

## Evidence Based Nursing Practices of Developmental Supportive Care for Preterm Neonates: Intervention Program for Internship Nursing Students

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**Abstract: Background:** Developmental supportive care (DSC) is a professional practice, education and research opportunity that nurses need to explore, evaluate and refine continuously within the rapidly changing technological environment of the Neonatal Intensive Care Units (NICUs). It is aiming to provide a structured care environment which supports, encourages and guides the developmental organization of the premature and/or critically ill neonates.

**Aim:** The aim of this study was to evaluate the effect of intervention program about evidence based nursing practices of developmental supportive care for preterm neonates on knowledge and practices of the internship nursing students. This aim can be achieved through assessing the knowledge and practices of internship nursing students regarding developmental supportive care in NICU, designing, implementing and disseminating English brochure for all internship nursing students about DSC of neonates. **Design:** A quasi-experimental study was utilized.

**Setting:** This study was conducted at the Neonatal Intensive Care Unit (NICU) at Maternity and Gynecological Hospital and Children's Hospital affiliated to Ain Shams University Hospitals, where the setting being of highest capacity of premature neonates and also available for training of the internship nursing students.

**Sample:** A purposive sample composed of 50 internship nursing students and 50 preterm (PT) neonates.

**Tools:** 1. **Pre-designed Questionnaire Format by Interviewing;** to assess demographic characteristics of the studied students & preterm neonates and assess students' knowledge regarding DSC.

2. **Medical Records:** to collect data about preterm neonates.

3. **Observation Checklists:** to assess studied students' practices regarding DSC. 4. **Students' Perception Regarding Core Measures for Developmentally Supportive Care in NICUs:** to assess the studied students' perception regarding DSC.

**Results** of the study revealed that after application of DSC intervention program and brochure dissemination, the studied students showed significant improvement in their satisfactory knowledge and correct practices. Also, application of DSC intervention program was effective in increased level of students' perception regarding core measures of DSC in care of preterm neonates.

**Conclusion:** Application of DSC intervention program has a positive effect on the internship students' knowledge, practices and increased level of their perception regarding DSC in NICU. This study

**recommended** that DSC can be applied more widely in NICUs as one of the nursing interventions aiming to improve nurses' and nursing students' knowledge, practices and perception to provide safe and high quality of care for preterm neonates in NICU.

**Key Words:** Evidence-Based Nursing Practices, Preterm Neonates, Developmental Supportive Care, Nursing, Neonatal Intensive Care Unit Environment.

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### I. Introduction

The environment of the developing fetus is characterised by a supported flexed posture; containment, limited light and noise exposure, protected sleep cycles and an unrestricted access to the mother. This positive sensory environment is crucial for normal brain development. In contrast to this, a preterm or unwell neonates are exposed to completely different environmental stimuli with painful procedures, excessive light, noise and handling, lack of containment and reduced ability to move, interrupted sleep and separation from his mother (Jenkins et al., 2016).

The incidence of preterm birth worldwide is almost 11.1% of all pregnancies. Also, preterm births represent for approximately 70% of neonatal deaths and 36% of infant deaths (Furdon et al., 2018) and (Al-Qurashi et al., 2016). The World Health Organization (2015) has estimated that 15 million neonates are born

preterm every year (**Blencowe et al., 2013**). In Egypt, The percentage of preterm deliveries was 8.2% of all deliveries (**Abdelhady and Abd Elwahid, 2015**).

Continuous advances in neonatology have increased the chances of survival of preterm and critically ill neonates. Although neonatal intensive care unit (NICU) provides highly specialized medical care, it does not necessarily offer an ideal environment for the development of neonates. There is a huge difference between intrauterine environment and the NICU environment (**Rodriguez, 2016**).

Some neonates may need intensive care services due to prematurity or physical health problems. Hence, premature and full-term neonates who are hospitalized in NICU are deprived from stimulations which are normally provided to healthy ones either in the sheer heaven of their mother's uterus or in families. Accordingly, they usually experience sensory deprivation or overload in NICU (**Godarzi et al., 2015**).

The pain and discomfort caused by treatment and caregiving of very low birth weight (VLBW) neonates during hospitalization is a considerable concern. These procedures make it difficult for such neonates to experience undisturbed periods of restful sleep. Also, three of four hypoxemic episodes in preterm neonates have been reported to be associated with caregiving itself and their circulating levels of stress hormones increase in association with routine nursing procedures (**Westrup et al., 2017**).

As stated by **Soleimani et al., (2016)** the NICU is a harsh sensory stimulant that is unsuitable for the demands of the developing nervous system and thus, exposes the preterm infant to a wide range of morbidities. Therefore, there is a need to change neonatal care practices in NICU to support the neuro-developmental processes in extra uterine environment.

Evidence-based nursing practices (EBNP) is an approach for making quality decisions and providing nursing care based upon personal clinical expertise in combination with the most current, relevant research available on the topic. EBNP implements the most up to date methods of providing care, which have been proven through appraisal of high quality studies and statistically significant research findings (**Melnyk, 2011**). As mentioned by **Karkada, (2015)**, Evidence-based nursing practices is one approach that may enable nurses to manage the explosion of new literature and technology and ultimately may result in improved patient outcomes.

The goal of EBNP is to improve the health and safety of patients while also providing care in a cost-effective manner to improve the outcomes for both the patient and the healthcare system. To properly implement EBNP, the knowledge of the nurse, the patient's preferences, and multiple studies of evidence must all be collaborated and utilized in order to produce an appropriate solution to the task at hand. These skills are taught in modern nursing education and also as a part of professional training. Nursing students must learn to develop independent, evidence-based methods of clinical decision making (**Melnyk, 2011**).

Developmental supportive care (DSC) is a professional practice, education and research opportunity that nurses need to explore, evaluate and refine continuously within the rapidly changing technological environment of the NICU. The goal of developmental supportive care is to provide a structured care environment which supports, encourages and guides the developmental organization of the preterm neonates. Developmental care recognizes the physical, psychological and emotional vulnerabilities of premature and/or critically ill infants and their families and is focused on minimizing potential short and long-term complications associated with the hospital experience (**Coughlin, et al., 2009**).

Developmental supportive care is a broad category of interventions that is designed to minimize the stressors in the NICU environment. The elements of developmental supportive care include control of external stimuli (vestibular, auditory, visual, tactile) by noise and light reduction as well as minimal handling, clustering of nursing care activities, and positioning of the preterm neonates to provide a sense of containment similar to the intrauterine experience is included under the umbrella of developmental care (**Zhang et al., 2016**).

As mentioned by **Coughlin et al., (2009)**, the American Joint Commission on Accreditation of Healthcare Organizations, the five domains of developmental supportive care are daily routine care (including feeding, skin care, and positioning), protected sleep, provision of a healthy environment (sound and light management, teamwork, and evidence-based practice), family-centered care, and pain and stress assessment and management

Developmental care provides a framework in which caring processes and environment are modified and a supportive structure is created for facilitating neonates growth and development, providing individualized care, and fulfilling neonates and families' psychological needs.

The elements of developmental care can be divided into macroenvironment and microenvironment. The macroenvironment include the levels and patterns of NICU light, sound and temperature control. The microenvironment of preterm or high risk infant include those related to the individual infant's environment or care experiences such as positioning, handling, containment and touching (**Littleton and Engebretson, 2005**) and (**Acevedo et al., 2017**).

As stated by **Frasers and Bowman (2009)**, the Principles of developmental care including recognize physiological stressors, protect from light, protect from noise, protect from over stimulation, alter patterns of care to allow maximum time for sleep and growth, establish day and night patterns (diurnal rhythm) and normalize parent expectations.

