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Original research

Promoting developmental supportive care in preterm infants and families in a level III neonatal intensive care unit (NICU) setting in India

Y. Sathish[a], L.E. Lewis[b], J.A. Noronha[c,*], B.S. Nayak[c], M.S. Pai[c], Altimier L.[d]

[a] Manipal College of Nursing, Manipal, India
[b] Neonatal Unit, KH, Manipal, India
[c] Manipal College of Nursing, India
[d] Philips HealthTech & Northeastern University, Boston, USA

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ABSTRACT

Despite evidence of short- and long-term benefits of developmental care, several studies have documented nurses' lack of knowledge and skills related to developmental care concepts. This study aims to enhance neonatal nurses' abilities to acquire care practices (knowledge and skills) regarding Developmental Supportive Care (DSC).

A nonrandomized before and after intervention design was adopted to improve the knowledge and skills of staff nurses in DSC practices for preterm infants in Level III B NICU. The study included 50 level III B NICU nurses (25 in interventional group, 25 in control group) located within a tertiary care hospital in India.

A significant increase in the mean knowledge score was seen among participants in the intervention group (pre-test: 16.6 ± 3.1, post-test: 29.9 ± 4.1, $p = 0.01$) but not in the control group (pre: 16.4 ± 2.2, post: 18.6 ± 3.6, $p = 0.98$). The improvement in the skills of providing DSC among neonatal nurses was also higher in the intervention group (106.4 ± 7.4) relative to the control group (65.8 ± 3.6), $p < 0.01$, at 0.05 level of significance.

The Developmental Supportive Care Program (DSCP) had a significant impact in improving the knowledge and skills of nurses in providing care and preventing complications in preterm infants.

1. Introduction

Newborn infants are the most susceptible population worldwide. It is estimated that 15 million infants are born preterm (before 37 completed weeks of gestation), and this number is rising. Globally, prematurity is the leading cause among the deaths in children under the age of five. (Liu et al., 2016). Almost one million children die each year due to complications of preterm birth. Many survivors face lot of problems that includes learning disabilities, visual and hearing problems (Blencowe et al., 2012). Medical advances in the care of infants have improved the chance of survival, yetthe impact this experience has on an infant and their parents cannot be underestimated. Stress is one of the main complications among preterm infants admitted to a neonatal unit, which has short- and long-term effects on health status, growth, and development (Montirosso and Provenzi, 2015).

The neonatal team can minimize the amount of stress in preterm infants by monitoring stress levels and intervening when necessary. Additionally, attempts must be made to reduce the negative impact of potentially harmful stimuli that preterm infants are exposed to. The caregiver is central to the infant's developing Central Nervous System (CNS) system; it has even suggested that the caregiver serves as a buffer against stress (Als et al., 2003).

Subsequent studies have demonstrated improvement in the neuromuscular developmental outcomes and clinical improvement by providing a developmentally appropriate sensory milieu, which includes promoting a healing environment, positioning the infant in alignment, flexion, and containment, minimizing disruptions, and providing care based on infant cues. (Als et al., 2004) (Altimier et al., 2015.) (Altimier et al., 2005).

Incorporating and hard wiring developmental care principles and neuroprotective interventions into any NICU involves many aspects and disciplines. The basic physical, sensory, and inter-relational needs of preterm infants and their families can partially be achieved by (1) promoting physical design changes that are healing in nature, (2)

* Corresponding author.
E-mail addresses: yashoda.s@manipal.edu (Y. Sathish), leslie.lewis@manipal.edu (L.E. Lewis), judith.n@manipal.edu (J.A. Noronha), baby.s@manipal.edu (B.S. Nayak), mamatha.spai@manipal.edu (M.S. Pai), laltimier@gmail.com (L. Altimier).

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selecting developmentally-sensitive equipment (e.g. quiet motors), (3) incorporating developmental care concepts and neuroprotective interventions into all policies, procedures, protocols and guidelines rather than having one single developmental care policy, and (4) ensuring that all NICU staff are educated and trained on concepts of developmental care. Changes to the environment and developmental supportive interventions can positively impact preterm infant brain development and long-term outcomes. A successful developmental care program is the product of multidisciplinary teams, which includes parents, nurses, nurse practitioners, neonatologists, occupational/physical therapists, administrators, architects, engineers, and social workers (Ramachandran and Dutta, 2013.) (Altimier et al., 2015.).

