



**Category: Applied Research in Health and Medicine**

**REVIEW**

## **Neurodevelopment in Preterm Neonates: A Comprehensive Approach to Quality of Life**

### **Neurodesarrollo en Neonatos Prematuros: Un Enfoque Integral hacia la Calidad de Vida**

Rosa Inés Bobillo <sup>1</sup>

<sup>1</sup> Universidad Abierta Interamericana, Facultad de Medicina y Ciencias de la Salud, Licenciatura en Enfermería. Sede Rosario, Rosario. Santa Fe, Argentina.

**Cite as:** Bobillo RI. Neurodevelopment in Preterm Neonates: A Comprehensive Approach to Quality of Life. SCT Proceedings in Interdisciplinary Insights and Innovations.2025;3:491. DOI: <https://doi.org/10.56294/piii2025491>

**Submitted:** 12-10-2024

**Reviewed:** 06-11-2024

**Accepted:** 04-01-2024

**Published:** 09-01-2025

**Editor:** Emanuel Maldonado 

#### **ABSTRACT**

**Introduction:** Prematurity constituted a significant challenge for world public health, being one of the main causes of neonatal mortality. The admission of preterm newborns (PNBs) to neonatal intensive care units (NICU) represented a crucial solution for their survival, although it implied separation from their families and exposure to adverse stimuli. In this context, Neurodevelopmental Centered Care (NCC) emerged as an innovative strategy that reorganized neonatal care towards a more humanized and patient-centered model.

**Development:** NCC integrated practices such as the kangaroo method, non-pharmacological pain management and the active participation of families, promoting an environment that favored the neurodevelopment of the premature infant. These strategies demonstrated benefits such as reduced hospital stay and improved long-term neurological outcomes. However, their implementation was heterogeneous, facing barriers such as lack of specialized training, limited resources and resistance to change in health care teams. Models such as NIDCAP and the integrative approach of Altimier and Phillips offered effective frameworks to guide this care.

**Conclusions:** The CCN was shown to be a key tool for improving the quality of life of RNP and their families. However, its mass adoption will require a coordinated effort that includes ongoing training, inclusive public policies, and adequate resources. The integration of families and an adapted NICU environment emerged as fundamental pillars for the success of this strategy.

**Keywords:** Prematurity; neurodevelopmental; patient-centered care; NICU; NIDCAP.

#### **RESUMEN**

**Introducción:** La prematurez constituyó un desafío significativo para la salud pública mundial, siendo una de las principales causas de mortalidad neonatal. El ingreso de los recién nacidos prematuros (RNP)

en unidades de cuidados intensivos neonatales (UCIN) representó una solución crucial para su supervivencia, aunque implicó la separación de sus familias y la exposición a estímulos adversos. En este contexto, surgió el Cuidado Centrado en el Neurodesarrollo (CCN) como una estrategia innovadora que reorganizó la atención neonatal hacia un modelo más humanizado y centrado en el paciente.

**Desarrollo:** El CCN integró prácticas como el método canguro, el manejo del dolor no farmacológico y la participación activa de las familias, promoviendo un ambiente que favoreciera el neurodesarrollo del prematuro. Estas estrategias demostraron beneficios como la reducción de la estancia hospitalaria y la mejora de los resultados neurológicos a largo plazo. Sin embargo, su implementación fue heterogénea, enfrentando barreras como la falta de formación especializada, recursos limitados y resistencia al cambio en los equipos de salud. Modelos como el NIDCAP y el enfoque integrativo de Altimier y Phillips ofrecieron marcos efectivos para guiar estos cuidados.

**Conclusiones:** El CCN mostró ser una herramienta clave para mejorar la calidad de vida de los RNP y sus familias. No obstante, su adopción masiva requerirá un esfuerzo coordinado que incluya formación continua, políticas públicas inclusivas y recursos adecuados. La integración de las familias y un ambiente UCIN adaptado emergieron como pilares fundamentales para el éxito de esta estrategia.

**Palabras clave:** Prematuridad; neurodesarrollo; atención centrada en el paciente; UCIN; NIDCAP.

## INTRODUCTION

Prematurity is a well-known problem in the world. The rate of preterm birth is increasing globally and is the leading cause of newborn deaths and the second leading cause of death after pneumonia in children under 5 years of age. Preterm newborns (PNB) have criteria for admission to neonatal intensive care units (NICU) for care and survival, but this determines that the newborn is separated from the family and that interventions are regulated exclusively by the healthcare team (Chattas, 2021).

Neurodevelopmental care (ND) or Neurodevelopmental Centered Care (NCC) is an innovative care culture that strongly impacts how nursing care is managed and organized. It is the continuity of two decades where neonatal nursing care ceased to be task-centered and became patient-centered (Egan, Quiroga, and Chattás, 2012). It has been an expected development to the extent that the admission and stay in the Neonatal Intensive Care Unit (NICU) have inspired more humanized care to accompany and contain the newborn and his family in this difficult experience. The NICU introduced and articulated concepts such as parental involvement in the care of their child, the use of the kangaroo method, non-pharmacological analgesia, interventions aimed at the control of external stimuli, and the maintenance of an appropriate posture of the premature infant. There is the idea that this practice “produces a reduction in the need for intensive care, hospital stay, and family anxiety, as well as an improvement in long-term neurodevelopmental outcomes” (Ruiz Fernández, 2016)

## DEVELOPMENT

### Prematurity

According to WHO (2017), about 15 million preterm infants are born each year, and this number continues to rise. Premature newborns spend a long period in Neonatal Intensive Care Units (NICU), which provide

a very different space from the ideal intrauterine world; the stay in this extrauterine environment significantly influences the neurodevelopment of the neonate (Alegre, Córdova, and López; 2016).

Perinatal interventions in recent decades use technological advances and better equipment in neonatal intensive care units (NICU), "the use of prenatal steroids, ventilatory techniques, the use of surfactant, better nutrition through the use of orogastric tubes and parenteral feeding has changed the patterns of mortality and morbidity of high-risk neonates. This has allowed the survival of children with increasingly lower weight and gestational age, which leads to the risk of alterations that often prevent them from normal development and their full insertion into a productive and self-sufficient life in society" (Sánchez, Arévalo, Figueroa and Nájera; 2014).

The Ministry of Social Development of Argentina (2020) issued a document for the classification of prematurity and starts with the WHO classification "preterm infants are divided into subcategories according to gestational age: extremely preterm (less than 28 weeks), very preterm (28 to 32 weeks) and moderate to late preterm (32 to 36 weeks)". For the Ministry, a premature birth is a situation that is experienced as something unexpected and does not conform to expectations regarding birth. A premature baby has premature mothers and/or fathers who may experience the birth with feelings such as anguish, fear, or sadness. Beyond the complexity of the baby's clinical condition and the degree of prematurity, "it is important to know that in all cases, the support of the mother, father or someone who represents an emotional bond is fundamental in reducing the stress of hospitalization and the baby's recovery. Entering the Neonatal Intensive Care Unit (NICU) has an impact. Seeing the baby in an incubator or connected to devices, a tube, a respirator, is not what is expected about birth."