### **Significance of the study**

Developmental supportive care has its roots in the principles of nursing science. It is a philosophic approach to the care of the preterm neonates who may be hospitalized for a prolonged period of time and are subjected to many tests, procedures and therapies during hospitalization. It is used broadly to describe any neonates care protocol designed to promote optimal physical, cognitive and emotional development in the first weeks or months of life (Symington and Pinelli, 2010).

Learning in the clinical practice is an important component of nursing education considering that nursing is practice-based profession. The transition from an educational setting to the practice setting is widely recognized as a period of stress, role adjustment, and reality shock. Graduate nurses have stated that they want additional clinical time, more technical skills, a broader range of real-life experiences, and more practice communicating with physicians during their educational program (Casey et al., 2011). Consequently, developmental supportive care is a new concept for internship nursing students. From here, the researchers highlights on the importance of preparing them and to be ready to competently apply this concept for preterm neonates (Kaphagawani and Useh., 2013).

### **Aim of the Study**

The aim of this study was to evaluate the effect of intervention program about evidence based nursing practices of developmental supportive care for preterm neonates on knowledge and practices of the internship nursing students. This aim can be achieved through assessing the knowledge and practices of internship nursing students regarding developmental supportive care in NICU, designing, implementing and disseminating English brochure for all internship nursing students about DSC of neonates.

### **Research Hypothesis**

The current study hypothesized that application of intervention program about evidence based nursing practices of developmental supportive care for preterm neonates will be associated with positive effect on knowledge and practices of the internship nursing students as regards care of neonates.

## **II. Subjects and Methods**

### **A. Research Design**

The study design was a quasi-experimental.

### **B. Research Setting**

This study was conducted at Neonatal Intensive Care Units (NICUs) at Maternity and Gynecological Hospital and Children's Hospital affiliated to Ain Shams University Hospitals, where these settings have being a highest capacity of premature neonates and also available for training of the internship nursing students.

### **C. Research Subjects**

**Sample Size and Characteristics:** A quasi-experimental one group pre, post and follow up tests were used for this study. Out of the 58 participants who attended the intervention program, a purposive sample composed of 50 internship nursing students who responded to pre, post and follow up tests and 50 PT neonates were chosen from the previously mentioned settings according to the following criteria.

#### **Inclusion criteria for the studied internship nursing students:**

- Internship nursing students from both genders.
- Scheduled for training for one month in the morning shift in one of the previously mentioned settings.

#### **Inclusion criteria for the studied preterm neonates:**

- Preterm neonates regardless of their gender.
- Gestational age ranged between 25-30 weeks
- Expected duration of hospital stay not less than 30 days.
- Present weight 1000-1250 gm.
- Physiologically stable and on intravenous fluids, total parenteral nutrition or by gavage feeding.

#### **Exclusion criteria for the studied preterm neonates:**

- PT neonates whom were suffering from necrotizing enterocolitis, intraventricular hemorrhage, acute stage of respiratory distress syndrome or pathological hyperbilirubinemia.
- PT neonates on mechanical ventilation.
- Presence of umbilical artery catheter, jugular or femoral venous catheter, thoracic or abdominal drainage

- PT neonates with congenital anomalies, skin problems or fluid intake restriction.

### **Tools of Data Collection**

*Data were collected through using the following tools:*

#### **I. Pre-designed Questionnaire Format by Interviewing:**

It was designed by the researchers based on updated related literatures to assess demographic characteristics for the studied internship nursing students and their knowledge regarding developmental supportive care in NICU, it consisted of two parts:

**Part 1: Characteristics of the studied subjects including:** *A. Characteristics of the studied internship students such as;* age, gender, previous experience in NICU or not, previous experience in care of high risk neonates or not, receiving educational program about DSC in NICU or not. *B. Characteristics of the studied PT neonates such as;* gender, birth weight, length, gestational age, chronological age, diagnosis, duration of hospital stay, vital signs, oxygen saturation, weight gain / day. These data were checked with the PT neonates' medical records.

**Part 2: Questions regarding Developmental supportive care in NICU that involved:** Definition, elements and principles of developmental supportive care, health effects of noise on preterm neonates, signs of thermal stress, containment, positioning, handling and touching, kangaroo care as well as non-nutritive suckling. The studied students were interviewed individually or in groups that entail 2-5 students according to their availability and readiness, the questionnaire format was filled in by the studied students.

Scoring system, according to the answers obtained from the studied students, a scoring system was followed to obtain the outcome of their knowledge. The total score for the questionnaire was 50 grades (equal 100%). The studied students' answers were checked using a model key answer and accordingly, their knowledge were categorized into; satisfactory knowledge, 30 grads or more (scored 60% and more), and unsatisfactory knowledge, less than 30 grads (scored less than 60%).

**II. Medical Records:** It was used to collect data about neonates' diagnosis, gestational age, birth weight, condition progress and the general condition.

#### **III. Observation Checklists:**

It was adopted from **Bowden and Greenberg (2008)**, and was used by the researchers to assess nursing students' actual practices as regards; containment, positioning, handling and touching, kangaroo care and non-nutritive sucking. Time consumed for assessing each procedure was 5-15 minutes. The total number of procedures was 5, each procedure scored from five to fifteen according to total number of steps for each procedure that made a total score of 60 grades (equal 100%) for all procedures. Accordingly, the scoring system of students' actual practices was classified into either correct practices equals 36 grads or more (scored 60% and more) or incorrect practices equals less than 36 grads (scored less than 60 %).

**IV. Students' Perception Regarding Core Measures for Developmentally Supportive Care in NICUs,** it was adopted from **Coughlin et al ., (2009)**, to assess the studied students' perception regarding DSC pre, post the intervention program and at follow up. It was consisted of five (5) Core measures. Each core measure consisted of 9 items that made total items of 45. Each item scored on likert scale bases, strongly agree (4), agree (3), neither (2), disagree (1) and strongly disagree (0). The total score for each core measure was (36) and the total score of all items was 180 (100%). Studied students' perception was classified into either perceived core measures for developmentally supportive care in NICU that represents 108 score and more (60% and more) or unperceived core measures for developmental supportive care in NICU that represents less than 108 score (less than 60 %).

### **Phases of Study Application**

#### **1. Preparatory Phase**

After reviewing the past and current regional and international related literature covering all aspects of the study using available books, journals, articles and magazines to get acquainted with the research problem and guide the researchers in questionnaire preparation and also in preparing a guiding brochure about DSC that was designed in English language.

- **Validity and Reliability**

It was ascertained by three experts from pediatric medical and nursing academic staff. Their opinions were elicited regarding the tools consistency and scoring system. Assessing content validity by both internal

consistency and test-retest reliability, whereas internal consistency coefficients (Cronbach's alpha) for study tools were 0.81 to 0.89.

## **2. Exploratory Phase**

### **A. Pilot study**

A pilot study was carried out on 10% of the studied sample, involved 5 internship nursing students and 5 of preterm neonates for the purpose of testing the tools, to determine its clarity, applicability, objectivity, time required to fill in each tool and feasibility of conducting the study. The necessary modifications were carried out as revealed from the pilot study results to develop final form of the questionnaire and the subjects included in the pilot study were excluded later from the study sample.

### **B. Field work**

This study was conducted in a period of 7 months started at August 2015 and ended February 2016 for data collection and program application, divided as 2 weeks for assessment phase and pretest using the study tools, 12 weeks for program implementation phase and 2 weeks for evaluation phase and posttest, ended by 4 weeks for follow up phase using the same study tools.