Literature gives evidence of short and long-term benefits of DSC in developing countries, several studies have documented nurses' lack of knowledge in developmental Supportive Care.(Symington and Pinelli, 2002). Neonatal nurses being primary caregivers in the NICU, they are in a key position to minimize positional deformities, and to promote normal and healthy growth by providing a conducive environment (Altimier et al., 2015.). The implementation of a DSC program demands that NICU staff acquire new knowledge and skills, it is surprising to note that very little has been published on developmental care training programs (Altimier et al., 2015.) (Louw and Maree, 2005). Although it is clear that developmental care is effective in improving outcomes, less is known about how to improve Developmental Supportive Care, especially related to positioning for preterm infants by the nurses providing the care. (Altimier and Phillips, 2016). In Indian scenario majority of the nurses working in the neonatal care unit are with the Basic Nursing Degree or diploma with experience. However the concept of developmental supportive care is new. The current nurses are exposed to regular in service education on neonatal care and none of them have received DSC training. Thus there is a gap between the evidence and existing practice. The present study examines the effectiveness of Developmental Supportive Care Program to improve the knowledge and skill of NICU nurses in providing healing environment, family partnerships, positioning, handling (minimizing stress and pain), protecting skin, safeguarding sleep, and optimizing nutrition for preterm infants through a Developmental Supportive Care Program.

2. Methods

The present study was conducted in a Level III B NICU at the selected hospital of Udupi district using a nonrandomized before and after intervention. Knowledge of NICU nurses providing DSC to preterm infants was assessed utilizing a structured DSC knowledge questionnaire before and after the DSCP intervention and skill was assessed post intervention using observational check list.

The Developmental Supportive Care Program (DSCP) was carried out to NICU nurses only in the Interventional group. Training was split into seven (7) separate sessions with a total of six (6) learning modules. (Table 1). During the first session, an explanation of the DSC program and the scheduling of the program was provided, and informed consent was obtained. A Pre-test knowledge levels of all neonatal nurses (Interventional group and control group) was measured using the structured knowledge questionnaire of DSC of preterm infants. A DSC training manual with educational contents was then distributed to only interventional group participants.

Session 2 consisted of the first learning Module which covered developmental theories, preterm infant behaviors and fetal brain development. Theoretical concepts on various Developmental Care models were taught, one of which included Heidelise Als Synactive Theory of Infant Development. (Heildes, 1986) The second developmental care theory discussed was the Neonatal Integrative Developmental Care Model (Neonatal IDC) (Philips HealthTech, Cambridge, MA) which was used as an educational framework for the DSCP curriculum to guide the implementation of neuroprotective care for premature infants. (Altimier and Phillips, 2016) (Altimier and Phillips, 2013).

The Neonatal IDC Model which utilizes neuroprotective interventions as strategies to support optimal synaptic neural connections, promote normal neurological, physical, and emotional development and prevent disabilities was applied. Seven core measures for neuroprotective family-centered developmental care of premature infants are depicted on petals of a lotus as the Healing Environment, Partnering with Families, Positioning & Handling, Safeguarding Sleep, Minimizing Stress & Pain, Protecting Skin, and Optimizing Nutrition (See Fig. 1). The integrative nature of developmental care is depicted in the over lapping petals of the model. (Altimier and Phillips, 2013) The center of the lotus represent the mother/child dyad by symbols representing extra-uterine environment in which the infant now lives the healing environment, the significance of the developing infant's sensory system, and the influence of family, and staff have on the infant-family unit. The model also gives emphasis to the skin-to-skin contact (SSC). It is also a foundation for care of preterm infants and is the ideal environment for care to be provided in the NICU. Each of the seven distinct core measures identified in the Neonatal IDC model provides clinical guidance for NICU staff in delivering neuroprotective family-centered developmental care to preterm infants and their families while in the NICU (Anderson et al., 2016) (Bockli et al., 2014) (Cooper et al., 2007.).

Further each core measure is related to the specific core measure and explained with a policy and protocol to guide care of infants and family core measure. Corresponding infant characteristics, which are measurable reflections of the desired neuroprotective interventions that define and specify the actions required to meet the goal re explained interms of clinical application. (Altimier and Phillips, 2013).

The preterm behavioral development that includes, assessment of the autonomic, motoric, and state subsystems are given priority in care by assessing the pain and stress behavioral stress cues and safeguarding sleep. (Spittle and Treyvaud, 2016) (Graven, 2006) (Sharek et al., 2006).

