

# Light-Dark Cycle: Weight Gain and Reduction in Length of Stay in Premature NICU Infants

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## SUMMARY

**Objective:** To describe how the light-dark cycle has a positive effect on weight gain and reduction of days of hospital stay in premature patients in the Neonatal Intensive Care Unit.

**Methods:** Qualitative research, literature review type, question formulated in IOP format, terms were listed for translation into scientific language by means of queries in DeCS and MeSH, for the creation of search strings, the sources consulted for localization were: VHL, Cochrane Library, Google search engine, Espistemonikos, Wolters Kluwer. As a strategy for an accurate search, the AND operator was used, as well as free terms. We included studies with randomized clinical trial designs and systematic reviews, published from 2013 onwards and studies in premature populations. The screening process was carried out by means of the PRISMA declaration; the quality was evaluated by FLC 3.0.

**Results:** A total of 148 articles were retrieved, of which 134 were eliminated because they did not contain useful information, duplication or inaccessibility. 5 more were discarded due to their lack of contribution to the topic and their low quality of information. 100% (9) articles were eligible, whose designs are: 88.88% (8) high-quality and medium-quality clinical trials, 11.12% (1) high-quality systematic review. The OCEBM scale was used to assign the level of evidence and degree of recommendation, with a gradation of "A" and level "1c".

**Conclusion:** The light-dark cycle in premature patients in the Neonatal Intensive Care Unit favors weight gain and decreases their hospital stay, improving their speedy recovery.

**Keywords:** Light; Dark; Preterm; Weight Gain; Neonatal Intensive Care Unit

**Abbreviations:** IOP: Intervention Population Outcome; RN: Newborn; PTNN: Reterm Newborn; DeCS: Descriptors in Health Sciences; MeSH: Medical Subjects Headings; PRISMA: Preferred Reporting Items for Systematic Reviews and Meta-Analyses; FLC: Critical Reading Worksheets; OCEBM: Center for Evidence-Based Medicine Oxford, CL-O: Light Dark Cycle; NICU: Neonatal Intensive Care Unit

## Introduction

The change that a newborn undergoes to life outside the womb begins with its first breaths and the interruption of maternal-fetal circulation, which produces physiological, hemodynamic and respiratory changes [1]. The newborn is the product of conception from birth to 28 days; and the preterm newborn (PTNN) whose gestation was from 22 to less than 37 weeks. When gestational age is not known, a product weighing less than 2,500 grams will be considered preterm [2]. Prematurity is the leading cause of

neonatal morbidity and mortality. Most of the sequelae derived from prematurity are usually neurological, pulmonary and digestive. The lower the weight and gestational age, the greater the risk of health problems [3]. The more premature a baby is, the more sensitive it is to light, so it is recommended to use a suitable light environment, which helps reduce cortisol levels, prolongs the duration of sleep, stimulates the release of growth hormones and favors the early development of a circadian rhythm. This, through the use of the light-dark cycle (CL-O);

Studies show beneficial effects on PTRN such as: less anxiety, better rest and greater reactivity during the day [4]. Although some studies diverge on when to establish a circadian rhythm in the RNPT: Morag in 2008 mentions that by performing 12 hours of light and 12 hours of darkness it is possible to simulate the changes of external light [5].

Another intervention by Castellanos and Escobar showed that by establishing a light-dark cycle in an experimental group, there was a better tolerance to food compared to the group that was exposed to constant light conditions. This had a direct result in weight gain and reduced hospital stay [6]. International and national studies [7-9] mention that PTRNs who are exposed to CL-O (as is often the case in the neonatal intensive care unit (NICU) show improvement in terms of rest, tolerance to food, weight gain, reduction in hospital stay and decreased risk of contracting nosocomial diseases secondary to prolonged hospitalization. CL-O is a feasible intervention to be performed and monitored by nursing staff, and it is even an activity that is routinely implemented in NICUs. However, it is carried out for other therapeutic purposes such as maintaining euthermy, improving rest or measuring comfort. This intervention, in addition to not being an invasive procedure for premature infants; It is low-cost, innovative and scientifically supported, which demonstrates the potential that this activity has in the practice of nursing in neonatal critical care units. Based on the above, the objective of this study is the effectiveness of the light-dark cycle in increasing body weight and reducing hospital stay in premature patients in the NICU.

## Material and Methods

Qualitative research, of the literature review type, the research question was formulated according to the Population, Intervention and Outcome (IOP) model. The study variables were: light-dark cycle, preterm infants in the intensive care unit, weight gain, and hospital reduction. The selection and discarding process of the articles was carried out with the support of the Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) statement [10], the evidence and degrees of recommendation of the localized evidence were evaluated and finally assigned.

## Search Protocol

A team of two reviewers was formed to search for evidence. The location was independent. Data collection was divided into two periods: the first was from August 27 to September 15, 2023, while the second was from September 18 to October 10, 2023. The data obtained from the different articles located were tabulated in logs using Microsoft Word software. During the search protocol for scientific articles, all those studies that met the following criteria were considered as study populations:

- 1) Scientific articles with a randomized clinical trial design and systematic review,

- 2) Generated within the period from 2013 to 2023,
- 3) With relevance to the topic: light/dark cycle for weight gain and reduction of hospital stay in premature infants,
- 4) In Spanish, English, Portuguese and French.

