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RESEARCH

Effects of Handling and Environment on Preterm Newborns Sleeping in Incubators

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ABSTRACT

Objective: To describe the total sleep time, stages of sleep, and wakefulness of preterm newborns and correlate them to levels of sound pressure, light, temperature, relative air humidity, and handling inside incubators.

Design: Observational, correlational study.

Setting: A neonatal intermediate care unit.

Participants: Twelve preterm newborns, who were 32.2 ± 4.2 weeks gestational age and weighed 1,606 ± 317 g.

Methods: Sleep records were assessed by polysomnograph. Environmental variables were measured with a noise dosimeter, light meter, and thermohygrometer. To record time and frequency of handling, a video camera was used. All recordings were made for an uninterrupted 24-hour period.

Results: Mean total sleep time in 24 hours was 899 ± 71.8 minutes (daytime = 446 ± 45.3 and nighttime = 448 ± 60.2). Mean wakefulness was 552 ± 94.0 minutes. The predominant stage was quiet sleep. A significant correlation was identified only between the levels of light and wakefulness ($r = 0.65$ and $p = .041$).

Conclusion: The environmental conditions and care provided to hospitalized preterm newborns did not influence sleep except for high light levels, which increased wakefulness. Nurses in clinical practice should implement strategies to promote and protect sleep by decreasing newborns' exposure to excessive light.

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As a consequence of cerebral and subcortical cortex immaturity and the absence of frontal lobe neuronal organization, preterm birth can cause anatomic and structural changes in the brain. This is due to the interruption of prenatal developmental stages, especially between the late second and early third trimesters of pregnancy. In addition, the anticipated birth promotes abrupt environmental differences for preterm newborns, who require admission to neonatal units to enable early adaption to the extrauterine life (Bonan, Pimentel Filho Jda, Tristao, Jesus, & Campos, 2015).

In recent decades, technologic advancements have changed neonatal units in terms of the environment and care provided to preterm newborns, and this has led to increased survival rates (Bonan et al., 2015; White, 2011). Although the neonatal unit is essential to the survival of these newborns, its environment includes an overload of stimuli. Constant exposure to light, high noise levels, and a large number of interventions contribute to deleterious effects on preterm newborns, because their immature nervous systems cannot sufficiently process multiple and excessive stimuli (Bonan et al., 2015; Lai & Bearer, 2008; Salgado, Adirson, La Cava, & Camacho, 2011). These adverse conditions may have direct short- or long-term implications on some physiologic functions, with implications for neuropsychomotor development (Calciolari & Montirosso, 2011).

Sleep is among the most important of physiologic functions, but it is less frequently studied in this population (Bonan et al., 2015; Salgado et al., 2011). Sleep is an essential basic human need for brain maturation; hippocampal structure; bridge, midbrain, and brainstem development;

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Neonatal units, essential to newborn survival, are inhospitable environments with multiple stimuli that can negatively affect the sleep of preterm newborns.

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and maturation of neurosensory systems: limbic, olfactory, tactile, and auditory.

Sleep presents a polyphasic pattern during the neonatal period and is classified as active sleep (AS), quiet sleep (QS), and indeterminate sleep (IS). During AS, maturation and differentiation of the central nervous system, preservation of brain plasticity, memory consolidation, and learning occur and can be identified in the fetus beginning at 28 weeks gestation. QS can be identified beginning at 32 weeks gestation and becomes more developed between 35 and 38 weeks, during which time a decrease in energy expenditure, protein synthesis, and hormone production (e.g., growth and thyroid stimulating hormone, testosterone, and others) occurs. The IS stage occurs when the characteristics of QS and AS are not identified. This stage accounts for 30% of the total sleep period of preterm newborns between 27 and 34 weeks gestational age (GA), and this percentage decreases gradually depending on the maturation of the central nervous system (Bonan et al., 2015; Calciolari & Montirosso, 2011; Heraghty, Hilliard, Henderson, & Fleming, 2008).

Research is lacking in which polysomnography was used to demonstrate the effects of the environment and handling on the sleep of preterm newborns. This is especially critical given the importance of sleep for neonatal development. Therefore, the purpose of this study was to determine how light, noise, temperature, relative air humidity, and handling during care provided by the health care team influence the sleep of preterm newborns in incubators. Our objective was to describe the total sleep time and the different stages of sleep and wakefulness of preterm newborns and to correlate these with the sound pressure level (SPL), level of light, temperature, relative air humidity, and handling inside the incubators over a complete 24-hour period.

Methods

Design and Setting

We conducted an observational, prospective, correlational study in a conventional neonatal intermediate care unit (NImCU) of a hospital in São Paulo, Brazil. The study was approved by the ethics committee of the institution (CEP no. 19387), and the Terms of Free and Informed Consent form was signed by the parents.

The NImCU had nine beds and provided care for patients of the Unified Health System, serving as a reference center in neonatal care for the Ministry of Health.

In the NImCU, newborns remain in incubators or under radiant warmers, according to their clinical conditions. During data collection, the incubator used was the FANEM model 1186 A (Sao Paulo, Brazil), which had been in use for approximately 2 years. Only a few developmental care interventions were implemented for care of newborns in this NImCU, such as minimal handling protocol; quiet time characterized by reduced handling, noise, and light at four different times of the day; and kangaroo care. The newborns' parents may remain with their newborns 24 hours per day and are encouraged to interact with them and participate in their care.

The unit has a soundproof floor, double-glazed sealed windows, and interior blinds that allow brightness control. Artificial lighting inside the rooms is provided by fluorescent lights and is used at night or when natural light is insufficient. Each bed has individual lighting aimed at the incubator, but the level of brightness cannot be adjusted.

Sample

The sample consisted of 12 preterm newborns hospitalized in the NImCU. The convenience sample size was established because of limited time and financial resources available to conduct the research. Inclusion criteria included male or female preterm newborns, with GA up to 36 6/7 weeks and weight of 1,200 to 2,000 g at the time of data collection, who were maintained in an incubator. All newborns were clinically stable without medications to assist with the stability of cardiac, respiratory, and metabolic parameters and were free from medical complications, including infection and respiratory and neurologic disorders, as indicated by medical and nursing records.

The exclusion criteria for preterm newborns included congenital malformations; Grade II, III, and IV periventricular hemorrhage; use of invasive and noninvasive mechanical ventilation; phototherapy; central nervous system depressants and

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