“Activities of Daily Living” (ADL) which consisted of three neuroprotctive core measures: Positioning and Handling, Protecting skin, and Optimizing nutrition. (Altimier, 2015) and Healing Environment involves content related to the developing Sensory System environment, the actual NICU physical environment, and the People environment. All three subsystems interplay to either promote a healing environment, or create a sometimes harsh, loud, and bright physical environment, and unfortunately, the biggest source of noise in the NICU setting is staff. In addition to improving neonatal clinical outcomes, a primary goal of DSCP is to improve family satisfaction by providing continuity of care through trained NICU staff as well as by providing a unique environment for families to participate in this care. The psychosocial needs of parents who are enduring the unexpected and extreme stress of having a hospitalized preterm or sick newborn has been long neglected and most NICU staff have not been trained to recognize the psychosocial needs of NICU parents. The neuropotective core measure of partnering with families is discussed in detail with interventions on how to coach and support parents, especially moms, in the care of their infant. Throughout each and every learning module, the topic of skin-to-skin/kangaroo care pops-up. This topic is essential to the care of premature infants and their families. While neuroprotective care helps to protect the preterm brain from the relatively harsh, extra-uterine environment of the NICU, neurosupportive care provides a foundation upon which neuroprotection can occur. (Altimier and Phillips, 2013). Once all of the learning modules were taught to the Interventional group of staff nurses, preterm infants were then randomly assigned to either the intervention or control group of neonatal nurses, which was part of Session 6. DSC practices were observed by the nurse researcher. Assistance in DSC concepts (ex. positioning & handling) was provided by the nurse researcher on request by intervention nurses, but this occurred only during the first week of the study. The final session, (7), consisted of a Post-DSC Program Assessment. A Post-test DSC Knowledge Level assessment was performed again on both the Interventional and Control groups of neonatal staff nurses, utilizing the structured knowledge

Table 1
Outline of the developmentally supportive care program (DSCP).

Session	Description
1	**Explanation of DSC program and schedule were provided; informed consent was obtained** ● **(Pretest)** –Knowledge level was assessed using the structured knowledge questionnaire on DSC of preterm infants for both the intervention and control groups ● **DSC Manual** was distributed only to the intervention group of staff nurses
2	**Module 1):** Preterm infants & fetal brain development ● Developmental Theories: (Synactive Theory of Infant Development/Neonatal Integrative Developmental Care Model) ● Outcomes of Developmentally Supportive Care ● Developing Brain (stages of brain development/brain functions) ● Features of prematurity, classification of prematurity, and gestational age assessments
3	**Module 2):** Understanding preterm behavioral Development ● Communication Signals – Behavioral Cues (Autonomic, Motoric, and State Subsystems) **Module 3):** Core Measure – Minimizing Stress & Pain ● Minimizing Stress - Reduce stressors associated with the NICU o Signs of Stress – Reading signals/Stress Reduction Strategies ● Assessment & Management of Pain - Physiologic/Behavioral/Chemical Manifestations of Pain o Pain Assessment (PIPP scale) o Non-pharmacologic pain management – Strategies to promote comfort and manage pain - Comfortable positioning, sucrose, skin-to-skin/kangaroo care, breastfeeding **Module 3):** Core Measure – Safeguarding Sleep ● Sleep - Awake States/Cues/Sleep patterns/Circadian Rhythms/Day-Night Cycling ● Strategies to promote sleep
4	**Module 4):** ADL: Core Measure - Positioning & Handling ● Principles of Midline, Flexed, Contained, and Comfortable Positioning ● Use of Positioning aids & boundaries to support positioning (Snuggle-Up Positioning Aids) ● Minimal Handling, Clustering of Care, & Promoting containment **Module 4):** ADL: Core Measure – Protecting Skin ● Principles of Humidity ● Skin Assessment (WHO Skin Assessment Tool) ● Sponge/Swaddled Bathing **Module 4):** ADL: Core Measure – Optimizing Nutrition ● Breastmilk/Breast pumping/Breastfeeding ● Non-nutritive sucking/Cue-Based Feedings/Promote positive oral feeding experiences ● Facilitate early, frequent, and prolonged skin-to-skin contact/kangaroo care
5	**Module 5):** Core Measure - Healing Environment in the neonatal unit ● Sensory System development ● Strategies to Protect the developing sensory system **Module 6):** Core Measure – Partnering with Families ● Principles of Family-Centered Care (FCC)/Core Concepts of FCC ● Encouraging Family participation in infant care
6	**Methodology** ● Preterm infants were randomly assigned to either the intervention or control group of neonatal nurses. ● DSC practices were observed in both groups by the researcher ● Assistance in DSC concepts (ex. positioning & handling) was provided on request by intervention nurses only the 1st week
7	**Post-Program Assessment** ● **Post-test:** DSC Knowledge Level scores of staff nurses in the Interventional group were assessed using the DSC structured knowledge questionnaire after Week-One of the DSCP intervention ● **Observation:** DSC practice skills of each staff nurse (in both the interventional and control groups) were observed and recorded using the Observation Check-list of DSC practices after providing DSC for one week.

questionnaire. This questionnaire was given one week following the DSCP intervention. After implementing the DSC Program for one week, DSC practice skills of each staff nurse (in both the interventional and control groups) were again observed and recorded by the research nurse using the Observation Check-list of DSC practices, stress level of preterm infants, clinical and growth and developmental outcome were documented as outcome measure of developmental supportive care programme.

