

"The Effect and Implication of Developmental Supportive Care Practices in Preterm Babies"

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Abstract:-

➤ *Background*

With the growth in the field of Neonatology there is a noticeable decline in both neonatal and infant mortality rate; however, morbidity rate due to neurodevelopmental impairment has not shown any change for the babies who are born preterm. Before the delivery the preterm baby is in the safe environment i.e. inside the mother's womb but immediately after birth the preterm infant has to undergo through a lot of stressful environment in the Neonatal Intensive Care Unit (NICU). These stressful sensory experiences can be harmful for the brain development of infant. This stressful environment may include events such as painful medical procedures, excessive light, excessive noise, disturbed sleep, and most importantly separation from mother. As per the previously done researches, in the developing foetal brain the positive sensory input are replaced by negative sensory inputs which in turn can permanently alter the normal brain development among the preterm babies. For the optimal development of preterm newborn's brain and neurobehavior, an evidenced based intervention- 'Developmental Supportive Care (DSC) practice' can be effective. It stimulates normal motor functions, sensory neurological development, supports stability of autonomic nervous system and promotes organization of behaviour states of preterm babies and also reduces the stress of NICU environment. This paper aimed to provide a systematic review of literature on 'Effects and implications of developmental supportive care (DSC) for preterm babies in NICU'. Method- an electronic search was conducted using the keywords: "Developmental supportive care, preterm baby, NIDCAP, family centred care, neurobehavioral capacity neuroprotection environment and Swaddling". Studies conducted from 2000 - 2020 were fetched from five different research databases (PubMed, Cochrane, CINHAL, Scopus, and Google Scholar). The study search was executed from January to December 2020. A sum of 74 articles were identified which were fulfilling the inclusion criteria, out of which 24 studies (quantitative and qualitative) were involved in this systematic review. During the first stage of review, two researchers singly appraised the titles and abstracts which were followed by second stage of the full text review. Data were individually extracted.

➤ *Result*

All the reviews incorporated in this review article have shown positive results and supporting the developmental supportive care for the preterms babies and their families and none of the review have found any negative impact on the preterm babies. For their outcome measures most of the conducted studies have assessed short term outcome measures at discharge. The considerable areas where positive results are identified include- feeding behaviour, growth, reduced hospital stay, improved neurobehavioral, neuro-physiological, and neuro-structural functioning.

➤ *Conclusion*

For improving the brain and neurodevelopment among preterm babies in NICU, Developmental supportive care is an effective evidenced based intervention. In spite the fact that DSC is very effective, its implication is limited in NICU. Healthcare workers including nurses and doctors plays a major role for its implication in NICU setting.

Keywords:- *Developmental Supportive Care, Preterm Baby, NIDCAP, Family Centred Care, Neurobehavioral Capacity and Neuroprotection Environment, Individualized Developmental Supportive Care, Nurse's Perception.*

➤ *What is Already Known about this Topic –*

- Developmental supportive care has been a perceived clinical implementation approach in neonatal intensive care units for over two decades.
- Developmental supportive care has been associated with different beneficial clinical results.

➤ *What this Paper Adds –*

- Five fundamental estimated sets for evidence based developmental supportive care were recognized: protected sleep, pain, stress assessment and management, developmental activities of daily living, family centred care and the healing environment.
- These five categories review the concepts that materialized from the literature review regarding developmentally supportive care and quality caring practices in neonates.

- This paper displays a compelling authentication that DSC should be implicated in NICUs for optimal growth and development of preterm babies.

I. INTRODUCTION

A nature is supreme in the way it takes care of all the needs of the baby within the womb of its mother. The baby is mildly rocked in the warm amniotic fluid and is well protected from infections and effectively protected from light and sound (Singh M (Ed.), 1999.) Babies born before term have lost the uterine support for the subsystems, comprising containment of the uterine wall and the resilience of the amniotic fluid; state supports like diurnal (daytime) cycles of the mother's sleep-wake cycle, and attention/interaction supports like diminished visual and auditory input (Tecklin, 2007).

According to WHO, every year about 15 million babies are born prematurely across the world and that is more than 1 in 10 of all babies born globally. Almost 1 million children die each year due to complications of preterm birth (2013). Across 184 countries, the rate of preterm birth ranges from 5% to 18% of babies born. In India, out of 27 million babies born every year (2010 data), 3.5 million babies are premature. (<https://www.who.int/en/news-room/fact-sheets/detail/preterm-birth>).

Healthy term babies are neurologically mature to endure this environmental assault and they swiftly adjust to the extrauterine environment with slight assistance without any serious complications, but preterm babies are neurologically undeveloped and physiologically unstable and face challenges to bear environmental insults and stresses, which may unfavourably disturb their neuromotor development. Due to advances in technology, the endurance of preterm babies has improved but the quality of life among the survivors has not considerably increased. (Blackburn S.1998)

During the last three to four decades' technology has revolutionized the care of preterm babies. The earlier relatively humanized approaches in the care of preterm babies by gentle handling and "masterly inactivity" has been replaced by the use of aggressive and invasive hi-tech modalities to provide life support to tiny babies to improve their survival. The art of Newborn care has been sacrificed at the altar of technology (Lucey JH 1977). 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).

The babies are being handled as "objects" without any concern either for their comfort or for their stimulation. The intensive care of the newborn babies has become mechanical or "robotic" and stereotyped instead of being flexible and

individualized. It is a pity that technological advances have dehumanized the care of preterm babies. NICU should have baby-friendly womb-like ambience and ecology to simulate in-utero environment. Depending upon the degree of immaturity, graded rhythmic and soothing stimulation should be introduced when baby has achieved physiologic stability. (Thomas EB, Ingersoll EW, Acebo C.1991). Developmental care is an approach to provide intervention adjusted to the individualized developmental needs of each infant to facilitate improve neurodevelopmental outcome. (Kennel JH. 1999) (Charpak N, Ruis JG, de Calume ZF.2000)(Vander VK. 1992)(Laadt BG, Lilley PK, Westby CE. 1993)(Buehler DM, Als H, Duffy FH, McAnulty GB, Liederman J.1995;96). it includes-

- **Light**-adjustable ambient light between 0.5ft candles to 60ft candles(16). Simulated day night environment to promote diurnal rhythms.
- **Noise level** (Leq) of 45 decibels (dB) and an hourly L10 (the noise level exceeded for 10% of the time) of 50 dB. Transient sounds or Lmax (the single highest sound level) shall not exceed 65 Db, (25). handled with gentle, slow modulated manoeuvres without sudden movements.
- **Handling**-Frequent handling and touching disturbs sleep which leads to decreased weight gain and decreased state regulation. Routine procedures often cause hypoxia. Most episodes of hypoxemia happen during handling by caregivers. Clustering, the idea of performing more care giving tasks at one time limiting the frequency of interruptions as well as providing appropriate quality and intensity of stimulation during wakefulness.
- **Positioning**- Developmentally supportive care giving practices aims at minimizing energy expenditure while promoting a balance between flexion and extension of any infant. Appropriate positioning such as – midline orientation, hand-to-mouth activity, flexion, self-soothing, and self-regulatory abilities –contributes to neurobehavioral development.
- **Containment**: It refers to the 360 degrees of surface pressure the fetus is provided in utero. Body containment is important because it increases the infants feeling of security and self-control and decreases stress. Infants who are contained tend to be calmer, require less medication, and gain weight more rapidly.
- **Family-centered care**: In the NICU it offers a philosophy which acknowledges that family has the greatest influence over an infant's health and well-being. Key principles of this include respect for the infant and parents, promotion of shared information, and parent planning and participation. True family centered care creates a collaborative partnership between the health care team and the family. (Gates et al 2004).