### **C. Procedures technique:**

#### **I. Assessment Phase:**

The researchers conducted an interview sessions for all selected students. After giving simple explanation about the nature of the study to the studied students, the researchers allocated 2 weeks to collect data about the studied students by interviewing them individually during the period of the orientation program for the internship students using the questionnaire format to assess the students demographic characteristics and their knowledge about DSC (pretest). The time consumed to fill the questionnaire format ranged from 10-15 minutes.

During the actual periods for training of the studied students in the previously mentioned settings, the researchers first of all assessed their actual practices individually using observation checklists (pretest) regarding DSC including containment, positioning, handling and touching, kangaroo mother care and non-nutritive sucking. Also a meeting time was arranged with the studied students that would be during the next visit.

#### **II. Implementation phase**

As a preface for the practical part of the intervention program, 2 days before beginning of the studied students in NICUs the researchers conducted an initial visit for NICUs and introduced themselves to the head nurse of the unit, explained the purpose of the visit and gave simple explanation about the nature of the study, its expected outcomes. Also, the researchers carried out an assessment for all the PT neonates as regards progress, changes, the attached devices and treatment used for each case to select the study subjects fulfilling the study criteria.

The researchers were available 3 days/ week in the morning shift, and allocated two sessions to cover the theoretical part and four sessions for practical procedures as regards evidence based practices about containment, positioning handling and touching, kangaroo mothers care and non-nutritive suckling. For the application each session took 45-60 minutes for demonstration and re-demonstration according to the students' readiness. DSC intervention program was carried out using illustrated English brochure that involved clear instructions to improve the students' knowledge and practice regarding applying DSC for neonates.

The researchers were handling four to six students in each setting per month and their PT neonates individually. Methods of teaching were through using modified lectures, group discussion, demonstration and re-demonstration, as well as guiding brochure with colored pictures; video film and power point presentation using laptop were used as teaching media. Positioning material (special nests for containment, blankets, swaddling material for kangaroo care and sterile gloves for non-nutritive sulking are used in the real situation of the intervention program. Learning activities are done inside the specialized mothers' area for feeding affiliated to the NICUs during the sleeping time of the preterm neonates.

#### ***Intervention program construction involved the following:***

##### **I. Setting the Objectives:**

A. **Setting general objective** of the intervention program was to acquire internship nursing students with knowledge and practices as regards evidence based practices for developmental supportive care of preterm neonates.

##### **B. Setting specific objectives of the intervention program included the following:**

1. Discuss concept of developmental supportive care in the NICUs.
2. Describe nursing strategies for reducing the effects of lighting on neonates in the NICU.
3. Explain nursing intervention for acceptable noise levels to be established in the NICU.
4. Apply nursing intervention for prevention of heat loss in premature neonates.
5. Implement nursing intervention for maintaining healthy positioning for premature neonates.
6. Demonstrate guidelines for handling of the preterm neonates.
7. Apply nursing intervention to prevent or reduce pain for premature neonates in NICU(containment, positioning, handling and touching, kangaroo mother care and non-nutritive suckling).

**II. Content of the Program:** According to the previously mentioned objectives, **theoretical content of the program were included:** Definition of preterm neonates, definition and principles of DSC, evidence based nursing practice in DSC, purposes and elements of DSC, nursing strategies for reducing the effects of lighting on neonates in the NICU. Adverse noise – induced health effects on the preterm neonates, nursing intervention for acceptable noise levels to be established in the NICU. Methods of heat loss in neonates, signs of hypo and hyperthermia in neonates, nursing intervention for prevention of heat loss in premature neonates. Definition and indications of containment in the NICU. Effects of poor positioning on the preterm neonates, nursing intervention for maintaining healthy positioning for preterm neonates. Effect of and guidelines for handling of the preterm neonates. Definition and benefits of kangaroo mother care for preterm neonates and mother. Definition and benefits of non-nutritive sucking and nursing intervention to prevent or reduce pain for neonate in NICU. **Practical content of the program were included:** Application of containment, positioning, handling and touching, kangaroo care and non-nutritive sucking.

**III. Evaluation Phase:** the researchers allocated 2 weeks to evaluate the outcome of the intervention program on students' knowledge and practices regarding applying DSC for neonates. Students are assessed for containment, positioning, handling and touching, and non-nutritive sucking during their actual care, while assessed for kangaroo care during their work with the mothers at the visiting time. The researchers using the same study tools of assessment phase immediately after program implementation (posttest) and two weeks after application of DSC intervention program (follow up test).

**Administrative Design:** An official approval to conduct the study was obtained from the hospitals manager and head nurse in the previously mentioned study settings. Also, an official approval was obtained from the head of Nursing Administration Department affiliated to the Faculty of Nursing-Ain Shams University, as well as voluntary and oral acceptance of the studied internship students was a pre-requisite to participate in the study.

**Statistical Analysis:**Data were collected, organized, revised, coded, tabulated and analyzed by using the Statistical Package for Social Science (SPSS) version 20. Numerical data were presented as number, percentage, mean and standard deviations. The comparison between qualitative data pre and post application of the intervention program was done by using **Chi-square ( $X^2$ ) test**, while correlation between knowledge and practices of studied students was done by using **Spearman correlation coefficients test (r test)**. The p-value was considered significant as the following:  $P > 0.05$  (Non-significant),  $P < 0.05$  (Significant) and  $P < 0.01$  (Highly- significant).

### Ethical Considerations

- An oral permission was obtained from the studied students and each preterm neonate mother. Clear and simple clarifications about the aim, objectives and expected outcomes of the study were explained to all studied students. Students participation was voluntary.
- The researchers ensured that all the gathered data and information were confidential.
- Permission for data collection at the previously mentioned study settings was obtained.

### III. Results

**Table (1): Distribution of the Studied Students according to Their Characteristics [No. = 50 (100%)]**

Students' Characteristics	No.	%
Age (Years)		
≤ 22	33	66
≥ 23	17	34
$\bar{X} \pm SD$	21.15 ± 6.34	
Gender		
Male	16	32
Female	34	68

<b>Previous working in NICU</b>		
Yes	17	34
No	33	66
<b>Attended previous educational programs about care of High risk neonates.</b>		
Yes	3	6
No	47	94
<b>Ever received related Developmental Supportive care courses?</b>		
Yes	0	0
No	50	100

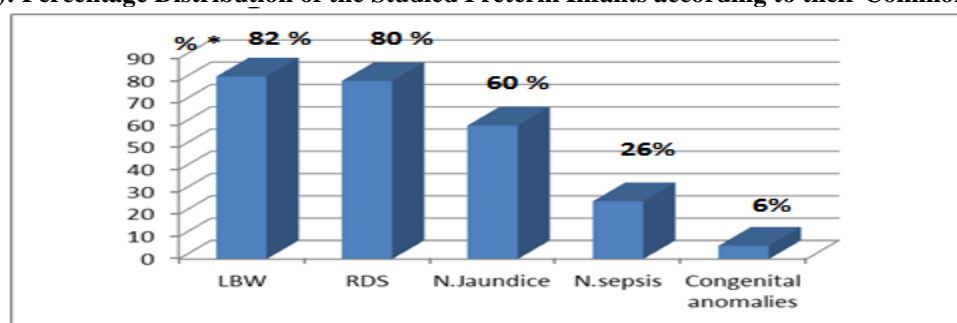
Concerning the characteristics of the studied students, table 1 showed that, the mean age of the studied students was  $\bar{X} \pm SD = 21.15 \pm 6.34$  and more than two thirds (68%) of them were female and none of them received developmental supportive care courses.