Preterm infants can also be classified according to weight for estimated maturity; RNs are classified as appropriate for gestational age (AEG) -between 10th and 90th percentiles-; large for gestational age (LGA) -above 90th percentile- and small for gestational age (SGA) -below 10th percentile- (Phaloprakarn, 2015).

The severity of health complications will depend mainly on gestational age and weight, which are positively correlated with the degree of maturity. Short-term complications can be neurological, cardiac, and respiratory in the most severe cases. These include respiratory distress syndrome due to surfactant deficiency; apnea where RNP stops breathing for 20 seconds or more -sometimes accompanied by bradycardia-; bronchopulmonary dysplasia or chronic lung disease due to lung tissue lesions secondary to the continued use of a ventilator and oxygen -associated with surfactant deficiency-; persistent ductus arteriosus where the duct that communicates the aorta with the pulmonary artery is not obliterated, causing difficulty in breathing and feeding, which can lead to heart failure; intraventricular hemorrhage consisting of bleeding from the cerebral ventricles; hypotension and, finally, infections due to immaturity of the defense mechanisms that make them prone to pneumonia or urinary tract infection (Veritas Intercontinental, 2021).

Sanchez et al. (2014) clearly express that premature newborns account for 75% of neonatal mortality and about 50% of the incidence of short and long-term sequelae, especially in those with extreme prematurity, where up to 60% suffer neurological disabilities. The degree of maturity and low birth weight are directly related to the immaturity of devices and systems, which implies a great possibility of presenting morbid processes, so a high percentage are admitted to Intensive Care Units for prolonged periods of hospitalization. One of the systems of greatest susceptibility in the premature infant is the nervous system, which during the neonatal period is undergoing an important development process, which makes it vulnerable to various physiological alterations determined by immaturity (Sánchez, Arévalo, Figueroa, and Nájera; 2014).

### Neurodevelopment

Artigas-Pallarés et al. s. (2013) define neurodevelopment as "a process whose evolutionary correlate is the adaptation to the environment and the contribution, through behavioral patterns, to the maintenance of a reproductive rate capable of sustaining the survival of the species." Genes are the repository of the biological and cognitive conditions of the species that combine with the evolutionary design of the brain to condition a functional and useful structure for adaptation to an ancestral environment that is very different from the current scenario (Artigas-Pallarés, Guitart, Gabau-Vila; 2013).

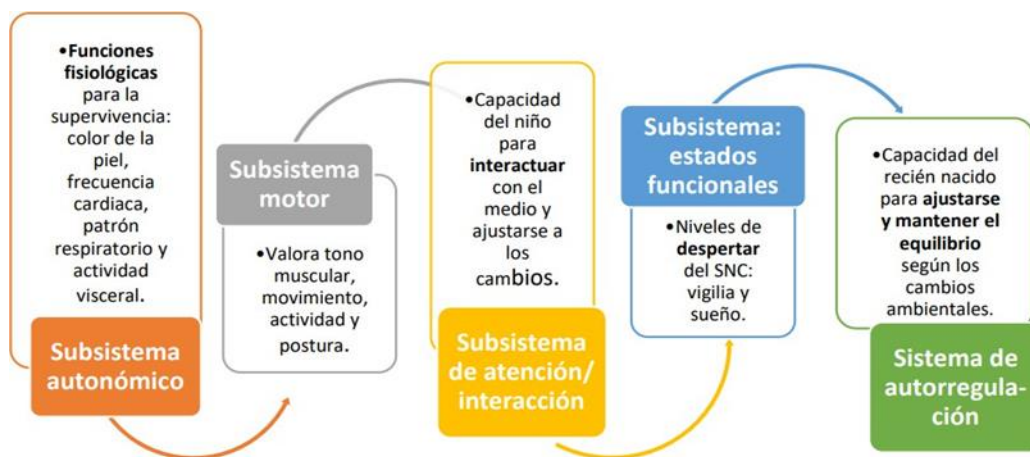
In neurodevelopment, there are mechanisms through which the nervous system is organized. These mechanisms "interact intrinsically generating different variables such as attention, intentionality, emotion, thought, memory, language, socialization, and motor control to respond to the demands of the environment" so that neurodevelopment is closely linked to the child's affective, environmental, and genetic world. The Synactive theory developed by Dr. Heidelise (1982) postulates that human infants actively regulate their development and have the capacity for attention interaction with the environment and caregivers. This constant communication of the organism with the environment has made it possible to identify the interaction of several subsystems within the organism. These subsystems are involved in physiological regulation, motor activity, and the organization of wake-sleep states as they interact with the environment in which the newborn finds himself. In contrast, inadequate and inappropriate stimuli for the neonate will be responsible for systemic disorganization. "Numerous and considerable critical complications of the respiratory or circulatory type that occur with high frequency in PTNBWs (preterm newborns) will be due to efforts made by the organism to adapt to the aggression that the extrauterine environment and the sanitary procedures to which they are exposed" (Braz, 2016).

This theoretical axis states that the PTNB, against an inadequate stimulus in complexity or intensity, will first defend itself, and the younger the gestational age, the less defense capacity it will have. "If such stimulus is prolonged, it will become disorganized due to its inability to maintain the balance and adjustment between its subsystems." However, appropriate stimuli (in time, complexity, and intensity) will provide the desired balance. Therefore, a thorough assessment of the RNPT's behavior and

physiological state will be key for adequate exposure to external stimuli, seeking to avoid disorganization and promoting its growth and neurodevelopment (Jorrín Bengoechea, 2018).

The four hierarchical subsystems should be assessed for stimulus control (Braz, 2016). First of all, the autonomic subsystem is in charge of regulating basic physiological functions necessary for survival. The lower the gestational age, the greater the predominance and influence of this subsystem. Secondly, the self-regulatory system refers to the ability of the newborn to maintain the balance between the other four subsystems -autonomic, motor, states, and attention/interaction- (Sánchez, 2016).

Figure 1: Regulatory subsystems of Dr. Heidelise Als' Synactive Theory. Source: Care for Neurodevelopment. Author: Lauren, M. (2014).



Source: Own elaboration

The benefits of the Synactive Theory can be added to those of the Integrative Model of Altimier and Phillips (2013), which proposes central measures for neurodevelopment based fundamentally on the concept of neuroprotection. These measures favor the interaction of several subsystems with the environment to avoid an imbalance of any of them. In other words, the imbalance of one subsystem affects all the others. These seven measures are (Chattas, 2021):

1. Provide a healing physical environment in the NICU, with space for the NB and parents -promoting privacy-.
2. Establish agreements with families to optimize neurodevelopmental care.
3. Perform proper positioning and manipulation, offering support for musculoskeletal development.
4. To perform gentle, soft and modulated manipulation.
5. Minimize stress and pain.

6. Protect the skin, and thus all its functions.

7. Optimize nutrition, prioritizing breastfeeding and promoting its effect on brain development.

The Integrative Model combines evidence-based best practices to facilitate the physiological and developmental needs of each newborn. This personalized approach includes educational programs for both mother and family. The model is represented by a set of overlapping petals that show the integrative nature of developmentally based care. The petals represent the core measures and the center items represent the key factors to be considered in care.

