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Neonatal and Infant Pain Assessment and Management

A literature review

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Abstract:

Studies have shown that babies experience pain as early as 20 weeks of fetal age. During hospital stays, neonates and infants are exposed to many painful and stressful procedures, such as heel lancing, vaccination, mucous suctioning, venipuncturing, lumbar puncturing and peripheral IV insertion. Because neonate's and infants's pain is usually assessed based on behavior and physiological changes, it is critical that the pediatric nurses recognizes the signs of pain.

This qualitative literature review comprises articles that are no more than 10 years old, published at peer-reviewed scientific journal and deal with the assessment of pain in babies using pain scales and pain management from a non-pharmacological perspective. For the study, articles from electronic databases such as PubMed, Sage Journals, and EBSCO were retrieved. Data were analyzed using deductive content analysis. This literature review concluded that different pain scales can be used to measure the intensity of pain in neonates and infants. Assessment is based on behavioural and physiological changes during and after painful procedures. Some of the scales have proven to be reliable, but more precise scales will be required in the future. Non-pharmacological pain management methods are frequently utilized and chosen to treat baby's pain due to their low side effects and high risk-benefit ratio. Breastfeeding and glucose solution are the most effective pain management methods, according to studies.

Keywords: infant, neonatal, non-pharmacological, pain assessment, pain management, pain scale

Sisällysluettelo

1. INTRODUCTION

Neonate, or newborn refers to a baby between the age from birth and 28 days (WHO, n. d.), whereas infant is defined as a baby younger than one year old (For Farlex Partner Medical Dictionary, n.d.).

Even the smallest and most immature premature babies experience pain as the fetal pain system develops by 24 weeks of pregnancy. Many routine procedures, such as taking blood samples, are painful and stressful for the newborn and infant. Newborns are subjected to a variety of painful procedures and treatments, particularly in intensive care. Although pain management for premature babies was not considered necessary decades ago, not treating it today would be unethical and inhumane (Juujärvi et al 2021).

Pain is the most urgent and demanding of our five senses. It is necessary for survival, but if it persists, it can cause serious clinical problems (Fitzgerald, 2015). Pain is defined as an unpleasant experience associated with or threatened tissue damage or described in terms of tissue damage (Käypä hoito-suositus, 2017). Individual variability in pain makes it difficult to measure and treat, and this is especially problematic for newborns and infants, who not only lack the ability to verbalize their experiences, but also have immature central nervous system, including pathways and networks involved in somatosensory and emotional processing (Fitzgerald, 2015).

Assessing pain does not cause pain, but failing to adequately assess and appropriately respond to pain has perpetuated poor pediatric pain management and suboptimal pain treatment in children (Manworren et al. 2016).

The idea for this literature review was inspired by the author's personal interest in caring for babies. A pediatric nurse's work includes the correct and precise use and control of pain scales and pain management methods.

2. BACKGROUND

Both preterm and term infants can recognize, process, and respond to painful stimuli, according to research (Shen et al. 2022). For infant or neonatal patients suffering from acute, recurring,

or chronic pain, assessment serves as the foundation for diagnosis, treatment selection, and treatment effectiveness evaluation. Extensive research has yielded a number of valid, reliable, and recommended tools for assessing neonates and infant's pain. Even so, evidence suggests that neonatal and infant pain is still not being assessed or treated optimally. Efforts to improve pediatric pain management have included strategies to standardize and improve the use of validated pain assessment tools, as well as to encourage thorough evaluation (Manworren at al. 2016).

Neonatal pain exposure can cause a number of neurophysiological and behavioral changes that have been linked to long-term consequences such as feeding difficulties, hyperalgesia, chronic metabolic diseases, and even lower cognitive scores, motor ability, and behavioral control ability in childhood (Shen et al. 2022). Effective pain management in neonates and infants is required to reduce acute physiological and behavioral distress and may also improve acute and long-term outcomes (Walker, 2013). Because of increased awareness of newborn and infant pain, numerous assessment tools for use in pain assessment have been developed (Fitzgerald, 2015).

Non-pharmacological pain management methods are preferred not only for ethical reasons, but also for its high benefit-risk ratio (Shen et al. 2022). Although both non-pharmacological and pharmacological approaches can be used to relieve pain in neonates, non-pharmacological approaches are recommended as the first-line treatment in neonatal pain management guidelines (Shen et al. 2022).

2.1 Pain mechanisms in neonatal and infant

In terms of vital functions, a newborn cannot be compared to a child over one year old or an adult. During the first year of life, an infant's physiology undergoes significant changes (Juujärvi et al. 2021).

Nociception is the process of noxious stimuli by the central nervous system and peripheral nervous system, such as tissue injury and temperature extremes, which activate nociceptors and

their pathways (Kendroud et al. 2022). The connections of the pain pathway are formed by 24 weeks of pregnancy, after which the rapid development of the cerebral cortex continues (Juujärvi et al. 2021).

Pain is the subjective sensation caused by the activation of these pathways. Nociceptors are the receptors responsible for relaying nociceptive information. They can be found on the skin, joints, viscera, and muscles, among other places. Several chemical substances, including globulin and protein kinases, arachidonic acid, histamine, nerve growth factor, substance P, calcitonin gene-related peptide, potassium, serotonin, acetylcholine, low-pH solutions, ATP, and lactic acid, activate these receptors. Temperature extremes, high pressures, and tissue damage that causes inflammation all activate receptors (Kendroud et al. 2022).

