



## **Effect of developmental supportive care training program on nurses' practice regarding behavioral response of premature neonates**

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### **Abstract**

**Background:** Survival rate of premature neonates has increased due to the technological advances in medical care. Developmental care interventions may help preterm neonates cope better with the environment of the Neonatal Intensive Care Unit and provide healthy developmental outcomes.

**The study was aimed:** to evaluate the effect of developmental supportive care training program on nurses' practice regarding behavioral response of premature neonates.

**Subjects and method:** A convenience sampling of fifty nurses who were responsible for providing nursing care for premature neonates was included in the study, also, all premature neonates who receiving care were included in the study, Three tools were used to collect data: Structured interview schedule, Nurses practice of Developmental Supportive Care for premature neonates using an observational checklist, Observational checklist to assess nurse's practice regarding behavioral response of premature neonates.

**The results:** revealed that there was statistically significant difference of levels of total nurses' knowledge between before, immediate, and after one month of a supportive developmental care training program.

**The study was concluded:** that developmental supportive care had a positive effect on nurses' knowledge and practice as well as their perceived self-competence regarding behavioral response of premature neonates as evidenced improved their oxygen saturation, regulate heart rate and respiration.

**The study was recommended:** that application of administrative policy and procedures for nursing practice of developmentally supportive care for high-risk neonates are needed and incorporate neonatal intensive care units design.

**Keywords:** Behavioral response, developmental supportive care, nurses' practice, premature neonates

### **Introduction**

Premature infants according to the World Health Organization (WHO) are born before 37 weeks of gestation and are physically vulnerable due to the incomplete evolution of various organs<sup>[1]</sup>. Prematurity is considered the number one cause of newborn mortality. Premature infants are classified into extremely preterm <28 weeks, very preterm 28 - <32 weeks, and moderate preterm 32 - <37 completed weeks of gestation<sup>[2]</sup>. In Egypt, the incidence of prematurity was found at 12%. Premature neonates are liable to many problems either in the short term or in the long term<sup>[3]</sup>. In Tanta University Hospital in Tanta, the rate of premature neonates in the Neonatal Intensive Care Unit was 70% of the total number of admissions<sup>[4]</sup>.

Early intervention 'consists of multidisciplinary services provided to premature neonates to promote child health and well-being, enhance emerging competencies, minimize

developmental delays and prevent functional deterioration. A variety of different techniques is used in early intervention, based on psychotherapy, developmental psychology, clinical psychology, occupational therapy, and rehabilitation psychology<sup>[5]</sup>.

Long-term impact of NICU environment-related sensory input is only beginning to be studied. In its Fifth Consensus Conference on NICU Design based on clinical experience and updated research findings, the US Committee to Establish Recommended Standards for Newborn ICU Design recommends adjustable ambient lighting levels through a range of 10–600 lux, separate procedural lighting available at each infant's care station, at least one source of daylight with shading devices, a combination of continuous background sound and transient sound not exceeding an hourly mean of 50 dB and maximum transient sounds not exceeding 70 dB<sup>[6]</sup>.

Developmental care 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. In addition to this, the intervention and philosophical interpretation of developmental care may vary across units, the goal is to provide a structured care environment that supports, encourages, and guides the developmental organization of the premature and/or critically ill infant [7].

Developmental Supportive Care (DSC) refers to the orientation of all health care procedures toward maintaining the premature infant in organized or stable a condition as possible and managing the physical care and social environment to minimize stressors. The practice of DC as a model of care is aimed at minimizing the adverse effects of the NICU on high-risk infants to support the infants' growth and development [8].

The component of developmental care include control of external stimuli (vestibular, visual, auditory, tactile), medical and nursing care activities, and positioning or swaddling of the preterm neonate so as to provide a sense of containment similar to the intrauterine environment. Moreover, DSC many positive effects have on premature neonate, including improved growth and development rather than traditional care. Developmental care activities: positioning, kangaroo care, non-nutritional sucking, containment, and reducing light and sound [9].

The nursing profession has a responsibility of creating and maintaining an environment conducive to the healing process in monitoring and reducing noise levels, Lighting should be adjustable, infants should be provided with developmentally supportive positioning to optimize musculoskeletal development and behavioral organization, provide opportunities for kangaroo care when possible and minimize the infant's exposure to noxious stimuli such as strong fragrances, open alcohol swabs outside the incubator, clinical procedures and adhere to lighting and noise guidelines [10].

