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REVISIONES

Sleep promotion in neonatal intensive care units: scoping review

Promoção do sono em unidades de cuidados intensivos neonatais: scoping review

Promoción del sueño en unidades de cuidados intensivos neonatales: scoping review

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ABSTRACT:

Sleep plays a fundamental role in the growth and development of newborns, with their deprivation having many negative effects. The environment of the neonatal intensive care units (NICU) presents itself as disturbing and harmful for the neonatal sleep.

Objective: Map the existing scientific evidence regarding the strategies promoting newborn's sleep in the NICU setting.

Methodology: Scoping review based on the methodology proposed by the Joanna Briggs Institute, using the following search engines and databases: MEDLINE via PubMed, CINHAL Plus with Full Text and Nursing & Allied Health Collection: Comprehensive via EBSCO-HOST, Academic Search Complete, ScienceDirect and Directory of Open Access Journals via B-ON, LILACS, RCAAP and SciELO. As search limiters, there were defined articles published in the last 5 years (until February 2019), available in Portuguese or in English and in full text.

Results: A total of 186 results were listed, and the final sample included 9 studies that responded to the review objective based on the selected inclusion criteria. The sleep-promoting strategies identified refer to the management of the environment in the NICU, the concentration of Nursing care respecting the newborn's sleep-wake cycle, and non-pharmacological interventions such as proper positioning, physical restraint, non-nutritive sucking, Yakson technique, gentle human touch, kangaroo mother care, massage, calm auditory stimuli and remolding mattress.

Conclusion: Given the importance of sleep in the newborn's development, the nurse's role is crucial through the implementation of protective and promoting sleep strategies, especially in the NICU.

Keywords: sleep; newborn; infant; preterm; neonatal intensive care units; nursing.

RESUMO:

O sono tem um papel fundamental no crescimento e desenvolvimento dos recém-nascidos, com a sua privação a apresentar inúmeros efeitos negativos. O ambiente das unidades de cuidados intensivos neonatais (UCIN) apresenta-se como perturbador e nocivo do sono neonatal.

Objetivo: Mapear a evidência científica existente quanto às estratégias promotoras do sono do recém-nascido em contexto de UCIN.
Método: *Scoping review* baseada na metodologia proposta pelo *Joanna Briggs Institute*, com recurso aos seguintes motores de busca e bases de dados: MEDLINE via PubMed, CINHAL Plus with Full Text e Nursing & Allied Health Collection: Comprehensive via EBSCO-HOST, Academic Search Complete, ScienceDirect e Directory of Open Access Journals via B-ON, LILACS, RCAAP e SciELO. Definidos como limitadores artigos publicados nos últimos 5 anos (até fevereiro de 2019), disponíveis em português ou inglês e em texto integral.
Resultados: Foram localizados 186 registos, tendo a amostra final incluído 9 estudos que responderam ao objetivo da revisão com base nos critérios de inclusão definidos. As estratégias promotoras do sono identificadas remetem para a gestão do ambiente na UCIN, concentração dos cuidados de Enfermagem respeitando o ciclo de sono-vigília dos recém-nascidos, posicionamento adequado, contenção, sucção não-nutritiva, técnica de Yakson, toque humano suave, canguru materno, massagem, estímulos auditivos calmos e colchão modelador.
Conclusão: Dada a importância do sono no desenvolvimento dos recém-nascidos, é fulcral o papel do Enfermeiro através da adoção de estratégias protetoras e promotoras deste, especialmente em contexto de UCIN.

Palavras-chave: sono; recém-nascido; unidades de cuidados intensivos neonatais; enfermagem.

RESUMEN:
El sueño desempeña un papel fundamental en el crecimiento y desarrollo de los recién nacidos, su privación presenta numerosos efectos negativos. El ambiente de las unidades de cuidados intensivos neonatales (UCIN) se presenta como perturbador y nocivo del sueño neonatal.
Objetivo: Mapear la evidencia científica existente en cuanto a las estrategias promotoras del sueño de los recién nacidos en contexto de UCIN.
Metodología: *Scoping review* basada en la metodología propuesta por el Joanna Briggs Institute, utilizando los siguientes motores de búsqueda y bases de datos: MEDLINE via PubMed, CINHAL Plus with Full Text e Nursing & Allied Health Collection: Comprehensive via EBSCO-HOST, Academic Search Complete, ScienceDirect e Directory of Open Access Journals via B-ON, LILACS, RCAAP e SciELO. Definido como limitadores artículos publicados en los últimos 5 años (hasta febrero de 2019), disponibles en portugués o inglés y en texto completo.
Resultados: Se localizaron 186 registros, y la muestra final incluyó 9 estudios que respondieron al objetivo de la revisión sobre la base de los criterios de inclusión definidos. Las estrategias promotoras del sueño identificadas remiten a la gestión del ambiente en la UCIN, concentración de los cuidados de enfermería respetando el ciclo de sueño / vigilia de los recién nacidos, posicionamiento adecuado, contención, succión no nutritiva, técnica de Yakson, toque humano suave, canguro materno, masaje, estímulos auditivos tranquilos y colchón modelador.
Conclusión: Dada la importancia del sueño en el desarrollo de los recién nacidos, es fundamental el papel del Enfermero a través de la adopción de estrategias protectoras y promotoras de éste, especialmente en contexto de UCIN.
Palabras clave: sueño; recién nacido; unidades de cuidados intensivos neonatales; enfermería.
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INTRODUCTION

Sleep plays a fundamental and preponderant role in newborn's growth and development [1,2]. Specifically, it is of great importance for the development of the central nervous system, particularly of the cerebral structures, sensory and behavioral systems, being crucial its preservation[1,3-7].

