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THE INFLUENCE OF SLEEP PROMOTION ON THE DEVELOPMENT OF THE NEWBORN PRE-TERM: A NARRATIVE REVIEW

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ABSTRACT

The environment in Neonatal Intensive Care Units, although fundamental for the survival of the premature newborn presents sophisticated technology which assures life to the newborn, however, it provides a considerably different space from that of the mother's womb. The newborn is exposed to an excessive and diverse stimuli which may influence, in a negative way, the sleeping pattern and the adequate development of his/her central nervous system and his/her capabilities for life. **Objective**: to reflect on the providing of care that interferes on sleep and on the development of the newborn. **Methods**: Narrative revision that resulted from the remote control access to the database electronic platform EBSCO and to the Scielo database. **Results**: The neonatal intensive care units are destined to receive newborn babies who need special care, being essentially premature who seem to have less ability to deal with environmental stimuli. **Conclusions**: The premature newborn show the risk of suffering from disturbances in his/her development with repercussions for his/her future life. Nurses assume a crucial role in the provision of safe care, with adequate knowledge for the protection of sleeping patterns and the development of the newborn.
Descriptors: newborn; sleep; neonatology; development

INTRODUCTION

The womb environment is the adequate place for the growing and complete development of the fetus. With the birth of the premature baby and his/her subsequent need of hospitalization in a Neonatal Intensive Care Unit (NICU), arises an abrupt environmental difference, which may influence the instability of sleep and quietness of the premature, so that it may result in complications for his/her development. The mother's womb enables the fetus to rest and to sleep profoundly and constitutes the ideal means for the growing process and maturity of anatomic, physiologic and neurophysiologic structures related to the fetal development to take place.

When birth occurs prematurely, the progression of the development of the brain structures are altered as the environment outside the womb does not provide the ideal conditions for its adequate progress, therefore putting the neuro development at risk which may lead to functional incapacities (Tamez & Silva, 2006). The Pediatrics Society of Neuro Development, of the Portuguese Pediatrics Society (SPND-SPP), defines the neuro development of the child as "a set of competences through which the child interacts with the environment that surrounds him/her in a dynamic perspective, according to his/her age,

his/her level of maturity, his/her intrinsic biological factors and the stimuli from the environment" (SPND-SPP, n.d.).

The constant technological developments in the neonatology area have increasingly allowed an adequate intervention on the quality of life of the premature newborn in a (NICU); however, the deprivation of sleep is very frequent in these units and may be associated to a late pattern of maturity of the development of premature babies.

Whereas the (NICU) are essential for the survival of the newborn (NB), the unexpected and harmful environment, including the constant exposure to light, the high level of noise and the many non-programmed interventions generate stimuli that may echo on the adequate development of the central nervous system (CNS) and on the maturity of the pattern of sleep. Programmes such as that of the evaluation and the individual care for the development of the premature are developed with the purpose of improving the care provided to the premature baby and to minimize the harmful impact of the environment of the NICU. According to the World Health Organization the premature newborn, as to his/her gestational age, is classified as that who is born before 37 complete weeks, whereas the babies born before 32 weeks show an increased risk of developing complications.

Gaiva, Marquesi and Rosa (2010, p. 603) refer that, "sleep is considered as a state of unconsciousness out of which the person may be awaken by external stimuli".

Sleep is a fundamental and irreplaceable for good health, and of great importance for the growing and development of the NB admitted in NICU (Gaiva *et al.*, 2010).

The nursing professionals play a fundamental role in the organization and preservation of the NB's sleep in NICU, as they closely and continuously accompany the baby during hospital stay.

The training of nursing professionals to learn about the singular needs of each baby is of great importance so that the proceedings and painful and invasive care may be applied in a singular and individual way. Therefore, a careful observation of the behavioral and physiological answers of the baby, are needed, so as to contribute to the promotion of sleep, comfort, safety and development.

Nevertheless, the nursing professionals that work in the neonatology units should be made aware of the influence of the environment in the development of the baby. In spite that the environment in an incubator never provides similar conditions to that of a mother's womb, one can take measures to minimize the negative effects in the sleep of the premature newborn.

DEVELOPMENT

Sleep and the premature newborn

In a study by (Tamez & Silva, 2006) it was observed that in the womb the fetus is in deep sleep about 80% of time which promotes brain growth and maturity.

After admission in NICU, the sleep of the NB is interrupted on average 132 times in 24 hours, with periods of rest which range from 4,6 to 9,2 consecutive minutes. The premature babies take longer to get sleep and show shorter cycles of sleep, which means that the grown incapacity to protect themselves from the stimuli leads to difficulty in passing from light to deep sleep. A complete cycle of sleep takes from 55 to 90 minutes (Brazelton & Cramer, 2004).