**Table (2): Distribution of the Studied Neonates according to Their Characteristics [No. = 50 (100%)]**

Neonates' Characteristics	No	%
<b>Gender</b>		
Male	34	68
Female	16	32
<b>Method of delivery.</b>		
Normal vaginal delivery	28	56
Caesarean section	22	44
<b>Gestational age (Weeks)</b>		
< 26	2	4
26 - < 30	30	60
30 - < 34	18	36
$\bar{X} \pm SD$	<b>28.35 ± 4.17</b>	
<b>Birth weight (Grams)</b>		
< 1000	2	4
1000 - < 1500	17	34
1500 - < 2000	16	32
> 2000	15	30
$\bar{X} \pm SD$	<b>1430.2 ± 365.5</b>	
<b>Hospital stay (Days)</b>		
15 - < 30	5	10
30 - < 45	21	42
45 - 60	24	48
$\bar{X} \pm SD$	<b>44.3 ± 10.35</b>	
<b>Appropriateness for gestational age</b>		
SGA	9	18
AGA	41	82

As clarified from table 2, less than two thirds (60%) of the studied neonates, their gestational age was 26 - < 30 weeks with  $\bar{X} \pm SD = 28.35 \pm 4.17$ . As regards their birth weight, it was found that, more than one third (34%) of the studied neonates their birth weight ranged from 1000 - < 1500 grams with  $\bar{X} \pm SD = 1430.2 \pm 365.5$  and 82% of them were appropriate for gestational age.

Figure (1): Percentage Distribution of the Studied Preterm Infants according to their Common Diagnosis



\* Total number is not mutual exclusive

As regards diagnosis of the studied PT neonates, figure 1 revealed that, the most common diagnosis in the studied PT neonates was low birth weight (LBW) as found in 82 % of the studied PT neonates. Meanwhile neonatal sepsis (N.S) found in 26 % of them.

Table (3): Percentage Distribution of Students’ Satisfactory Knowledge Regarding Concept of Developmental Supportive Care in Neonatal Intensive Care Units Pre / Post and at Follow up the Intervention Program [No. = 50 (100%)]

Items	Students’ Satisfactory Knowledge (≥ 60%)			Test of significance	
	Pre %	Post %	Follow up %	X <sup>2</sup> 1	X <sup>2</sup> 2
Definition of Developmental Supportive care.	6	78	80	53.202 *P< 0.001	0.06 P=0.806
Principles of Developmental Supportive care.	6	64	66	36.967 *P< 0.001	0.044 P=0.833
Elements of Developmental Supportive care.	6	76	72	50.641 *P< 0.001	0.208 P=0.648
Total Scores of Students’ Satisfactory Knowledge	6	86	62	64.412 *P< 0.001	7.484 P=0.006

P<0.05= statistical significance, \*P<0.001 = highly statistical significance, P>0.05= statistical insignificance. X<sup>2</sup> 1= the difference between Pre and Posttest, X<sup>2</sup> 2= the difference between Post and Follow up test.

As noticed from table 3 there was a significant improvement in the total score of students' satisfactory knowledge post application of the intervention program and at follow up test regarding concept of developmental supportive care that indicated statistical significant difference.

Table (4): Percentage Distribution of Students’ Satisfactory Knowledge Regarding Elements of Macro-environment in Neonatal Intensive Care Units Pre / Post and at Follow up the Intervention Program [No. = 50 (100%)]

Items	Students’ Satisfactory Knowledge (≥ 60%)			Test of significance	
	Pre %	Post %	Follow up %	X <sup>2</sup> 1	X <sup>2</sup> 2
Nursing strategies for reducing the effects of lighting on neonates in the NICU.	12.0	78.0	74.0	44.00 *P< 0.001	0.219 P=0.639
Adverse noise – induced health effects on neonates	26.0	72.0	70.0	21.168 *P< 0.001	0.049 P=0.824
Follow specific guidelines of acceptable noise levels for protecting of neonates from the noise.	24.0	96.0	90.0	54.00 *P< 0.001	1.382 P=0.239
Methods of heat loss in neonates.	20.0	94.0	94.0	55.855 *P< 0.001	0.000 P=1.000
Signs of hypothermia in neonates	36.0	94.0	90.0	36.967 *P< 0.001	0.543 P=0.461
Signs of hyperthermia in neonates	78.0	94.0	88.0	5.316 P=0.021	1.099 P=0.294
Nursing intervention for prevention of heat loss for neonates.	26.0	90.0	76.0	42.036 *P< 0.001	3.473 P=0.062
Total Score of Students’ Satisfactory Knowledge	28.0	100.0	86.0	56.25 *P< 0.001	7.527 P=0.006

P<0.05= statistical significance, \*P<0.001 = highly statistical significance, P>0.05= statistical insignificance. X<sup>2</sup> 1= the difference between Pre and Posttest, X<sup>2</sup> 2= the difference between Post and Follow up test.



Table 4 indicated that, there was a significant improvement in the majority of the total score of students' satisfactory knowledge post intervention program application and at follow up regarding elements of macro-environment in NICU with statistical significant difference that reflected the positive effect of the intervention program.

**Table (5): Percentage Distribution of Students' Satisfactory Knowledge Regarding Elements of Micro-environment in Neonatal Intensive Care Units Pre / Post and at Follow up the Intervention Program [No. = 50 (100%)]**

Items	Students' Satisfactory Knowledge ( $\geq 60\%$ )			Test of significance	
	Pre %	Post %	Follow up %	X <sup>2</sup> 1	X <sup>2</sup> 2
Definition of containment.	10	76	76	44.431 *P< 0.001	0.000 P = 1.000
Indications of containment in the NICU.	12	68	68	32.667 *P< 0.001	0.000 P = 1.000
Effects of poor positioning on the preterm neonates.	30	90	90	37.500 *P< 0.001	0.000 P = 1.000
Positioning guidelines for the preterm neonates.	18	86	86	46.314 *P< 0.001	0.000 P = 1.000
Effect of handling on preterm neonates.	8	90	90	67.267 *P< 0.001	0.000 P = 1.000
Guidelines for handling of the preterm neonates.	12	86	86	54.782 *P< 0.001	0.000 P = 1.000
Definition of kangaroo care.	10	82	82	52.174 *P< 0.001	0.000 P = 1.000
Benefits of kangaroo mother care for baby and mother.	12	86	86	54.782 *P< 0.001	0.000 P = 1.000
Definition of Non-nutritive sucking	72	88	88	4.000 P< 0.045	0.000 P = 1.000
Benefits of Non-nutritive sucking	14	86	86	51.84 *P< 0.001	0.000 P = 1.000
Guidelines for reducing pain for neonate in NICU.	38	80	80	18.231 *P< 0.001	0.000 P = 1.000
Total Scores of Students' Satisfactory Knowledge	26	94	94	48.167 *P< 0.001	0.154 P=0.694

P<0.05= statistical significance, \*P<0.001 = highly statistical significance, P>0.05= statistical insignificance. X<sup>2</sup> 1= the difference between Pre and Posttest, X<sup>2</sup> 2= the difference between Post and Follow up test.

As noticed from table 5, the majority of the students their total knowledge were satisfactory regarding elements of micro-environment post intervention program as reported by 94 % of them compared to nearly quarter (26 %) of them pre implementation of the program that reflected highly statistical significance difference (P, < 0.001). While, insignificance differences were observed between post and follow up (P= 0.694).