2.1. Participants

A total of 54 staff nurses were recruited to the study through enumerative sampling. (See Fig. 2). Four nurses were excluded (two from each group); three resigned and one was on an extended leave of absence during the study period. Background information and characteristics of all fifty NICU staff nurses was obtained. The staff nurses recruited were randomly assigned to either the intervention or control group through a lottery method. Informed consent was obtained by each participant after thoroughly explaining the study purpose.

2.2. Ethical consideration

Although developmental care has become a standard of care in many NICU's across the world, it has yet to become an accepted or standard of care for NICU's in India. As the introduction of these developmental care concepts were entirely new to nurses in the NICU.

The study was therefore conducted after obtaining approval from the Institutional Research Committee, Institutional Ethical Committee Board. (IEC:239/2012) and administrative permission from both the hospital Chief Operating Officer and the NICU Department Head.

2.3. Data collection procedure and instruments

Data collected on all NICU staff nurse participants included a demographic profile consisting of age, religion, professional qualifications, and previous exposure to principles of Developmentally Supportive Care. The investigator underwent DSC training program prior to implementation of the intervention. The training program was delivered by investigator alone to maintain the consistency in content delivery.

Recruitment: Recruitment of both the Interventional and Control groups was based on the availability of nurses (2–5), that were

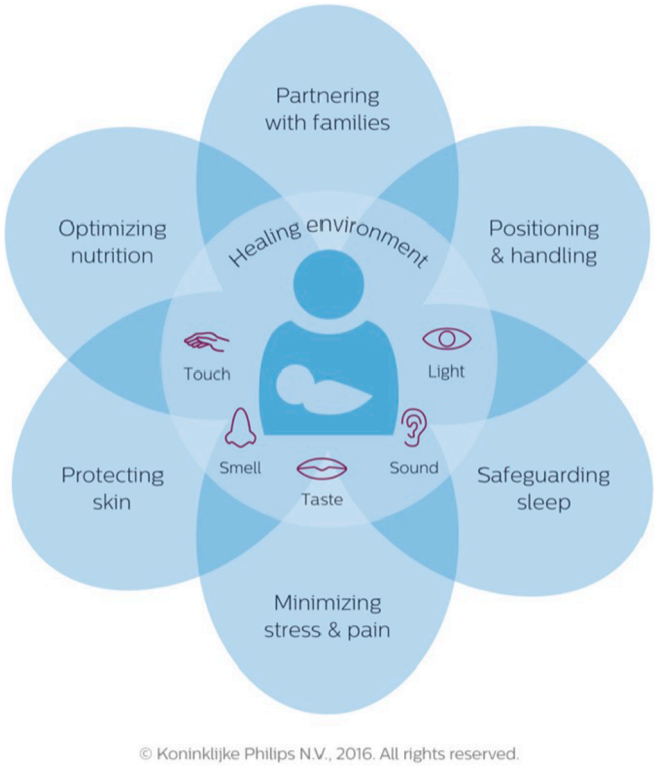

Fig. 1. Neonatal integrative developmental care model. (adpated with permission from Altimier and Phillips, (MCh development))

assigned < 32 weeks' gestation pre-term infants within 72-h of birth.

Day One of Recruitment: Interventional Group**:**

- Informed consent was obtained from the mother.
- DSC program content and study design were discussed with the mother.
- Developmentally Supportive Care was initiated by DSC trained nurses.

Day 1 – Day 28: Interventional Group: The following Developmental Supportive Care practices were provided, and outcome measures were documented.

1. **Positioning:** Each infant was positioned in a snuggle-up (Philips) to maintain an aligned, flexed, and contained position during all caregiving activities.
2. Maintaining a Healing environment
   a. Noise: Protocol to control Noise levels were followed in the NICU.
   b. Light: Dimmed lighting was maintained at 250 lux (day), 25 lux (night).
3. **Protecting Skin:** Routine skin assessment and skin integrity was assessed using a reliable assessment tool at least once per shift and documented. The skin surface was protected during application, utilization, and removal of adhesive products.
4. **Providing Clustered care:**
   a. Infant position was evaluated with every infant interaction and was modified to support symmetric development.
   b. Routine cleaning occurred (disinfection of cradle or incubator).
   c. Physiological parameters were measured, and salivary cortisol was collected.