Synchronous-active theory shows that the premature newborn has a high capacity to register and process sensorial information, presenting, however, incapacity in avoiding its entry, because of absence of inhibitory control. This theory outlines ways for the observation of brain function through the babies' behaviour, explaining the organisation of the premature newborn through the dynamic interrelation between the various subsystems that constitute it and the environment, therefore being organised in five subsystems (Hiniker & Moreno, 2006). The *autonomous subsystem* is the first to come up in fetal life, being constituted by the somatoform autonomic functions. It may be evaluated through respiratory and cardiac frequencies, alterations in colour, existence of tremors and visceral signs (hiccups, yawns). There is a tendency of considering it as the operating Centre of the organism. The stability of this behaviour shows us that the autonomous subsystem is, at that moment, capable of managing its own internal and external stimuli. When it goes out of balance, signs of *stress* may emerge.

The *motor subsystem* arises in the twelfth week of gestation and can be observed through the muscle tone, movement, activity and posture of the NB.

With respect to the *behavioural States subsystem*, it is based on the states of consciousness, which vary from deep sleep to crying. The states of sleepiness are classified in: deep sleep, light sleep, drowsiness, quiet alert, shaking and crying. Deep sleep is of great importance for brain development, because it is in this State that some of the memories are stored, allowing ways of learning, only present in this State. In the premature baby and according to Silva (2006), it is the one that shows a higher level of oxygenation, allowing his/her nervous system to rest and to organise itself. This is the State that most closely resembles what the intrauterine environment provides and it the most affected (shorter duration and frequent interruptions) by the stimuli of NICU.

During light sleep, the information is processed in an active way and stored in the memory. This state is the one responsible for most of the learning and memory decreasing with maturity. Crying is a state that causes great discomfort, being its intensity directly connected with heart rate, higher power consumption and a decrease in the oxygen saturation in the blood and in the brain.

The *subsystem of social attention/interaction* can be observed through the ability of the NB to remain in the state of alert, revealing the ability to grasp the information received from the environment and to establish communication. Gonçalves (2009) considers that this begins by 25 to 28 weeks gestation, being only completely developed by 40 weeks.

The last *subsystem* referred is that of *self-regulation* integrating the strategies that the child develops, in order to maintain or acquire a State of stable equilibrium at a level of the subsystems. This acquisition can be facilitated by environmental stimuli. Quoting Gonçalves (2009, p.11) "an organized child enters a State of homeostasis easily, decreasing power wear.

As the premature baby does not have the systems developed nor prepared to function in an adequate way, and due to the great demand of autonomous and motor systems, there is little energy left for the functioning of the other subsystems. Obtaining the homeostasis is his/her primary task, being this hampered by the immense variety of stimuli to which it is subject.

The threshold to the environmental response varies according to gestational age. If to the 32nd week he/she is easily over stimulated, between the 32nd and 34th week he/she shows more stability, trying to interact before external favorable conditions, however, the risk of deregulation is still present. Only between the 35th and 37th week does the baby present well defined States and shows an increase of self-regulation skills (Gonçalves, 2009).

In the fetal period, sleep is divided in active sleep, peaceful sleep and undetermined sleep (Khan, Raya & Nunes, 2009). According to the author mentioned above, active sleep compatible with QOM (Quick Ocular Movement) includes maturity and differentiation of CNS, consolidation of memory and learning and behavioral pattern support. It is the sleep characterized by quick eye movement with high physiological activity in which the blood flow, along with the supply of oxygen to the brain are higher, being fundamental for the development of the premature baby.

Peaceful sleep, compatible with sleep NREM (Non Rapid Eye Movement) is characterized by the period of rest, maintenance of energy, increased protein synthesis and growth hormone release, period in which there is suction movement, smiles, light eye blinks, grimaces, shakes, breathing and heart beat are regular and eye movement is absent or is regular.

Undetermined sleep is the period of time in which neither peaceful sleep nor the stirred one can be identified (Khan *et al.*, 2009).

With the growth and development of the NB, the pattern of sleep continues changing due to neurophysiological changes and to the development in the structures of the CNS. Therefore, the amount of active sleep decreases and that of peaceful sleep increases and becomes dominant at three months of age.

The premature infants have a sleep pattern with a low degree of organization and with a less amount of peaceful sleep, also showing more episodes of apnea, which are more common during active sleep.

At the NICU, due to the critical state of health and the procedures performed as well as the entire environment, sleep can be harmed and its interruption may adversely influence the recovery of the health of the newborn Preemie.