In newborns, sleep cycles are still not well developed[1,8]. According to the American Academy of Sleep Medicine, neonatal sleep (approximately until six months of age) has three stages: active sleep, quiet sleep and indeterminate sleep[3,5,6-8].

Active sleep (the equivalent of REM sleep) is essential for the maturation and development of the central nervous system, including the growth of the sensorineural system and development of the behavioral pattern[1,3,6,7]. This period is characterized by the presence of rapid ocular movements, with rapid and irregular breathing and

body and facial movements[1,6-8]. Quiet sleep (the equivalent of N-REM sleep) promotes energy recovery and cell repair[1,3], with an increase in protein synthesis and growth hormone production[1], also contributing to the learning and memory processes[6,7]. This time is characterized by a rest period, with regular deep breathing and heart rate, and absence of bodily or ocular movements[1,6,8]. Indeterminate sleep is described as the transition between active sleep and quiet sleep[1,3,6,8].

The percentage of time at each stage differs throughout development, following an orderly sequence[5], with a complete sleep cycle lasting between 55 and 90 minutes[1]. Newborns requiring hospitalization in neonatal intensive care units (NICUs) are exposed to frequent stimuli and sleep cycle interrupters, with studies indicating an average of 132[1] to 234[7] sleep disruptions in a given period of 24 hours.

The NICU environment is disturbing and harmful to the neonatal sleep, given the intense and prolonged brightness, excessive noise and constant manipulations resulting from frequent (medical and nursing) invasive and painful procedures that present as stressing factors/stimuli and sleep disturbances of the newborn[1-7,8].

Maintaining the sleep cycle contributes to the maintenance of brain plasticity[7]. So from this point of view, sleep deprivation in the newborn has a negative impact on the adequate development of the central nervous system (especially in premature infants)[1,5], which can result in neurological damage and negative effects on their growth and development[1,4,5,7] and may also adversely affect their health recovery[1,4], leading to delayed hospital discharge and behavioral changes in adulthood[3].

Considering the importance of sleep in the newborn's development, it is extremely important to prioritize it whenever possible, providing neuroprotective strategies for this vulnerable population.

Nursing professionals play a fundamental role in the defense, promotion and preservation newborn's sleep hospitalized in the NICU, given their constant presence throughout the hospitalization. Thus far, it is important to educate these professionals for the strategies that promote and protect newborn's sleep in this particular setting.
It is therefore justified to carry out the present scoping review on the subject in question, which aims to map the existing scientific evidence regarding the strategies promoting newborn's sleep in the NICU setting.

METHODOLOGY

The methodology adopted was the scoping review, carried out through bibliographic research in scientific databases, following the revision protocol proposed by the Joanna Briggs Institute.

Inclusion Criteria

According to the Joanna Briggs Institute, this scoping review was based on three previously defined inclusion criteria: participants, concept and context (acronym PCC)[9]. Regarding the type of participants, there were considered all studies that included newborns up to 28 days of age, regardless of gestational age (preterm, term or post-term). Regarding the concept, there were considered all studies referring to

nursing strategies or interventions to promote newborn's sleep, and in terms of context, there were considered all studies conducted in NICUs.

Thus, the question of revision was formulated: "What strategies should be implemented by nurses for the promotion of newborn's sleep in NICU setting?".

Regarding the type of studies, all existing literature of primary or secondary origin (literature reviews, observational qualitative, quantitative or mixed studies and experimental studies) was included, with the exception of opinion articles or editorial articles.

Search Strategy

The research strategy used was based on three steps, carried out in February 2019. In the first stage, an initial research was carried out, limited to two databases, MEDLINE (via PubMed) and CINHAL Complete (via EBSCO), in order to identify the articles on the subject, followed by an analysis of the words contained in the titles, abstracts and descriptors of said articles.

For the second research, MeSH descriptors and boolean operators were used for the formulation of the research equation. In response to the inclusion criteria, the following descriptors were used: ***newborn***, ***sleep*** and ***newborn intensive care units***. The term nurs *, despite being a descriptor, was also a limiter, so it was not considered. In this way, the following research equation was stated: **[(newborn OR neonate) AND (sleep) AND (newborn intensive care units OR NICU)].**

The research was carried out in the following search engines and databases: MEDLINE via PubMed, CINHAL Plus with Full Text and Nursing & Allied Health Collection: Comprehensive via EBSCO-HOST, Academic Search Complete, ScienceDirect and Directory of Open Access Journals via B-ON, LILACS, RCAAP and SciELO. There were defined as limiters articles published in the last 5 years (in order to obtain the most recent scientific evidence), between January 2014 and February 2019, available in Portuguese or English (considering the language barrier) and in full text (allowing full reading and analysis).