≥ 31-Weeks' gestation – 34 Weeks' gestation:

1. Positioning, maintaining a healing environment, protecting skin, clustering care (Steps 1–4) continued.
2. Non-nutritive sucking with NG feedings was initiated. Assessment of feeding readiness cues and quality of oral feedings were documented with each oral feeding encounter.
3. Sensory stimulation (via tactile and auditory-visual) was introduced by the care providers (nurse and mother) after 30-weeks' gestation.

Mother's Role: When the mother arrived in the NICU:

1. The purpose of the study was explained.
2. The nurse trained in DSC oriented the mother to the NICU and

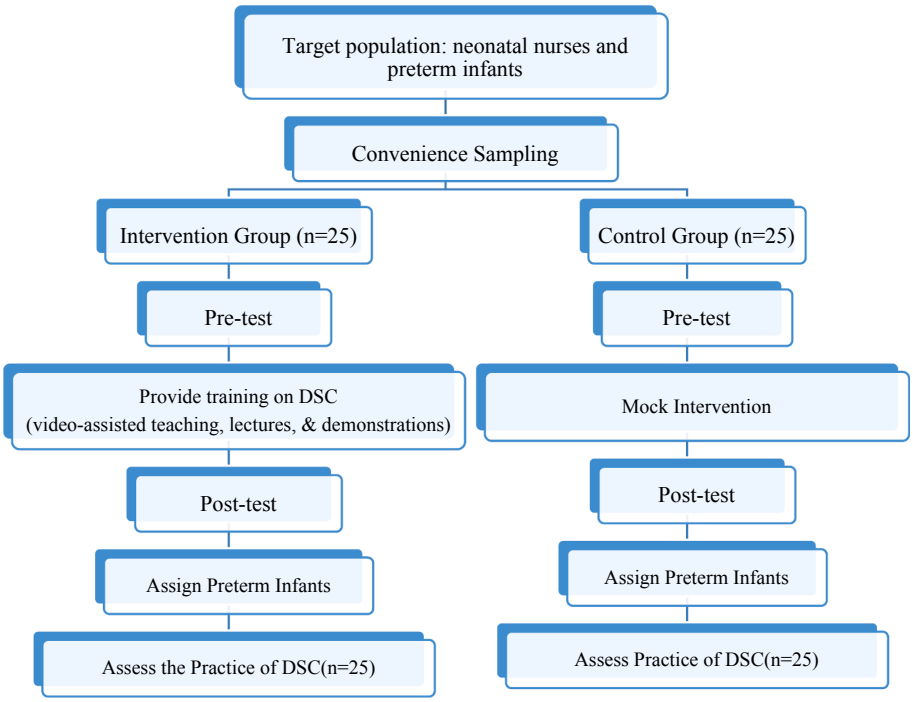

Fig. 2. Research design.

equipment.
3. The mother was encouraged to touch her infant and handle once stable.
4. Kangaroo care was initiated as early as possible once the infant was stable and was continued throughout the hospitalization.
5. The mother was taught the importance of non-nutritive sucking, eye-to-eye contact, and interacting with her infant.

Control Group:

Day 1: Informed consent was obtained from the mother and the research study and design were discussed with the mother.

The following routine standard care practices were provided, and outcome measures were also documented.

1. Folded sheets were placed around the infant, without standard positioning aids.
2. No changes were made in relation to noise or lighting practices.
3. Mothers visited their baby on and off throughout the NICU stay.
4. Kangaroo care was provided by mom whenever she visited the infant. No standard sensory stimulation was provided to infant by the nurse or mother

2.3.1. DSC structured knowledge questionnaire

The structured knowledge questionnaire used to assess DSC knowledge acquisition included questions related to the following topics: preterm infants, brain development, understanding preterm behavior/cues, assessment and management of stress and pain, and the importance of protecting sleep. Additional questions related to activities of daily living (positioning and handling, protecting skin, feeding and nutrition, kangaroo care), along with healing environment and family-centered care questions were assessed. The reliability was 0.759.

