Reference Values of the Sleep-wake Cycle of Newborns During Hospitalization in the Neonatal ICU - a Systematic Review Protocol

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Protocol

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Abstract

Background: Annually, approximately 15 million children are born prematurely (less than 37 weeks of gestation). These newborns are hospitalized from weeks to months in the Neonatal Intensive Care Units (NICU), undergoing painful invasive and non-invasive procedures, and various stimuli in an environment that contrasts with the maternal uterus, which may result in reduced sleep time or changes in the sleep-wake cycle. Therefore, the purpose of this review is to describe the reference values of the sleep-wake cycle of neonates admitted to the NICU and summarize the main sleep assessment tools used during the neonatal hospitalization phase.

Methods: Databases will be used systematically to search for studies that provide reference values for the sleep-wake cycle of newborns admitted to the NICU. Two independent reviewers will search the articles, while a third reviewer will analyze the disagreements.

Discussion: The results of the review will contribute to the planning of approaches that do not interfere with sleep time, maintaining an adequate sleep-wake pattern for the development of newborns in the NICU.

Systematic review registration: submitted on 13. Dec. 2020 IN PROSPERO

Background

Annually, approximately 15 million infants are born prematurely (i.e., less than 37 weeks of gestation) (1). These newborns are hospitalized from weeks to months in Neonatal Intensive Care Units (NICU which may change the sleep time or the sleep-wake cycle (2, 3, 4).

The sleep-wake cycle in the neonatal phase has a polyphasic pattern that progressively shifts to a monophasic pattern, with individual variations. This endogenously generated rhythmic pattern is essential for healthy development and synchronizes with other hormonal rhythms, such as the growth hormone that promotes greater tissue regeneration and improves body function (5). In healthy newborns, sleep deprivation for 2 to 4 hours results in cardiac function changes during the next phase of sleep, due to increased sympathetic activity (6). Also, it increases tonicity and respiratory problems (11).

Complications related to the sleep-wake cycle can culminate in hypoxia, increased heart rate, increased intracranial pressure, and intraventricular brain hemorrhage in infants (6), promoting an increase in the neonates' painful perception (8). Although the total sleep time of infants between 0 and 12 months of age during a 24-hour period tends to decrease over the months (9), no studies have evaluated these values in infants in the NICU.

The NICU seems to be an inhospitable environment for the development of the sleep-wake cycle since the light and noise compromise the sleep-wake pattern (10). Premature newborns spend less time sleeping and have more NREM (non-rapid eye movement) sleep compared with full-term newborns (NB) with

similar chronological age. Furthermore, immaturity (very low gestational ages) leads to delayed sleep architecture. (11)

Although the total sleep time of infants between 0 and 12 months of age during 24 hours tends to decrease over the months (9), no studies have evaluated these values in infants in the NICU. If we consider that the length of stay in a NICU is long (i.e., 30 to 219 days, depending on clinical conditions) (14), a systematic review summarizing the main sleep assessment tools used during the neonatal hospitalization phase and consistent with the evidence base regarding reference values is necessary for the sleep-wake cycle of neonates admitted to the NICU.

Methods

Research objectives

The purpose of this review is to describe the reference values of the sleep-wake cycle of neonates admitted to the NICU and summarize the main sleep assessment tools used during the neonatal hospitalization phase.

There are two main objectives:

- 1: Describe the reference values for the sleep-wake behavior of newborn's admitted to a NICU
- 2: Synthesize the tools used to assess sleep in the neonatal hospitalization phase.

Research questions

The main questions of this review are as follows:

What are the reference values of the sleep-wake cycle in newborns admitted to the NICU?

What tools are used to assess the sleep-wake cycle during the neonatal hospitalization phase?

Systematic review

The research questions will be addressed using a systematic review of the literature, and conclusions will be summarized in a narrative review using the evidence found. The components of this systematic review are:

Inclusion criteria

For the study selection through titles and abstracts, two reviewers will consider studies with the following inclusion criteria: 1- randomized and original empirical studies; 2- studies including neonates in the NICU; 3- studies assessing reference values or changes in at least one of the sleep-wake cycle parameters; and 4- studies published in the last ten years.

Exclusion criteria

Non-original research (i.e., literature reviews, systematic reviews, or meta-analyses), case reports, unique case studies, and non-normative samples will be excluded. Also, the reference list of the included studies will be reviewed for potentially relevant studies.

Searching

The searches will be conducted in the MEDLINE, Web of Knowledge, and PsycINFO using the following Medical Subject Headings (MeSH) descriptors: 'sleep', 'circadian rhythm', 'neonate', 'baby', 'intensive care'. The Boolean operators 'AND' and 'OR' were used to combine all synonyms of the concepts.

Methods for study selection

The article search for this systematic review aims to identify the reference values of the sleep-wake cycle in newborns between 0 and 28 days in the NICU and the tools used to assess sleep in this environment. The article selection will be conducted in two different stages: in the first, the titles and abstracts will be screened, according to the inclusion criteria. In the second stage, the texts will be analyzed in full, confirming whether the studies should be included in the final review. Two independent reviewers will search and include the articles, and a third reviewer will resolve disagreements.

Methods for data extraction

After selecting the articles by reading the title and abstract, identifying the relevant publications, and observing the inclusion and exclusion criteria, the studies will be categorized and tabulated according to the following criteria: database, year of publication, type of study, journal of publication, keywords, country of publication, authors, sample characteristics, and intervention protocols.

Quality assessment

The Grading of Recommendations Assessment, Development and Evaluation (GRADE) system will be used to obtain greater reliability in both the cumulative evidence and the results of the selected articles. This system uses critical components to evaluate the evidence of the studies in a transparent way. Its approach is divided into four levels of evidence: high (further research is very unlikely to change the confidence in the estimate of effect), moderate (further research is likely to have an important impact on confidence in the estimate of effect and may change the estimate), low (further research is very likely to have an important impact on confidence in the estimate of effect and is likely to change the estimate), and very low (any estimate of effect is very uncertain). Also, randomized clinical trials begin as high-quality evidence, but its quality can be reduced due to study limitations, the inconsistency of results, risk of bias (13).

Data synthesis

Data will not be synthesized using quantitative techniques but summarized in tables and narrative review. The values and changes in the sleep-wake cycle will be compared to obtain reference values for this population. The outcome measures will be those variables related to the sleep-wake cycle: sleep duration for three time periods (time that infants sleep during the 24-hour period); the day and night; wakefulness during the night (number of hours that infants spend awake at night); sleep periods (number of naps/sleep episodes) and night awakening (number of awakenings during the night); sleep latency (time in minutes that infants take to fall asleep); most extended sleep phase (most extended sleep episode); bedtime/sleep start time (sleep start at night); time of awakening (beginning of the morning wakefulness); and sleep efficiency (percentage of sleep duration, from bedtime to awakening time).

Discussion

Sleep is among the most important physiological functions, but it is less studied in neonates attended in NICUs (12). Thus, the main objective of this review is to gather evidence to obtain reference values and recognize changes in the sleep-wake cycle of this population. Furthermore, we intend to characterize the sleep-wake cycle assessment tools used with these newborns.

Thus, the results of the review will contribute to the planning of non-pharmacological therapies and humanized care practices to maintain an adequate sleep-wake pattern for the development of infants in the NICU.

Abbreviations

GRADE: Grading of Recommendations Assessment, Development and Evaluation; RN: Full-term newborns; PTNB: Premature Newborns; NICU: Neonatal Intensive Care Units;

Declarations

Competing interests

The authors declare that they have no competing interests.

Authors' contributions

All authors read and approved the final manuscript.

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