Nurses can also use core measures as a framework for clarifying and enriching parental and staff knowledge of developmental care. Didactic teaching sessions or interactive learning opportunities in which caregivers experience the contrast of standard (such as experiencing loud noises, frequent handling, or bright lights) vs. developmental care practices (as defined by the core measures) may be used to increase understanding of developmental care [11].

## 2. Aim of the study

**The study was conducted** to evaluate the effect of a developmental supportive care training program on nurses' practice regarding behavioral response of premature neonates.

## 3. Subjects and Method

A quasi-experimental research design was used. The study was conducted at neonatal Intensive Care Unit (NICU) of Tanta Main University Hospital.

**Sample I:** A convenience sampling of 50 nurses and premature neonates were included in the study. The sample

size was based on the following parameters confidence level error level 5% type I error 0.05 and power of test 95%. They were selected and divided randomly (using the simple random method). Nurses were assessed pre, during, and post of the developmentally supportive care training program.

### Three tools were used to collect data

**Tool I: Structured interview schedule:** It consisted of two parts: Part (1): Socio-demographic characteristics of the studied nurses such as: the form covered the personal characteristics of the studied nurses, including their age, level of education, years of experience, and previous attendance of developmentally supportive care programs for premature neonates. Part (2): It covered the Socio-demographic characteristic of premature neonates and medical history including gestational age, birth weight, length, diagnosis, and laboratory investigation. Part (3): It included nurses' knowledge about developmentally supportive care of premature neonates such as: Definition of premature neonate's developmental supportive care, benefits of implementing developmental supportive developmental care, the behavior of premature neonates.

**Nurses' knowledge was scored as follows:** Correct and complete answer was scored (2), Correct and incomplete answer was scored (1), Wrong answer or don't know was scored (0).

### The total score of Nurses' knowledge was calculated:

Less than 60% was considered poor knowledge, from 60-75% was considered fair knowledge, from 75% and more were considered good knowledge

### Tool II: Nurses practice of Developmental Supportive Care for premature neonates using an observational checklist:

It was included the following items [12]:

- Reducing noise such as *set al.*arms and phones at the lowest safe.
- b- Reducing light and vision such as protect neonates from focused lighting during medical procedures, covering incubator, using an eye mask.
- Postures support/positioning (15 items)
- Containment:** (2items) placed the hand gently on the premature neonate's head while doing flexion and containment (hand swaddling) and started containment before the painful procedure.
- Kangaroo Care:** (9 items): this meets the neonate's and parents' needs for warmth, love, and prolonged skin-to-skin contact
- Non-nutritive sucking:** (4 items) Nonnutritive sucking is used during gavage feeding and in the transition from gavage to breast/bottle feeding in premature neonates to promote the development of sucking behavior and improve digestion of enteral feedings.

### The Scoring system for nurse's practice was as follows:

Done correctly and complete was score (1), done incorrectly or not done was score (0).

### The total score for nurses' practice was calculated as follows:

Less than 60 were considered unsatisfactory, from 60-100% was considered satisfactory.

**Tool III: Observational checklist to assess nurse's practice regarding the behavioral response of premature neonates: It consisted of one part:** Part (1): Behavioral response of premature neonates checklist such as signs of a physiological state as regular heart rate, easy breathing, pink color, hands to face and mouth that could be influenced by developmentally supportive care were assessed before, during, and after. Signs of physiological distress as color change, cyanosis, change in breathing pattern, heart rate, and oxygen saturation. It was assessed before, during, and after

### Method

This study was approved by Research Ethical Committee REC of Faculty of Nursing and medical at 15- 5-2019. Written consent was obtained from the NICU head manager before starting data collection after explaining the aim of the study. The tools were presented to a jury of five experts to check content validity, clarity, relevance, comprehensiveness, understanding, applicability and ease for implementation. Content validity index was 98.9%.to assess reliability, the study tools were tested and the value of Cronbach's alpha coefficient was 0.8972. A pilot study was carried out on 5 nurses and 5 premature neonates (10%) of the sample to test clarity, visibility and applicability of the study tools and the necessary modification was done. Those nurses and infants were excluded from total sample of the study.