2.3.2. DSC observational checklist

To assess the acquisition of developmental care skills (care practices) in the NICU, a 32-item DSC observational checklist with a four-option rating scale was developed. The DSC observation checklist includes measurements related to the following areas: preterm brain development and behavioral cues, the healing NICU environment (physical, sensory, and staff), partnering with families, positioning and handling, safeguarding sleep, minimizing stress and pain, protecting skin, feeding and optimizing nutrition, family-centered care, as well as kangaroo care. To interpret the level of developmental care practices acquired, scores were classified as Excellent (≥ 96), Good (86–95), Fair (51–85), and Poor (≤ 50). The reliability of the observational check list was 0.793.

2.4. Data analysis

Data analysis was performed using descriptive and inferential statistics. Frequency and percentage were computed for categorical measures and continuous data were analyzed using mean and standard deviations (SD). An independent *t*-test was used to compare the mean score between pre- and post-tests within and between the intervention and control groups. Paired *t*-test computations were utilized to analyze the mean post-test score between the intervention and control groups.

3. Results

3.1. Background information and characteristics

Background information and characteristics of all 50 NICU staff nurses were obtained and percentage distributions are described in Table 2. The majority of the 50 staff nurses working in the NICU, the mean age in years was 26.3 ± 2.4 in intervention group and 25.5 ± 3.4 in control group, majority held a 'Diploma in Nursing' professional qualification, and had less than five years of NICU experience.

Table 2
Sample characteristics of neonatal nurses' background information.

	Intervention (n = 25)	Control (n = 25)	X^2 Value	p value
Nurses' age in years, mean (SD)	26.3 ± (2.4)	25.5 (3.4)		.39
Professional qualification,	n (%)	n (%)		
• Diploma in nursing	16 (64)	18 (72)	12	.91
• BSc Nursing	6 (24.0)	4 (16)		
PB BSc Nursing	2 (8.0)	2 (8)		
• PB Diploma in Nursing	1 (4.0)	1 (4)		
Experience in neonatal unit, n (%)				
• < 5 years	21 (84)	23 (92)	.93	1.0
• > 5 years	4 (16)	2 (8)		

3.2. DSC knowledge level scores

Prior to the intervention, all nurses (100%) had poor knowledge score of DSC in both groups. Post-test DSC knowledge acquisition scores in the Interventional group increased as follows: 10 (40%) scored 'adequate', 3 (12%) scored 'moderate', and 12 (48%) scored 'poor'. One hundred percent (25/25) of NICU nurses in the control group demonstrated a 'poor' DSC knowledge level score in both the pre- and post-test knowledge scores. Table 3 demonstrates pre- and the post-test categories of DSC Knowledge Scores among NICU staff nurses in both the Intervention group (n = 25) and the Control group (n = 25).

3.3. Mean pre- and post-test DSC knowledge level scores

The mean pre- and post-test DSC knowledge scores for the interventional group were 16.6 and 29.9, respectively. The Control group mean pre- and post-test DSC knowledge scores were 16.4 and 18.6, respectively. The differences within each group was not statistically significant at the 0.05 level; however, differences between the Intervention and Control groups, mean post-test DSC knowledge scores of the Interventional group nurses compared to the Control group nurses was statistically significant ($p < 0.001$). Table 4 shows the statistical data related to pre- and post-test DSC Knowledge Scores among NICU staff nurses in both the Intervention and control groups.

3.4. NICU Unit-Wide Distribution of DSC knowledge scores

A NICU Unit-Wide Distribution of Pre- and Post-test DSC Knowledge Scores among staff nurses working in NICU are outlined in Table 5, and Fig. 3 is a graphic representation of these same results.

Scores are further delineated by the six DSC program modules. Statistical significance was recognized in all six content areas of the Intervention group's post-test scores, demonstrating knowledge acquisition.

3.5. Observation of DSC skills/practices

In addition to knowledge acquisition, observations of DSC skills/practices yielded similar results, demonstrating the ability of NICU nurses to transfer learned knowledge to DSC care practices in preterm infants. The frequency and percentage distribution of observed levels of DSC skills/practices are demonstrated in Table 6.

Post-test observations of DSC skills/practices revealed that of the 25 Interventional group nurses, 22 (88%) achieved an excellent score and 3 (12%) achieved a good level score. Among the 25 control group nurses, 12 (48%) practiced DSC at a fair level and 13 (52%) practiced DSC at a poor level.

The mean differences in DSC Skills/Practice scores between the

Table 3
Pre- and post-test categories of DSC Knowledge scores among Interventional and Control groups of NICU staff nurses (N = 50).