Figure 2: Altimier and Phillips Integrative Model by Altimier L and Phillips.

(2013).



Source: Own elaboration

Neonatal Intensive Care Unit (NICU) and neurodevelopment.

The admission of a premature newborn to a Neonatal Intensive Care Unit (NICU) involves being exposed to a series of painful and stressful stimuli for which he/she is not prepared and which may hurt his/her neurodevelopment (Mosqueda Peña, 2016).

The Diagnostic and Statistical Manual of Mental Disorders (5th ed.; DSM- V; American Psychiatric Association, 2013) defines Neurodevelopmental Disorders (NDD) as "a set of conditions that appear early in the course of child development interfering with and causing deficits in the way the child performs in personal, social, academic or occupational domains." This variability in the areas affected and the degree to which they are affected results in various combinations and possibilities that make subsequent clinical management difficult (Vacas & Sanchez-Raya, 2020).

Regarding the morphological and functional manifestations characteristic of their immaturity, Narberhaus and Segarra (2004) state that "uncomplicated premature infants present in the neonatal stage a reduction of the cortical gray matter, an increase of the lateral ventricles and an affectation of the white matter that becomes more evident at later ages. At 3-8 years of age, deficits in IQ are mainly observed, and reading and calculation are added at 14-15 years of age". On the other hand, in infancy and at 13 years

of age, difficulties are observed in general cognitive performance and some specific skills, such as memory.

Gutiérrez Crespo et al. s. (2017) described the neurodevelopmental sequelae of extremely low birth weight and very low birth weight preterm infants at two years of age discharged from the Neonatal Intensive Care Unit of the Edgardo Rebagliati Martins National Hospital. In a descriptive, retrospective, cross-sectional study on a population of 190 extremely low-weight and very low-weight preterm infants born and discharged from the Neonatal Intensive Care Unit from January 2009 to June 2014. These patients attended the institutional follow-up program where psychomotor development, sensorineural hearing loss, retinopathy of prematurity, presence of cerebral palsy, and seizure syndrome were evaluated. The average birth weight was  $1,180.53 \pm 212.40$  grams with a gestational age of  $29.86 \pm 2.33$  weeks, and 51.58% were male. Of the very low birth weight preterm newborns, 42.63% had delayed psychomotor development.

psychomotor developmental delay; 25.26%, retinopathy; 13.68%, sensorineural hearing loss; 3.68%, cerebral palsy; and 3.68%, convulsive syndrome. Of the extremely low birth weight preterm infants, 52.27% had delayed psychomotor development, 50% had retinopathy, 15.91% had sensorineural hearing loss, and 2.27% had seizure syndrome. From these results, they concluded that delayed psychomotor development and retinopathy were the most important complications presented by extremely low birth weight preterm infants and very low birth weight preterm infants at two years of age (Gutiérrez Crespo, Matzumura Kasano, Melgarejo García, Zamudio Eslava, & Fernández Sierra; 2017).

It is not logical to discuss the need to become aware of the need to adapt care strategies for these patients. CCN interventions are tools aimed at favoring the development of the RNP as normally as possible and in the abnormal and harmful context of the NICU. NCC is a strategy to achieve the adequate evolutionary development of the RNP's neurological system and to counteract the impact of their hospitalization. Its application is discontinuous in different countries and even within each national health system (Ruiz Fernández, 2016).

Neurodevelopmental care (NC) or Neurodevelopmental Centered Care (NCC) is an innovative care culture that strongly impacts how Nursing care is managed and organized. It is the continuity of two decades where neonatal nursing care ceased to be task-centered and became patient-centered (Egan, Quiroga, and Chattás, 2012). It has been an expected development to the extent that the admission and stay in the Neonatal Intensive Care Unit (NICU) have inspired more humanized care to accompany and contain the newborn and his family in this difficult experience.

The NCC introduced and articulated concepts such as parental involvement in the care of their child, the use of the kangaroo method, non-pharmacological analgesia, interventions aimed at the control of external stimuli, and the maintenance of an appropriate posture of the premature infant. There is the

idea that this practice "produces a reduction in the need for intensive care, hospital stay, and family anxiety, as well as an improvement in long-term neurodevelopmental outcomes" (Ruiz Fernández, 2016).

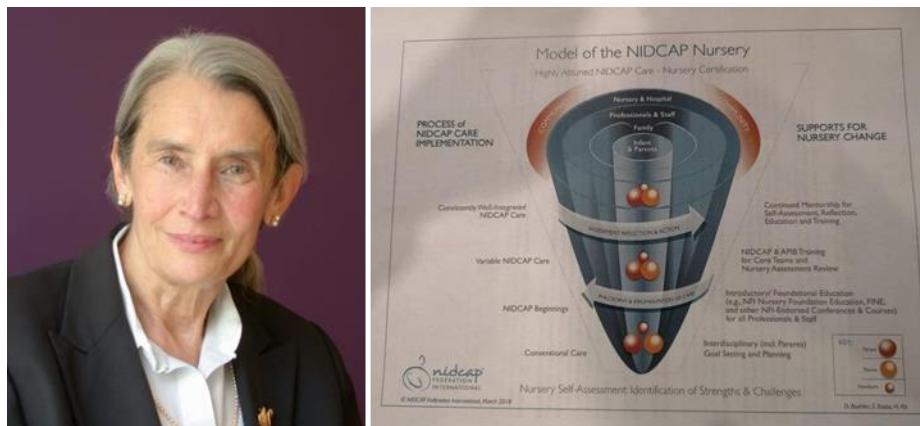
NIDCAP (Newborn Individualized Developmental Care and Assessment Program).

The intrauterine environment provides adequate stimuli for fetal brain development and maturation. Admitting the PTNBW to a NICU means being exposed to several painful and stressful stimuli for which he or she is not prepared. "These stimuli will not only trigger responses in the acute moment, but will also affect the structure and function of the immature brain -they will influence the formation of synapses and cortical development- and, consequently, will affect later neurodevelopment" (Mosqueda Peña, 2016).

In 1984, Heidelise Als published the theory and systematic method for assessing the developmental needs of preterm infants and introduced developmental and family-centered care (DCF) as a group of interventions designed to modify the NICU environment to minimize and anticipate the stress, pain, and discomfort experienced by the preterm infant (Sizun & Westrup, 2003).

Figure 3 and 4. Dr. Heidelise Als and posting on her social network of the NIDCAP Nursery scheme.

#### NIDCAP Nursery.



Source: Own elaboration

NIDCAP (Newborn Individualized Developmental Care and Assessment Program) includes modifying external stimuli (visual, auditory, tactile, vestibular), care grouping, positioning and restraint, and support of the family-child bond. "It focuses on individuality and respect for the newborn and family by conducting observations of the newborn before, during, and after. In this way, the observer assesses at each moment the newborn's ability to organize and modulate the four subsystems that are part of the inactive theory and that will mature simultaneously, interacting with each other throughout development: autonomic, motor, organizational state, attention/interaction, and self-regulatory system." Individualized care recommendations arise from this continuous observation activity and define



changes in the environment according to the child's current state of development and the family's needs. These recommendations aim to decrease stress and promote the child's competence to cope with that stress and discomfort. "Parents are more attentive to their child's needs, learn to recognize states of alertness and sleep, and can provide appropriate stimulation at all times. All this will allow a better brain organization with positive long-term results and improve the prognosis of RNPT (Mosqueda Peña, 2016).