**Implementation of the study:** The study was conducted through four phases:

#### 1) 1-Assessment phase

It was done by the researcher for all study subjects to assess the studied nurses and premature neonates who met the inclusion criteria of this study. The researcher also, firstly met NICU head nurse and their nurses to explain the purpose of the study to gain their cooperation after taking permission from related authorities and premature neonates were administered individually by using (Tool I). During the initial interview, the purpose of the study and the practice were explained and the oral consent was obtained from the participants.

Nurses' practice of Developmental Supportive Care for premature neonates was assessed three times per week and was done in the morning shift (Tool II). The researcher was assessed nurses' practice before, immediately and one month after implementation of the program.

#### 2) Planning phase

Training program was developed by the researcher to facilitate nurses understand based on literature review, articles, and magazine according to nurse' experience, information needs, quality of practice and expected outcomes criteria were formulated, different methods and materials for educational intervention were used including PowerPoint presentations, small lectures, videos, and group discussion.

#### 3) Training Program

The training program for the NICU nurses was developed by the researchers after reviewing the literature to improve nurses' knowledge and practices of supportive

developmental care core measure.

The researcher attended at 10 am to 2 pm two days/ week according to nurses' schedule to collect the data. The program consisted of four sessions including theory and practice. The total number of nurses was divided into 5 groups; each group was included 3 to 10 nurses according to their work schedule and their availability. Each group was attended four sessions using different teaching strategies as (PowerPoint presentation, videos, photographs, group discussion and demonstration), each session was 30-45 minutes. Training program was implemented by the researcher at the above mentioned settings to supervise the practice of study subjects. The researcher was observed every nurse individually during re demonstrations of nurse practice regarding the developmental supportive care.

#### 4) The sessions covered the following topic

**Session I:** Focused on the definition of developmental supportive care, core measure of developmental supportive care, definition of premature neonates, benefits of implementing developmental supportive care, and, behavioral response of premature neonates.

**Session II:** Demonstrated how to apply nurses' practice to reduce noise and light, postural support /positioning, skin care, and containment.

**Session III:** Demonstrated nonnutritive sucking and kangaroo care.

**Session IV:** Demonstrated benefit of kangaroo care for premature neonates and their parents and how to apply it correctly and discuss the obstacles for its application.

#### 5) Evaluation phase

Training program was evaluated before, immediately after the completion of the sessions, and after one month from training program implementation of developmental supportive care for premature neonates using constructed neonates (Tool I part III, tool II, and, III) immediately and after one month. The data was collected over a period of six months from beginning of February 2020 to July 2020. The study work took a period of 2 years.

#### Statistical analysis

The collected data were organized, tabulated, and statistically analyzed using SPSS software (Statistical Package for the Social Sciences, version 26, SPSS Inc. Chicago, IL, USA). For quantitative data, the range, mean, and standard deviation were calculated. For qualitative data, a comparison between two groups and more was done using the Chi-square test ( $\chi^2$ ). For comparison between means of two related groups (before & after change) of non-parametric data, the Z value of Wilcoxon Signed Ranks Test was used. For comparison between more than two means of parametric data, the F value of the ANOVA test was calculated. Correlation between variables was evaluated using Pearson's correlation coefficient (r). For a comparison between more than two means of non-parametric data, Kruskal-Wallis ( $X^2$  values) was calculated. Significance was adopted at  $P < 0.05$  for the interpretation of the results of tests of significance [13].

**Result**

**Table (1):** Shows bio-sociodemographic characteristics of studied nurses. As regards the age, it was evident those more than half (58.0%) their age above 30 years, while 38% of them ranged from 25 – 30 years with main age 30.140 ± 3.440 years.

Regarding their years of experience, 36% of them had 5 - <10 years of experience with mean years of experience (8.780 ± 4.395) years. All nurses hadn't attended the previous training program about developmental supportive care.

**Figure (1):** Regarding the educational level of studied nurses, two-thirds (66.0%) of them graduated from Nursing Technical Institute, 34% of studied nurses were Bachelor of nursing.

