withdraw at any time without providing a reason and without any adverse consequences. A guarantee of confidentiality was provided, stating that all information would be used exclusively for this study. The research was designed to ensure that no harm would come to any participant throughout its duration. Professional help and advice were provided as needed.

Pilot study

A pilot study was conducted following the development and validation of the research instrument and prior to the commencement of full-scale data collection. The

pilot utilized a sample equivalent to approximately 10% of the target sample size for the main study, comprising five nurses. This preliminary phase, which extended over a ten-day period, served to evaluate the instrument's applicability, clarity, and feasibility, as well as to estimate the time required for form completion and to identify potential obstacles in the data collection process. Subsequent to the pilot, the instrument was refined based on its findings. Consequently, data obtained from the pilot participants were excluded from the final study sample to prevent bias.

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' knowledge 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. 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 collected data provided baseline (pretest) measurements for comparison and informed the design of the intervention program based on identified learning 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. The program's general aim was to improve nurses' knowledge of 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 with the Damietta governorate. The program was administered in three sessions regarding general knowledge of nurses about developmental supportive care, such as cluster care, swaddling, kangaroo care, developmental positioning, non-nutritive care, nesting, massage and touch, light, and noise. The duration of each session lasts 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 once a week during a period of three months from the first of October 2024 to the end of December 2024.

The intervention was designed according to adult learning principles, emphasizing interactivity and participant engagement. Instructional delivery incorporated diverse methodologies, including brief lectures, group discussions, and the demonstration and redemonstration of practical skills. Furthermore, a variety of audiovisual aids, such as images, videos, and printed handouts, were utilized to support the instruction of each module.

Evaluation phase: The effectiveness of the program was based on assessing the improvement in nurses' knowledge. 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..

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 tool through its internal consistency. Qualitative categorical variables were compared using the chi-square test. The 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, a paired sample t-test was used. 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**
- Diplome	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**

Table (1) shows 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 30 years **(36. 0 %)**. Moreover, less than three-quarters of them were married **(70.0%)**, and less than half of the studied nurses had less than five years of experience (**46.0 %)**. and less than three-quarters of the studied nurses graduated from the 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. 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 mean 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 ($p < 0.00$).

Table (4): Percentage distribution of the studied nurses regarding their knowledge about cluster care in NICU throughout the program phases (n=50).

knowledge of nurses about cluster care in NICU:	preprogram	Post program	Follow up	P1 X^2 P-value	P2 X^2 P-value
	N (%)	N (%)	N (%)		
Definition of cluster care in NICU:					
- A nursing care model that involves several tasks and procedures.	1(2.0)	46(92.0)	43(86.0)		
- It needs to be performed on a premature or critically ill newborn Instead of performing each task separately.	5(10.0)	45(90.0)	35(70.0)	X^2=.081 P=.775	X^2=8.44 P=.004*
- It minimizes disturbances to the infant's sleep, and reduces stress.	1(2.0)	45(90.0)	32(64.0)		
- **During cluster care, a nurse may check the baby's vital signs, change the diaper, perform a feeding, and administer medication all at once**	2(4.0)	49(98.0)	41(82.0)		
- Other	7(14.0)	0(0.0)	0(0.0)		
- Don't know	**34(68.0)**	0(0.0)	0(0.0)		
Techniques of cluster care in NICU:					
- **Grouping care tasks**	0(0.0)	**48(96.0)**	**46(92.0)**		
- Coordinating care with other healthcare providers	0(0.0)	44(88.0)	39(78.0)		
- Involving parents in care	0(0.0)	26(52.0)	26(52.0)	X^2=.437 P=.508	----
- Using technology	1(2.0)	41(82.0)	36(72.0)		
- Creating a care plan	0(0.0)	45(90.0)	31(62.0)		
- It is important to ensure that cluster care is implemented safely and effectively.	0(0.0)	39(78.0)	38(76.0)		
- Don't know	**49(98.0)**	0(0.0)	0(0.0)		
Benefits of cluster care in NICU:					
- Improved sleep patterns	0(0.0)	47(94.0)	44(88.0)		
- Better weight gain	0(0.0)	49(98.0)	43(86.0)		
- Reduced stress	0(0.0)	45(90.0)	38(76.0)		
- Shorter hospital stays.	0(0.0)	43(86.0)	29(58.0)		
- Reduce the risk of hospital-acquired infections and other complications	0(0.0)	41(82.0)	36(72.0)	----	----
- Increased parental involvement	0(0.0)	42(84.0)	35(70.0)		
- Cost savings	0(0.0)	43(86.0)	34(68.0)		
- Improve the quality of care that neonates receive in the NICU and promote better outcomes.	0(0.0)	44(88.0)	38(76.0)		
- Better neurodevelopmental outcomes	0(0.0)	42(84.0)	38(76.0)		
- Don't know	**50(100.0)**	0(0.0)	0(0.0)		
Barriers for applying cluster care in NICU:					
- Shorting staff	0(0.0)	46(92.0)	44(88.0)		
- Lack of training and education	0(0.0)	46(92.0)	38(76.0)		
- Lack of standardization	0(0.0)	48(96.0)	34(68.0)	----	----
- Lack of family involvement	0(0.0)	39(78.0)	30(60.0)		
- Resistance to change among NICU staff	0(0.0)	34(68.0)	31(62.0)		
- Others	1(2.0)	0(0.0)	0(0.0)		
- Don't know	49(98.0)	0(0.0)	0(0.0)		
Complications of cluster care in NICU:					
- Interrupting the baby's sleep	0(0.0)	49(98.0)	44(88.0)		
- Neonates' overstimulation	0(0.0)	48(96.0)	37(74.0)	----	----
- Inability of neonates to tolerate cluster care due to medical condition	0(0.0)	48(96.0)	46(92.0)		
- Don't know	**50(100.0)**	0(0.0)	0(0.0)		
Total knowledge of nurses about cluster care	**Pre/post program** X^2=5.13 **P=.040***			**Pre/ follow up** X^2=7.73 **P=.050***	