Implementing this type of care in NICUs requires an important effort from all the professionals involved; on the other hand, we know that the application of CCD, in general, is very heterogeneous in the different neonatal units. "This can be partly explained by the absence of formal training for professionals working in neonatology. In this sense, it would be very useful to develop training courses on CCDs and assess their impact to try to homogenize the application of this type of care and thus improve the outcomes of our children." Mosqueda Peña (2016) studied the professional perception in the NICUs of two Spanish level III hospitals (12 de Octubre in Madrid and Vall d'Hebron in Barcelona) while implementing the NIDCAP method. It expresses that professionals perceive the difficulty of implementing care based on time consumption, nurses' working conditions, and the impact of decreased lighting in the unit. The professionals showed an attitude and an intention to implement it, whereas neonatologists had more positive perceptions than the nursing staff. Professionals understand that the discussion centers on more time, education, and staffing. The need for staffing was considered by more nurses than physicians (93% vs 74%).

The main obstacle identified was the lack of coordination between different professionals (77%), followed by the noise level in the unit (35%); physicians expressed strongly in comparison to Nursing regarding the noise level (61% vs 23%) as the preponderant obstacle. Professionals with more years of service perceived their colleagues as an obstacle to a greater extent, particularly the nursing staff. Most respondents (91%) believed that NIDCAP was essential to medical care for newborns. It is concluded that the assessment of NIDCAP by the healthcare professionals of the two Spanish NICUs analyzed is positive, especially by the neonatologists. The attitude towards NIDCAP and the intention to put it into practice are also positive. Implementing NIDCAP is perceived as laborious, especially because of the resources that the professionals consider necessary (more time, education, personnel, and materials, as well as modification of the physical environment) and the need to overcome obstacles such as the lack of coordination of the different professionals. However, most feel that NIDCAP is beneficial and essential and that the implementation of DCC (Developmental Centered Care) in Spain has improved. There would still be room for improvement in areas such as sucrose or noise control, but the positive change that has occurred in relation to parental input should be highlighted. Prior knowledge of the CCD in the professionals of the hospitals in Madrid is similar regardless of the level of care. The training course applied with pre and post-implementation evaluation significantly improves the hit rate (Mosqueda Peña, 2016). Roué et al. s (2017) performed an in-depth review and published what they called the eight principles for patient and family-centered care for newborns in the intensive care unit.

- **PRINCIPLE 1:** free access for parents 24 hours a day without limitations due to staff shift changes or medical rounds.

The presence of the family in the NICU is based on philosophical, psychological, and neuroscientific arguments; the family is the constant in the child's life and its primary source of strength and support (Committee on Hospital Care and Institute for Patient- and Family-Centered Care, 2012). In Europe, moreover, the statement of the European Association for Children in Hospitals declares "the right to have their parents or surrogates with them at any time, place, 24 hours a day, regardless of the age of the child or young person" (European Association for Children in Hospital). Similarly, the Convention on the Rights of the Child states that a child has "the right to be cared for by his or her parents and not to be separated from them against his or her will" (Convention on the Rights of the Child, United Nations Human Rights).

The presence of parents throughout hospitalization and their commitment to the care of their child has been associated with a lower prevalence of retinopathy of prematurity, a shorter hospital stay, and a reduced risk of moderate to severe BPD (Bronchopulmonary Dysplasia). Moreover, it constitutes an intervention in favor of the parents concerning the construction of the bond and attachment (Roué et al., 2017).

- **PRINCIPLE 2:** psychological support for parents.

Kim et al. (2017) argue that parents of hospitalized PTNBWs are exposed to a traumatic and stressful experience that could lead to acute stress illness or post-traumatic stress. This situation can negatively impact the child's future development and be associated with behavioral disorders in infants.

"According to a recent meta-analysis, early educational and behavioral interventions focused on adaptation and self-regulation reduce symptoms of psychological trauma in mothers after preterm birth." Psychological support of parents has an axis in parental education (Kraljevic & Warnock, 2013).

- **PRINCIPLE 3:** pain management.

A systematic review of observational studies identified a higher number of invasive procedures per neonate per day, often associated with inadequate pain management, with the most immature neonates having the most painful experiences. Pain assessment should be based on validated composite scales. Two scales have metric adjustments for prematurity (the PIPP and N-PASS), and the EDIN and N-PASS scales have demonstrated validity and reliability for prolonged neonatal pain. Pain management is a critical issue. Nonpharmacologic approaches are based on scientific evidence. According to a recent Cochrane meta-analysis, interventions accompanied by non-nutritive sucking, breastfeeding, sucrose, and tucking/wrapping are efficient in reducing pain reactivity during invasive procedures in preterm newborn infants (Roué et al., 2017).

- **PRINCIPLE 4:** supportive environment.

Preterm infants and high-risk newborns are exposed to sensory stimuli very different from the uterine environment during a critical period of brain development, including excessive lights and excessive sound. "Preterm infants may react to moderate variations in sound or light, affecting their psychological and behavioral well-being. This environment may also negatively impact sleep quality and duration, altering brain development. Controlling the environmental quality of the NICU is critical. Early exposure to parental voice appears to be important for the cognitive and language development of the infant" (Roué et al., 2017).

- **PRINCIPLE 5:** postural control. Vaivre-Douret et als.

(2004) published that inappropriate positioning can lead to muscle tone abnormalities in preterm newborns. Furthermore, Hunter (2010) reinforces the concept that "preterm infants in unsupported extension positions may exhibit stress and agitation."

The goals of postural support are to prevent musculoskeletal deformities and to promote overall behavioral development. It will seek to position the infant to promote flexion, "facilitate hand-mouth activity, facilitate midline orientation and symmetrical posture, support movement and posture, optimize skeletal development and alignment, promote a calm state, and prevent cranial deformities and torticollis." Proper tucking improves development and motor organization, decreases psychological stress, and supports the self-regulatory capacity of premature infants. On the other hand, restraining the hands or facilitating grasping and "keeping the infant's arms and legs in a flexed position close to the midline of the body seems to be efficient in reducing pain symptoms during procedures.". The use of nests facilitates the movements above to and across the midline and decreases abrupt movements and fixed postures of arms and legs (Roué et al., 2017).

- **PRINCIPLE 6:** skin-to-skin contact.

Roué et als. (2017) publish findings where continuous or intermittent skin-to-skin contact of PTNBW and their parents (recommended by WHO) is associated with decreased risk of mortality, severe infection -or sepsis-, hypothermia and hypoglycemia. On the other hand, they promote a shorter hospital stay, increased infant growth, breastfeeding, mother-child attachment; as well as greater parental satisfaction, better sleep organization, and decreased pain perception during procedures.

- **PRINCIPLE 7:** breastfeeding and breastfeeding support.