**Table (2):** Illustrates the percentage distribution of premature neonates according to their socio-demographic characteristics. It was observed that (84%) were premature (32 up to 36 weeks of gestational age). From this table, it was evident that the gestational age of the studied premature infants ranged from 28-36 with Mean ± SD was 33.460 ± 2.54 weeks of gestational age. Besides, the birth weight of the studied premature infants ranged from 1000-1800 gm with Mean ± SD was 1460.00 ± 203.03 gm.

Concerning the length of the studied premature infants ranged from 32 – 52 cm with Mean ± SD was 44.460 ± 5.51 cm. The mean of their head circumference was 30.38 ± 2.44 and 28.760 ± 2.42 was the mean of their chest circumference. Regarding their diagnosis, it was the highest percentage nearly one third (30%) of them had jaundice, followed by (22%) suffered from apnea, (16%) anemia, (12%) respiratory distress and septicemia, and (4%) complained from aspiration pneumonia and pulmonary hemorrhage.

**Table (3):** Illustrates percentage distribution of level of total nurses' knowledge about developmental supportive care of premature neonates. It was observed that 94.0% of studied nurses had poor knowledge before the SDC training program, while 100.0% and 68.0% had good knowledge immediately and one month after the SDC training program with mean ± SD of total knowledge score were 5.480 ± 3.88, 22.820 ± 1.78, and 20.540 ± 2.476 respectively before, immediate, and after supportive developmental care program training. There was a highly statistically significant difference of levels of total nurses' knowledge (P 0.0001 and x<sup>2</sup> value 96.078, 85.139, and 19.048) between before, immediate, and after one month of a supportive developmental care training program. Regarding total nurses' knowledge scores, there was a highly statistically significant difference (as p-value 0.0001 and x<sup>2</sup> value

546.379).

**Table (4):** Clarifies percentage distribution about behavioral response of premature neonates before, during, and after the practice of developmental supportive care. It was found that the mean scores of premature ' respiration related to the behavioral response of the SDC program were 51.78 ± 4.81, 54.10 ± 5.23, and 52.08 ± 4.14 (c/m) before, immediately, and one month after the SDC training program respectively with highly significant difference (P =0.032)

Concerning oxygen saturation, the mean score of premature behavioral response was 36.54 ± 0.401 before the SDC program. Besides, the mean scores of premature' oxygen saturation were 36.73 ± 0.468 and 36.65 ± 0.408 immediately and one month after the SDC training program respectively with highly significant difference (P =0.0001)

The same table also demonstrated that the mean score of premature ' heart rate was 132.58 ±6.08, 138.72 ±10.04, and 137.74 ± 9.59 (b/m) before immediately and one month after the SDC program respectively with highly significant difference (P =0.001).

**Table (5):** Explains the correlation between nurses' knowledge and practice related to developmental supportive care of premature neonates before and after the program. It was observed that (94%) of nurses with poor knowledge and unsatisfactory practice before the SDC training program, while all of them (100%) had good knowledge with satisfactory practice immediately after the SDC training program.

On the other hand, 68% of studied nurses had good knowledge with satisfactory practice and 26% had fair knowledge with satisfactory one month after the SDC training program. It was found that there was a positive non-significant correlation was revealed between before, immediately after, and one month after the program.

**Table (6):** Clarifies the relationship between nurses' practice scores and their socio-demographic data before, immediate, and one month after the program. It was observed that there was no significant relationship between nurses' age, educational level, years of experience, and their practice score where (P=0.365, 0.740, 0.623 and x<sup>2</sup> value 2.017, 0.110, 1.762) immediate than before the developmental supportive care program.

The same table demonstrated that there were no statistically significant differences between nurses' age, educational level, years of experience where (P=.0.118, 0.330, 0.697 and x<sup>2</sup> value 4.279, 0.947, 1.435) after one month than before the developmental supportive care program. There was no significant relationship between total nurses' practice scores and their socio-demographic data before, immediate, and one month after the developmental supportive care program.