The environment of the NICU and the premature newborn

The uterus, for its characteristics of "filter" of Visual and auditory stimuli promotes a balanced brain development by limiting sensorial activity. It offers the baby a containment structure to the sequenced development of sensory systems, minimizing the amount and/or complexity of sensory experience. Inside the womb, the fetus benefits of optimum conditions for its proper development. The temperature is ideal and constant (heat neutral); the pressure on the skin is smooth; the sounds (spread through the amniotic fluid) arrive at a low frequency; the light is tenuous or non-existent and the smells and flavours are pleasant. Although there are numerous stimuli in the uterine environment, the majority is of a reassuring nature, being the ideal place, in a sensorial point of view and, for most babies, an extremely comforting place (Faure & Richarson, 2004).

However, the NICU environment provides a quite different space from that of the intrauterine world. At the NICU there are numerous sources of stimulation, such as noise, light, constant manipulation and pain (associated to invasive procedures). In this way, the premature newborn is subject to an excessive sensory overload for his/her incomplete neurological maturation, as his/her development process is forcibly changed. So, as a result of the interruption of the stages of prenatal development, the prematurity can lead to anatomical and structural changes of the brain and may cause motor and cognitive problems.

According to Hiniker and Moreno (2006) the pre-term newborn has a high capacity to record and process sensory information, showing, however, an inability to prevent its entrance, by the absence of inhibitory control.

The sensory organs are developed in the uterus, following the tactile, auditory, olfactory/gustatory and visual sequences. However, despite the functional structures being practically formed in the premature baby, there are still maturing processes being developed, which influence the processing of received messages.

Tact is the sense that starts to influence the baby while it is still a fetus. Most of the stimulation the baby feels, still in the mother's womb is skin related. Hands, fingers, mouth and face have higher tactile density very early on, which gives it greater sensitivity (Bloch, Lequien & Provasi, 2006). There are hundreds of thousands of sensitive nerve endings in the skin, allowing the NB to feel touch, pressure, heat, cold and pain.

Excessive sensory stimulation becomes a major source of *stress* for the NB, causing, in addition to damage to the CNS development and sensory structures, physiological, behavioral and/or psychological response. Aurélio (2009) refers as main manifestations of *stress* in the NB, the changes in heart rate, apnea, decreased oxygen saturation, paleness, increased blood pressure, increased respiratory rate, nausea and vomiting, hyperextension of limbs, restlessness, crying and irritability.

In addition, the increased sensory stimulation also causes changes in the baby's sleep pattern. Contrary to what occurs during intrauterine life, in which the fetus is in deep sleep the majority of the time, during his/her stay in a neonatal unit, the NB's sleep is interrupted numerous times (Tamez & Silva, 2006). The baby's sleep cycle is thus completely changed, since he/she cannot reach the State of deep sleep, which is essential for brain growth and his/her maturation, as well as to the increase in the weight progression, through the release of the growth hormone (Cordeiro, 2010).

Noise is touted as one of the main sources of environmental *stress* in the neonatology units. According to Brown (2009) noise levels in neonatal units should be kept below 45 decibels (dB). However, you can register noise levels between 50 and 88 dB, with peaks that can reach 140 dB during the admission of new babies, emergencies, change of shift, sound alarms, closing of the doors of the incubator, chatting, among numerous other situations, with the highest incidence to noise related to human activity.

From the 27th week of pregnancy onwards, the hearing ability of the baby is fully developed, as the fetus is already able to hear sounds present in the womb of the mother and also the external sounds, recognizing at an early stage the mother's voice and other familiar ones (Faure & Richarson, 2004).

The incubator works as a speaker of the outside sounds. The sound universe of the baby is that way quite changed, preventing him/her to also establish correspondences between what he/she hears and what he/she sees (Bloch *et al.*, 2006).

The effects of excessive noise can cause rather more than systemic effects, also effects in the structures of the ear itself, which may damage the cochlea which in serious situations leads to permanent deafness in his/her future life.

The visual systems is the last to be formed in fetal life, and although virtually all ocular structures are formed from the 25th week of pregnancy onwards, the myelination of the optical channels as well as the growth of the retina are not complete. Below 30 weeks of gestation there is a decrease in pupillary reflex and constriction, therefore less defense capability to light stimuli. Similarly, excessive brightness in neonatology units contributes to significant changes in the development of the premature baby. This is because the continuous lighting interferes in the perception of the pattern day and night, fundamental to the formation of the circadian rhythm, thus interfering with the sleep pattern of the baby. Furthermore, the fact that prolonged exposure to light can lead to abnormal development of the retina, thereby increasing the risk of retinopathy of prematurity and eventual blindness (Tamez & Silva, 2006).