P1: pre/posttest, P2: pre/follow up test, X2: Chi square test, * Significant level (p< 0.05), DSC: developmental supportive care.

Table(4): Regarding definition of cluster care in NICU; it was found that; 68% of the studied nurses didn't have any knowledge of the cluster care concept pre-program, while there was a significant improvement, 98% of studied nurses correctly identifying cluster care as a nurse should check the baby's vital signs, change the diaper, perform a feeding, and administer medication at one time and shouldn't interrupt baby sleeping times post-program, (P=0.04). The proportion decreased slightly to 82% At Follow-Up phase.

Concerning techniques of cluster care in NICU; It was noted that 98% of the participants didn't have any knowledge about techniques of cluster care preprogram, While Post-Program There was an improvement with 96% correctly identifying technique of cluster care as a grouping of care tasks. at follow-up the proportion decreased slightly to 92%.

Regarding benefits of cluster care in NICU, it was found that; none of the nurses had any knowledge of all benefits of cluster care Pre-Program. When talking about the most notable benefits of cluster care "better weight gain", nurses' knowledge about it was 0 before the program application, then it became 98% after the program and slightly declined to 86% in the follow-up phase. Also, regarding "Improved sleep patterns" as a benefit of cluster care, the percentage of nurses' knowledge about it before the program was 0 and increased to 98% post-program, and declined to 88% at follow-up phase.

Regarding barriers for applying cluster care in NICU, lack of standardization which means that the cluster care is not applied consistently (regularly or uniformly) between medical teams in hospitals, which can lead to variations in the quality of care and its impact on the child's development, it was reported by 96% of nurses that it was the biggest obstacle post-program. In addition, "Shorting staff" was mentioned by 92% of nurses it was hindering the implementation of cluster care post-program, followed by "Resistance from staff and families"; approximately 68% of studied nurses faced resistance from staff or family members to apply cluster care during post-program phase.

By the way; The most notable complication of cluster care from points of view of the studied nurses was "Interrupting the baby's sleep" post- program for 98% of them. Followed by "neonates' overstimulation "and "inability of neonates to tolerate cluster care due to medical condition" as reported by 96% of nurses post program.

Total knowledge regarding cluster care improved significantly after program application comparing with preprogram, and at follow up phase comparing with preprogram application P= 0.040 and 0.050 respectively.