**Table 1:** Percentage distribution of studied nurses regarding bio-sociodemographic characteristics

Bio-sociodemographic characteristics	(n=50)	
	No	%
<b>Age (years)</b>		
20 - < 25	2	4.0
25 - < 30	19	38.0
30 ≥	29	58.0
Range	24 – 36	
Mean ± SD	30.140 ± 3.440	

Educational level		
Nursing Technical Institute	33	66.0
Bachelor of nursing	17	34.0
Years of experience (years)		
1 - <5	10	20.0
5 - <10	18	36.0
10 - < 15	16	32.0
15 - 20	6	12.0
Range	1 – 16	
Mean ± SD	8.780 ± 4.395	
Previous training program about developmental supportive care		
No	50	100.0

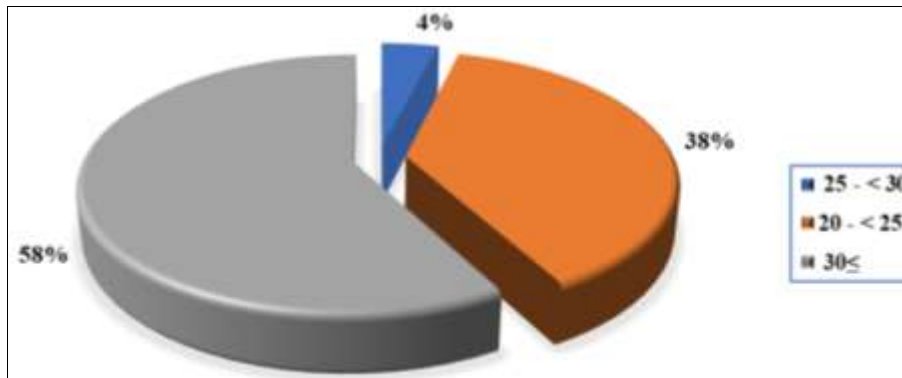


Fig 1: Age of nurses (years)

Table 2: Percentage distribution of studied premature neonates regarding socio-demographic characteristics

Sociodemographic characteristics	(n=50)	
	No	%
<b>Gestational age (weeks)</b>		
Very preterm (28 - <32)	8	16.0
Preterm (32 - <37)	42	84.0
Range	28 – 36	
Mean ± SD	33.460 ± 2.54	
<b>Birth weight (gm)</b>		
Very low birth weight (< 1500)	22	44.0
low birth weight (1500 – 2500)	28	56.0
Range	1000 – 1800	
Mean ± SD	1460.00 ± 203.03	
<b>Length (cm)</b>		
Subnormal (< 48)	34	68.0
Normal (48 – 53)	16	32.0
Range	32 – 52	
Mean ± SD	44.460 ± 5.51	
<b>Head circumference (cm)</b>		
Subnormal (< 33)	46	92.0
Normal (33 - 35.5)	3	6.0
Above normal (> 35.5)	1	2.0
Range	25 – 36	
Mean ± SD	30.38 ± 2.44	
<b>Chest circumference (cm)</b>		
Subnormal (< 30.5)	43	86.0
Normal (30.5 – 33)	5	10.0
Above normal (> 33)	2	4.0
Range	24 – 34	
Mean ± SD	28.760 ± 2.42	
<b>Diagnosis:</b>		
Apnea	11	22.0
Respiratory distress II	6	12.0
Aspiration pneumonia	2	4.0
Pulmonary Hg	2	4.0
Septicemia	6	12.0
Jaundice	15	30.0
Anemia	8	16.0

**Table 3:** Percentage distribution of levels and mean scores of total nurses’ knowledge about developmental supportive care of premature neonates

Total knowledge about developmental supportive care	Before (n=50)		Immediate after (n=50)		One month after (n=50)		I	II	III
	No	%	No	%	No	%	$\chi^2$	$\chi^2$	$\chi^2$
<b>Levels of total knowledge</b>									
Poor knowledge < 60% (0 - 15)	47	94.0	0	0.0	1	2.0	96.078 0.0001*	85.139 0.0001*	19.048 0.0001*
Fair knowledge 60% - <75% (16 - 19)	2	4.0	0	0.0	15	30.0			
Good knowledge 75% - 100% (20 - 26)	1	2.0	50	100.0	34	68.0			
<b>Total knowledge scores</b>							<b>F value P</b>		
Range (0 - 26)	1 – 20		20 – 26		15 – 25		546.379		
Mean ± SD	5.480 ± 3.88		22.820 ± 1.78		20.540 ± 2.476		0.0001*		

I between before and immediate

II Between before and after one month

III Between immediate and after one month

\*Statistically significant difference at ( $P < 0.05$ )