Phototherapy, for example, can cause lethargy and/or irritability and difficulty in feeding. When the baby is more stable and available to interact, strong light will prevent him/her to open his/her eyes and explore the environment.

Other factors to take into account, when taking care of premature infants admitted to neonatal units, is the constant manipulation by the multidisciplinary team that, in addition to also interfering in the sleep cycle, are often associated to pain.

According to Nascimento (2010), we must bear in mind that through the exponential development in the field of Neonatology, there has been an increase in clinical situations, techniques and procedures that can fuel generating situations of pain, discomfort and suffering, which consequently cause physiological and behavioural changes in the NB. Nevertheless, the premature birth and the subsequent hospital stay in NICU implies that, although there are sensory areas over stimulated, there are others which suffer changes in the development by the deprivation of stimulation. The olfactory and gustatory systems are an example of this, since the premature newborn is, for the most part, deprived of breastfeeding or even oral feeding. These systems are functional at around 25 weeks of gestation. The fetus inhales and swallows the amniotic fluid, which is different depending on the food that the mother ingests, being able to distinguish four flavors: sweet, salty, acid and bitter.

The gastric feeding tube, does not allow a connection between food and gustatory pleasure. Similarly, the stay in the incubator, limits the baby's contact with the outside smells and mainly with the smell of mom, which prevents the early formation of olfactory memory (Bloch *et al.*, 2006).

Intervention strategies in the NICU

In order to minimize the impact of the relocation of the premature newborn, in the NICU, it becomes a priority to create an environment with adequate stimulation levels. It is essential to filter the excessive sensory information to prevent the baby of going into overload, regulating not only the amount of stimulation received, but also the type of sensory information and the specific consequential effect on its level of tranquillity. It is necessary that the whole team understand that by adopting simple measures it can transform the unit into a place that is less harmful and more pleasurable for the baby.

With regard to the reduction of noise, according to Brown (2009), one should decrease the volume of alarms (cardiorespiratory monitors and ventilators), reduce the tone of voice in the communication between the team members, avoid placing objects on top of the incubators, avoid phone sounds and mobile phones, close the access doors to the incubator carefully, avoid hitting the incubator and avoid opening packages and wrappers inside the incubator. The introduction of soft music for short periods of time, resorting to the use of sound equipment, can also be used as neonatal therapy. Ambient music must comply with the 45 dB recommended by the environmental health Committee of the American Association of Paediatrics (Johnson, 2001).

Music produces physical, mental and emotional effects that help the baby gain weight, decrease *stress* and cope better with the pain. As regards to lightness, its reduction is achieved by placing cloths covering the incubators and the use of softer lights, restricting the strongest lights only to the undergoing of procedures that require greater visibility, in order to promote sleep and rest. There should also be no sudden brightness increases, being careful not to turn the focus of light directly to the face of the baby (Bloch *et al.*, 2006).

Regarding the touch intervention, one must take into account the need for care group to coincide with the time of feeding, respecting the baby's sleep period. For proper placement, malleable rollers and "nests" must be used, providing limits and support for the body, keeping the balance between contention, exploration and self-organization. In addition, the use of manual restraint (or positive touch) which consists of the placement of the hands, without excessive pressure, in an elastic sort of way (giving in to movements and then returning them), holding the head, the buttocks and the members. The firm touch provides the baby with a sense of security and comfort by decreasing the level of motor activity.

However, it is important to talk with the baby before you touch him/her and handle him/her gently and gradually, so that the transition from sleep to wakefulness is the least abrupt possible. It is important that parents are taught to touch firmly, since the light and hesitant touch is not usually well tolerated, as it increases the level of stimulation (Tamez & Silva, 2006).

In what the olfactory system is concerned, one should avoid the use of substances with strong or aggressive odours, using the smell of milk (the mother or adapted) as a positive stimulus. Finally, with regard to the gustatory system, the interventions go through the early adaptation to the breast and the use of a pacifier with the use of sucrose, which in addition to the gustatory contact, non-nutritive suckling, also allows the reduction of pain/*stress* indicators after painful procedures (Tamez & Silva, 2006).

To ensure the effectiveness of intervention strategies and a good clinical evolution in the baby, before approaching him/her, the nurse must plan well the activities and care. Keep in tune with the baby (respecting the periods of sleep, identifying signs of *stress*, interacting during periods of wakefulness, etc.), is essential for a good clinical evolution. These strategies and activities must be strengthened and discussed frequently with the team.