## Search Strategy

Evidence collection focused on locating articles that were relevant to the topic and population of the study. The documentary sources consulted during the search for the articles were: Virtual Health Library (VHL) [11], Cochrane Library [12], Epistemonikos [13] and Wolters Kluwer [14]. A free query was also carried out, without the use of specific search strings, in the Google search engine [15]. As a strategy for an effective search, the Boolean operator (DNA) was used, together with keywords whose documentary terms will be found in the MeSH [16] and DeCS [17]: infant premature, Intensive Care Units Neonatal, light, Darkness and Weight Gain. In order to locate as many items as possible, it was decided to add the following free terminology: cycle, light/dark cycle and premature. Each of the words described above were translated into Spanish, English, Portuguese and French. In addition to the above, the following primary search chains were formed: «light/dark cycle AND premature AND weight gain», «Cycle AND weight gain AND premature» and «infant Premature AND Intensive Care Units Neonatal AND light AND Darkness Weight Gain». Subsequently, the analysis of the variables presents in the titles and abstracts of the identified articles began. Regarding the use of the light-dark cycle; Their focus population, the objective of the intervention, and the use of the cycle during the research were evaluated. Regarding the variables of weight gain and reduction of hospital stay, the aim was for the article to mention at least one of the two in its methodology or results. Finally, it was also assessed that the study population was preterm infants in the Neonatal Intensive Care Unit (NICU).

## Results

After conducting a literature search to locate significant evidence, in accordance with the inclusion criteria in the aforementioned search engines, a total of 148 articles were identified See Figure 1. Of these, 134 were eliminated because they did not meet the aforementioned criteria, 14 were chosen for a complete critical reading, however 5 were eliminated due to their deficient contribution to the topic and low quality of the information, finally 9 (100%) articles were chosen, whose designs were 1 (11.12%) systematic review and 8 (88.88%) randomized clinical trials evaluated with the Critical Reading Sheets (FLC) version 3.0 platform [18]. The interpretation used to assign the level of evidence and the degree of recommendation of the selected articles was developed using the scale of the Center for Evidence-Based Medicine, Oxford (OCEBM) [19] See Table 1. Obtaining a level of evidence 1c and a recommendation grade A.

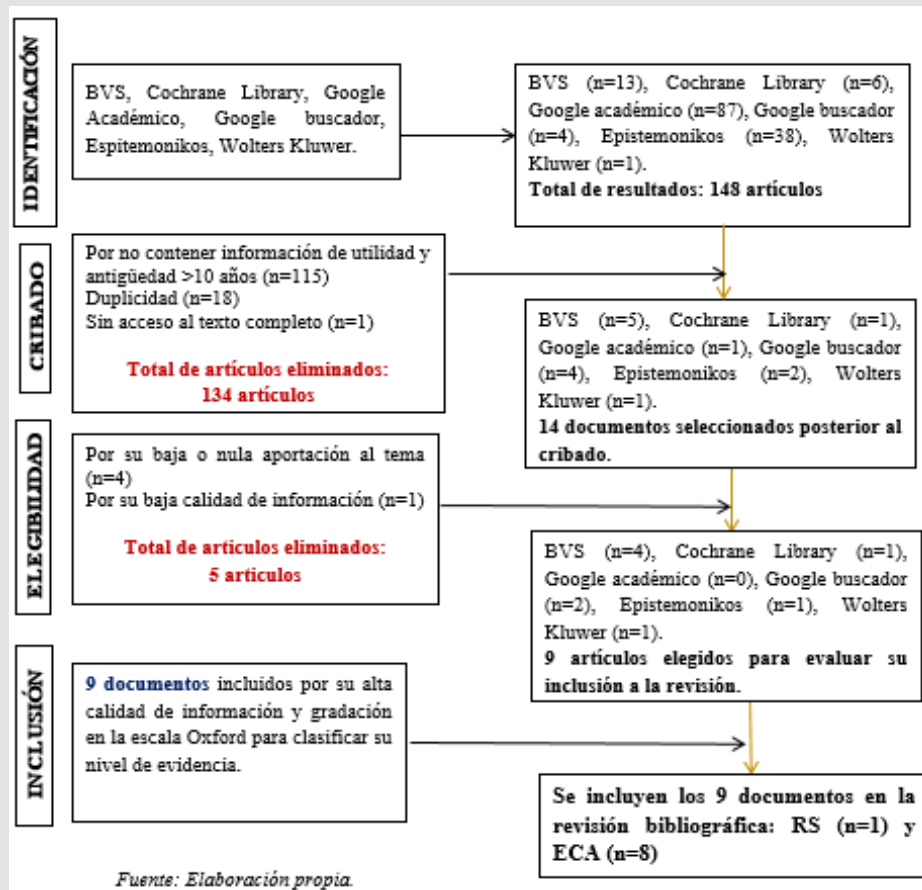


Figure 1: Esquema de evidencias incluidas por declaración PRISMA.