**Table 4:** Percentage distribution about behavioral response of premature neonates before, during, and after the practice

Behavioral response of premature neonates	(n=50)						I Range Mean ± SD	II Range Mean ± SD	III Range Mean ± SD
	Before		During		After				
	No.	%	No.	%	No.	%			
<b>Respiration (c/m)</b>									
Normal	50	100.0	50	100.0	50	100.0	45 – 60 51.78 ± 4.81	45 – 60 54.10 ± 5.23	44 – 60 52.08 ± 4.14
F value							3.522		
P							0.032*		
<b>Skin color</b>									
Pink	50	100.0	50	100.0	50	100.0	--	--	--
<b>Oxygen saturation</b>									
Normal	50	100.0	50	100.0	50	100.0	95 – 98 97.0 ± 1.010	95 – 98 96.38 ± 1.19	95 – 99 97.54 ± 1.12
F value							13.592		
P							0.0001*		
<b>Temperature (°c)</b>									
Normal	50	100.0	50	100.0	50	100.0	36 – 37.5 36.54 ± 0.401	36.2 – 37.5 36.73 ± 0.468	36 – 37.5 36.65 ± 0.408
F value							2.480		
P							0.087		
<b>Heart rate (b/m)</b>									
Normal	50	100.0	50	100.0	50	100.0	120 – 145 132.58 ± 6.08	125 – 158 138.72 ± 10.04	120 – 157 137.74 ± 9.59
F value							7.095		
P							0.001*		
<b>Random blood sugar (mg/dl)</b>									
Normal	50	100.0	50	100.0	50	100.0	69 – 120 97.50 ± 19.87	69 – 122 104.9 ± 17.45	69 – 120 100.06 ± 18.66
F value							2.021		
P							0.136		

**Table 5:** Correlation between nurses’ knowledge and practice related to developmental supportive care of premature neonates before and after the program

Total practice before the program	Levels of total nurse’ knowledge (n =50)						R	P
	Poor knowledge		Fair knowledge		Good knowledge			
	No.	%	No.	%	No.	%		
<b>Before program</b>								
Unsatisfactory practice	47	94.0	2	4.0	1	2.0	0.012	0.933
<b>Immediate after program</b>								
Satisfactory practice	0	0.0	0	0.0	50	100.0	0.195	0.174
Unsatisfactory practice	0	0.0	0	0.0	0	0.0		
<b>One month after program</b>								
Satisfactory practice	0	0.0	13	26.0	34	68.0	0.052	0.791
Unsatisfactory practice	1	2.0	2	4.0	0	0.0		

**Table 6:** Relationship between nurses' practice and their socio-demographic data before, immediate, and one month after the program

Socio-demographic data of nurses	Total practice scores (n =50)			
	Immediate than before		After one month than before	
	Mean±SD	χ2 value P	Mean±SD	χ2 value P
<b>Age in years:</b>				
20 - < 25	10.00±4.24	2.017	8.50±6.63	4.279
25 - <30	13.63±3.16	0.365	13.26±3.19	0.118
≥ 30	13.44±2.44		11.24±2.73	
<b>Educational level</b>				
Nursing technical institute	13.363±2.89	0.110	12.27±3.26	0.947
Bachelor of nursing	13.411±2.76	0.740	11.17±3.06	0.330
<b>Years of experience (years)</b>				
1 - < 5	12.700±3.36	1.762	12.400±3.59	1.435
5 - < 10	13.944±2.68	0.623	12.500±5.93	0.697
10 - < 15	13.250±2.48		11.437±2.55	
15 – 20	13.166±3.48		10.500±4.37	

**Discussion**

Premature birth is a major healthcare issue affecting 15 million births every year. It is the leading cause of mortality and morbidity among children aged less than 5 years, with a majority of deaths due to preterm birth occurring in the neonatal period. More than one million of those babies die shortly after birth; countless others suffer some type of lifelong physical, neurological, or educational disability, often at great cost to families and society [14].

Many studies have highlighted the positive impact of developmental care on premature neonates; it is still a relatively new approach to care. Furthermore, developmental care has been proven to have several positive impacts on the premature neonates who receive it, even if it is not a standard of care in many NICUs. Developmental care can help premature neonates to maintain heart rates, regulate sleep cycles, gain weight and improve appropriate neurobehavioral development. Also, it focuses on healthy long-term growth and development of the premature [15].