In the growing interest in understanding the premature baby and in assessing the adequacy of care procedures, a number of studies about his/her behaviour have been conducted, in particular with the objective of identifying patterns that reflect his/her maturity or the adaptive features of his/her perceptive, cognitive or motor sensorial responses. Thus, the training of professionals towards a new vision of the baby is of great importance so that premature care can be thought and employed individually. A good example of the systematic application of the concepts presented up to this point is the Individualized Development Neonatal Care and Assessments Program (NIDCAP).

Care towards development

The NIDCAP program was developed in 1986 by Heidelise Als and her team, is a program of Individualized assessment and Care for the development of the NB, with the philosophy of improving hospital care of the premature baby hospitalized in NICU, and was created with the aim of reducing the negative impact of the environment of NICU in the premature baby out of the mother's womb.

The NIDCAP is based on an intervention that attempts to minimize the impacts between the immature brain, sensory experiences and harmful procedures in the environment of NICU, promoting adequate sensory stimulation for levels of adaptation of neurological maturation of the NB (Pimentel, 2010).

The NIDCAP model aims to create a relationship based on a support environment for the NB and the family, and proposes that the interactions regarding care and the environment should take into account the subsystems of the newborn, have a long-term support, also alleviating the consequences of prematurity for the dyad. Therefore, it increases the confidence of parents and health professionals ' satisfaction, involves the training and formal

education and requires a multidisciplinary commitment in the definition of the team, introducing modifications both in the hospital and in the community.

The Foundation of the development-centred care is not by simply covering the incubator or using neither brackets to the positioning of the baby, nor simply to dim the lights and sounds. While these actions may be part of the care plan and become part of caring for a baby, these do not constitute the core of NIDCAP. The main focus depends on the relationships that the nurse is willing to build with the NB who is now seen as an active collaborator in his/her own care, fighting in a determined way to continue the path of the fetal development that took place in the womb (Santos, 2011). According to the same author, it is postulated that the newborn behaviors (physiological and behavioral responses) provide the best information from which we can model the care, namely, the provision of care based on information that the behavior of the NB provides us. It allows the formulation of a plan of care that improves and strengthens the forces of the NB and that may support him/her in situations of sensitivity and vulnerability.

The NIDCAP consequently has a concern with the sleep of the premature baby. With its mechanisms it tries to minimize the impacts of NICU on the sleep of the premature baby, decreasing the fragmentation of sleep, providing moments of rest and a peaceful sleep (Pimentel, 2010).

The NIDCAP key elements are: coordination; evaluation; quiet environment; consistency in caring/care; grouping of care/structuring to 24 hours; proper positioning; opportunities for skin-to-skin contact; individualized support for food; comfort for the family (Santos, 2011).

This philosophy depends essentially on the care provided by nursing professionals, where it should be intended that the sense of belonging be returned to the parents of premature babies, allowing them to be experts in their child's care.

COMMENTS

Strategies that contribute to the preservation of the premature newborn's sleep and rest are effective for improving physiological stability, increase the rate of weight gain, improve the results of neuro behavioral system of the premature baby and increase the continuous period of peaceful sleep through care towards his/her development. According to Tamez and Silva (2006) the permanence in a NICU and consequently increased sensory stimulation, causes change in the baby's sleep, since sleep is interrupted numerous times. Cordeiro (2010) reinforces the fact that sleep is essential for brain growth, maturation

and weight of premature progression. Note the benefits of care towards the development in the premature newborn's sleep in the study of Pimentel (2010) which states that the program NIDCAP minimizes the impacts of NICU on sleep, reducing its fragmentation, providing with its mechanisms, increased rest periods and peaceful sleep essential for his/her development and physiological stability in the future. Gaiva *et al.* (2010) *stresse*s the importance of improving care for promoting sleep, noting that it is a key element for the growth and development of the NB admitted in hospital.

The NICU are places intended to receive NB who need special care, being mostly premature infants that feature less ability to deal with environmental stimulation. Thus, preterm newborns run a higher risk to suffering of developmental disorders.

Therefore, health professionals, especially nurses, have a crucial role to ensure the provision of care in neonatology, bearing in mind the need to control environmental stimulation present in the units as aftereffects future protection in his/her adult life. It is up to the multidisciplinary team to assure that the surrounding environment is as affable as possible so that we can take care of the premature baby and family in its fullness. Simple actions – lights out, whispering, etc. – may positively influence sleep and significantly the environment, promoting a better development of the premature baby and a good quality of life. It becomes thus imperative to realize that the premature baby is an active being, involved in care and that fights to continue in a correct way the trajectory of fetal development. In each NICU, the multidisciplinary team and especially nurses must develop strategies to alleviate the sleep fragmentation and ensure an environment that is less harmful to the newborn Preemie.

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