Developmentally Supportive Care (DSC) practices are evidence-based interventions that promote newborn brain and neurobehavioral development. Neurodevelopmental care has the potential to support the brain development of preterm babies during hospital stay and to enhance parental

competencies and well-being. (Als H, Duffy FH, McAnulty GB, et al 2004). They minimize the stress of NICU environment, support autonomic stability, normal motor, sensory neurological development and promote behaviour state organization. Developmental Care in the NICU involves efforts in unit design, equipment selection, policies, care protocols, and staff training to maintain the basic physical, sensory, and interpersonal needs of the preterm infant while minimizing exposure to noxious and painful stimuli. (Sengupta Amitava 2014)

In practice, it requires understanding of the interactions between professionals, neonates, and parents in the organization of care. (Franck LS, Oulton K, Bruce E.2014). Factors influencing the implementation of neurodevelopmental care in neonatal clinical practice are poorly understood, and evidence-based strategies for accomplishing changes are needed. The nurses should be trained to provide individualized developmentally supportive care to preterm babies by adopting a "flexible" approach. All the health care professionals in the NICU should be gentle, considerate and compassionate in providing care to preterm babies. (Kennel JH.1999), (Charpak N 1999), (Ruis JG, de Calume ZF 2000). Early and intensive participation by family members in the care of preterm babies should be encouraged to promote bonding, facilitate physical growth and neuromotor development. (McGrath JM, Conliffe-Torres S 1996).

II. METHOD

A total of 230 relevant references were identified in an electronic search of five databases: five databases (PubMed, Cochrane, CINHALL, Scopus and Google Scholar). Duplicated references were removed, and 162 articles remained. The titles and abstracts of the identified references were screened, and 88 non-relevant references were excluded. The full text of the 74 remaining studies was then screened, and 24 studies met one or more inclusion criteria. At the final stage, 24 studies were included in the review. A flow diagram of the search selection for the included studies is presented in Fig. 1, and the procedures are described below.

➤ *Data Sources and Search Methodology (Identification)*

An electronic search for empirical articles in **PubMed, Cochrane, CINHALL, Scopus, and Google Scholar** from 2000 to 2020 was performed according to the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) statement (Moher et al., 2009). The search used the following keywords related to the review subject combined with standard MeSH terms: **Developmental supportive care, preterm baby, NIDCAP, family centred care, neurobehavioral capacity and neuroprotection environment, Individualized developmental supportive care, nurse's perception.** The electronic search was

independently performed by the first author and then replicated by the co-author.

Randomized control trials were considered the strongest level of evidence. When unavailable, cohort, case control, consensus statements and qualitative methods were considered the strongest level of evidence for a particular clinical issue. Five core measure sets for evidence-based developmental care were evaluated: (1) protected sleep, (2) pain and stress assessment and management, (3) Physiological wellbeing (4) family-centred care, and (5) the healing environment. These five categories reflect recurring themes that emerged from the literature review regarding developmentally supportive care and quality caring practices in neonatal populations. This practice model provides clear metrics for nursing actions having an impact on the hospital experience of infant-family dyads.

➤ *Study Selection (Screening)*

For the purpose of this review, only empirical studies that assessed the effect and implication of Developmental supportive care in preterm babies were included. Different aspects of DSC were considered—**Like Neuroprotection in the NICU, Reduces Length of Stay, sleep pattern, family involvement, positioning and handling, Minimizing stress & pain, Physiological stability, Nurses awareness regarding DSC.** Studies were included regardless of the study design, the sample size or the measurement type. Only primary research was considered. Studies that met the following criteria were excluded: a) non-original research (review articles and meta-analysis) and b) studies focused only on the effects of kangaroo mother care. The included studies were assessed for quality based on the following criteria: 1) Developmentally supportive care should be given to the preterm babies and 2) studies should identify the outcome measurements.

➤ *Data Extraction (Eligibility And Inclusion) Eligibility*

In the first stage, the two authors (Rakhi Chandel and Ratna Tadi) independently evaluated the titles and abstracts of all identified articles (n=230) in order to assess potentially relevant references. Abstracts that did not address the effect and implication of DSC in preterm babies were automatically excluded at this stage (n= 162). The agreement rate between the two investigators at the first stage was 95.44%.

In the second stage, the articles with abstracts that appeared relevant were selected for full-text evaluations (n= 74). Study selection was independently determined by the two authors based on the inclusion and exclusion criteria: non-original studies and studies focusing on the effects of kangaroo mother care and breast feeding was excluded (n=50). The agreement rate between the two investigators was 89.85%.

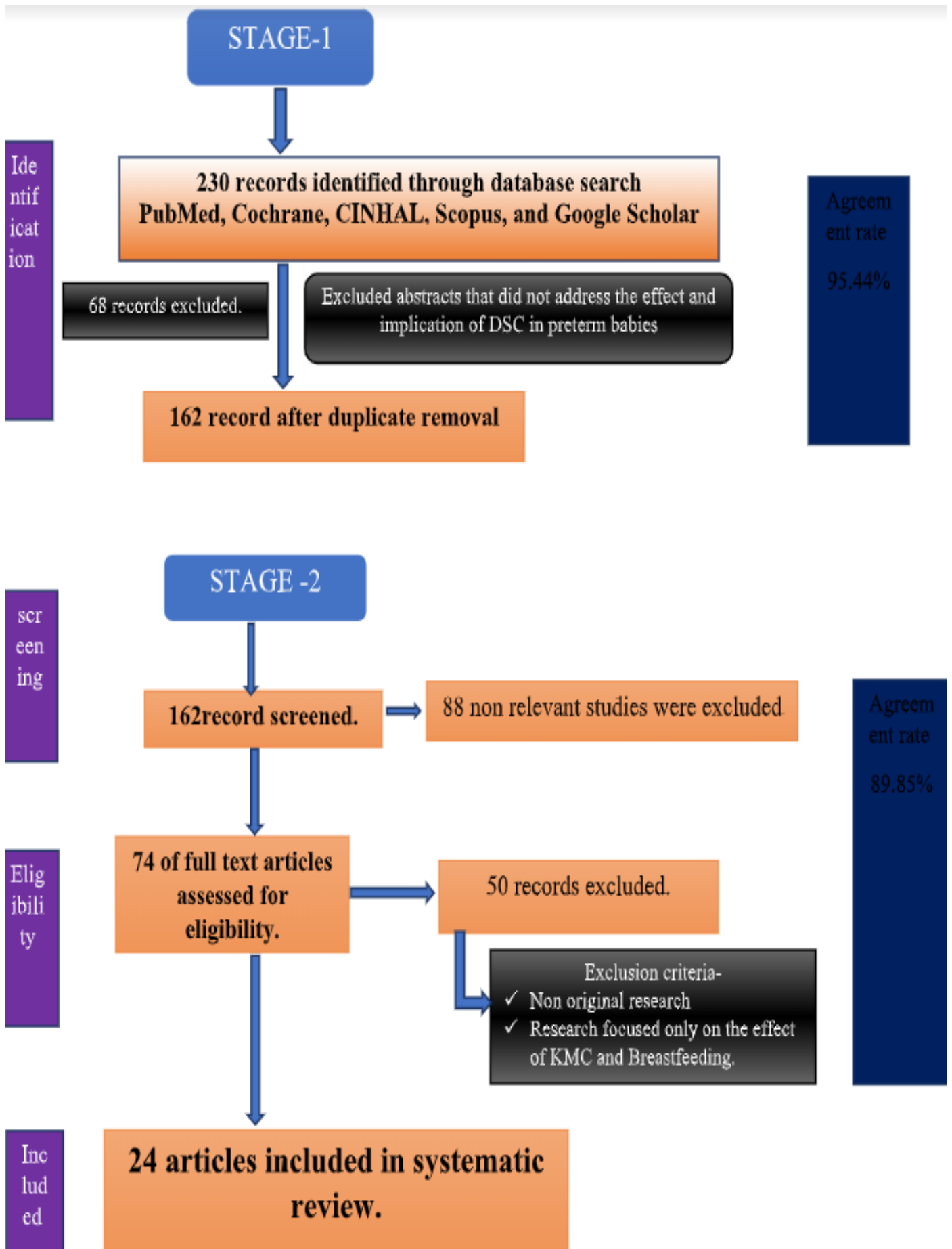


Fig 1 Search Strategy Flow Diagram

➤ *Inclusion*

The two authors independently extracted data from the selected studies (n=24) and fulfilled a standardized data extraction sheet. For each article, the extracted data included information about the authors, the publication year, the study's aim, the study methodology, the measures and the results.