The current study was conducted to evaluate the effect of a developmental supportive care training program on nurses' practice regarding the behavioral response of premature neonates. The results of the current study revealed that about two-thirds of studied nurses graduated from Nursing Technical Institute, one third of studied nurses were Bachelor of nursing. This can be explained by the ignorance of developmentally supportive care not related to educational level and must include in the curriculum of graduate students, also, there were about near one -thirds high qualified nurses and slightly near three quarter were nurse's technician in NICU. In addition, the result of Elarousy (2020) who inconsistent with the present result as they stated that three fifth of studied nurses had a bachelor's degree in nursing [16].

Regarding socio-demographic characteristics of the studied nurses, concerning attendance to the previous training program about developmental supportive care, the present study revealed that all nurses hadn't attended the previous training program. From the researchers' point of view, these are because of lack of orientation to all neonatal staff, not an application of evidence practical guideline recommendation about developmental supportive care, and diminish of research studies. This result of Pineda (2017) who was in the same direction with the current result and stated that education from qualified experts in neonatal behavioral interpretation is necessary to ensure the neonate is 'seen as

an individual with unique responses and needs [17]. The result of Milette (2017) who recommended that developmental care training should be offered in post-graduate and advanced practice courses in neonatal care [18]. This result may be interpreted on the basis that all nurses hadn't attended the previous training program. On the other hand, Zhang (2016) who mentioned that the current result and found that all the participants reported that they had received 6 to 14 hr. of developmental care training either from their NICU more than two third or from the Chinese Nursing Association (CAN, one third) [19].

Regarding the gestational age of the studied premature neonates in the current study, it was observed that more than four fifth were premature (32 up to 36 weeks of gestational age). From the researcher's point of view, they were the available premature neonates in the pediatric medical department according to the inclusion criteria of the study. The result of WHO (2018) who in agreement with the present study as they reported that every year, over 14.9 million children are born prematurely [20], also, in this period of data collection, 273 premature neonates were admitted to the neonatal intensive care unit Tanta University statistics (2020) [21].

A recent study conducted by Upadhyay (2021) who in the same direction current result and reported that the number of premature neonates less than one hundred admission/month. Regarding their diagnosis, the present study showed that the highest percentage nearly one-third of them had jaundice [22].

Furthermore, Center for Disease Control and Prevention (2018) who reported that congruent with the present study result and reported that preterm birth accounted for less than one third of infant deaths, even when preterm birth does not result in the death of an infant, infants are susceptible to breathing and feeding problems, vision and hearing loss, and cerebral palsy [23].

The current study revealed that the birth weight of the majority of the studied preterm neonates ranged from 1000-1800 gm it was observed than more than half were low birth weight. The researcher can justify this result as most of them were born with low birth weight. On the other hand, Alemdar (2019) who mentioned that the current result and found that the birth weight of all premature neonates >1,000 g [24].

As regards socio-demographic characteristics of premature neonates, it was observed that the highest percentage of

them had jaundice followed by apnea, anemia, respiratory distress, and septicemia, aspiration pneumonia, and pulmonary hemorrhage. This result stands in contrast to March of Dimes (2015) who found that NICUs were intensive care nurseries for neonates born prematurely or with complex medical conditions, such as, respiratory distress, anemia, apnea, and sepsis [25].

The current study revealed that the laboratory investigation of premature neonates' hemoglobin, platelets, and total bilirubin had a subnormal result. The researcher can justify this result of the investigation as all studied premature neonates were relevant to their medical condition and prematurity.

Developmental care is a standard of care and best practices to preterm neonate care, yet the requirements and barriers perceived by professionals performing developmental care in the NICUs have been minimally reported [26]. So, there is evidence to support that enhancing NICU nurses' knowledge and nursing care is an effective strategy for ensuring the positive development of the preterm neonate in the NICU [26]. Regarding caregivers of the studied children, the results of the present study revealed that the studied NICU nurses had a lack of information about developmental supportive care of premature neonates, its component and could not carry out developmental care quality protocol. Furthermore, difficulties in application kangaroo positions in NICU.