Quigley and McGuire (2014) point out that breastfeeding has short- and long-term health benefits for preterm infants; even tube feeding with the mother's own milk and reduces the risk of severe disease such as enterocolitis (e.g., breastfeeding with the mother's own milk).

According to the European Society for Pediatric Gastroenterology, Hepatology and Nutrition (Arslanoglu et al., 2013) the mother's own fresh milk is the first choice in preterm infant feeding. When not available, fortified donor human milk is the recommended alternative.

Establishing exclusive breastfeeding in preterm infants is associated with infant, maternal, and clinical practice factors. There are evidence-based recommendations on how to protect, promote, and support breastfeeding in NICUs that include early initiation of breastfeeding with the sole criteria being infant stability, no separation of mother and infant, skin-to-skin contact, and family-centered care (Roué et al., 2017).

- **PRINCIPLE 8:** sleep protection.

Sleep is a major physiological function in mammals and plays an important role in brain development. Environmental factors such as unadjusted sounds and light levels and medical and nursing routines can disrupt sleep in the NICU.

"In healthy term infants, short sleep deprivation is associated with the development of obstructive apnea and significantly increased awakening thresholds. Animal model research demonstrated changes in respiratory patterns, altered subsequent learning, and long-term effects on behavior and brain function due to sleep deprivation during the neonatal period." These data promote the need to protect sleep in the NICU (Roué et al., 2017)

Dissemination and awareness of Neurodevelopmental Centered Care.

After agreeing that neonatal intensive care units (NICUs) impose developmental stressors and that there has been awareness of the need to change practices, we found that the trend has focused primarily on the medical qualities of NICUs and less on their developmental ecology.

López Maestro et al. (2014) believe that although information on the implementation of Neurodevelopmental-Centered Care has been available since 1999, the actual degree of implementation is not known. In a follow-up conducted between 2006 and 2012, they concluded that implementation in Spain had improved, with room for improvement in areas such as sucrose, noise control, and unrestricted parental visits.

Panning through the teams performing in Israel's NICUs assessed three domain areas: parent and family involvement, environmental monitoring, and individualized care and assessment. The results suggest high heterogeneity in applying procedures and programs considered developmentally appropriate, where units with a relatively large multidisciplinary team scored high. Environmental control is high, but parental involvement was the most prominent, and contradictions between knowledge of the subject and its implementation could be observed (Pierrat et al., 2007).

Alegre Fernández (2011) publishes similar inconsistencies between theory and practice in the Neonatology Service of the National Hospital of Itauguá (Paraguay) between April 2008 and March 2009; some of the professionals with maximum scores in theory had low practical and attitudinal evaluations, where one out of three people surveyed performs a correct practice (Alegre Fernández G, 2011). At the XVIII Congress of the Cuban Nursing Society 2019, González et al. (2018) presented that, regarding a group of nurses who expressed theoretical knowledge about neurodevelopment, participatory observation determined that many of these procedures were omitted despite knowing the benefits.

Gómez Quispe (2021) describes in La Paz -Bolivia- that only 12% of a group of nurses executed the tasks correctly according to the checklist, concluding the lack of training and execution for the mentioned technique.

The dichotomy between theoretical knowledge of the benefits of Neurodevelopmental-Centered Care and its practical application is constant. NCC is seen as a must but does not reach professional practice in the context of intra-services heterogeneity in the NICUs.

The degree of implementation in NICUs in Mexico in 2017 showed a lack of strategies to raise CCD coverage, improve parental education regarding the measures used in this program, and ensure that developmental-centered care is applied in all regions due to its low cost and great benefit. Applicability, in that cross-section, was below the indicators for Spain, Argentina, and the United States (Gutiérrez Crespo et al., 2017).

Regarding the level of information and knowledge of Nursing, Díez Recinos (2017) publishes "rather discouraging initial data on the knowledge that caregivers possess on this topic in Guatemala" that would have been reversed after relevant formative interventions of Nursing professionals. Alegre et al. (2016) found that 83% out of 65 nurses in a NICU in the province of Mendoza, Argentina, were unaware of the definition of neurodevelopment (Alegre, Cordova, and Lopez Saucedo, 2016).

We should broaden the view on training difficulties. In that case, a literature review shows that professionals detect common elements that hinder the implementation of care -regardless of the effector and country- where one of the elements in which the articles coincide is in the training of the healthcare personnel working in the unit. "The nurses themselves are aware of their limitations and therefore demand initial training on care to be able to understand the changes that will have to be carried out in their daily routines, but they also emphasize the need for ongoing training to enable them to carry out care correctly and rigorously." It becomes clear that, as a consequence of this new model of care, it is necessary to modify and adjust the roles played by each team member. To this end, it is required " to give the staff time and facilities to redefine their role, to identify with it and to provide them with the tools so that they can acquire the new skills that derive from this new role". Nursing also points out that the care load must be modulated to compensate for the time required for this adjustment. Another obstacle perceived by the professionals is the lack of coordination among the multidisciplinary team,

which may be because the professionals have specific criteria for care that may not coincide with those of their colleagues, and therefore, tensions may arise in the team. It is recognized that parental involvement in care decreases the stress level in the family, improves the attachment relationship, and allows nursing to diagnose family needs better. Although it has been shown that nurses are very well disposed toward applying care, they encounter specific difficulties when putting it into practice. There is a certain reluctance to share the responsibility of care. Some of the drawbacks they see to sharing care with parents is that parents intervene in their daily routines, which means spending more time on already scheduled tasks and taking longer to make daily rounds. "There is also controversy about whether or not parents should be present during painful, invasive procedures or CPR (Cardiopulmonary Resuscitation) maneuvers. "At those times, parents get upset, as they are not very pleasant situations that generate fear, insecurity, and anxiety." Some nurses think that the presence of parents is not very appropriate since having to pay attention to them also reduces the attention paid to the critical neonate. Some authors point out that the high level of technical training of the professionals working in this type of unit can create differences with the parents. Training is another of the barriers most frequently mentioned to explain why NCCs are not fully implemented. "One of the reasons nurses give is that they do not have sufficient communication skills to give bad news to parents or do not have sufficient strategies to manage parental stress". In addition, some authors emphasize that as nurses' clinical experience increases, these skills become more acquired, and staff focus more on the psychosocial side and less on the physical. "This may be because more experienced staff are more confident in their actions, while staff with less professional experience, due to insecurity, spend more time on physical care and have less opportunity to worry about the needs of the family." The review notes the importance parents give to the experience of sharing care responsibilities in the NICU. They express their appreciation for the work of Nursing, but they also point to short circuits in communication with the healthcare team (Aguilera Vegas, 2018).

In line with the positive responses found by some authors to educational interventions on professionals regarding NCC, Ortiz-Mendoza et al. (2021) found that a training program in Individualized Newborn Developmental Care (NIDCAP) in the nursing staff of the Regional Hospital of Valle del Mezquital (Mexico) changed a low level of knowledge to a high level of expertise that was maintained even three months after the end of the training (Ortiz-Mendoza et al., 2021).