➤ *The Selected Papers were Organized According to the Study Aims and Design. in these Aspects-Two Main Differences were Found:*

- Experimental studies that analysed the effect of developmental supportive care in preterm infants in order to sleep, neurodevelopment maturity, physiological stability, weight gain, and reduced hospital stay.
- Associative studies analysing the implication of Developmental Supportive Care in practices by assessing the knowledge, practice and perspective of nurses and other health care personnel in NICU.

➤ *Studies were then Organized According to these Two Items:*

- Does the Developmental supportive care is effective in preterm care,
- An integration of developmental supportive care principles into practice in the NICU?

Studies were organized alphabetically by the first author. At this stage, the agreement rate between the two investigators was 89.85%. In all stages, in the case of a disagreement, a consensus was reached after discussion.

➤ *Data Analysis*

Quantitative results of each study regarding the effect of DSC in preterm infants and implication in NICU were retrieved.

III. RESULT

➤ *Study Characteristics-*

The included studies were published between 2000 and 2020 in 13 different countries and evaluated a total 1884 participants. The majority of the studies were conducted in the United States (n=7) and in the Sweden (n=1). The remaining studies were published in Turkey (n=2), Iran (n=2), Canada (n=2), Netherland (n=2), India(n=1), Korea(n=1), Switzerland (n=1), Taiwan (n=1), Switzerland (n=1), France (n=1) and Egypt (n=2).

Developmental supportive care interventions were given to the infants and different parameters were assessed. Effect and implication of Developmental Supportive care were assessed with different measures.

Personal Information Form, Premature Follow-Up Form &(NTISS) Neonatal Therapeutic Intervention Scoring System (n=1), neurobehavioral testing using the NICU Network Neurobehavioral Scale (NNNS),&Feeding assessment with the Neonatal Oral Motor Assessment Scale (NOMAS)(n=1), medical record n=3, Structured Observation of Motor Performance in Infants (SOMP-I)-(n=1), user satisfaction questionnaire, neurodevelopmental testing was performed on infants using the Alberta Infant Motor Scale and the Bayley Scales of Infant and Toddler Development, Third Edition.(n=1), Plan-Do-Study-Act (PDSA) cycles for small tests of change(n=1), Premature follow-up form -discharge weight and height(n=2), Clinical outcomes including body temperature, heart rate, respiration rate, oxygen saturation, SCRIP score (n=1), General characteristics of the subject knowledge of posture support nursing Perform postural support nursing measurement tools, NMI score, Physiological variables were measured using the heart rate, respiratory rate, and oxygen saturation(n=3)11-item parental satisfaction tool, which uses a 5-point Likert scale, physiologic data, gestational age was determined by ultrasound during early pregnancy(n=1),, Premature Infant Pain Profile (PIPP), (n=1), Assessment of Preterm Infants' Behavior (APIB). Prechtl Neurologic Examination of the Fullterm Newborn Infant (Prechtl)(n=1),A demographic questionnaire, a physiological parameters registration form, and the face states registration form based on Neonatal Facial Coding System (NFCS) (n=2), Neurobehavioural and neurophysiological outcome assessment n=3,Indirect observation (n=1).

Table 1 Does the Developmental Supportive Care is Effective in Preterm Care?

AUTHOR	TITLE	AIM	PARTICIPANTS	MEASURES & PROCEDURE	RESULT	QUALITY
Als H, et al 2004	A Three-Center, Randomized, Controlled Trial of Individualized Developmental Care for Very Low Birth Weight Preterm Infants: Medical, Neurodevelopmental, Parenting, and Caregiving Effects	Medical, neurodevelopmental, and parenting effects of individualized developmental care were investigated in a three-center, randomized, controlled trial.	A total of 92 preterm infants, weighing less than 1250 g and aged less than 28 weeks, participated. USA	Measures- Assessment of Preterm Infants' Behaviour (APIB), ³³ using the six standard system summary variables. ³⁴ Parent functioning was assessed by the four standard summary scores of the Parenting Stress Index. Three NICU environment parameters (light, sound, and activity) and 11 caregiving parameters, each on a 5-point scale, ³⁶ were measured every 6 months for three randomly selected control and three experimental group infants cared for in the nursery closest to the 6-month mark.	The results consistently favoured the experimental groups. shorter duration of parenteral feeding, transition to full oral feeding, intensive care, and hospitalization; lower incidence of necrotizing enterocolitis; reduced discharge ages and hospital charges; improved weight, length, and head circumferences; enhanced autonomic, motor, state, attention, and self-regulatory functioning; reduced need for facilitation; and lowered family stress and enhanced appreciation of the infant. Quality of care was measurably improved.	Very low birth weight infants and their parents, across diverse settings, may benefit from individualized developmental care.
Als, H., et al. 2020	NIDCAP improves brain function and structure in preterm infants with severe intrauterine growth restriction	AIM-The effect of NIDCAP (Newborn Individualized Developmental Care and Assessment Program) was examined on the neurobehavioral, electrophysiological and neurostructural development of preterm infants	A total of 30 infants, 27–33 weeks gestation, were randomized to control (C; N=17) or NIDCAP/experimental (E; N=13) care. USA	Measure- Baseline health and demographics were assessed at intake; electroencephalography (EEG) and magnetic resonance imaging (MRI) at 35 and 42 weeks postmenstrual age; and health, growth and neurobehavior at 42 weeks and 9 months corrected	C and E infants were comparable in health and demographics at baseline. At follow-up, E infants were healthier, showed significantly improved brain development and better neurobehavior. Neurobehavior,	NIDCAP significantly improved IUGR preterm infants' neurobehavior, electrophysiology and brain structure. Longer-term outcome assessment and larger samples are recommended.

		with severe intrauterine growth restriction (IUGR).		age (9 months). Timepoint- severe IUGR preterms were enrolled consecutively after admission	EEG and MRI discriminated between C and E infants. Neurobehavior at 42 weeks correlated with EEG and MRI at 42 weeks and neurobehavior at 9 months.	
Bjo`rn Westrup, et al 2000	A Randomized, Controlled Trial to Evaluate the Effects of the Newborn Individualized Developmental Care and Assessment Program in a Swedish Setting	To investigate effect of Newborn Individualized Developmental Care on need of ventilatory assistance, growth, and hospitalization in a Swedish setting.	Preterm infants born with a gestational age <32 weeks and with a need of ventilatory assistance at 24 hours were randomly assigned to either NIDCAP (n = 12) or conventional care (n = 13). Sweden	Measures- physiologic data, gestational age was determined by ultrasound during early pregnancy. The severity of illness was analysed using the Clinical Risk Index for Babies (CRIB),38 which is calculated from the birth weight and gestational age, as well as the levels of blood gases and fraction of the inspired oxygen during the first 12 hours. Time point- Preterm infants with a gestational age <32 weeks and with a need of ventilatory assistance at 24 hours	The duration of mechanical ventilation (median [range] was 2.8 [0–36.7] days in the intervention group vs 4.8 [.1–29.8] days; not significant [NS]) among the controls and continuous positive airway pressure was applied for 26.1 (6.9–52.0) vs 43.9 (5.0–65.1) days. Supplementary oxygen was withdrawn at 33.0 (29.3–35.7) vs 38.1 (33.1–44.9) weeks of postconceptional age (PCA). The weight gain up to 35 weeks of PCA was 13.0 (6.7–21.0) vs 9.8 (6.8–16.6) g/day (NS). The head growth up to 35 weeks of PCA was .73 (.56–1.3) vs .63 (.56-.77) cm/week (NS). The age of the infant at discharge was 38.3 (36.1–57.7) vs 41.0 (36.9–48.4) weeks of PCA (NS).	NIDCAP does not seem to have detrimental effects on Swedish very low birth weight infants in comparison with conventional care. Indeed, NIDCAP might even be advantageous.