Since the focus of the present study was on strategies to promote newborn's sleep, there were excluded studies that included infants after the first 28 days of life, as well as studies referring to settings other than the NICU, studies on sleep promotion newborn's mothers, studies that did not address sleep promotion strategies and studies related to the prevention of sudden infant death syndrome.

The selection process of the studies was based primarily on the analysis of the titles and abstracts, followed by an analysis of the full text of the selected articles, based on the previously specified inclusion criteria.

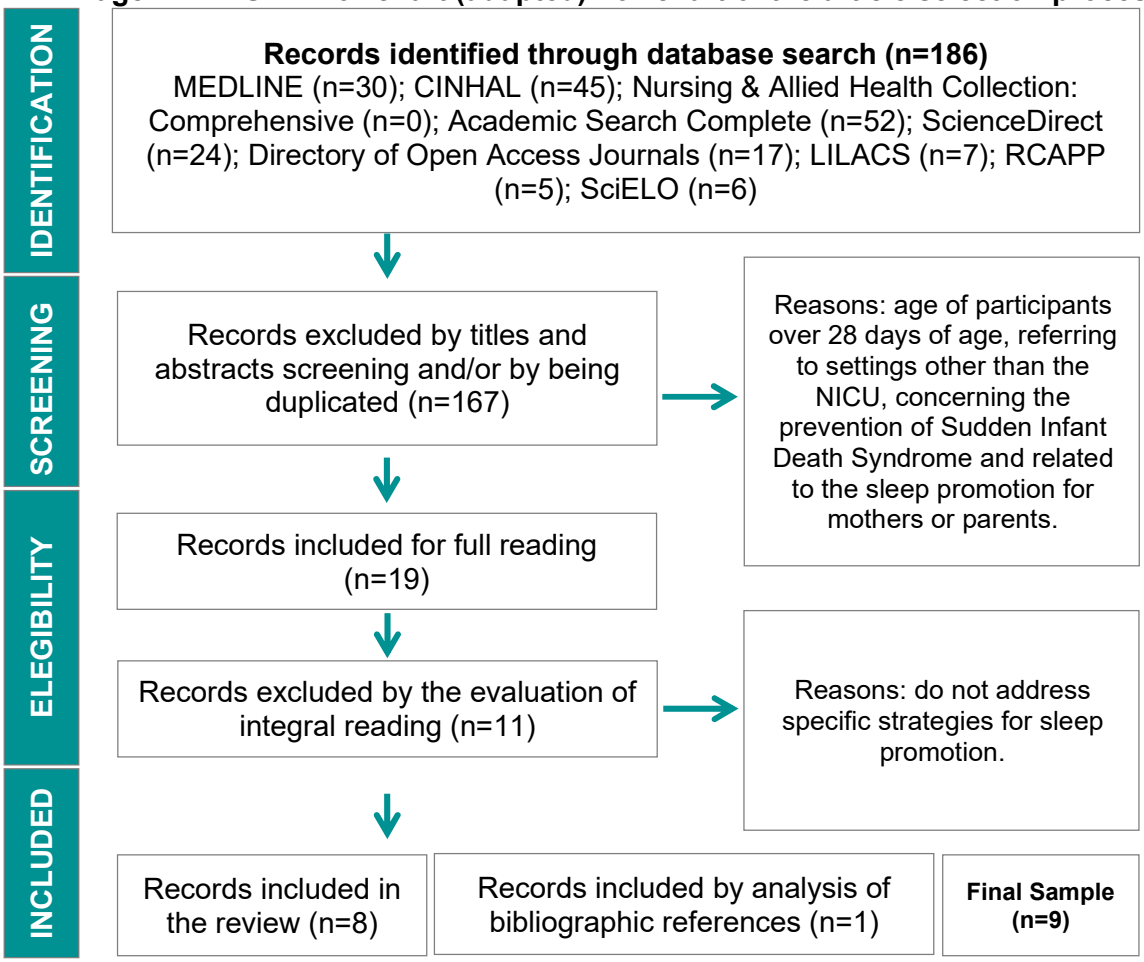
Finally, in the third step, an article was included by analyzing the bibliographic references of the selected studies, since it was considered pertinent to the review in question, and in order to cover the maximum possible results.

The search was conducted on February 25, 2019 and the selection process is presented through a PRISMA flowchart in the "Results" section.