In recapitulation, technical-scientific advances are increasingly more significant, especially those with technological applications in highly specific areas such as NICUs. This has allowed the survival of PTNB, even in extreme cases. On the other hand, their level of lability feeds back the need to adapt the services and the healthcare team. The need for updating and evidence-based professional practice should not be stated. On the other hand, updating implies learning professional competencies and not merely reciting theory; it means ethical professional practice and not simply stating what is beneficial but without applying it. The CCN strategy is proven, but its implementation - at least in the Spanish-speaking world -

is heterogeneous. Training is deficient, and when observed, it shows an inferior degree of practical application.

On the other hand, sufficient information exists on the aspects that need to be improved to promote its application, and the positive impact of in-service training when it is planned is once again corroborated.

## CONCLUSIONS

Prematurity represents a significant global public health problem associated with high rates of neonatal mortality and morbidity. Technological advances have increased the survival of preterm newborns (PNBs) but have also shown the need to adopt comprehensive approaches to their care, especially in the neurodevelopmental field. Prolonged admission of PNBs to Neonatal Intensive Care Units (NICU) exposes these patients to environmental factors and procedures that, if not properly managed, can negatively impact their neurodevelopment.

Neurodevelopmental-centered Care (NCC) emerges as a fundamental strategy to mitigate the adverse effects of the extrauterine environment on the development of PNBs. This approach promotes individualization of care, active involvement of families, and implementation of practices such as the kangaroo method, non-pharmacological analgesia, and optimization of the physical environment in NICUs. Studies show that these interventions reduce parental anxiety, improve long-term neurological outcomes, and shorten hospital stays.

Despite the demonstrated benefits of CCN, its implementation presents significant challenges. Health systems face heterogeneity in applying these practices, influenced by factors such as lack of specialized training, limited resources, and cultural barriers. Difficulties in interdisciplinary coordination and the reluctance of some professionals to change their routines are recurrent obstacles. However, research highlights the positive impact of continuing education programs and the development of professional competencies in improving the quality of neonatal care.

Altimier and Phillips' Integrative Model and the NIDCAP program are effective theoretical and practical frameworks for NCC. Both emphasize the importance of neuroprotection, adaptation of the NICU environment, and integration of families into care. Successful implementation of these strategies requires a profound cultural change in neonatology services, accompanied by continuous training and periodic evaluation of results.

In summary, CCNs benefit RNPs regarding neurological development, strengthening family bonds, and humanizing NICU care. To move towards its mass adoption, it is necessary to overcome the barriers identified through health policies prioritizing professional training, adequate resource allocation, and promoting evidence-based practices. This joint effort will ensure optimal development for preterm infants, reducing inequalities in neonatal care and improving their long-term prospects.

## REFERENCES

1. Aguilera Vegas B. Cuidados centrados en el desarrollo y la familia en la UCIN: barreras en su implementación. Revisión narrativa [tesis de grado]. Madrid: Universidad Autónoma de Madrid; 2018

[citado 2025 ene 3]. Disponible en: [https://repositorio.uam.es/bitstream/handle/10486/684674/aguilera\\_vegas\\_beatriztfg.pdf?sequence=1&isAllowed=y](https://repositorio.uam.es/bitstream/handle/10486/684674/aguilera_vegas_beatriztfg.pdf?sequence=1&isAllowed=y).

2. Alegre Fernández G. Conocimientos, prácticas y actitud del personal de enfermería acerca de los cuidados del neurodesarrollo del recién nacido prematuro [Internet]. 2011 [citado 2025 ene 3]. Disponible en: <http://scielo.iics.una.py/pdf/hn/v3n2/v3v2a04.pdf>.

3. Alegre V, Córdova M, López Saucedo S. Grado de conocimiento del profesional enfermero sobre el neonato y su neurodesarrollo durante la estancia hospitalaria en el servicio de neonatología [tesis de grado]. Mendoza: Universidad Nacional de Cuyo; 2016 [citado 2025 ene 3]. Disponible en: [https://bdigital.uncu.edu.ar/objetos\\_digitales/8647/alegre-victor.pdf](https://bdigital.uncu.edu.ar/objetos_digitales/8647/alegre-victor.pdf) .

4. Als H. Newborn Individualized Developmental Care and Assessment Program (NIDCAP): An Education and Training Program for Health Care Professionals. Boston (MA): Children's Medical Center Corporation; 1986. rev. 2006.

5. Altimier L, Phillips R. The Neonatal Integrative Developmental Care Model: Seven Neuroprotective Core Measures for Family-Centered Developmental Care. *Newborn and Infant Nursing Reviews*. 2013;13:9-22. Disponible en: [https://www.researchgate.net/publication/257612439\\_The\\_Neonatal\\_Integrative\\_Developmental\\_Care\\_Model\\_Seven\\_Neuroprotective\\_Core\\_Measures\\_for\\_FamilyCentered\\_Developmental\\_Care/citation/download](https://www.researchgate.net/publication/257612439_The_Neonatal_Integrative_Developmental_Care_Model_Seven_Neuroprotective_Core_Measures_for_FamilyCentered_Developmental_Care/citation/download).

6. Arslanoglu S, Corpeleijn W, Moro G. ESPGHAN Committee on Nutrition. Donor human milk for preterm infants: current evidence and research directions. *J Pediatr Gastroenterol Nutr*. 2013;57:535-42.

7. Artigas-Pallarés J, Guitart M, Gabau-Vila E. Bases genéticas de los trastornos del neurodesarrollo. *Rev Neurol*. 2013;56(Supl 1):S23-34. Disponible en: <https://www.neurologia.com/articulo/2012658>.

8. Braz ML. Neurodesarrollo y el niño [Internet]. *Neuropediat*; 2016 [citado 2025 ene 3]. Disponible en: <https://neuropediat.wordpress.com/>.

9. Chattas G. Neurodesarrollo en la Unidad de Cuidados Intensivos Neonatales. Del cuidado centrado en los profesionales al cuidado centrado en la familia [Internet]. 2021 [citado 2025 ene 3]. Disponible en: <https://www.cienciasdelasalud.uns.edu.ar/docs/Programa%20curso%20neurodesarrollo.pdf> .

10. Committee on Hospital Care and Institute for Patient- and Family-Centered Care. Patient-and family-centered care and the pediatrician's role. *Pediatrics*. 2012;129:394-404. Citado por Roué et al. Disponible en: <http://fn.bmj.com/on April 21, 2017 - Published by group.bmj.com>.

Aquí está la continuación de las referencias en estilo Vancouver:

11. Convention on the Rights of the Child, United Nations Human Rights. Secondary Convention on the Rights of the Child, United Nations Human Rights [Internet]. 2017 [citado 2025 ene 3]. Disponible en: <http://www.ohchr.org/en/professionalinterest/pages/crc.aspx>.