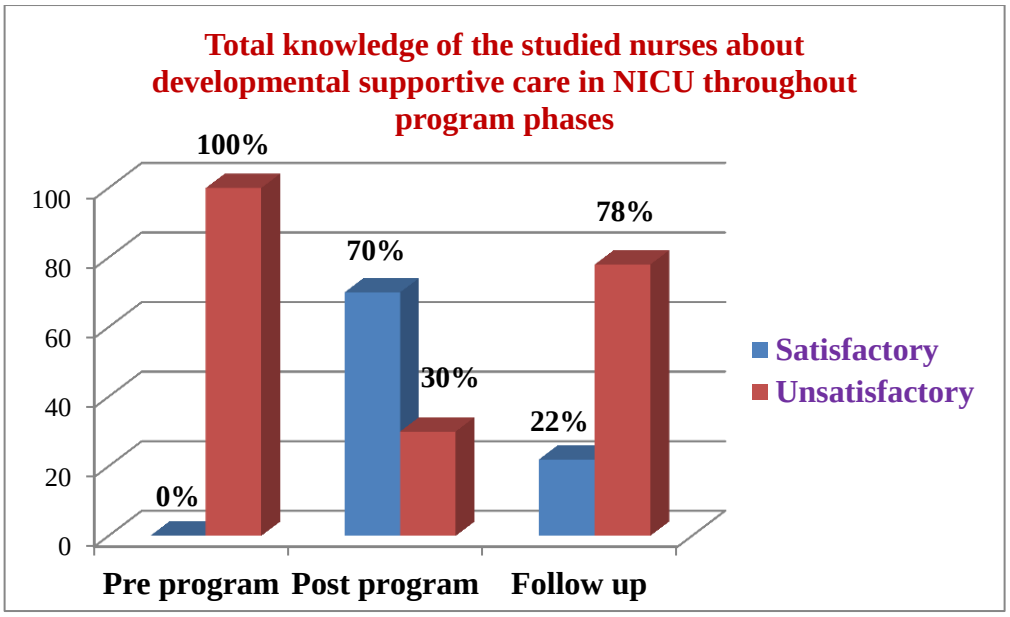

Figure (1): Percentage distribution of the studied nurses regarding their total knowledge about developmental supportive care in NICU throughout program phases (n=50).

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 the results of post post-program.

DISCUSSION

With regard to the overall knowledge of the studied nurses, the current research demonstrated a marked improvement immediately after program implementation, with mean scores increasing from 15.8 ± 6.66 to 76.4 ± 1.2 ($p < 0.001$). Although knowledge levels at follow-up (62.6 ± 7.7) remained significantly higher than baseline, a decline was noted compared with the immediate post-test results, indicating some degree of knowledge attrition ($p < 0.001$). This outcome highlights the effectiveness of the educational program, which was tailored to the nurses' identified needs, utilized simple and accessible language, and avoided overly complex scientific terminology. The reduction in knowledge during follow-up is a natural phenomenon, as information tends to fade over time, emphasizing the need for ongoing education and refresher training for NICU nurses.

These findings are consistent with the Egyptian study by Selim et al. (2024), *"Effect of Developmental Supportive Care Program for Preterm Neonates on Nurses' Performance."* That study reported that most nurses initially had unsatisfactory knowledge scores during the pre-test, which improved markedly after program participation, with the majority achieving satisfactory scores post-test, and slightly fewer maintaining these levels at follow-up. Specifically, mean total knowledge scores rose from 31.5 ± 9.8 at pre-test to 96.4 ± 7.5 post-test, before declining slightly to 90.2 ± 15.7 at follow-up, with differences reaching high statistical significance.

Similar results were reported by Sankar, Marakkar, and Varghese (2022) in Iran, in their study *"Effectiveness of Developmentally Supportive Education Program on Nursing Knowledge of Retinopathy of Prematurity in Neonatal Intensive Care Unit."* They observed that mean post-test scores (14.53 ± 2.39) were significantly higher than pre-test scores (9.00 ± 3.68), confirming the positive impact of educational interventions ($t_{3\ 2} = 10.09$, $p < 0.001$).

The present study also identified a significant association between nurses' total knowledge of developmental supportive care and certain demographic characteristics.

Post-program, knowledge was significantly related to educational level and marital status, while at follow-up, years of experience also played a key role. Higher educational attainment and longer professional experience were associated with greater knowledge retention, likely due to broader exposure, deeper understanding, and increased opportunities for applying developmental supportive care in practice.

This observation aligns with findings from a Chinese study by Zhong, Cai, Wang, Wu, and Sun (2025), *"The Knowledge, Attitude and Practice of Nurses on the Posture Management of Premature Infants: Status Quo and Coping Strategies."* Their results showed that years of work experience, marital status, and prior training in premature infant posture management were the main factors influencing nurses' knowledge, beliefs, and practices regarding postural care in neonates.

In line with the current findings, an Egyptian study by Elarousy, Abd El Aziz, and Youssef (2020), *"Effectiveness of Nurses' Training Program about Neuroprotective Developmental Care for Premature Neonates on their Knowledge and Practices in Neonatal Intensive Care Unit,"* demonstrated that most nurses had "poor" knowledge and "unsatisfactory" practices prior to training. However, statistically significant improvements were observed in both knowledge and practice immediately and one month after program implementation. Similarly, Mousa et al. (2021) reported that more than half of the studied nurses exhibited inadequate practices related to developmental care. Comparable results were also noted by Hendy, Alsharkawy, and El-Nagger (2023) in their study, *"Nurses' Performance about Creating Healing Environment and Clustering Nursing Care for Premature Infants,"* which found that the majority of nurses had incompetent practices regarding developmental care.

Clustered care refers to combining or grouping several routine nursing activities together rather than performing them separately (Bazregari, Mirlashari, Ranjbar, & Pouraboli, 2019). The present study showed that more than two-thirds of the nurses had no prior knowledge of the concept of clustered care before the training program. This may be explained by the fact that although nurses were already practicing the integration of nursing tasks in the NICU, they were unfamiliar with the scientific terminology. A

similar finding was reported by Hendy et al. (2023) in Egypt, who found that only a small proportion of nurses had correct knowledge about minimal handling and the positive impact of clustered care prior to training.