RESULTS

As shown in the flowchart below (*vide* image 1), from the search equation, with the criteria of chronological limitation, language and availability of the full text, 186 potentially relevant results were initially obtained. Of these, 167 records were excluded due to the reading of the titles and summaries and/or because they were repeated, and 19 records were included for integral reading, in order to obtain an overall understanding of them. After this reading, and including only the articles that fit the inclusion criteria and considered relevant to answer the review question, a total of 8 articles were obtained, adding 1 article resulting from the analysis of the bibliographic references of the selected studies, with the final sample resulting in 9 articles that were used in the development of this scoping review.

Image. 1. PRISMA flowchart (adapted) flowchart of the article selection process.



The data from the articles analyzed were extracted based on the guidelines of the Joanna Briggs Institute. To do so, two tables were used to answer the objective and review question, which are presented below (Tables 1 and 2). Table 1 includes the title, authors, country of origin, year of publication, design and study objectives; and table 2 summarizes the main findings and conclusions and recommended strategies.

Table 1. Studies included by title, author, country, year, design and objectives.

	Title	Author/Country/Year	Design	Objectives
E1	Effect of nesting on sleep pattern among preterm infants admitted in NICU	Mony K, Salvam V, Diwakar K, Raghavan V / India / 2018	Randomized controlled clinical trial.	To compare the effect of the nesting and swaddling technique on the sleep pattern of the preterm newborn (PTNB) hospitalized in the NICU.
E2	Effects of a supportive care bundle on sleep variabls of preterm infants during hospitalization	Lan HY, Chang YC, Yang L, Hsieh KH, Yin T, Liaw JJ / Taiwan / 2018	Prospective randomized controlled trial.	To examine the prolonged effects of a supportive care bundle on the PTNB sleep pattern during hospitalization.
E3	Non-pharmacological Interventions for Sleep Promotion on Preterm Infants in Neonatal Intensive Care Unit: A Systematic Review	Liao JH, Hu RF, Su LJ, Wang S, Xu Q, Qian XF, He HG / China / 2018	Systematic literature review and meta-analysis.	To synthesize evidence on the effectiveness of nonpharmacological interventions in NICU preterm infants' sleep during their hospitalization.
E4	How to improve sleep in a neonatal intensive care unit: A systematic review	Teunis CJ, van den Hoogen A, Benders M, Dudink J, Shellhaas R, Pillen S / Netherlands / 2017	Systematic literature review	To systematically review the literature to determine interventions promoting neonatal sleep in the NICU, in order to develop key guidelines to improve neonatal sleep.
E5	Effects of nesting and swaddling on the sleep duration of premature infants hospitalized in neonatal intensive care units	Abdeyazdan Z, Mohammadian-Ghahfarokhi M, Ghazavi Z, Mohammadizadeh M / Iran / 2016	Prospective clinical trial.	To compare the effects of nesting and swaddling on the sleep duration of Iranian premature infants hospitalized in NICUs.
E6	Effects of neonatal intensive care unit nursing conditions in neonatal NREM sleep	Varvara B, Effrossine T, Despoina K, Konstan-tinos D, Matziou V / Greece / 2016	Randomized controlled clinical trial.	To measure the duration of neonatal NREM sleep and how it is affected by the implementation of improved nursing conditions, and especially the reduction of sound and light intensity in the NICU.
E7	Influência da Promoção do Sono no Desenvolvimento do Recém-Nascido Pré-Termo: Uma Revisão Narrativa	Chora MA & Azougado C. / Portugal / 2015	Narrative review of literature.	To reflect on the care that interfere with sleep and development of the newborn.
E8	Neuroprotective Core Measure 4: Safeguarding Sleep - Its Value in Neuroprotection of the Newborn	White, R. / United States of America / 2015	Descriptive study of a qualitative nature.	To identify protective strategies for sleep of the PTNB in the NICU setting and its benefits.

E9	The Effects of Massage Therapy to Induce Sleep in Infants Born Preterm	Yates C, Mitchell AJ, Booth MY, Williams DK, Lowe LM, Hall RW / United States of America / 2014	Randomized crossover trial.	To determine whether massage therapy can be used as an adjunct intervention to induce sleep in PTNB.

Table 2. Studies included by main results, conclusions and recommended strategies.