12. Cuevas Mendocilla MI. Competencias para el cuidado de enfermería y el nivel del neurodesarrollo del neonato prematuro hospitalizado [tesis de grado]. Trujillo: Universidad Nacional de Trujillo Facultad de Enfermería; 2019 [citado 2025 ene 3]. Disponible en: <https://dspace.unitru.edu.pe/bitstream/handle/UNITRU/15706/2E%20627.pdf?sequence=1&isAllowed=y>



13. Díez Recinos AL. Impacto de la implementación de los Cuidados Centrados en el Neurodesarrollo en las Unidades de Cuidados Intensivos Neonatales. *Guatemala Pediátrica*. 2017;1(1):1-8. Disponible en: <https://biblioteca.medicina.usac.edu.gt/revistas/guapedia/2017/1/1/02>.
  14. Egan F, Quiroga A, Chattás G. Cuidado para el neurodesarrollo. *Revista de Enfermería*. 2012;4:1-10. Disponible en: <https://www.fundasamin.org.ar/web/wp-content/uploads/2012/12/Cuidado-para-el-neurodesarrollo.pdf>.
  15. European Association for Children in Hospital (EACH). EACH Charter. Secondary European Association for Children in Hospital. EACH Charter [Internet]. 2017 [citado 2025 ene 3]. Disponible en: <http://www.each-for-sick-children.org>.
  16. Fernández Y, Funes M, Ladino V. Importancia del rol de enfermería en el neurodesarrollo del recién nacido pretérmino [tesis de grado]. Mendoza: Escuela de Enfermería Ciclo de Licenciatura; 2015 [citado 2025 ene 3]. Disponible en: <https://core.ac.uk/download/pdf/83116557>.
  17. Fonseca Fonseca M. Asociación entre el conocimiento, práctica y actitud del cuidado de enfermería en el neurodesarrollo del recién nacido prematuro [tesis doctoral]. Málaga: Universidad de Málaga Facultad de Ciencias de la Salud; 2016 [citado 2025 ene 3]. Disponible en: [https://riuma.uma.es/xmlui/bitstream/handle/10630/15670/TD\\_FONSECA\\_FONSECA\\_Madeline.pdf?sequence=1](https://riuma.uma.es/xmlui/bitstream/handle/10630/15670/TD_FONSECA_FONSECA_Madeline.pdf?sequence=1).
  18. Gaviria A. Estrés prenatal, neurodesarrollo y psicopatología. *Rev Colomb Psiquiatr*. 2006;XXXV(2):210-224. Disponible en: <https://www.redalyc.org/articulo.oa?id=80635206>.
  19. Gomez Quispe M. Competencias de enfermería orientadas al neurodesarrollo del recién nacido pretérmino [tesis de grado]. La Paz: Universidad Mayor de San Andrés; 2021 [citado 2025 ene 3]. Disponible en: <https://repositorio.umsa.bo/xmlui/bitstream/handle/123456789/25465/TE-1760.pdf?sequence=1&isAllowed=y>.
  20. González Portales A, Rodríguez Cabrera A, Borges Damas L. Conocimiento enfermero sobre cuidados centrados en el desarrollo en una Unidad de Cuidados Especiales. *Artemisa*. XVIII Congreso de la Sociedad Cubana de Enfermería; 2019 [citado 2025 ene 3]. Disponible en: <http://enfermeria2019.sld.cu/index.php/enfermeria/2019/paper/viewFile/263/89>
- Aquí tienes la continuación de las referencias en estilo Vancouver:
21. Gutiérrez Crespo H, Matzumura Kasano J, Melgarejo García G, Zamudio Eslava L, Fernández Sierra C. Secuelas del neurodesarrollo de recién nacidos prematuros de extremadamente bajo peso y de muy bajo peso a los dos años de edad, egresados de la Unidad de Cuidados Intensivos Neonatales del Hospital Nacional Edgardo Rebagliati Martins 2009-2014. *Horizonte Médico*. 2017;17(2):6-13. Disponible en: <https://www.redalyc.org/articulo.oa?id=371651249002>.
  22. Gutiérrez-Padilla JA, Pérez-Rulfo ID, Angulo-Castellanos E, Valle-Delgado E, García-Hernández HA, Martínez-Verónica R. Cuidados centrados en el desarrollo en unidades de neonatología de México, 2015. Encuesta a través de redes sociales. *Ginecol Obstet Mex*. 2017;85(6):355-63. Disponible en: [http://www.scielo.org.mx/scielo.php?script=sci\\_arttext&pid=S0300-90412017000600355](http://www.scielo.org.mx/scielo.php?script=sci_arttext&pid=S0300-90412017000600355).
  23. Harillo Acevedo D, López Martínez Á, Rico Becerra JI. La filosofía de los cuidados centrados en el desarrollo del recién nacido prematuro (NIDCAP): una revisión de la literatura. *Enfermería Global*. 2017;16(4):577-89. Disponible en: <https://www.redalyc.org/articulo.oa?id=365852824020>.

24. Hernández N, Rubio Grillo MH, Lovera A. Estrategias para el cuidado del desarrollo neonatal y el cuidado neonatal centrado en la familia. *Investig Educ Enferm*. 2016;34(1):104-12. Disponible en: <https://doi.org/10.17533/udea.iee.v34n1a12>.
25. Hunter J. Therapeutic positioning: neuromotor, physiologic, and sleep implications. En: Kenner C, McGrath JM, eds. *Developmental care of newborns and infants. A guide for health professionals*. 2nd ed. Glenview, IL: NANN; 2010. p. 283-312.
26. Jorrín Bengoechea C. Cuidados centrados en el desarrollo y la familia en el recién nacido prematuro [tesis de grado]. Cantabria: Universidad de Cantabria; 2018 [citado 2025 ene 3]. Disponible en: <https://repositorio.unican.es/xmlui/bitstream/handle/10902/14122/JorrinBengoecheaC.pdf?sequence=1&isAllowed=y>.
27. Kim WJ, Lee E, Kim KR. Progress of PTSD symptoms following birth: a prospective study in mothers of high-risk infants. *J Perinatol*. 2015;35:575-9. Citado por Roué et al. Disponible en: <http://fn.bmj.com/> on April 21, 2017 - Published by group.bmj.com.
28. Kraljevic M, Warnock FF. Early educational and behavioral RCT interventions to reduce maternal symptoms of psychological trauma following preterm birth: a systematic review. *J Perinat Neonatal Nurs*. 2013;27:311-27. Citado por Roué et al. Disponible en: <http://fn.bmj.com/> on April 21, 2017 - Published by group.bmj.com.
29. Lauren M. The Effect of Kangaroo Care on Neurodevelopmental Outcomes in Preterm Infants. *J Perinat Neonat Nurs*. 2014;28(4):290-99. Disponible en: <http://ovidsp.ovid.com/ovidweb.cgi?T=JSyNEWS=nyCSC=YyPAGE=fulltextyD=ovftyA N=00005237-201410000-00011>.
30. López Maestro M, Melgar Bonis A, Bertolo J, Perapoch López J, Mosqueda Peña R, Pallás Alonso C. Developmental centered care. Situation in Spanish neonatal units. *National Library of Medicine, PubMed.gov*. 2014;81(4):232-40. Disponible en: <https://pubmed.ncbi.nlm.nih.gov/24290892>.
31. Ministerio de Desarrollo Social de Argentina. Bebés prematuros. Parto y nacimiento [Internet]. Secretaría Nacional de Niñez, Adolescencia y Familia; 2020 [citado 2025 ene 3]. Disponible en: [https://www.argentina.gob.ar/sites/default/files/bebes\\_prematuros.pdf](https://www.argentina.gob.ar/sites/default/files/bebes_prematuros.pdf).
32. Mosqueda Peña R. Conocimientos y percepciones de los profesionales sobre los cuidados centrados en el desarrollo en las unidades de neonatología [tesis doctoral]. Madrid: Universidad Complutense de Madrid; 2016 [citado 2025 ene 3]. Disponible en: <https://eprints.ucm.es/id/eprint/38925/1/T37710.pdf>.
33. Narberhaus A, Segarra D. Trastornos neuropsicológicos y del neurodesarrollo en el prematuro. *Anales de Psicología*. 2004;20(2):317-26. Disponible en: <https://www.redalyc.org/articulo.oa?id=16720211>.
34. Organización Mundial de la Salud [OMS]. Nacimientos prematuros. Nota descriptiva [Internet]. 2017 [citado 2025 ene 3]. Disponible en: <http://www.who.int/mediacentre/factsheets/fs363/es/>.
35. Ortiz-Mendoza L, Baltazar-Téllez R, Tapia-García A, López Escudero A, Arias-Rico J. Efecto de una intervención educativa en enfermería sobre el nivel de conocimiento del programa NIDCAP. *Educ Salud Bol Cient Inst Cienc Salud Univ Autónoma Estado Hidalgo*. 2021;10(19):132-35. Disponible en: <https://repository.uaeh.edu.mx>.
36. Phaloprakarn. *Journal of Obstetrics and Gynaecology Research*. 2015;41(5):680-88. Disponible en: [http://www.saludinfantil.org/guiasn/Guias\\_PMontt\\_2015/Generalidades/Clasificaciones\\_Rebien\\_nacido.htm](http://www.saludinfantil.org/guiasn/Guias_PMontt_2015/Generalidades/Clasificaciones_Rebien_nacido.htm).