**Table (6): Distribution of Total Students' Satisfactory Knowledge Regarding Developmental Supportive care in Neonatal Intensive Care Units Pre / Post and at Follow up the Intervention Program [No. = 50 (100%)]**

Items	Total Students' Satisfactory Knowledge ( $\geq 60\%$ )			Test of significance	
	Pre %	Post %	Follow up %	X <sup>2</sup> 1	X <sup>2</sup> 2
Concept of Developmental Supportive Care	6	86	62	64.412 *P<0.001	7.484 P=0.006
Macroenvironment in Neonatal Intensive Care Units	28	100	86	56.25 *P<0.001	7.527 P=0.006
Microenvironment in Neonatal Intensive Care	26	94	92	48.167 *P< 0.001	0.154 P=0.694
Effect of Neonatal Intensive Care Units environment on Neonates	0	80	62	66.667 *P<0.001	3.934 P=0.047
Total Scores of Students' Satisfactory Knowledge	8	82	84	53.202 *P<0.001	0.068 P=0.754

P<0.05= statistical significance, \*P<0.001 = highly statistical significance, P>0.05= statistical insignificance. X<sup>2</sup> 1= the difference between Pre and Posttest, X<sup>2</sup> 2= the difference between Post and Follow up test.

As revealed from table 6 there was improvement in the total score of students' satisfactory knowledge regarding developmental supportive care in NICU post intervention program as reported by 82% of them compared to pre intervention program that indicated highly statistical significance difference (P < 0.001). Meanwhile, insignificance differences were noticed between post and follow up test (P= 0.754).

**Table (7): Distribution of Students' Correct Practices Regarding Developmental Supportive care in Neonatal Intensive Care Units Pre / Post and at Follow up the Intervention Program [No. = 50 (100%)]**

Items	Students' Correct Practices (≥ 60%)			Test of significance	
	Pre %	Post%	Follow up %	X <sup>2</sup> 1	X <sup>2</sup> 2
Containment	6	98	100	84.766 *P<0.001	1.01 P=0.314
Positioning	0	86	78	75.439 *P<0.001	1.084 P=0.297
Handling and Touching	0	92	90	85.185 *P<0.001	0.122 P=0.726
Kangaroo Mother Care	0	96	94	92.308 *P<0.001	0.211 P=0.645
Nonnutritive suckling	0	90	88	81.818 *P<0.001	0.102 P=0.749
<i>Total students' Correct Practices</i>	0	88	88	78.571 *P<0.001	0.000 P=1.000

P<0.05= statistical significance, \*P<0.001 = highly statistical significance, P>0.05= statistical insignificance. X<sup>2</sup> 1= the difference between Pre and Posttest, X<sup>2</sup> 2= the difference between Post and Follow up test.

Table 7 clarified that, there was improvement in total students' correct practices regarding developmental supportive care in NICU post intervention program as reported by the majority (88%) of them compared to pre intervention program that indicated highly statistical significance difference (P < 0.001). Meanwhile, insignificant differences were noticed between post and follow up test.

**Table (8): Distribution of Students' Perceived Core Measures for Developmental Supportive Care in Neonatal Intensive Care Units Pre / Post and at Follow up the Intervention Program [No. = 50 (100%)]**

Items	Studied Students' Perceived Core Measures for Developmental Supportive Care (≥ 60%)			Test of significance	
	Pre %	Post %	Follow up %	X <sup>2</sup> 1	X <sup>2</sup> 2
Protected sleep core measure.	34	66	68	13.673 *P<0.001	X <sup>2</sup> =0.045 P=0.832
Assessment & management of stress and pain core measure.	16	44	52	9.333 P=0.002	X <sup>2</sup> =0.641 P=0.423
Developmentally supportive activities of daily living core measure.	18	50	58	11.408 P=0.001	X <sup>2</sup> =0.644 P=0.422
Family-centered care core measure.	18	48	58	10.176 P=0.001	X <sup>2</sup> =1.004 P=0.316
Core measure for the healing environment.	16	40	52	7.143 P=0.007	X <sup>2</sup> =1.449 P=0.228
<i>Total Score of students' Perceived Core Measures.</i>	10	36	58	9.543 P=0.002	X <sup>2</sup> =4.857 P=0.027

P<0.05= statistical significance, \*P<0.001 = highly statistical significance, P>0.05= statistical insignificance. X<sup>2</sup> 1= the difference between Pre and Posttest, X<sup>2</sup> 2= the difference between Post and Follow up test.

As noticed from table 8, there was a clear improvement in the total score of students' perceived core measures for developmental supportive care in NICU post the intervention program and at follow up test compared to pre intervention program which reflected statistical significance difference (P = 0.002 and P=0.027).

**Table (9): Correlation between Total Scores of Students' Knowledge, Practices and Their Perception regarding Developmental Supportive Care in NICU Post Intervention Program**

Variables	Total Students' Knowledge		Total Students' Practices	
	r	p-value	r	p-value
Students' Perception	0.035	0.811 (NS)	0.175	0.225 (NS)

P > 0.05 = No Statistical Significant Difference

Table 9 clarified that, there was negative correlation (r = 0.035 and 0.175) between total score of students' knowledge, practices and their perception regarding DSC in NICU post intervention program. Whereas, significant improvement of the students' knowledge and their correct practices as regards DSC are not associated with increased level of their perception regarding core measures for DSC in NICU.

#### IV. Discussion

After the preterm neonates are born, exposure to various noxious sensory stimulations (loud noise, bright light, pain, invasive oral stimulation, prolonged restrictive positioning) occurs in the neonatal intensive care unit. The preterm neonates' neuronal circuitry is not ready to process these overwhelming physical stressors, which may affect normal brain development. In addition, the quality of parent-infant interaction is challenged after preterm birth due to unanticipated separation. Together, these environmental and social factors may hinder healthy brain development in preterm neonates (**Iuu et al., 2017**). The delivery of developmental care in neonatal intensive care units helps to save neonates' energy, maintains their physiologic stability, reduces their and their families' stress, shortens their hospital stay, and cuts healthcare costs (**Godarzi et al., 2015**).

The present study aimed to evaluate the effect of intervention program about evidence based nursing practices of developmental supportive care for preterm neonates on knowledge and practices of the internship nursing students as regards care of neonates.

Concerning the characteristics of the studied students (table 1), results of the current study showed that, more than one third of them worked in NICU, this may be attributed to the fact that some hospitals permit the graduates from health technical nursing institutes to work in NICU in summer season.

Regarding attended previous educational programs about care of high risk neonates (table 1), results of the current study showed that, the highest percentage of the students did not attend previous educational programs and none of them received related developmental supportive care courses, this means that the current intervention program during internship year was considered the first experience for them regarding DSC for preterm neonates in NICU that reflects the importance of the intervention program.

These findings were parallel with **Mohammed et al., (2014)** whom recommended that collaboration and continuing education of the staff in the NICU (doctors, nurses, etc.) are vital to improve the quality of care provided for preterm neonates. In the same context, **Seada and El Hanafy, (2012)** mentioned that, the educational preparation of nurses must provide the necessary skills and foundation for graduates to practice at a basic level of competency and safety. The importance of clinical teaching to the discipline of nursing has been well established. Also, clinical competence is essential to successfully fulfil the role and responsibilities of a registered professional nurse, as well as instructing students in the clinical setting comprises a significant portion of nursing curricula.

In relation to the characteristics of the studied preterm neonates (table 2), results of the current study showed that, the mean gestational age (GA) of the studied preterm neonates was  $28.35 \pm 4.17$  weeks. This result was parallel to **Bayoumi et al., (2015)**, who mentioned in their study that, the mean gestational age of the studied preterm neonates was  $30.3 \pm 1.88$  weeks. In relation to the neonates' birth weight, it was observed from results of the current study that, the mean birth weight was  $1430.2 \pm 365.5$  gm. This result was contradicted with **Montiroso et al., (2012)**, who reported in their similar study that the mean birth weight was  $1091.75 \pm 258.16$  gm.