	Main results and conclusions	Recommended strategies
E1	Study conducted with 21 PTNBs (between 30 and 36 weeks of gestational age), randomly allocated in two groups: nesting or swaddling. Sleep was assessed through the Sleep Assessment Scale, with the results of this study finding an increased total sleep duration in the nesting group, with decreased active sleep time and increased quiet and indeterminate sleep, compared to the swaddling group. The restraint of preterm newborns through nesting is beneficial for improving the sleep of PTNB admitted to the NICU, presenting better results when compared to the swaddling technique.	▪ Nesting; ▪ Swaddling.
E2	Study conducted with 65 PTNBs, randomly assigned to two groups, during invasive procedures: a control group who underwent routine procedures (positioning and positive touch) and an intervention group subject to routine procedures, associated with supportive care bundle interventions. The results of the study suggest that the set of supportive interventions can effectively improve the sleep cycle of PTNB since they not only significantly increased sleep efficacy and total sleep time, but also decreased the frequency of awakenings and drowsiness. It is then encouraged and supported the inclusion of this set of supportive care in the NICU during invasive procedures. Thus far, before starting an invasive procedure, it is recommended that the levels of light and noise be adjusted and the modulation of the state of the PTNB be initiated, speaking in a calm and relaxing voice in order to wake them gradually; afterwards the non-nutritive suction is stimulated through a pacifier, initiated two minutes before the procedure, remaining up to 5 minutes after; during suction, a 24% sucrose solution is simultaneously offered through a syringe; additionally, positive touch and manual restraint are applied. It is important for nurses to prevent and alleviate short- or long-term pain in preterm infants in order to protect the integrity of sleep during invasive procedures.	Supportive care bundle interventions to be adopted before performing a painful procedure: ▪ Adjusting light and noise levels; ▪ Modulation of the state of the PTNB; ▪ Non-nutritive sucking; ▪ Oral administration of sucrose; ▪ Gentle human touch; ▪ Facilitated tucking.
E3	Given the high heterogeneity of the data, it was not possible to include all the interventions in the meta-analysis. This demonstrated a significant difference in sleep duration between experimental groups that used cyclic lighting and remolding mattress, concluding that these interventions have favorable effects on the promotion of PTNB sleep. Strategies such as NIDCAP and cobedding did not reveal statistically significant differences in newborn sleep. With regard to the other interventions included in the review but not suitable for the meta-analysis: music therapy showed beneficial effects on sleep promotion in five of the eight included studies; the gentle human touch technique had positive effects in 5 of the 3 included studies; all studies on non-nutritive sucking (n=4) had a longer sleep time in the experimental group	▪ Cycled lighting; ▪ Remolding mattresses, ▪ Music; ▪ Gentle human touch; ▪ Non-nutritive sucking; ▪ Sleeping in prone position.

	compared to the control group; Finally, regarding sleep position, the review included a study that revealed a longer sleep in the prone position and another study a decrease in sleep in supine position.	
E4	The literature review concluded that there are several interventions promoting sleep in neonates hospitalized in the NICU. The NIDCAP and the use of the viscoelastic mattress showed no significant effects. The kangaroo mother care and the Yakson and Gentle Human Touch techniques revealed an increase in time in the periods of active sleep and quiet sleep, with decreased states of drowsiness and agitation/crying when compared to the control group. The massage revealed effects on increased drowsiness. The studies related to music therapy presented different results: the "remo ocean disk" study showed a positive impact on sleep patterns, with a longer sleep time during active sleep and quiet sleep. Studies on the influence of environment brightness (cycled lighting) on neonatal sleep had medium-term effects (20-30 days after the intervention). It is also recommended that routine procedures be performed during the waking hours of newborns.	▪ Kangaroo mother care; ▪ Yakson; ▪ Gentle human touch; ▪ Massage; ▪ Cycled lighting; ▪ Music (remo ocean disk); ▪ Clustered care; ▪ Respect the sleep-wake cycle of the newborn.
E5	Study carried out with 39 PTNBs, submitted to three interventions at different times: initially control intervention (no intervention), followed by nesting and/or swaddling in the feeding intervals. Sleep was evaluated through observation and Prechtl criteria. Both the nesting and swaddling techniques showed a significant increase in total sleep time and quiet sleep compared to the control intervention, with a slight increase in these times during swaddling compared to nesting, but without significant statistical differences between the two interventions. Moreover, the implementation of any of the techniques is suggested to improve the quality of sleep of the newborn 's sleep in the NICU.	▪ Nesting; ▪ Swaddling.
E6	Study conducted with 32 newborns (from 31 weeks of gestational age). Sleep was evaluated on the first day with the baseline conditions, on the second day with noise reduction (through Minimuffs Neonatal Noise attenuators) and on the third day with a decrease in light intensity (through covers in the incubator). The results revealed an increase in NREM sleep duration in the second (no noise) and third (no light) days compared to the first day, and longer duration in the third compared to the second day. Regarding REM sleep and total sleep duration, an increase in duration was also found, but not statistically significant. Considering the special importance of sleep in brain development and growth during the neonatal period, noise reduction is encouraged (in particular by reducing the intensity of the monitors' sound alarms and decreasing the tone of voice) and light intensity as a nursing practice in NICUs to facilitate NREM sleep duration (especially in preterm infants).	▪ Reduction of noise by reducing the intensity of the monitors' audible alarms and decreasing the tone of voice; ▪ Reduction of luminosity through covers in the incubator.
E7	The creation of an environment with adequate stimulation levels allows to minimize the impact on the sleep of the PTNB in the NICU. Thus, noise reduction should be achieved by decreasing the volume of the alarms of the cardiorespiratory monitors and ventilators, reducing the tone of voice in the communication between the elements of the team, avoiding placing objects on top of the incubators, avoiding sounds of telephones and mobile phones, closing incubator doors with care, avoiding hitting the incubator, avoiding to open packages and enclosures inside the	▪ Reduction of noise; ▪ Reduction of luminosity; ▪ Clustered care; ▪ Respect the sleep-wake cycle of the newborn.