<p>Cheryl Moody c, et al 2016</p>	<p>Early Initiation of Newborn Individualized Developmental Care and Assessment Program (NIDCAP) Reduces Length of Stay: A Quality Improvement Project</p>	<p>The specific aims of this quality improvement project were to- 1) compare the age at discharge for infants meeting inclusion criteria enrolled in NIDCAP with the age at discharge for those eligible infants not enrolled in NIDCAP; and 2) investigate the timing of initiation of NIDCAP (e.g., within six days of admission) on age at discharge.</p>	<p>87 infants admitted to NICU with a gestational age of 32 weeks or less USA</p>	<p>Measures- Plan-Do-Study-Act (PDSA) cycles for small tests of change. Time point- Gestational age of ≤ 32 weeks.</p>	<p>Infants who enrolled within 6 days of admission were discharged an average of 25 days sooner ($p = 0.055$), and at a younger post-menstrual age (by 3.33 weeks on average), than those enrolled later ($p = 0.027$).</p>	<p>Early NIDCAP intervention may lead to a reduction in length of hospital stay and in medical costs for infants in NICU. Implementation of NIDCAP may provide the framework for not only empowerment of parents in caring for their infants, but also a cost-effective means to educate newer nurses in developmental care.</p>
<p><u>G McAnulty et al 2009</u></p>	<p>Individualized developmental care for a large sample of very preterm infants: health, neurobehaviour and neurophysiology</p>	<p>To assess medical and neurodevelopmental effects of Newborn Individualized Developmental Care and Assessment Program (NIDCAP) for a large sample of very early-born infants.</p>	<p>One hundred and seven singleton inborn preterm infants, <29 weeks gestational age (GA), <1250 g birth weight, USA</p>	<p>Measure- Medical information was obtained from NICU and outlying hospital medical records Demographical and parent/ infant medical history information additionally was obtained from parent interview Neurobehavioural and neurophysiological outcome assessment Neurophysiological outcome measures Timepoint- gestational age (GA) at birth 24 h in the first 48 h, alive at 48 h.</p>	<p>The results indicated for the E-group significant reduction in major medical morbidities of prematurity as well as significantly improved neurodevelopmental (behaviour and electrophysiology) functioning significantly better neurobehavioural functioning was also found.</p>	<p>The NIDCAP is an effective treatment for very early-born infants. It reduces health morbidities and enhances neurodevelopment, functional competence and life quality for preterm infants at 2 week and 9 month.</p>
<p>Hill, S. et al 2005 .</p>	<p>Effects of Facilitated Tucking During Routine Care of Infants Born Preterm</p>	<p>To compare stress responses of infants born preterm during routine nursing assessments performed</p>	<p>A convenience sample of 12 infants born preterm, ages 25 to 34 weeks postconceptual age.</p>	<p>Measures- post conceptual age on the day of testing (mean 30.9 weeks), were evaluated using the Premature</p>	<p>A significant difference ($p = .013$) existed between the two testing positions as measured by</p>	<p>By incorporating facilitated tucking during routine care events, the stress level of</p>

		under two conditions. One condition incorporated a second caregiver supporting the infant in a facilitated tucked position, whereas the second condition did not.	USA	<p>Infant Pain Profile (PIPP), during the two caregiving conditions.</p> <p>Time point- Twelve infants born preterm (six male and six female) at 25 to 34 weeks corrected age (mean 30.9 2.5 weeks), with testing day weights ranging from 616 to 2105 g (mean 1410 473 g), participated in the study.</p>	the PIPP. Nine of the 12 infants received a lower PIPP score with facilitated tucking during routine care assessments.	the infants born preterm may be reduced. When the infants' stress levels are reduced, they may be better able to maintain stability in their autonomic, motor, and state systems.
Jacqueline F . et al, 2005	A Quasi-Experimental Trial on Individualized, Developmentally Supportive Family-Centered Care	To evaluate the impact of individualized, developmentally supportive family-centered care on infant physiological variables, growth, behavioral stress cues, return to sleep state, medical and developmental progress, complications, resource utilization, parental perception of the neonatal intensive-care unit experience, and overall parental satisfaction.	A convenience sample of 114 premature infants and their parents. USA	<p>Measure- infant's hospital record: demographic information, NMI score, Physiological variables were measured using the heart rate, respiratory rate, and oxygen saturation.</p> <p>11-item parental satisfaction tool, which uses a 5-point Likert scale</p> <p>Time point- premature baby admitted to one of the two NICU rooms and if the gestational age was less than or equal to 32 weeks.</p>	Between groups, there were no statistically significant differences in demographic factors, days to medical or developmental milestones, length of stay, or direct cost/case. Repeated measures analysis of variance determined that at every point of data collection, the average number of baseline, activity, and post activity stress cues were lower in the developmentally supportive group. Infants in the developmental group had 8% less sedatives/narcotics and 15% less vasopressors costs than the control group.	Preterm infants who received developmentally supportive family-centered care demonstrated fewer behavioral stress cues and comparable short-term outcomes and resource utilization than infants who received routine care.
KüçükAlem	The Effect of	To determine	136 preterm	Measures-	No statistically	Individualized

<p>dar, et al (2019)</p>	<p>Individualized Developmental Care Practices in Preterm Infants</p>	<p>the effect of individualized developmental care on physiological parameters, growth, and transition to oral feeding in preterm infants.</p>	<p>infants. TURKEY</p>	<p>Personal Information Form Premature Follow-Up Form Neonatal Therapeutic Intervention Scoring System (NTISS). Time point- first 24 hrs of birth.</p>	<p>significant difference was found between the groups in terms of weight, height, and head circumference at time of discharge. Mean SO2 values were statistically higher in the IC group than the other groups; however, the heart rate and respiratory rate were not statistically different in a significant sense between the groups. The briefest duration of transition to total oral feeding was seen in the BMO group.</p>	<p>developmental care practices based on the results of these interventions are likely to support the care of preterm infants.</p>
<p>Kathrine Leigh Peters, et al 2009</p>	<p>Improvement of Short- and Long-Term Outcomes for Very Low Birth Weight Infants: Edmonton NIDCAP Trial</p>	<p>To determine the impact of Newborn Individualized Developmental Care and Assessment Program (NIDCAP)-based care on length of stay of very low birth weight (VLBW) infants. Secondary outcome measures were days of ventilation, incidence of chronic lung disease, and 18-month neurodevelopmental outcomes.</p>	<p>110 One hundred VLBW singleton infants and 10 VLBW twin sets CANADA</p>	<p>Measure- Behavioral observations Time point-birth weight of 500 to 1250 g, gestational age of 32 weeks, birth weight between the 3rd and 97th percentiles for gestational age,34 and age of 2 to 7 days at the time of study entry.</p>	<p>NIDCAP group infants had reduced length of stay (median: NIDCAP: 74 days; control: 84 days; $P = .003$) and incidence of chronic lung disease (NIDCAP: 29%; control: 49%; odds ratio: 0.42 [95% confidence interval: 0.18–0.95]; $P = .035$). At 18 months of adjusted age, NIDCAP group infants had less disability, specifically mental delay (NIDCAP:</p>	<p>NIDCAP-based care for VLBW infants improved short- and long-term outcomes significantly.</p>