Knowledge Score Category	Intervention (n = 25)		*p* value	Control (n = 25)		*p* value
	Pre-test, n (%)	Post-test, n (%)		Pre-test, n (%)	Post-test, n (%)	
Adequate (> 32)	0 (0.0)	10 (40.0)	.001	0 (0.0)	0 (0.0)	.50
Moderate (25–32)	0 (0.0)	3 (12.0)		0 (0.0)	0 (0.0)	
Poor (< 24)	25 (100.0)	12 (48.0)		25 (100.0)	25 (100.0)	

Table 4
Mean difference in DSC Knowledge scores among intervention and control groups of NICU staff nurses (N = 50).

Group	N	Pretest			Post-test		Difference			
		Mean	SD	SE dif	Mean	SD	Mean dif	SE dif	*p*-value within group	*p*-value between groups
Intervention	25	16.6	3.1	0.8	29.9	4.1	11.28	1.4	0.01	0.01
Control	25	16.4	2.2		18.6	3.6	2.20		0.98	

Table 5
Unit-wide Distribution of Pre- and Post-test DSC Knowledge scores among NICU staff nurses N = 50.

Unit		Group	Pretest Mean (SD)	*p* value	Post test Mean (SD)	*p* value
I	Preterm infants & understanding of fetal brain development (9)	Intervention	4.0 (1.5)	.36	6.9 (1.1)	< 0.01
		Control	4.3 (0.9)		4.3 (0.9)	
II	Understanding preterm behavior (7)	Intervention	3.3 (1.5)	.70	6.0 (1.0)	< 0.01
		Control	3.5 (1.2)		4.1 (1.0)	
III	Assessment and management of Pain & Protected sleep (8)	Intervention	3.5 (1.2)	.07	5.6 (1.2)	< 0.01
		Control	3.4 (1.2)		5.2 (0.8)	
IV	DSC ADL: (positioning, feeding, skin care and kangaroo care) (10)	Intervention	4.9 (1.3)	.53	6.4 (1.5)	< 0.01
		Control	4.6 (1.4)		4.2 (0.9)	
V& VI	Healing environment in the NICU & Family-Centered Care (6)	Intervention	1.4 (0.8)	.29	5.6 (1.2)	< 0.01
		Control	1.2 (0.5)		4.1 (1.2)	

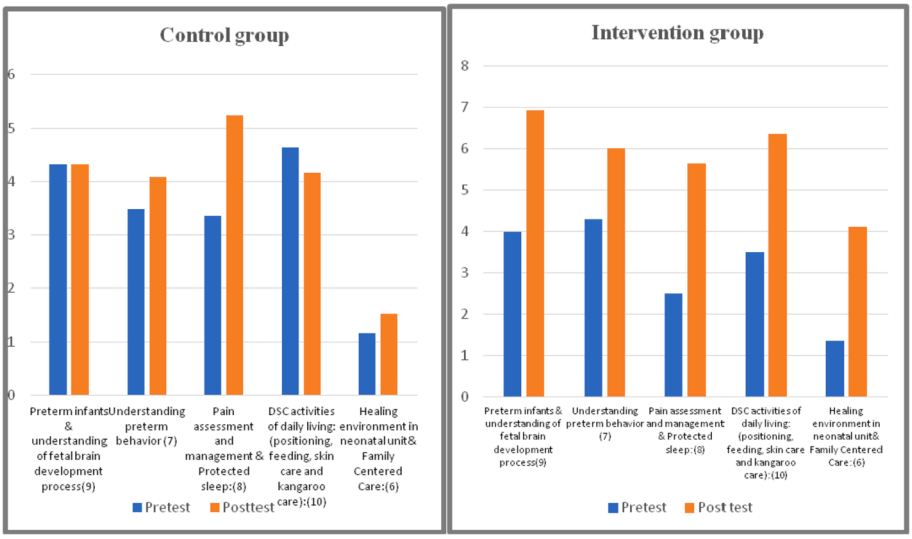

Fig. 3. Unit wide Distribution of Pre- and Post-test DSC Knowledge scores among NICU Staff nurses.

Table 6
Frequency and percentage of Observed mean DSC Practice scores among intervention and control groups of NICU nurses N = 50.

Practice Score	Intervention (n = 25), n (%)	Control (n = 25), n (%)
Excellent Score (≥96)	22 (88.0)	0
Good Score (86–95)	3 (12.0)	0
Fair Score (51–85)	0	12 (48.0)
Poor Score (≤50)	0	13 (52.0)

Table 7
Mean difference in DSC Practice scores among intervention and control groups of NICU nurses.