In investigating the common diagnosis of the studied neonates (Figure 1), the current study proved that, the most common diagnosis among the studied neonates was low birth weight. This result was compatible with **El-Nagger et al., (2013)**, who proved in a similar study that, the most commonly diagnosis observed in the studied neonates were prematurity and low birth weight.

In relation to the students' knowledge regarding concept of developmental supportive care (table 3), results of the current study proved that, there was a clear improvement of students' knowledge after application of the intervention program and at follow up compared to before application with statistical significance difference that reflects the positive effect of the intervention program. This may be due to the fact that, there was lack of graduated knowledge regarding DSC for neonates because this subject is not included in curriculum of undergraduate students' during academic years.

In this context, **Kaphagawani and Useh, (2013)**, mentioned that, students have to be given opportunities to practice different tasks to gain confidence, become perfect and learn from the mistakes they will make. As much as this suggestion is ideal, the number of students in the nursing colleges has increased in such that students are not given adequate opportunities to learn. The increase of students' numbers may lead to students not being competent to some tasks when completing their training, hence unable to provide quality care. Learning in clinical practice takes place if students know what they are doing is right or wrong. This is done through feedback that is provided to students from clinical nurses, mentors, preceptors and nurse educators during clinical learning. Feedback helps students to gain confidence as through feedback students know their progress.

On investigating the students' knowledge regarding elements of macro environment in Neonatal Intensive Care Units (table 4), results of the current study showed that, the minority of the studied student had satisfactory knowledge regarding strategies for reducing the effects of lighting on neonates in the NICU before the intervention program compared to after the program and at follow up with highly statistical significance

difference. This may be due to lack of their information about developmental supportive care. In this regard **Pickler et al., (2016)**, emphasized that evidence indicates that exposure to very bright light can harm the immature eye. High lighting levels have been associated with adverse clinical outcomes, less weight gain, behavioral and sleep disturbances, in addition to stress in very preterm or seriously ill patients.

Furthermore, **Reberto et al., (2016)**, mentioned that, a sudden change in the amount of light affects the preterm neonates. Rapid saturation declines in preterm neonates are observed after a sudden increase in lighting. Preterm neonates are visually more vulnerable: they get tired easily, have very thin eyelids and their immaturity prevents them from closing their eyes consistently, so they have limited resources for protection from light. Changes in ambient lighting include temporary effects: a reduced level of lighting produces an immediate and transient opening of the eyelids, followed by a significantly longer period when this dimmer illumination is kept. It has been published that effects of light reduction in the NICU include a better stability of the preterm neonates, respiratory stability, decreased heart rate and respiratory rate, blood pressure and motor activity, shorter time in ventilation and oxygen support.

Concerning the students' knowledge regarding noise in NICU (table 4), results of the current study showed that, only about one quarter of students had satisfactory knowledge regarding adverse noise – induced health effects on the preterm neonates and specific guidelines for acceptable noise levels to be established in the NICU before application of intervention program compared to the majority of them after the intervention program with highly statistical significance difference ( $P < 0.001$ ). In the current study, the researchers provided clear instructions and evidence based guidelines for the studied students about how to create a quiet environment to promote good sleep for preterm neonates to improve their brain development as well as to decrease infants' developmental problems due to insufficient sleep due to the noisy and crowded NICU environment with excessive handling and distracting procedures by staff.

These results were supported by results of **Lahav and Wachman., (2014)**, who reported in similar study that, elevated noise levels in the NICU have potentially adverse effects on preterm neonates' physiologic stability and future neurodevelopment. Loud transient noise has been shown to cause immediate physiological changes, such as increased heart rate, blood pressure and respiratory rate, and decreased oxygen saturation. Such changes increase the likelihood of subsequent apnea and bradycardia episodes. On the other hand **Lahav and Wachman (2014)**, stated that, there is a direct relationship between how critical the condition of neonate in the NICU is and noise levels due to the use of more equipment and presence of greater number of individuals.

In the same context, **Blanch et al., (2015)**, illustrated in a similar study that, excessive sound, termed as noise, is possible even with simple routine procedures done in NICU like placing bottles, closing incubator ports and running water during hand washing produced sound levels up to 75 dB.

These results were supported by **Hunt (2011)**, who stated that, there is a direct link between noise and health. Problems that are related to noise and health include: stress related illness, high blood pressure, speech interference, hearing loss, and sleep deprivation”.

**According to the Environmental Protection Agency (EPA), 2011**, sudden and loud noise leads to physiological and behavioral disturbances including sleep disturbance, motor arousals, such as startles, crying, hypoxemia, tachycardia, and increased intracranial pressure. Increased intracranial pressure can further contribute to intra-ventricular hemorrhage. The longer an infant's stay in the NICU, the more they are exposed to moderate noise levels.

Furthermore, study results of **Manske (2017)**, showed that, decreased noise exposure positively influences physiologic development in preterm neonates and minimizes growth and developmental delays. Staff education is another practice that is being utilized currently; to inform the staff about the danger of auditory overstimulation during the neonate's time in the NICU. They are taught to limit talking in normal voice tones while working with the infants and to monitor the overall noise level in the NICU periodically. Earmuffs and earplugs when used correctly can reduce noise by 15 to 30 decibels. There is a need for improved noise reduction interventions within the neonatal intensive care unit and nurses are responsible for maintaining the environment and the stability of the neonates.

Moreover, **Raman, (1997) and Hunt (2011)**, confirmed that, any interventions have been put into place to help decrease and monitor noise in the NICU. Staff behavior has changed to accommodate noise recommendations. Talking should be at a considerably low level and laughing should be discouraged. Equipment should not be placed on incubators and opening and closing of portholes in the incubator should be done in a gentle manner. Monitoring equipment should be minimal and manufacturers should be encouraged to reduce the noise levels in their products. During the night a noise policy or “quiet period” should be applied. Audible alarms should be replaced by visual alarms, and all units should be transported gently and with care.

On investigating the score of studied students' satisfactory knowledge as regards thermoregulation of the neonates in NICU, results of the current study revealed that, there were significant differences between pre and post intervention program in relation to methods of heat loss in neonates, signs of hypothermia and hyperthermia in neonates and measures for prevention of heat loss in premature neonates ( $P < 0.001$ ).

Fluctuations of environmental conditions and temperature cause significant stress in the infants. Nursing interventions should be undertaken to prevent heat loss during caregiver procedures. Every intervention with the preterm neonates requires to be done under thermal control in order to avoid hypothermia. For a better care of preterm neonates, time and resources should be invested in assisting new nurses into practice with evidence based nursing and bedside learning. Having a single preceptor for an extended period of time provides a safe relationship in which the preceptor can provide feedbacks on assessments and decision making to the new nurse and enhance their self confidence in practice (**Bouet et al., 2013**).

In this regards, results of **Ogunlesi et al., (2008)** and **Lunze et al., (2013)**, concluded that, thermal stress, particularly hypothermia, contributes significantly to the risk of mortality in high risk neonates. Additionally, **Amadi et al., (2014)**, illustrated in their study that, high risk neonates were at risk of hypo- and hyperthermia for various reasons, including climatic factors, incubator malfunctioning and ignorance of how to regulate incubator set-points. The use of fans and air-conditioners, insecure power supply and power cuts with resultant hyperthermia of neonates being nursed in cots.

On the other hand, **Purnamasari et al., (2017)**, emphasized that newborns are at risk of developing hypothermia due to the instability of their thermoregulation systems and inability to adjust to changes in ambient temperature. This risk increases during hospitalization, so education is a strategy to improve nurses' understanding of the prevention of hypothermia in neonates in the hospital.