Clustered care is widely recognized as an essential developmental care strategy to promote sleep in preterm infants, thereby enhancing neurodevelopment during NICU hospitalization (Avazeh & Babaei, 2023). In the current study, the majority of nurses became aware of "improved sleep patterns" as a major benefit of clustered care after completing the training program. This could be because they began to observe how infants rested more effectively following the application of clustered care. Supporting this, Bazregari, Mirlashari, Ranjbar, and Pouraboli (2019) in Iran, in their study *"Effect of Clustered Nursing Care on Sleep Behaviors of the Preterm Neonates Admitted to the Neonatal Intensive Care Unit,"* reported that clustered care increased both quiet and active sleep in neonates.

Similarly, Charan, Kalia, and Joshi (2024) in India, in their study *"Sleep Better, Grow Stronger: The Miraculous Impact of Clustered Nursing Care on Low Birth Weight Neonates in Neonatal Intensive Care Unit,"* found that the intervention group experienced longer sleep durations and less waking time, indicating that clustered care promotes physiological stability and healthier sleep patterns in premature infants.

The findings of the present study also indicated that most nurses recognized additional benefits of clustered care, including "better weight gain," "reduced risk of hospital-acquired infections and other complications," and "improved neurodevelopmental outcomes." This could be attributed to the nurses' understanding that uninterrupted sleep supports neonatal growth and lowers the likelihood of complications. In line with this, Wang et al. (2021) in China, in their study *"The Effect of Continuous Clustered Care on the Physical Growth of Preterm Infants and the Satisfaction with the Nursing Care,"* demonstrated that preterm infants in the experimental group had lower rates of respiratory, umbilical, and intestinal infections, while their weight, length, and head circumference at 6 and 12 months were significantly greater than those of the control group.

CONCLUSION

It can be concluded from the results of the current study that the training program about developmental supportive care on pediatric nurses' knowledge at neonatal intensive care units was effective in improving nurses' knowledge.

RECOMMENDATION

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

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أثر برنامج تدريبي عن الرعاية التنموية المساندة على معرفة ممرضى الأطفال فى وحدات العناية المركزة لحديثي الولادة

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الخلاصة

تُعد الرعاية التنموية المساندة ممارسة تمريضية فردية ومتكاملة تهدف إلى دعم الارتباط بين الآباء وأطفالهم، بالإضافة إلى ضمان أن بيئة وحدة العناية المركزة لحديثي الولادة تكون مماثلة قدر الإمكان لبيئة الرحم من أجل الحفاظ على الاستقرار الفسيولوجي والنمو الأمثل وتطور الأطفال الخدج.**الهدف :**تهدف الدراسة إلى تقييم تأثير برنامج تدريبي حول الرعاية التنموية المساندة على معرفة الممرضين في وحدات العناية المركزة لحديثي الولادة. **طرق وأدوات البحث منهج البحث :**استخدم تصميم شبه تجريبي تضمن مجموعة واحدة فقط لإجراء الدراسة. **مكان الدراسة** :أُجريت الدراسة في وحدات العناية المركزة لحديثي الولادة في مستشفى كفر سعد ومستشفى جامعة الأزهر، مصر.**العينة** :تكونت العينة من جميع الممرضين المتاحين العاملين في وحدات العناية المركزة لحديثي الولادة في المواقع المذكورة، وعددهم 50 ممرض/ممرضة، بغض النظر عن خبراتهم أو مستواهم التعليمي أو مناصبهم أو أعمارهم، وقد شاركوا في الدراسة خلال فترة إجرائها.**الأدوات :**تم استخدام أداة واحدة لجمع البيانات، والتي تكونت من ثلاثة أجزاء.**النتائج** :قبل البرنامج التدريبي، أظهرت جميع الممرضات مستويات غير مرضية من المعرفة. لوحظ بعد البرنامج تحسن كبير، حيث حقق 70% من الممرضات مستوى معرفي مرضٍ، بينما بقي 30% فقط دون المستوى المطلوب.**الاستنتاج :**يمكن الاستنتاج من نتائج هذه الدراسة أن البرنامج التدريبي حول الرعاية التنموية المساندة كان فعالًا في تحسين معرفة الممرضات. **التوصيات**: يوصى بتدريب مستمر للممرضات العاملات فى وحدات العناية المركزة لحديثى الولادة حول الرعاية التنموية المساندة.

الكلمات المرشدة :برنامج تدريبى , رعاية تنموية مساندة, ممرضى الأطفال, وحدة رعاية حديثى الولادة