					10%; control: 30%; odds ratio: 0.25 [95% confidence interval: 0.08–0.82]; <i>P</i> = .017).	
Madlinger-Lewis L, et al (2014)	The Effects of Alternative Positioning on Preterm Infants in the Neonatal Intensive Care Unit: A Randomized Clinical Trial	To investigate the effects of a new, alternative positioning device compared to traditional positioning methods used with preterm infants.	100 consecutive admissions of preterm infants born ≤ 32 weeks gestational age. USA	Measures- Neurobehavioral testing using the NICU Network Neurobehavioral Scale (NNNS) by a single, certified blinded rater. Feeding assessment with the Neonatal Oral Motor Assessment Scale (NOMAS) was also conducted and scored by the same rater. Additional clinical outcomes, such as days to achieve full oral feeds, days on the ventilator, days on oxygen, and post menstrual age at discharge were collected from each infant’s medical record. Time point- preterm infants born ≤ 32 weeks gestational age, within the first week of life	Infants in the alternative positioning arm of the study demonstrated less asymmetry of reflex and motor responses on the NICU Network Neurobehavioral Scale (<i>p</i> =0.04; Adjusted Mean Difference=0.90, 95% CI 0.05–1.75) than those positioned using traditional positioning methods.	the effects of positioning are evident before NICU discharge and that effective positioning can reduce asymmetry in preterm infants. Reductions in asymmetry among preterm infants is an important benefit of alternative positioning, as symmetrical movement and responses are crucial for early development.
Maguire CM, et al 2009	Effects of individualized developmental care in a randomized trial of preterm infants <32 weeks	The goal was to investigate the effects of the Newborn Individualized Developmental Care and Assessment Program (NIDCAP) on days of respiratory support and intensive care, growth, and neuromotor development at term age for	A total of 164 infants met the inclusion criteria (NIDCAP: <i>N</i> = 81; control: <i>N</i> = 83). NETHERLAND	Measure- formal behavioral observations of the infants, respiratory support, intensive care, and weight of <1000 g. Growth parameters were measured weekly or biweekly and at term age. Neuromotor development was assessed at term age. Time point-	A total of 164 infants met the inclusion criteria (NIDCAP: <i>N</i> = 81; control: <i>N</i> = 83). In-hospital mortality rates were 8 (9.9%) of 81 infants in the NIDCAP group and 3 (3.6%) of 83 infants in the control group. No differences in mean days of respiratory	NIDCAP developmental care had no effect on respiratory support, days of intensive care, growth, or neuromotor development at term age.

		infants born at <32 weeks.		Infants were assigned randomly, within 48 hours after birth, to a NIDCAP group or basic developmental care (control) group.	support (NIDCAP: 13.9 days; control: 16.3 days) or mean days of intensive care (NIDCAP: 15.2 days; control: 17.0 days) were found. Short-term growth and neuromotor development at term age showed no differences, even with correction for the duration of the intervention.	
Sathish, et al 2017	Clinical Outcomes of Snuggle up Position Using Positioning Aids for Preterm (27-32 Weeks) Infants	To determine the effectiveness of snuggle up positioning aids on clinical outcomes of preterm (<32weeks) infants.	A total of 56 preterm infants (27-32 weeks) were enrolled in the study. INDIA	Measures- Clinical outcomes including body temperature, heart rate, respiration rate, oxygen saturation, SCRIP score (periodic breathing, apnea, and deceleration of the heart rate), and duration of ventilation and hospital stay were recorded for each infant.; for every single parameter, it has three grades of severe instability (0 points), minor instability (1 point), and perfect stability (2 points). Temperature and SCRIP score were recorded at 8, 16, 24, 48, and 72 hours. positioning continued for four weeks. Weight (using electronic weighing machine on a daily basis) and follow-up of weight, as well as duration of ventilation and NICU stay were	There was a significant difference in respiratory rate, oxygen saturation, stability of the cardiorespiratory system in preterm infants (SCRIP) score, and weight gain between the intervention and control groups (P<0.05).	Use of snuggle up position with positioning aids increased stability of physiological parameters and weight gain and reduced duration of NICU stay. Thus, the use of positioning aids for preterm infants is recommended to facilitate their growth and clinical outcomes.

				recorded.		
Ullenhag A, et al (2009)	Motor performance in very preterm infants before and after implementation of the newborn individualized developmental care and assessment programme in a neonatal intensive care unit.	To compare motor performance in supine position at the age of 4-months corrected age (CA) in very preterm (VPT) infants cared for in a neonatal intensive care unit (NICU) before and after the implementation of the Newborn Individualized Developmental Care and Assessment Program (NIDCAP).	VPT infants cared for in a NICU at a Swedish university hospital before, Group A (n = 68), and after, Group B (n = 58). SWEDEN	Measure- level of motor development and quality of motor performance were made, using the Structured Observation of Motor Performance in Infants (SOMP-I). Time point- supine position at the age of 4-months corrected age (CA) in very preterm (VPT) infants cared for in a neonatal intensive care unit (NICU)	The infants who were treated after the introduction of NIDCAP showed higher level of motor development in the arms/hands and trunk.	The infants who were treated after NIDCAP care had been implemented showed a higher level of motor development in arms/hand and trunk and fewer deviations in head, legs and feet at 4-months CA than infants treated before NIDCAP implementation.
Valerie Bertellea et al 2005,	Sleep of preterm neonates under developmental care or regular environmental conditions	To assess whether DC is accompanied by changes in sleep in preterm neonates.	33 preterm neonates. France	A blinded electrophysiological analyzed sleep. The total sleep time (TST) was the primary outcome, duration of active (AS), quiet (QS) and indeterminate sleep, and latency before sleep were the secondary outcomes. Time Point- gestational age: 29.3 (1.8) weeks; birth weight: 1245 (336) g]	In DC condition vs. control: TST increased [in minutes, mean (S.E.M.): 156.2 (2.9) vs. 139.2 (4.6), p=0.002], with increase in AS [86.6 (3.7) vs. 77.0 (4.2), p=0.024] and in QS [47.1 (4.1) vs. 36.9 (4.2), p=0.015], and sleeping latency decreased (2.1 (0.7) vs. 10.5 (2.0), p=0.0005].	DC promoted sleep in our study.
Zahra Yazdanpanahi L et al 2020,	The Effect of Developmental Supportive Positioning on Pain from Venipuncture in Preterm Neonates Admitted to Neonatal Intensive Care Unit	To investigate the effects of developmental supportive positioning on the pain from venipuncture in preterm neonates admitted to the NICU.	54 preterm neonates admitted to the NICU were divided into control and intervention groups using the randomized block method. IRAN	Measures- A demographic questionnaire, a physiological parameters registration form, and the face states registration form based on Neonatal Facial Coding System (NFCS) were used for data collection. Time point- gestational age of 28-36 weeks,	The results showed a statistically significant difference between the mean scores of facial expression changes, heart rate and neonatal blood oxygen saturation at two and five minutes after	It seems that developmental supportive positioning of preterm neonates has a positive effect on the relief of the pain caused by venipuncture. Considering the importance of pain control in preterm neonates, it is

				stability of hemodynamic status in terms of regular heart rate, respiratory rate, body temperature, face color, activity level, and lack of musculoskeletal as well as nervous disorders	needle removal in the intervention and control groups ($P \leq 0.05$).	recommended to use this method when doing venipuncture.
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➤ *Does the Developmental Supportive Care is Effective in Preterm Care?*

Fifteen studies on the effect of developmental supportive care on preterm care (see table no.1) were published. A study was conducted to assess the Individualized Developmental Care for Very Low Birth Weight Preterm Infants: Medical, Neurodevelopmental, Parenting, and Caregiving Effects (Als H, Gilkerson L. et All 2004 in USA). The results consistently favoured the experimental groups. shorter duration of parenteral feeding, transition to full oral feeding, intensive care, and hospitalization; lower incidence of necrotizing enterocolitis; reduced discharge ages and hospital charges; improved weight, length, and head circumferences; enhanced autonomic, motor, state, attention, and self-regulatory functioning; reduced need for facilitation; and lowered family stress and enhanced appreciation of the infant. Quality of care was measurably improved. Very low birth weight infants and their parents, across diverse settings, may benefit from individualized developmental care.