On investigating the score of studied students' satisfactory knowledge as regards containment of the neonates in NICU (table 5), results of the current study revealed that, there were significant differences between pre and post intervention program ( $P < 0.001$ ) in relation to definition and indications of containment in the NICU. In this context **Oliveira et al., (2016)**, recommended in a similar study that, the nursing team must act therapeutically, using non pharmacological measures, such as reduction in light levels, reduction of noise, swaddling (wrapping in a blanket), containment (facilitated tucking), non-nutritive sucking, glucose and grouping of the care measures.

In the same line, **Lucas (2015)**, assured that, containment similar to the intrauterine experience is included under the umbrella of developmental care to provide a structured care environment which supports, encourages and guides the development of the preterm neonates and/or critically ill infant. It recognizes the physical, psychological and emotional vulnerabilities of premature and/or critically ill infants and their families and is focused on minimizing potential short and long-term complications associated with the hospital experience. Also, **Maguire (2008)**, stated that, the nurse should provide containment by gently swaddling the infant's body, arms and legs with hands or through the use of a soft blanket, standardized nests and positioning aids to reduce diffuse and jerky movements during caregiving interactions and reducing the physiological and behavioral destabilization associated with procedural handling.

In relation to the score of studied students' satisfactory knowledge regarding effects of poor positioning on the high risk neonates and measures for maintaining healthy positioning for preterm neonates (table 5), results of the current study showed that, less than one third (30%) and less than fifth (18%) of the studied students had satisfactory knowledge before intervention program regarding the previously mentioned items respectively compared to after program implementation with highly statistical significance difference, this improvement reflects the positive effect of the intervention program.

These results were supported by results of **Zarem, et al., (2013)**, who revealed in a similar study that, the majority of nurses and therapists surveyed perceived that alternative positioning was the easiest type of positioning to use and the most beneficial for preterm neonates.

In the same context **Hunt (2011)**, demonstrated that, positioning and handling strategies include enhancing flexion in the arms and trunk and preventing flailing and extensions and reducing infant stress. Swaddling and containment provide comfort before and after procedures. Nesting using blankets or commercial positioning devices provides boundaries and reduces infant stress. Kangaroo Mother Care (KMC) is also recommended as a positioning and handling technique for medically fragile infants.

Additionally, **Lewis et al., (2014)**, stated in a similar study that, positioning in physiological flexion (flexion of the shoulders, hips, and knees, scapular protraction, and posterior pelvic tilt) is the ideal position of the newborn, as it promotes proper joint alignment and symmetry, supports neuromuscular development, and promotes self-soothing and behavioral organization. However, preterm neonates' lack tonal responses and

strength at birth, and they often assume extended (straight) positioning of the neck, back and extremities, extended positioning can affect acquisition of developmental motor skills, hinder self-regulation and may interfere with oral feeding skills.

On the other hand, **Nakano et al., (2010)**, stated that, preterm neonates were more likely to demonstrate extension in the trunk which interfered with sitting posture and significantly influenced mobility, promoted asymmetry, and decreased hand function at 1 year of age. Goals of neonatal positioning with the preterm neonates include not only promoting flexion, but also can include prevention of head flattening and external rotation of the hips and promotion of midline orientation to prevent asymmetrical posture and movement. Moreover, researchers using a positioning protocol for preterm neonates concluded that, infants who were positioned appropriately had more variation in velocity of movements and brought hands to midline more than infants who had not received a positioning protocol.

In relation to studied students' knowledge regarding effect of handling on preterm neonates and guidelines for handling (table 5), results of the current study proved that, there was a clear improvement of the studied students' satisfactory knowledge after the intervention program with highly statistical significance difference ( $P < 0.001$ ).

**Ramchandran and Dutta (2013)**, confirmed that, the fetus receives rich tactile sensory experiences and bathed by the amniotic fluid. During NICU, preterm neonates are deprived of constant tactile stimulus of amniotic fluid and as well as exposed to varying touch stimulus during medical and nursing procedures which cause adverse effects as hypoxia, bradycardia, sleep disruptions, increased intracranial pressure and behavioral agitation. Therefore appropriate tactile stimulation and minimal & gentle handling is indicated at the same time.

In contrast to the fetal life, in the NICU, the preterm or unwell neonates are exposed to painful procedures, excessive light and noise and handling, lack of containment and reduced ability to move, interrupted sleep and separation from his mother. Inappropriate handling may cause stress pain, physiological instability; poor temperature control, disrupted sleep and growth patterns and disruption of smooth transitions between infant states (**Jenkins et al., 2016**).

In this context, **Hunt (2011)**, mentioned that developmental supportive care involves a combination of multiple philosophies and numerous intervention techniques all focused on the newborn as the central figure in the NICU. These strategies are aimed at increasing the infants' comfort and reducing stress in an individualized manner from admission through discharge. These include, but are not limited to developmentally supportive positioning and handling, recognizing and responding to infant cues, clustering of care and procedures to promote rest, and offering non-nutritive sucking for self-regulation and pain management.

On investigating the studied students' knowledge as regards the definition and benefits of kangaroo mother care (table 5), the current study showed that, there was a clear improvement of the studied students' satisfactory knowledge after the intervention program with highly statistical significance difference ( $P < 0.001$ ) that reflects the positive effect of the intervention program. These findings were supported by **Flynn and Warren (2010)**, who reported that, interactive workshops may increase nurses' knowledge, skills and confidence in the initiation of safe and effective kangaroo care with preterm neonates. These should support the neonatal nurse to educate and communicate the benefits of kangaroo care to all parents and other healthcare professionals within the neonatal environment focusing on the implementation of kangaroo care into everyday practice. This in turn can facilitate parents, infants and staff to have a positive kangaroo care experience.

Moreover, **Silva et al., (2015)** confirmed that, the nurse plays a fundamental role in the management of welcoming care, comfort, stimulation and environmental interventions, so as to promote skin-to-skin contact, the infant's development and the strengthening of affective bonds in the family.

In relation to the studied students' knowledge regarding definition and benefits of non-nutritive sucking (table 5), the results of the present study revealed that, there was statistical significance difference in their satisfactory knowledge as regards definition of non-nutritive sucking, this result may be due to the fact that non-nutritive sucking is commonly and routinely used in NICU. Also, there was a clear improvement of the studied student' satisfactory knowledge regarding benefits of non-nutritive sucking after the intervention program with highly statistical significance difference ( $P < 0.001$ ).

These findings were supported by **Noori et al., (2018)**, who reported that, non-nutritive feeding during gavage increases the secretion of digestive enzymes and improves digestion. As well as non-nutritive feeding not only evolves sucking habit, but also facilitates intestinal digestion, enhances oral feeding, and increases the activity of digestive system.

In the same context, **Touzet et al.,(2016)**, illustrated in a similar study that, non-nutritive sucking through the utilization of a pacifier accelerates transition to full oral feeding and allows earlier tube withdrawal, while decreasing hospitalization time. Early introduction to suck feedings also accelerates transition from tube

to oral feeding and allows for earlier tube removal. Pre-feeding oral and perioral stimulations (cheeks, lips, jaw, gums and tongue) result in earlier achievement of full oral feeding without noticeable impact on length of stay. Finally, oral-motor interventions (assisted movement to activate muscle contraction, and movement against resistance to build strength) prior to the introduction of oral feedings are also found to reduce the transition to full oral feeding autonomy.