DSC Practice Score	Intervention (n = 25)	Control (n = 25)	Mean Difference	*SE* Difference	*p* Value
	Mean, SD	Mean, SD			
	106.4 ± 7.4	65.8 ± 8.7	40.7	2.27	$p < 0.01$

Intervention group of NICU nurses (106.4 ± 7.4) compared to the Control group of NICU nurses (65.8 ± 8.7) demonstrated statistical significance ($p < 0.01$) at 0.05 level of significance (Table 7).

4. Discussion

Advanced technologies in neonatal intensive care units has greatly reduced mortality rates for preterm infants. In the traditional multifaceted environment of the NICU, the process of implementing transformational change presents many challenges. The neonatal team is challenged not only to ensure infants' survival, but to also reduce stress levels for infants and families and to simultaneously optimize their developmental course and ultimately, outcomes.

Snuggle-up positioning is an essential component of developmentally supportive care as it supports the infant in a mid-lined, flexed, contained, and comfortable position which contributes to maintaining the infant's airway, promoting thermoregulation, promoting rest and sleep, and improving gross-motor and fine-motor development (Coughlin et al., 2009) (Coughlin et al., 2010). In the present study, preterm infants were positioned in a Snuggle-up positioning aid (Philips Healthcare, Andover, MA) by neonatal nurses in the Intervention group. The main findings related to developmental supportive positioning in this study showed that the 80% (20/25) nurses in the intervention group answered all of the positioning-related DSC questions correctly. This finding demonstrated that the intervention group of nurses had a clear understanding of developmental appropriate positioning concepts and the importance of utilizing a Snuggle-up positioning aid to support the preterm infants' position.

A study by Spilker et al. (2016b) demonstrated that the majority of nurses (76%) agreed that they "always" used developmental positioning techniques (Spilker et al., 2016b).

A similar quasi-experimental one group pre-test/post-test design study showed significantly higher post-test scores for knowledge and theoretical acquisition of developmental care concepts, and recommended such training programs for nurses to facilitate the implementation of developmental care (Milette et al., 2005a). Yet another study conducted by Altimier et al. (2015), demonstrated the positive effect of a comprehensive developmental care training program (Wee Care) on Seven Core Measures for neuroprotective family-centered developmental care of premature neonates. The sample consisted of 81 hospital NICU sites from 27 US states as well as Belgium and the Netherlands, which had implemented the Wee Care comprehensive neuroprotective care training program and had completed pre- and post-site surveys. A secondary data analysis of the extant Wee Care database of pre- and post-testing surveys was done to evaluate the training program and results demonstrated that the Wee Care Neuroprotective NICU training program was effective in improving seven core measures for neuroprotective family-centered developmental care of premature neonates. Each core measure as well as the overall composite core measures score (core measures 1–7) showed statistically significant improvement post training ($p < 0.01$), and a recommendation was made that the program be widely implemented in neonatal units wanting to enhance neuroprotective care of premature and/or sick infants (Altimier et al., 2015.).

A study exploring the congruence of Nurses' Performance with NICU developmental care standards was conducted with 70 nurses in Tabriz, Iran. Nurses responded to a questionnaire collected from Robison's developmental program. Analysis of the Friedman test showed a statistically significant difference among four activity areas ($p = 0.001$).

Another study on the effect of a developmentally supportive care training program on nurses' performance and behavioral responses of newborn infants demonstrated a statistically significant relationship between nurses' obtaining training and nurses' good performance.

The implementation of effective developmentally supportive care was the primary goal for initiating the DSC Training Program, which required not only a big effort individually but also necessitated dedicated efforts of the entire NICU team working towards a common goal.

The present study findings support the aforementioned study results indicating that neonatal nurses working in the NICU showed improvement in knowledge scores regarding the concept of developmentally supportive care of preterm infants after a comprehensive developmentally supportive care training program was implemented.

4.1. Limitations of the study

1. Modification of the each baby cabinet with inbuilt lighting and noise control mechanism was not possible. However the care was taken to minimize the noise and light of the NICU environment.
2. The skill of the nurses in practicing the developmental supportive care was only measured and observed once as continuous observation was not possible for the investigator. However the entire unit functioning was based on the developmental supportive care concept.

5. Conclusions and recommendations

Developmental Supportive Care (DSC) practices and related infant outcomes are well known to the neonatal care team. Training of nurses have definitely enabled to provide neuroprotective care to every neonate, regardless of gestational age, throughout their hospitalization thus enhancing rapid brain growth and neurologic development occurring during the early neonatal period. We must continue making strides towards improving morbidity and mortality rates, while further enhancing neuroprotective interventions for these extremely preterm infants.

Conflicts of interest

The authors declare no competing interests.

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