	incubator and using ambient music according to the 45dB. Decreased brightness should be achieved by placing cloths covering the incubators, using soft lights, restricting the strongest lights only to perform procedures that require greater visibility and not turning light bulbs directly to the neonate's face. Care should be concentrated to match the time of the breast, respecting the sleep-wake cycles. PTNB positioning should be adequate through the use of malleable rollers and nests, providing limits and support for the body and stimulating self-organization, and through facilitated tucking. Nurses play a crucial role in providing care to the newborn in the NICU and should ensure the protection and promotion of sleep patterns and development of the PTNB.	▪ Nesting; ▪ Facilitated tucking.
E8	The protection of the newborn's sleep in the NICU, especially of the PTNB, is essential, and strategies should be adopted to minimize sleep disruptions. Structural and operational strategies that can be implemented to minimize harmful stimuli and promote sleep such as private rooms for each family (if family presence is ensured) are suggested; as well as noise control; control of brightness (cyclical alternation of light and avoid exposing the newborn to bright lights); calm auditory stimuli (through music, maternal's voice and heartbeat) and concentration of manipulations (avoiding unnecessary sleep interruptions for routine care and postponing non-emergent interventions until the newborn wakes up).	▪ Single rooms; ▪ Reduction of noise; ▪ Reduction of luminosity; ▪ Cycled lighting; ▪ Calm auditory stimuli; ▪ Clustered care; ▪ Respect the sleep-wake cycle of the newborn.
E9	Study carried out with 30 PTNB, randomly assigned to two groups: one group received massage during the 1st day and did not receive the 2nd day; the second group did not receive on the 1st day and received on the 2nd day. Based on the results of the present study, it was found that there was a greater number of PTNBs sleeping after the day they did not receive massage, which can be explained by the stimulation triggered by this intervention. In other studies reported by the authors, massage had beneficial effects on sleep in term newborns. The present study concluded that therapeutic massage does not induce sleep immediately after the intervention, and the PTNBs are more awake.	▪ Massage (with beneficial effects on sleep in term newborns).

The final review sample resulted in 9 articles, published between 2014 and 2018, in countries such as India, Taiwan, China, Portugal, Iran, Greece, the Netherlands and the United States of America.

Systematic literature reviews (n=2), prospective, randomized and controlled clinical trials (n=5), a narrative literature review (n=1) and a theoretical article (n=1) were identified. Considering the relevance and importance in the scientific literature and evidence-based practice of systematic reviews and prospective, randomized and controlled clinical trials, it was considered an important and productive sample. In general, these are observational and comparative studies allowed to evaluate the effectiveness of different strategies and interventions that promote newborn's sleep in the NICU setting.

The studies included premature newborns (E1, E2, E3, E5, E7, E8 and E9) or premature and term newborns (E4, E6) in their population.

The most frequently encountered strategies referred to the **management of the environment** in the NICU, namely from the **reduction of noise** (E2, E6, E7, E8) and the **reduction of luminosity** (E2, E6, E7, E8). In order to reduce noise, according to the analysis carried out, the following measures should be taken: decrease the volume of alarms (including monitors and ventilators) (E6, E7), reduce the tone of voice in communication between team members (E6, E7), avoid placing objects on top of incubators (E7), avoid phone and mobile phone sounds (E7), close incubator doors carefully (E7), avoid hitting the incubator (E7) and avoid opening packages inside the incubator (E7). Regarding to luminosity, it is important to reduce them by means of measures such as: to cover incubators with opaque covers (E6, E7), use softer lights (E7), to restrict the strongest lights only in order to perform procedures which so require (E7) and do not turn light bulbs directly onto the newborn's face (E7, E8). Cyclic lighting (E3, E4, E8) was another recommended strategy used to simulate the daytime and nighttime environment (approximately 12h of light on and 12h of light off). Another important strategy referred to in three different studies was the **concentration of the newborn's manipulations** (E4, E7, E8), meaning that the care should be clustered to coincide with the time of the feeding, avoiding unnecessary sleep interruptions for routine care and postponing interventions that are not emerging until the newborn wakes up (E8), thus **respecting the sleep-wake cycle**. In situations where care cannot be postponed, it is important to **modulate the state of the newborn** (E2) by awakening and speaking softly before the manipulation, in a gentle and gradual manner so that its transition from sleep to the waking state is as less abrupt as possible (E2, E7).

The studies included in this review showed beneficial effects of **nesting** (E1, E5), **swaddling** (E1, E5) and **facilitated tucking** (E2, E7), and are suggested for the promotion of newborn sleep. Studies E1 and E5 compared the effects of nesting with the effects of swaddling, with E1 reporting greater sleep duration with nesting and E5 better results for swaddling, both being beneficial for sleep promotion of the newborn. Other interventions that have proved to be beneficial in promoting sleep include **non-nutritive sucking** (E2, E3), **Yakson's technique** (E4), **Gentle Human Touch** (E3, E4) and **kangaroo mother care** (E4, E8). Regarding **massage**, different conclusions were found, being recommended in E4, with E9 showing beneficial effects on the sleep pattern only for term newborns. Concerning auditory stimuli, beneficial effects were found with the use of the remo ocean disk (E4) (an instrument filled with metallic balls that creates a sound effect similar to the sound of the waves (5)), as well as through the maternal’s voice (E8) and heartbeat (E8).