Results of relevant studies in different countries on physiological response of preterm neonates to NNS and also the effect of NNS on full oral feeding attainment are contradictory. In the majority of studies, NNS was mostly on a pacifier and administered with the researcher or therapist, without parental involvement. Since preterm neonates are immediately hospitalized in the NICU, breastfeeding is an unknown experience that decreases the chance for success. Non-nutritive sucking by mother, as a subset of developmental care, may have positive effects on preterm neonates (**Noori et al., 2018**).

Regarding the studied students' satisfactory knowledge as regards the interventions used to prevent or reduce pain for neonate in NICU (table 5), results of the current study proved that, the minority of them had satisfactory knowledge before intervention program, which improved obviously after the intervention.

In the same context **the National Association of Neonatal Nurses, (2018)**, mentioned that, pain prevention strategies in neonates include non-pharmacological interventions and the use of pharmacologic agents. The most effective way to alleviate pain is to reduce or eliminate unnecessary procedures. Other methods to reduce pain include developmental interventions performed by the caregiver or a parent. For routine care procedures, non-pharmacological interventions may be sufficient to reduce or prevent pain in an infant. Non-pharmacological interventions include, containment or facilitated tucking (swaddling, positioning), nonnutritive sucking (use of pacifier with oral sucrose or breast milk), kangaroo care or skin-to-skin contact with mother, maternal presence during procedure and decreasing light and noise to provide calming environment.

In relation to the total students' satisfactory knowledge regarding developmental supportive care in neonatal intensive care units (table 6), results of the current study proved that, there was a clear improvement in the total score of the students' satisfactory knowledge regarding developmental supportive care in NICU after intervention program with highly statistical significance difference ( $P < 0.001$ ).

These findings were similar with the results of **Mohammed et al., (2014)**, who proved in a similar study that, there were highly statistically significance differences ( $P < .001$ ) between all items of nurses' knowledge about developmental care pre and post DSC program application.

These findings were supported by results of **Milette et al., (2005)**, who concluded in a similar study that, the educational program emphasized the transmission of knowledge and the modification of attitudes. Because the implementation of a developmental care approach demands that NICU staff acquire new knowledge and skills, and the mean scores for the knowledge at the pre-test and post-test was a statistically significant difference.

On investigating the studied students' correct practices regarding developmental supportive care in neonatal intensive care units (table 7), results of the present study showed that, none of the students had correct practices regarding positioning, handling and touching, kangaroo mother care and non-nutritive suckling for the neonates pre the intervention program and the minority (6%) of them had correct practices in containment in painful procedures and stressful situation for the neonates with obvious improvement in their correct practices regarding all the previously mentioned practices items after the intervention program compared to before the program with highly statistical significance differences. These results could be attributed to the effect of the intervention program and keeping the guiding booklet with the studied nursing students in NICUs which reminds them for appropriate interventions.

These results were coincide with results of **Mohammed et al., (2018)**, who confirmed that none of the nurses placed their hand gently on the preterm neonates' head and feet while providing flexion, compared to the majority (92%) of nurses immediately after application of the program with slight decrease to 88% three months later with statistical significant difference ( $p < 0.001$ ).

In the same context, **Hunter et al., (2014)**, mentioned that, providing supportive proprioceptive input in the way of containment, thereby imitating the spatial limitations of the womb, has been demonstrated to positively influence neuromotor and neurosensory maturation of the newborn. Moreover, **Philips (2014)**, assured that, body containment is one of the first important concepts, which increases the infant's feelings of security and self-control and decreases stress and neonates who are contained tend to be calmer, require less medication, and gain weight more rapidly.

The current study findings were in harmony with the results of **Hunter et al., (2014)**, who confirmed that, education is effective in improving developmental positioning proficiency of NICU nurses, as well as

improving consistency in positioning. Moreover, forming a “nest” with soft boundaries, as well as a padded foot-roll for foot-bracing, provide postural, behavioral, and physiological stability to the preterm neonate. Also, **Karen et al., (2014)**, emphasized that, educational program improved the perception of value of KMC, the nurses’ role in implementing KMC, as well as increased the nurses’ value to encourage parent visitation in the NICU.

**Touzet et al., (2016)**, mentioned that non-nutritive sucking accelerates transition to full oral feeding and allows earlier tube withdrawal, while decreasing hospitalization time. Early introduction to suck feedings also accelerates transition from tube to oral feeding and allows for earlier tube removal.

In the current study, the studied students reported that NNS should be done sterile artificial nipples to avoid infection, while **Neiva and Leone, (2006)** & **Vargas and Rosa, (2017)**, recommended that the stimulation of NNS be conducted with the gloved finger, avoiding artificial nipples, in order to not interfere in breastfeeding (BF) which was emphasized by the researchers through practical sessions.

Teaching sessions for professionals could be included in staff orientation programmes. Additionally, continuing bed-side teaching may be included for current staff, and training workshops may improve nurses’ skills in transfer techniques, knowledge and confidence in the assessment and initiation of skin to skin contact in extremely low birth weight neonates (**Hunter et al., 2014**).

On investigating students’ perceived core measures for developmental supportive care in neonatal intensive care units (table 8), the minority of the studied students had perceived core measures before program implementation with a clear improvement in students’ perception after the intervention program and at the follow up with statistical significance difference ( $P= 0.002$ ). These findings were in opposition to results of **Mosqueda et al., (2012)**, who concluded that the neonatal unit staff perceived DSC positively but the assessment is more positive for neonatologists than for nurses.

In the same context, **Prendergast (2007)** and **Karen et al., (2014)**, studied the barriers to provision of developmental supportive care in the NICU as perceived by 146 neonatal nurses and concluded that, most of nurses (93%) perceived that developmental supportive care as an essential and beneficial for both newborn infants and nurses. This contradiction may be due to the difference of the study settings and subjects

In relation to the total score of the studied students’ perception regarding core measures for DSC in NICUs (table 8), findings of the current study proved that, there was a clear improvement in the total score of the students’ perceived core measures for developmental supportive care in NICU post the intervention program and at follow up compared to pre intervention program which reflected statistical significance difference, this may be due to the positive effect on the students’ level of perception and awareness regarding core measures for DSC in NICUs.

As regards the correlation between total score of studied students’ knowledge, practices and their perception regarding DSC after the application of the intervention program (table 9), results of the current study displayed that, there was negative correlation between total score of students’ knowledge, practices and their perception ( $r = 0.035$  and  $0.175$ ) and ( $P = 0.811$  and  $0.225$ ) respectively post intervention program. Whereas, improvement of students’ knowledge and their correct practices as regards DSC are not associated with increased level of their perception regarding core measures for DSC in NICUs.

## **V. Conclusion**

Based on the findings of the current study, it was concluded that, the majority of the studied internship nursing students had satisfactory knowledge, correct practices and perceived core measures regarding developmental supportive care in NICUs after the intervention program and at follow up compared to before the intervention program which support the positive effectiveness of the evidence based intervention program .

## **VI. Recommendations**

**Based on the current study results, it was recommended that:**

1. DSC can be applied more widely in NICUs as one of the nursing interventions aiming to improve nurses and nursing students’ knowledge, practices and perception to provide safe and high quality of care for preterm neonates in NICU.
2. In service continuing education programs of the nursing staff in the NICUs about DSC are vital aspects to improve the quality of care provided for preterm neonates in NICUs.
3. Encourage all new nurses working in NICUs in designing a developmental supportive care plan that meets the neonates’ needs.
4. Continuous researches must be done about developmental supportive care activities to determine which intervention is applied, what does not applied, and which interventions need further refinement to be applied safely and usefully in NICUs.



5. Future researches must be strategically targeted to fill the gaps and to provide more concrete information in the current evidence related to developmental supportive care in NICU.

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