A total of 8 studies were analysed which assessed the effect of NIDCAP (Newborn Individualized Developmental Care and Assessment Program). Among which one study assessed the effect of NIDCAP in -improving brain function and structure in preterm infants with severe IUGR (Als H *et al.* 2020). Baseline health and demographics were assessed at intake; electroencephalography (EEG) and magnetic resonance imaging (MRI) at 35 and 42 weeks postmenstrual age; and health, growth and neurobehavior at 42 weeks and 9 months corrected age (9 months). C and E infants were comparable in health and demographics at baseline. At follow-up, E infants were healthier, showed significantly improved brain development and better neurobehavior. Other study was conducted to investigate effect of Newborn Individualized Developmental Care on need of ventilatory assistance, growth, and hospitalization in a Swedish setting.,(Björn Westrupet All 2000) thought the study result does not have detrimental effect on Swedish very low birth weight infants in comparison with conventional care. Another study assessed the effect of Early Initiation of Newborn Individualized Developmental Care and Assessment Program (NIDCAP) Reduces Length of Stay (Cheryl Moody C *et al.*, 2016) the study favoured NIDCAP by concluding that Early NIDCAP intervention may lead to a reduction in length of hospital stay and in medical costs for infants in NICU. A study was conducted to assess medical and neurodevelopmental effects of Newborn Individualized Developmental Care and Assessment

Program (NIDCAP) for a large sample of very early-born infants. (G McAnulty *et al.*, 2009). The results indicated that E-group showed significant reduction in major medical morbidities of prematurity as well as significantly improved neurodevelopmental (behaviour and electrophysiology) functioning. Another study was conducted to determine the effect of individualized developmental care on physiological parameters, growth, and transition to oral feeding in preterm infants. (KüçükAlemdar *et al.*, 2019) the study result showed Individualized developmental care practices based on the results of these interventions are likely to support the care of preterm infants. Similar study was conducted to determine the impact of Newborn Individualized Developmental Care and Assessment Program (NIDCAP) (Kathrine Leigh Peters *et al.*, 2009). The effect of NIDCAP based care was assessed on the basis of length of stay of very low birth weight (VLBW) infants. Secondary outcome measures were days of ventilation, incidence of chronic lung disease, and 18-month neurodevelopmental outcomes. The study thus concluded that NIDCAP-based care for VLBW infants improved short- and long-term outcomes significantly. Another study was conducted to investigate the effects of the newborn Individualized Developmental Care and Assessment Program (NIDCAP) on days of respiratory support and intensive care, growth, and neuromotor development at term age for infants born at <32 weeks. (Maguire C *et al.*, 2009), thus the study concluded that NIDCAP developmental care had no effect on respiratory support, days of intensive care, growth, or neuromotor development at term age. Another study was conducted to compare Motor performance in very preterm infants before and after implementation of the newborn individualized developmental care and assessment programme in a neonatal intensive care unit.(Ullenhag A *et al.*, 2009) and the study concluded that the infants who were treated after NIDCAP care had been implemented showed a higher level of motor development in arms/hand and trunk and fewer deviations in head, legs and feet at 4-months CA (corrected age) than infants treated before NIDCAP implementation. Another study was conducted to evaluate the impact of individualized, developmentally supportive family-centered care on infant physiological variables, growth, behavioral stress cues, return to sleep state, medical and developmental progress, complications, resource utilization, parental perception of the neonatal intensive-care unit experience, and overall parental satisfaction. (Jacqueline F *et al.*, 2005) the study concluded that Preterm infants who received developmentally supportive family-centered care demonstrated fewer behavioral stress cues and

comparable short-term outcomes and resource utilization than infants who received routine care. A total of four studies were reviewed which assessed the effectiveness of postures among neonates admitted in NICU. This included a study that was conducted to compare stress responses of infants born preterm during routine nursing assessments performed under two conditions. One condition incorporated a second caregiver supporting the infant in a facilitated tucked position, whereas the second condition did not. (Hills et al., 2005.) and the study result showed that by incorporating facilitated tucking during routine care events, the stress level of the infants born preterm may be reduced. When the infants' stress levels are reduced, they may be better able to maintain stability in their autonomic, motor, and state systems. Another study was conducted to investigate the effects of a new, alternative positioning device compared to traditional positioning methods used with preterm infants. (Madlinger-Lewis L et al., 2014) and the study result showed that the effects of positioning are evident before NICU discharge and that effective positioning can reduce asymmetry in preterm infants. A

study was conducted to determine the effectiveness of snuggle up positioning aids on clinical outcomes of preterm (<32weeks) infants. (Sathishet al., 2017) thus the study concluded that there was a significant difference in respiratory rate, oxygen saturation, stability of the cardiorespiratory system in preterm infants (SCRIP) score, and weight gain between the intervention and control groups (P<0.05). Another study reviewed was intended to investigate the effects of developmental supportive positioning on the pain from venipuncture in preterm neonates admitted to the NICU. (Zahra Yazdanpanahi L et al., 2020). The results showed a statistically significant difference between the mean scores of facial expression changes, heart rate and neonatal blood oxygen saturation at two and five minutes after needle removal in the intervention and control groups (P<0.05). A study was conducted to assess whether Developmental Care is accompanied by changes in sleep in preterm neonates. (Valerie Bertellea et al., 2005) the study concluded that Developmental care promoted sleep among preterm neonates.

Table 2 Integration of Developmental Supportive Care Principles Into Practice in the NICU

AUTHOR	TITLE	AIM	PARTICIPANTS	MEASURES & PROCEDURE	RESULT	QUALITY
Gehan EL et al 2005	Effect of Implementing Learning Package of Nesting and Swaddling for Premature Infants on Nurses' Knowledge and Performance in NICU.	To assess the effect of learning package regarding nesting and swaddling for premature on nurse's knowledge and performance in NICU	77 nurses who work in the NICU as a convenience sample. EGYPT	Measures- two tools used to collect the study: A Structured questionnaire sheet to assess nurses' knowledge regarding nesting and swaddling and the observation sheet to assess nurses' performance of nesting and swaddling in NICU. Time Point- Nurses who work in the NICU	There was a statistically significant difference regarding nurses' knowledge and performance about nesting and swaddling immediately after and three months later compared with before learning package.	Increased Nurses knowledge and performance about nesting and swaddling in NICU for premature infants will improve the care.
HeidelseAls et al. 2004	Early Experience Alters Brain Function and Structure	To investigate the effects of early experience on brain function and structure.	90 low-risk preterm infants and their parent(s) constituted the study sample SWITZERLAND	Measures- Assessment of Preterm Infants' Behavior (APIB). Precht Neurologic Examination of the Fullterm Newborn Infant (Prechtl). Time Point- gestational age at birth of 28 weeks 4 days to 33 weeks 3 days after mother's last menstrual period.	The groups were medically and demographically comparable before as well as after the treatment. However, the experimental group showed significantly better neurobehavioral functioning, increased coherence between frontal and a broad spectrum of mainly occipital brain regions, and higher relative	This is the first in vivo evidence of enhanced brain function and structure due to the NIDCAP. The study demonstrates that quality of experience before term may influence brain development significantly.

					<p>anisotropy in left in-ternal capsule, with a trend for right internal capsule and frontal white matter. Transverse relaxation time showed no difference. Behavioral function was improved also at 9 months' corrected age. The relationship among the 3 neurodevelopmental domains was significant. The re-sults indicated consistently better function and more ma-ture fiber structure for experimental infants compared with their controls.</p>	
Jila Mirlashari et al. 2018	Nurses' and Physicians' Experiences of the NIDCAP Model Implementation in Neonatal Intensive Care Units in Iran	The purpose of this study was to investigate nurses' and physicians' experiences of implementing the NIDCAP model to optimize its implementation for both caregivers, infants, and families in the NICU.	11 nurses and four physicians participated in this qualitative study. IRAN	Measures-Data were collected by face-to-face and semi-structured interviews. Timepoint- Nurses and doctors currently working in the neonatal intensive care unit.	Six themes and 20 sub-themes were constructed during data analysis. These included; NIDCAP as a milestone, Helping to rebuild the core of the family, Caregiver excellence, Realism towards the feasibility of NIDCAP, Proper managerial position of NIDCAP specialists in the health system, and Caring for the caregiver.	The findings of this study highlight how NIDCAP provides a comprehensive and effective care model for premature infants, with the goal to promote neonatal growth and development while also facilitating the self efficacy of caregivers. Implementation of the
Kardaş Özdemir et al 2014	The effect of individualised developmental care practices on the growth and hospitalisation duration of premature infants: the	To assess the effect of individualised developmental care practices on the growth and hospitalisation duration of premature infants.	Premature infants who received treatment and care in the newborn intensive care unit (n = 97). TURKEY	MEASURES- Premature follow-up form -discharge weight and height. TIMEPOINT- Infants, who were stabilised during the first 24 hours.	The study determined that premature infants in control group and experimental groups were similar in terms of means of gestational age, birthweight, birth	Newborn intensive care unit nurses might lay the premature infants down in the flexion position and make them sense their