The **remolding mattress** has also been shown to be beneficial (E3), since it allows the newborn to assume a position similar to that adopted in the intrauterine environment (3). With respect to the sleeping position, prone position (E3) was identified as most beneficial. Study E8 also suggests the use of **private rooms**, when the presence of the family is assured.

Preterm infants are often submitted to invasive procedures in the NICU setting, which may result in pain and stress, and, consequently, disturb the newborn’s cycles and quality of sleep, whose influence on the development of PTNB is already known. Moreover, the relationship between pain prevention and the protection of sleep of the newborn is established, and Nurses should implement these measures whenever it is necessary to perform these procedures. The E2 study sought to find strategies to promote sleep during invasive and painful procedures, suggesting a bundle of support interventions to adopt before the procedure, namely: adjustment of light and noise

levels, modulation of the state of the newborn, non-nutritive sucking, oral administration of sucrose and facilitated tucking.

Table 3 summarizes the interventions found in the studies, divided into two subcategories: interventions to protect sleep (avoiding interruptions of the sleep cycle) and interventions to promote sleep (promoting/inducing sleep state). Table 4 organizes the interventions found according to their type (environmental or sensorial).

Table 3. Synthesis of interventions in subcategories.

Interventions to protect sleep	Interventions to promote sleep
Reduction of noise	Cycled lighting
Reduction of luminosity	Nesting
Respect the sleep-wake cycle	Swaddling
Clustered care	Facilitated tucking
Modulation of the state of the newborn	Non-nutritive sucking
Single rooms	Yakson
	Gentle human touch
	Kangaroo mother care
	Massage
	Calm auditory stimuli
	Remolding mattress

Table 4. Synthesis of the interventions according to the type of intervention.

Environmental strategies	Sensorial strategies
Reduction of noise	Nesting
Reduction of luminosity	Swaddling
Cycled lighting	Facilitated tucking
Respect the newborn's sleep-wake cycles	Remolding mattress
Clustered care	Non-nutritive sucking
Modulation of the newborn's state	Yakson
Single rooms	Gentle human touch
	Kangaroo mother care
	Massage
	Calm auditory stimuli

DISCUSSION

Newborns' sleep is often disturbed in the NICU setting, due to the environment itself and the need to perform procedures necessary to maintain the newborn's life.

After analyzing the studies listed, it's notorious a growing concern about the implementation of measures aiming to protect and promote the newborn's sleep, particularly in the NICU setting, in order to promote healthy development.

All the studies analyzed in this scoping review addressed non-pharmacological interventions for sleep promotion. Pharmacological and non-pharmacological interventions have been used to promote the sleep of the newborn[3]; however, pharmacological interventions have the effect of reducing active sleep as a side effect, and the use of sedative or hypnotic drugs is not recommended given the state of rapid growth and neurodevelopment of the newborns. Therefore, non-pharmacological interventions more recommended.

The strategies were divided into 2 categories (interventions to promote sleep and to protect sleep) and organized according to 2 types of intervention (environmental and sensorial interventions).

The main environmental factors that interfere in the neonate's sleep in the NICU[1] are noise and luminosity. Concerning noise, the recommendations are that the levels remain below 45 decibels (dB), although levels above those recommended are observed[1], coming mainly from human activity and equipment and respective sound alarms[1, 7]. Regarding brightness, it arises from artificial sources such as environment brightness and examination lights (and phototherapy when applicable[7]). Consequently, the reduction of noise and brightness are particularly important interventions in the order to protect the newborn's sleep. Continuous and intense luminosity have also a negative effect on the establishment of the newborn's circadian rhythm[7]. Another recommended intervention in the field of luminosity control is the cycled lighting, used to simulate the daytime and nighttime environment, thus supporting the development of the circadian rhythm, which influences the production of hormones[3] and is important in the process of healing[2].

Excessive manipulation by the multidisciplinary team is another disturbing factor in the sleep of the newborn[1]. In order to protect and respect the sleep/wake cycles, the manipulations must be clustered, being important the nursing care management in this sense.

It is thus possible to understand that priority is given to managing the environment in the NICU in order to maintain adequate stimulation levels (by reducing noise and light), ensuring a calm environment, minimizing sources of stress and adjusting nursing care.

Adequate positioning and restraint are important interventions, since they contribute to the self-regulation of the baby and avoid motor disorganization [1,10]. This review has shown beneficial effects on the promotion of newborn sleep.