Table 1: Synthesis and Gradation of Evidence.

Oxford (OCEBM)					
Evidence	Author/Year/Place	Design/Sample	Level of Evidence	Degree of Recommendation	Conclusions
Comparison of the Effects of Constant and Cyclic Illumination on Weight Gain and Length of Stay in the Neonatal Intensive Care Unit Among Preterm Infants: A Two-Group Randomized Controlled Clinical Trial [23].	Married in 2018, Irán	Clinical trial Randomized Controlled n= 78 RN	1c	A	This study concludes that cyclic lighting was ineffective in shortening the stay of preterm infants in the NICU, but had significant efficacy in gaining weight in preterm infants in their first 15 days of life. This also improved the parents' satisfaction when they saw the results in the babies.
Comparison of the effects of continuous and cyclic illuminations on weight gain and length of hospital stay in preterm infants [24].	(Esmaeili zadeh M, et al. [24]) Iran	Clinical trial n= 60 RN	1c	A	It was concluded that simulated day/night lighting did improve the weight gain of preterm infants, decreased the length of their hospital stay and increased their sleep time.

Effectiveness of cyclic illumination in the neonatal intensive care unit on weight and cardiorespiratory function in preterm infants [25].	(Marzouk S, [25]), Egypt	Clinical trial n= 38 RN	1b	A	There were no differences in the hospital stay of preterm infants exposed to cyclic light and continuous light; But the implementation of cyclic light showed statistically significant improvements in weight gain, pulse stability, and oxygen saturation.
The effect of the incubator cover on the newborn's vital signs: the design of repeated measurements in two separate groups with no control group [26].	(Cetin K [26]), Turquía	Clinical trial n= 91 RN	1c	A	In this work, it is concluded that although the cycle of light and darkness (with cover in the incubator) did show alterations in the vital signs of the newborns.
Effect of a light-dark cycle on body weight gain in preterm infants admitted to the neonatal intensive care unit [27].	(Sánchez M, et al. [27]), Mexico	Clinical trial n= 300 RN	1c	A	The study showed that premature infants exposed to a light-dark cycle show better physiological development, which favors an increase in body weight and, therefore, a decrease in their hospital stay.
The effect of developmentally individualized care practices on preterm infants [28].	Little D, 2020, Turquía	Clinical trial n= 136	1c	A	In this work, it was concluded that the use of a cover in the incubator offers safe stimuli with greater relevance in the regulation of oxygen saturation.
Influence of Exposure to Night Light on Sleep Development and Body Growth of Preterm Infants [29].	(Kaneshi Y, et al. [29]), Japan	Clinical trial n= 42 RN	1c	A	The study concluded that there were no significant differences in weight gain between the control and experimental groups. She also mentions that nursing care at 3- to 4-hour intervals to light babies <15 min does not disrupt their circadian circus, as long as babies are exposed to a regular cycle of light and dark.
A light/dark cycle in the NICU accelerates body weight gain and shortens the time to discharge in premature infants [30].	(Vásquez S, et al. [30]), Mexico	Clinical trial n= 38 RN	1b	A	This study concluded that exposing premature infants to a light/dark cycle improved their physiological development, promoted rapid weight gain, and decreased hospital discharge time.
Cyclic light in the intensive care unit for premature and low birth weight babies [31].	(Morag I [31]), Israel	Systematic review n= 544 RN	1a	A	The paper concluded that the use of cyclic light is preferable to continuous bright light. The researchers also suggest conducting further research on the comparison of cyclic light versus near-darkness.

## Discussion

During the review, it was found that C-LO has a significant impact on weight gain, which coincides with a study conducted by Brandon Debra in 2018, who showed that the average weight gain was 193.8 grams in a group exposed to the cycle compared to 176.3 grams in the group without the exposure to the cycle [20]. On the other hand, a study carried out in 2012 by Guyer also supports the effectiveness of C-LO in increasing daily weight. [21] Another result that was found during the review was that C-LO decreases hospital stay, Brandon Debra in 2018 mentions that preterm infants in the group exposed to the cycle returned home on an average of 5 days earlier than preterm infants who did not have an exposure to the cycle [22]. During the review, it was found that C-LO exposure causes an improvement in oxygen saturation, in agreement with the study carried out by Castellanos in 2012 in which it was evidenced that they presented improvement in oxygen saturation, measured through pulse oximetry [23-31].

## Conclusion

Achieving adequate lighting in the NICU is a major challenge, due to the lack of protocols in medical units for light regulation used in neonatal intensive care units. It is intended to be a work so that, together with other future research, a safe lighting environment can be achieved and favors the adequate development of the premature newborn hospitalized in the NICU for weight gain and reduction of hospital stay.

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## Conflict of Interest

The authors declare that they have no conflict of interest in relation to this work.

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