	effect of mother's scent and flexion position				length, birth head circumference, weight in hospitalisation, height in hospitalisation and head circumference in hospitalisation as well as gender ($p > 0.05$). It was specified that the difference between experimental groups and control group in terms of means of discharge weight was significant, The difference between experimental groups and control group in terms of means of discharge height was significant ($p < 0.05$)	mother's scent to accelerate their growth and shorten their hospitalisation duration.
Luu TM et al (2017)	Web-Based Intervention to Teach Developmentally Supportive Care to Parents of Preterm Infants: Feasibility and Acceptability Study.	This study aimed to test the feasibility and acceptability of the intervention by parents of preterm infants and assess clinical benefits on child neurodevelopment and parental outcomes during the first year of life.	107 infants born at <30 weeks and admitted to neonatal intensive care unit and their parents were enrolled in a nonrandomized controlled before-and-after interventional study (intervention n=55, comparison n=52). CANADA	Measure-User satisfaction questionnaire at 4 months' corrected age for parents. At 12 months' corrected age, neurodevelopmental testing was performed on infants using the Alberta Infant Motor Scale and the Bayley Scales of Infant and Toddler Development, Third Edition. Time point- Infants were at 4 months' corrected age. At 12 months' corrected age.	The majority of parents (43/45) were satisfied with the intervention program and all would recommend MAQ to others. MAQ met their need for evidence-based information that proved useful to support their child development.	Acceptability of the program was high among parents thus supporting the relevance of such intervention.
Liaw J et al (2009).	Improving neonatal caregiving through a developmentally supportive care training program	This study was performed to explore the effects of a training program in developmentally supportive care (DSC) on nurse caregiving and preterm infant	Twenty preterm infants were bathed 120 times by 13 nurses. TAIWAN	Measure- Indirect observation was adopted to collect all behavioral data. Timepoint- GA between 27 and 35 weeks; ages after birth of between 3 and 54 days	Results showed that infants felt less stress and nurses were more supportive during post training baths.	Caregivers should receive training in DSC, and its applications could be expanded to other nursing caregiving activities.

		behavior during bathing in a neonatal unit.				
Min-Jung Kim et al 2018	Knowledge and Performance of Developmentally Supportive Positioning for Premature Infants among Neonatal Intensive Care Unit Nurses.	<ul style="list-style-type: none"> This study was conducted to assess the knowledge and performance of developmentally supportive positioning for premature infants (DSPP) among neonatal intensive care unit (NICU) nurses. To provide basic data when developing a position support nursing education program for nurses by confirming the knowledge and performance of position support nursing. 	131 nurses working in the NICU. KOREA	<p>MEASURES- knowledge of posture support nursing Perform postural support nursing measurement tools.</p> <p>TIME POINT- Nurses working in the neonatal intensive care unit.</p>	average DSPP knowledge score of NICU nurses was 24.7 out of 33.0, and their average DSPP performance score was 3.2 out of 4.0. A statistically significant positive correlation was observed between knowledge and performance of DSPP ($r=.32, p<.001$). In this study, nurses in the neonatal intensive care unit had inaccurate knowledge when performing position-supporting nursing, and it could be confirmed that there is a risk of negatively affecting the growth and development of premature infants due to inappropriate position-supporting nursing.	To improve the level of NICU nurses' knowledge and performance of DSPP, educational programs should be developed and their effectiveness should be verified. it can be concluded that the development and application of a systematic and standardized position support nursing education program is urgent in order to improve the position support nursing performance of neonatal intensive care unit nurses.
Mona Ali Kunswa et al 2018	Evidence Based Nursing Practices of Developmentally Supportive Care for Preterm Neonates: Intervention Program for Internship Nursing Students.	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.	A purposive sample composed of 50 internship nursing students and 50 preterm (PT) neonates. EGYPT	<p>Measures-1.Pre-designed Questionnaire Format by Interviewing; to assess demographic characteristics of the studied students & preterm neonates and assess students' knowledge regarding DSC.</p> <p>2. Medical Records: to collect data about preterm neonates.</p> <p>3. Observation Checklists: to</p>	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	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

				assess studied students' practices regarding DSC .4. Students' Perception Regarding Core Measures for Developmentally Supportive Care in NICUs.	students' perception regarding core measures of DSC in care of preterm neonates.	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
Van der Pal et al 2007	Staff opinions regarding the Newborn Individualized Developmental Care and Assessment Program (NIDCAP)	to explore nursing and (para) medical staff's opinions concerning the use of NIDCAP in a Dutch NICU. This study furthermore aims to explore the determinants influencing the intention to use the NIDCAP method in the NICU.	168 parents were included two-phased randomized controlled trial NETHERLAND	Measure- A questionnaire was used.	Respondents were positive about NIDCAP and felt that using NIDCAP is fulfilling and leads to improvement of the infant's development, health and well-being.	This study shows overall positive attitudes of the nursing and (para)medical staff regarding the NIDCAP implementation in a NICU.

➤ *An Integration of Developmental Supportive Care Principles into Practice in the NICU-*

Total nine studies (table 2) were found concerning about the integration of developmental Supportive care principles into practice in the NICU. A study was conducted to assess the effect of learning package regarding nesting and swaddling for premature on nurse’s knowledge and performance in NICU (Gehan EL et al., 2005) the study concluded that there was a statistically significant difference regarding nurses' knowledge and performance about nesting and swaddling immediately after and three months later compared with before learning package. Among the study reviewed two studies were intended to find the implication of NIDCAP. The first study was done to investigate the effects of early experience on brain function and structure. (Heidelise Als et al., 2004) the study result stated that the groups were medically and demographically comparable before as well as after the treatment. However, the experimental group showed significantly better neurobehavioral functioning, increased coherence between frontal and a broad spectrum of mainly occipital and higher relative anisotropy in left internal capsule, with a trend for right internal capsule and frontal white matter. Transverse relaxation time showed no difference. Behavioural function

was improved also at 9 months’ corrected age. The relationship among the neurodevelopmental domains was significant. The results indicated consistently better function and more mature fibre structure for experimental infants compared with their controls, thus concluding that this is the first in vivo evidence of enhanced brain function and structure due to the NIDCAP. The study demonstrates that quality of experience beforeterm may influence brain development significantly. Similarly, another study was conducted to investigate nurses' and physicians' experiences of implementing the NIDCAP model to optimize its implementation for both caregivers, infants, and families in the NICU. (JilaMirlashari et al., 2018), The findings of this study highlight how NIDCAP provides a comprehensive and effective care model for premature infants, with the goal to promote neonatal growth and development while also facilitating the self-efficacy of caregivers. Three of the studies were focused on the implication of developmental care which included study conducted to assess the effect of individualised developmental care practices on the growth and hospitalisation duration of premature infants. (Kardaş Özdemir et al., 2014). The study determined that premature infants in control group and experimental groups were similar in terms of means of gestational age, birthweight,

birth length, birth head circumference, weight in hospitalisation, height in hospitalisation and head circumference in hospitalisation as well as gender ($p > 0.05$). It was specified that the difference between experimental groups and control group in terms of means of discharge weight was significant, the difference between experimental groups and control group in terms of means of discharge height was significant ($p < 0.05$). Similarly, a study was conducted Web-Based Intervention to Teach Developmentally Supportive Care to Parents of Preterm Infants: Feasibility and Acceptability Study. (Luu TM et al., 2017) the study finding suggested that the majority of parents (43/45) were satisfied with the intervention program and all would recommend MAQ to others. MAQ met their need for evidence-based information that proved useful to support their child development. Another study also was intended to Improve neonatal caregiving through a developmentally supportive care training program. (Liaw, J. et al., 2009. This study was performed to explore the effects of a training program in developmentally supportive care (DSC) on nurse caregiving and preterm infant behaviour during bathing in a neonatal unit. Results showed that infants felt less stress and nurses were more supportive during post training baths. A study was conducted to assess the knowledge and Performance of Developmentally Supportive Positioning for Premature Infants (DSPP) among Neonatal Intensive Care Unit Nurses. (Min-Jung Kim et al., 2018). The study result showed that the nurses in the neonatal intensive care unit had inaccurate knowledge when performing position-supporting nursing, and it could be confirmed that there is a risk of negatively affecting the growth and development of premature infants due to inappropriate position-supporting nursing, thus in order to improve the level of NICU nurses' knowledge and performance of DSPP, educational programs should be developed and their effectiveness should be verified.