Three types of restraint were identified: nesting, which helps to keep the newborn in a position that reduces the effect of environmental stimuli, minimizing sudden movements, and promoting and improving comfort and sleep[6,8]; swaddling, which involves wrapping the newborn in a sheet or blanket, flicking the limbs and trunk[10], and facilitated tucking, consisting of the use of the hands of the practitioner or parent to hold the baby's head, arms and legs keeping the trunk and limbs aligned and in flexion[10]. These interventions are also covered by the technical guidelines on pain management in newborns issued by the portuguese Direção-Geral da Saúde (2012) and presented in this document as effective non-pharmacological strategies for newborn's pain relief. Considering that newborns are exposed to multiple invasive and/or painful procedures, suffering from about eight to ten painful events per day[12], and also presenting pain resulting from the presence of devices such as nasogastric or orogastric tubes, peripheral venous accesses, tubes from the invasive and non-invasive ventilation, among other necessary devices for the maintenance of life, it is important to recognize the crucial role of pain relief, promoting the organization and self-regulation of the newborn, in order to promote comfort and sleep.

Other interventions that proved to be beneficial were non-nutritive sucking through the pacifier, Yakson's technique (consisting on placing one hand resting on the chest and abdomen while the other supports the baby's back for 5 minutes, followed by a period

of caressing 5 minutes and an end period of another 5 minutes of hand support[5]), the Gentle Human Touch, consisting on placing the fingertips above the eyebrow line, with the palm of the hand on the baby's face and the other hand supported on the newborn's abdomen for 15 minutes[5]), the kangaroo mother care (technique of placing the newborn in skin-to-skin ventral contact with the breast of the mother, wearing only a diaper, covering it with her clothing and/or blanket[10], the massage and the calm auditory stimuli.

These strategies differ within, but are confluent in appealing to the senses of the newborn (sensorial interventions), focusing predominantly on the palate (through nonnutritive sucking), touching (through Yakson technique, gentle human touch, kangaroo mother care and massage), and in hearing (through calm auditory stimuli).

In conclusion, regarding sleeping position, prone position has been identified as the most beneficial. Considering that this position is contraindicated in the prevention of sudden infant death syndrome[11], since it is associated with an increased risk of hypercapnia and subsequent hypoxia, decreased cerebral oxygenation and overheating[11], in the care for discharge, it is particularly important to provide instruction to parents and caregivers, emphasizing that infants should be placed in the supine position to sleep, being the only safe and recommended position[11], safeguarding that in the NICU setting it is verified continuous monitoring and follow-up, which is not applicable at home.

The interventions found and mentioned have as advantages the fact that their applicability is autonomous for the Nurse, bas well as safe and non-invasive. The vast majority of identified strategies are readily available, presenting no risks, side effects or associated high costs.

Regarding limitations, this scoping review included only articles published in English or Portuguese, and articles published in other languages could also have important contributions to this review. The limited availability of full text articles has also considerably reduced the number of articles that could be analyzed.

CONCLUSIONS

With the present review, it was possible to map the existing scientific evidence regarding effective strategies in the protection and promotion of newborn sleep in the NICU setting. Given the importance of an adequate sleep pattern and its strong impact on the development of newborns, it is the nurses' responsibility to implement strategies that protect and promote sleep in this vulnerable population and to have in-depth knowledge about sleep, making it possible to identify and apply effective intervention for its promotion and protection.

From this review it was possible to answer the question of revision "What strategies should be implemented by nurses for the promotion of the newborn's sleep in the NICU setting?". The results obtained allowed us to understand that newborn sleep should be protected through the management of the NICU environment, reducing noise and light levels, promoting cycled lighting and adjusting care through the concentration of manipulations, respecting the sleep/awake cycle of the newborn. When care is needed, modulation of the newborn should be used. In addition to sleep protection, there are important interventions to promote sleep, including adequate

positioning, namely through nesting, swaddling and facilitated tucking, non-nutritive sucking through the use of pacifiers, Yakson technique, gentle human touch, kangaroo mother care, massage, calm auditory stimuli, the use of remolding mattress and prone position to sleep.

As protective and sleep-promoting strategies for the neonate in the NICU setting, they should be considered as important tools that all nurses must provide, given their central role in protecting this vulnerable population, in order to minimize the negative influences of sleep interruption in the NICU, promoting their comfort and stability.

Implications for Research

Through the methodology used in the present review, no studies were found that portrayed the national reality in Portugal regarding the implementation of strategies promoting sleep in the NICU setting (only a review of the literature that did not portray national data). For such reason, it is suggested to carry out studies that evaluate the effectiveness of these strategies in the Portuguese population. Some studies presented a reduced number of participants in their samples, requiring replication with larger samples for more robust conclusions. Considering that massage was an intervention with no well-defined conclusions in the included studies, it is suggested to carry out further studies to prove its efficacy, both for term and preterm newborns.

Implications for Pratice

Based on the data obtained, this review provides a body of knowledge about strategies promoting newborn sleep in the NICU setting, providing a set of strategies based on scientific evidence and enabling the improvement of the quality of nursing care provided to the newborn and its family.

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