The current study figured out that there was a highly significant improvement in total nurses' knowledge about nurse's roles in providing developmentally supportive care after the SDC training program. From the researchers' point of view, this improvement in nurses' knowledge was due to the enthusiasm of nurses to improved understanding and best practice of SDC, its importance, and its important impact on growth and development.

From the researchers' point of view, lack of ongoing evidence-based practice issues training played an important role in the improvement of their knowledge most of studied nurses had poor knowledge before the SDC training program; the majority of studied nurses had good knowledge after the SDC training program. Guiles (2016) who agreed with the present study as they found that a significant improvement in neonatal nurses' competency, knowledge, and practices post-training program [27].

Valizadeh (2013) was in the same direction with the current results who found that structured teaching programs regarding developmental supportive care for premature neonates can improve the quality of nursing care in NICU [28]. While Ouladsahebmadarek (2020) who against the current result and stated that providing incomplete developmental care was expected in certain working shifts, such as night shifts, when the noise, light, and other dimensions of developmental care could not be fully controlled by the researcher [29].

The present study revealed that there was a significant improvement in total nurses' practice after the implementation of the SDC training program. This result may be interpreted by the researcher that improvement of nurses' knowledge increased their perceived benefits of applying SDC. The significant improvement after the training program may be contributed to the commitments of the nurses toward improving their practices when they have the chance to attend training to provide a high quality of

care for premature neonates. This result was supported by Johnson (2017) who found that a significant improvement in neonatal nurses' practices and knowledge post-training program [30].

From the findings of the present study, it was concluded that the mean scores of nurses' practice one month after than before the SDC. This result may be interpreted by the researcher that improvement of nurses' practice knowledge increased their perceived benefits of implementing the core of SDC and raising their awareness after the training program. This result was supported by Khawash (2018) who agreed with the current results and notified that increase nurses' awareness improves their practice [31]. Conversely, Park and Kim (2019) mentioned that the majority of nurses were aware but did not routinely practice KC, nesting and there was no clear guideline and not all nurses are supportive of developmental care [32].

The present study revealed that there was a highly significant difference related to premature' respiration, oxygen saturation, and heart rate. This result was supported by Reyhani (2014) who reported that reduced heart rate and hypoxia during developmental care practices such as KC, modify positioning reducing environmental noise and light [33]. Loewy *et al.* (2013) and Ranger *et al.* (2018) suggest that the application of SDC helps premature neonates regulate their physiological functioning, decrease in heart rate and allow effective growth and positive development [34, 35]. Also, Abdallah *et al.*, (2013) agreed with the present result and clarified that SDC has a positive impact on premature neonates [36]. Cho *et al.* (2016) indicated that the importance and effectiveness of SDC in improving the physiological functioning of premature neonates [37].

On the other hand, Dolgun (2017) was incompatible with the present result and reported that there were no significant differences between the two groups in terms of heart rate, respiratory rate, and oxygen saturation [38].

Regarding the correlation between nurses' information and practice related to developmental supportive care of premature neonates before and after the program, all of them had good information with the satisfactory practice immediately after the SDC training program. It was found that there was a positive non-significant correlation was revealed between before, immediately after, and one month after the program. Macho (2018) who mentioned with the present study and stated that revealed a positive correlation between nurses' practice, and perceived self-competency regarding developmental care in the NICU [39]. From the findings of the present study, there was no relation between nurses' information and their socio-demographic data [40].

## 6. Conclusion

Based on the findings of the present study, it can be concluded that developmental supportive care had a positive effect on nurses' knowledge and practices as well as their perceived self-competence regarding the behavioral response of premature neonates as evidenced improved their oxygen saturation, regulate heart rate and respiration.

## 7. Recommendations

Based on the findings of the present study, the following recommendations are suggested:

- 1) Implementation and continuing education of the staff in



the NICU (doctors, nurses, etc.) are important to improve the quality of care provided for premature neonates.

- 2) Developmental supportive care as an evidence-based practice for premature neonates can be included in the curriculum of graduate students of the faculty of nursing.
- 3) Implementation of the national and international guidelines of DC to be successful and sustainable.
- 4) Implementation quality control standard as National Safety Requirements for premature neonates.
- 5) Administrative policy and procedures for nursing practice of developmentally supportive care for high-risk neonates are needed.

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