IV. DISCUSSION

This systematic review provides an overview of the effect of Developmental supportive care on preterm babies and its implication in NICU. It includes studies from several countries published over a 20 Years. However, the four selected keywords may have led to the exclusion of relevant references. Despite methodological differences between the included studies (e.g., differences in the studies' designs, and in different measurement tools), all studies showed effect of Developmental supportive care on preterm care and assessed health care workers for its implication in NICU.

DOES THE DEVELOPMENTAL SUPPORTIVE CARE IS EFFECTIVE IN PRETERM CARE studies showed the effect of DSC on preterm included 15 reviews. Als H et al., 2004: Als H. et al. 2020: Bjo`rn Westrup et al., 2000: Cheryl Moody c et al., 2016: G McAnulty et al., 2009: Hill S. et al., 2005: Jacqueline F et al., 2005: K Alemdar et al., 2019: Athrine Leigh Peters et al., 2009: Madlinger Lewis L et al., 2014: Maguire CM et al., 2009: Sathish et al., 2017: Ullenhag A et al., 2009: Valerie Bertellea et al., 2005: Zahra Yazdanpanahi L et al., 2020.

Studies determine the effect of individualized developmental care on physiological parameters, growth, and transition to oral feeding in preterm infants and result showed that DSC support the care of preterm infants, Preterm infants who received developmentally supportive, family-centered care demonstrated fewer behavioral stress cues and comparable short-term outcomes and resource utilization than infants who received routine care. (K Alemdar, et al (2019), Jacqueline F . et al, 2005, Valerie Bertellea et al 2005). One study investigated the effects of a new, alternative positioning device compared to traditional positioning methods used with preterm infants and it was found that effective positioning can reduce asymmetry in preterm infants. (Madlinger-Lewis L, et al., 2014), Another study compared the age at discharge for infants meeting inclusion criteria enrolled in NIDCAP with the age at discharge for those eligible infants not enrolled in NIDCAP; Infants who enrolled for NIDCAP intervention within 6 days of admission were discharged an average of 25 days sooner, and at a younger post-menstrual age (by 3.33 weeks on average), than those enrolled later. Family centered developmentally supportive care of very low birth weight infants, provided by the newborn Individualized Developmental Care and Assessment Program (NIDCAP) has been reported to have positive medical and economic impacts. Our aim was to investigate its effect on need of ventilatory assistance, growth, and hospitalization in a Swedish setting. NIDCAP does not seem to have detrimental effects on Swedish very low birth weight infants in comparison with conventional care. Indeed, NIDCAP might even be advantageous. (Bjo`rn Westrup, et al 2000). Another study suggested that the purpose of this study was to compare stress responses of infants born preterm during routine nursing assessments performed under two conditions. One condition incorporated a second caregiver supporting the infant in a facilitated tucked position, whereas the second condition did not. By incorporating facilitated tucking during routine care events, the stress level of the infants born preterm may be reduced. When the infants' stress levels are reduced, they may be better able to maintain stability in their autonomic, motor, and state systems. (Hill, S. et al 2005). Another study assessed the effect of Developmental Supportive Positioning on pain from venipuncture in Preterm neonates admitted to Neonatal Intensive Care Unit and result suggested that It seems that developmental supportive positioning of preterm neonates has a positive effect on the relief of the pain caused by venipuncture. Considering the importance of pain control in preterm neonates, it is recommended to use this method when doing venipuncture. (Zahra Yazdanpanahi L et al 2020,), Another study assessed medical and neurodevelopmental effects of Newborn Individualized Developmental Care and Assessment Program (NIDCAP) for a large sample of very early-born infants. The NIDCAP is an effective treatment for very early-born infants. It reduces health morbidities and enhances neurodevelopment, functional competence and life quality for preterm infants at 2 and 9 mCA, (G McAnulty et al 2009), Another study was intended to investigate the effects of the Newborn Individualized Developmental Care and Assessment Program (NIDCAP) on days of respiratory support and

intensive care, growth, and neuromotor development at term age for infants born at <32 weeks. NIDCAP developmental care had no effect on respiratory support, days of intensive care, growth, or neuromotor development at term age. (Maguire CM, et al 2009). Another study was done to determine the impact of Newborn Individualized Developmental Care and Assessment Program (NIDCAP)-based care on length of stay of very low birth weight (VLBW) infants. Secondary outcome measures were days of ventilation, incidence of chronic lung disease, and 18-month neurodevelopmental outcomes. NIDCAP group infants had reduced length of stay and incidence of chronic lung disease. At 18 months of adjusted age, NIDCAP group infants had less disability, specifically mental delay, thus concluding that NIDCAP-based care for VLBW infants improved short- and long-term outcomes significantly. (Kathrine Leigh Peters, et al 2009)

AN INTEGRATION OF DEVELOPMENTAL SUPPORTIVE CARE PRINCIPLES INTO PRACTICE IN THE NICU in various studies knowledge and practice of health care workers were included which shows the implementation of the DSC in NICU. This study aimed to test the feasibility and acceptability of the intervention by parents of preterm infants and assess clinical benefits on child neurodevelopment and parental outcomes during the first year of life. Acceptability of the program was high among parents thus supporting the relevance of such intervention. (Luu TM et al 2017, Gehan EL et al 2005, Heidelise Als et al. 2004, Jila Mirlashari et al. 2018, Kardaş Özdemir et al 2014, Liaw J et al 2009. Min-Jung Kim et al 2018, Mona Ali Kunswa et al 2018 and Van der Pal et al, 2007)

V. CONCLUSION

The increased survival rate of infants with complex health care needs means that more infants are at greater risk for developmental delays. Many of the very small and very sick babies admitted to the NICU begin a journey that may require many months of highly specialized nursing care before they go home. For years, nursing care of a sick neonate was carried out in NICUs with little understanding about the impact of the way care was being delivered or how the surrounding environment influenced the developing infant. These babies were often transported by isolette or ambulance to the NICU, “stabilized” in a noisy, chaotic environment, stuck for blood samples multiple times daily, and routinely underwent intrusive complex medical procedures. Developmental supportive care (DSC) is an evidenced based practice, that nurses need to explore, evaluate and refine continuously within the rapidly changing technological environment of the NICU. The goal of DSC is to offer 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. One care delivery model that optimizes developmental outcomes

for premature infants is the Newborn Individualized Developmental Care Assessment Program (NIDCAP) model that promotes a continuum of developmentally supportive care from admission to discharge and transition to home. NIDCAP, as described by Als and Gilkerson, is a conceptual framework that guides a relationship-based developmentally supportive approach to caring for premature newborns in the intensive care setting. A developmental framework for understanding preterm infants guides the approach and also addresses family adaptation. The NIDCAP approach permits a developmentally trained professional to conduct observations and make recommendations for ways to support the preterm’s physiologic stability, behavioral organization, and developmental improvement.

The implementation of individualized developmental care reassures the shift from a protocol-based task and scheduled oriented framework of NICU care to an individualized and relationship-based framework of care. The introduction of NIDCAP in the neonatal departments will reduce the mismatch between intra-uterine environment and NICU by taking into account the individual infant’s current thresholds of behavioral organization, diminishing stress, and supporting each infant’s strengths and competencies. With the help of NIDCAP approaches in neonatal care all staff will study how to observe and identify infants’ behavior, to hear their voices and understand them. Our smallest and most fragile patients should feel comfort and a sense of security that are so important for their healthy development. 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.

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