37. Pierrat V, Goubet N, Peifer K, Sizun J. How can we evaluate developmental care practices prior to their implementation in a neonatal intensive care unit? *Early Hum Dev.* 2007;83(7):415-18. Disponible en: [https://www.researchgate.net/publication/6393983\\_How\\_can\\_we\\_evaluate\\_developmental\\_care\\_practices\\_prior\\_to\\_their\\_implementation\\_in\\_a\\_neonatal\\_intensive\\_care\\_unit](https://www.researchgate.net/publication/6393983_How_can_we_evaluate_developmental_care_practices_prior_to_their_implementation_in_a_neonatal_intensive_care_unit).

38. Quigley M, McGuire W. Formula versus donor breast milk for feeding preterm or low birth weight infants. *Cochrane Database Syst Rev.* 2014;(4):CD002971. Disponible en: <http://fn.bmj.com/> on April 21, 2017 - Published by group.bmj.com.

39. Quispe Gutiérrez Y. Conocimiento y práctica de las enfermeras sobre cuidado centrado en el desarrollo del prematuro hospitalizado [tesis]. Trujillo: Universidad Nacional de Trujillo Facultad de Enfermería; 2018 [citado 2025 ene 3]. Disponible en: <https://dspace.unitru.edu.pe/bitstream/handle/UNITRU/11714/2E542.pdf?sequence=1&isAllowed=y>

40. Roué JM, Kuhn P, Lopez Maestro M, Maastrup R, Mitanchez D, Westrup B, Sizun J. Ocho principios para el cuidado centrado en el paciente y la familia para recién nacidos en la unidad de cuidados intensivos. *Arch Dis Child Fetal Neonatal Ed.* 2017. DOI:10.1136/archdischild-2016-312180. Disponible en: <http://fn.bmj.com/> on April 21, 2017 - Published by group.bmj.com

Aquí tienes las últimas referencias en estilo Vancouver:

41. Ruiz Fernández E. Cuidados centrados en el Neurodesarrollo del recién nacido prematuro hospitalizado. *Rev Enferm CyL.* 2016;8(1):61. Disponible en: <http://www.revistaenfermeriacyl.com/index.php/revistaenfermeriacyl/article/viewFile/177/148>.

42. Sánchez AJ. Fisioterapia manual para favorecer el neurodesarrollo en bebés pretérmino estables en la Unidad de Cuidados Intensivos Neonatales [trabajo de fin de grado]. Navarra: Universidad Pública de Navarra; 2016 [citado 2025 ene 3]. Disponible en: <https://academicae.unavarra.es/handle/2454/21183>.

43. Sizun J, Westrup B. Early developmental care for preterm neonates: a call for more research. *Arch Dis Child Fetal Neonatal Ed.* 2004;89:384.

44. Sánchez C, Arévalo MM, Figueroa OM, Nájera NR. Atención del neonato prematuro en la UCIN centrada en la prevención de factores de riesgo de daño neurológico y promoción del neurodesarrollo. México DF: Manual Moderno; 2014.

45. Streit Morsch D, de Abreu e Silva M, de Souza Mendes Gomes MA. Atención humanizada ao recém-nascido de baixo-peso. Método Canguru e cuidado centrado na família: correspondências e especificidades. *Physis - Rev Saúde Coletiva.* 2010;20(3):835-52. Disponible en: <https://www.redalyc.org/articulo.oa?id=400838228008>.

46. Vacas J, Antolí A, Sánchez-Raya A. Análisis de perfiles cognitivos en población clínica infantil con trastornos del neurodesarrollo. 2020;1(54). Disponible en: <https://www.redalyc.org/journal/4596/459664448005/>.

47. Vaivre-Douret L, Ennouri K, Jrad I. Effect of positioning on the incidence of abnormalities of muscle tone in low-risk, preterm infants. *Eur J Paediatr Neurol.* 2004;8:21-34. Disponible en: <http://fn.bmj.com/> on April 21, 2017 - Published by group.bmj.com.

48. Veritas Intercontinental. Bebé prematuro, factores de riesgo y complicaciones [Internet]. 2021 [citado 2025 ene 3]. Disponible en: <https://www.veritasint.com/blog/es/bebe-prematuro>.

49. Waldow V. Enseñanza de enfermería centrada en el cuidado. *Aquichan.* 2009;9(3):246-56. Disponible en: <https://www.redalyc.org/articulo.oa?id=74112147005>.

### **FINANCING**

The authors did not receive funding for the development of this research.

### **CONFLICT OF INTEREST**

The authors declare that there is no conflict of interest.

### **AUTHORSHIP CONTRIBUTION**

Conceptualization: Rosa Inés Bobillo

Data curation: Rosa Inés Bobillo

Formal analysis: Rosa Inés Bobillo

Research: Rosa Inés Bobillo

Methodology: Rosa Inés Bobillo

Project Administration: Rosa Inés Bobillo

Resources: Rosa Inés Bobillo

Software: Rosa Inés Bobillo

Supervision: Rosa Inés Bobillo

Validation: Rosa Inés Bobillo

Visualization: Rosa Inés Bobillo

Writing - original draft: Rosa Inés Bobillo

Writing - revision and editing: Rosa Inés Bobillo.