In neonates, responses to painful stimuli can be seen in nociceptive pathways from the periphery to the cortex, though the degree and nature of the response change with age. Following birth, peripheral nociceptors respond to mechanical, thermal, and chemical stimuli, and peripheral sensitization or primary hyperalgesia (reduced threshold and enhanced response to previously painful stimuli) develops (Walker, 2013). Neonates are more sensitive to pain than older children and adults. Pathways that prevent pain develop only after birth, which can expose newborns to excruciating pain (Juujärvi et al. 2021).

Pain can be acute, recurring, chronic, or a combination of acute and chronic. (Figure 1) Acute pain is associated with medical procedures (for example, injections, electromyograms, and surgery), injury (for example, bruises and broken bones), and acute illness and disease exacerbation (Manworren et al. 2016).

Chronic pain is defined as persistent or recurring pain. Chronic pain in children and adolescents is commonly defined as any prolonged pain that lasts more than three months or any recurring pain that occurs at least three times in a three-month period (Manworren et al. 2016).

Pain can be nociceptive, neuropathic, or a combination of the two (both nociceptive and neuropathic). Somatic (bone, muscle, joint, skin, or connective tissue) and visceral pain are two types of nociceptive pain (organs such as stomach and pancreas) (Manworren et al. 2016).
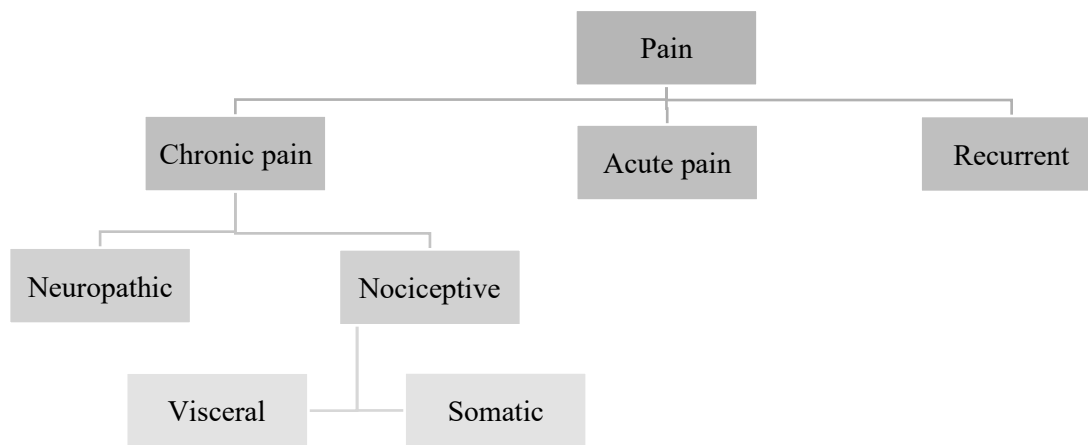
Figure 1.Pain (Manworren et al. 2016).

2.2 Assessing neonatal and infant pain

The majority of pain assessment tools are concerned with determining the intensity of pain. A thorough pain assessment, on the other hand, provides critical information for evaluating the pain experience, diagnosing the most likely cause of pain, and selecting the most appropriate treatments (Manworren et al. 2016).

The child's developmental stage and fetal age influence how they express their pain. Since neonates and infants do not know how to express themselves in an easily interpretable way, it is sometimes challenging to assess pain (Juujärvi et al. 2021).

Pain assessment tools for patients who are unable to self-report their pain experience are actually indirect measures of pain; they indicate the intensity of pain-related distress and pain reactivity rather than the intensity of pain. These tools are based on the observation of physiological and behavioral changes in neonates as a result of pain (Manworren et al. 2016).

Unidimensional pain scales validated in pre-verbal and non-verbal pediatric patients rely on behaviors associated with acute pain. The severity of the illness, gestational age, and development all have an effect on behavioral responses. As a result, pain assessment tools validated in neonates and infants include gestational age adjustments (Manworren et al. 2016).

However, because older infants, toddlers, and non-verbal children may voluntarily alter their behaviors in response to pain, parents and healthcare providers must consider pain assessment scores obtained using even these validated behavioral tools as proxy pain measures to be interpreted based on the child's expected or previously experienced pain from similar procedures and conditions (Manworren et al. 2016).

| *Obtain a pain history* | *Assess the child's pain using a developmentally appropriate pain assessment tool* | *Reassess the child's pain having allowed time for pain-relieving interventions to work* |

Figure 2, Key steps assessing children's pain

Pain should be assessed regularly to detect the presence of pain and to evaluate the effectiveness of treatments (Manworren et al. 2016).

2.3 Pain Management

It is not always necessary to use analgesic to treat pain. The priority is to treat the underlying cause of pain, which reduces the need for pain medication. The primary methods in mild and short-term procedural pain are non-pharmacological alternatives, with the nurse's role emphasized in implementation. They are simple to implement and may be sufficient to treat minor pain and discomfort (Juujärvi et al. 2021). Furthermore, they offer more benefits due to their low risk and lack of side effects, ease of implementation, low cost, and nurse-friendliness (Shen et al. 2022).

Early or preventive non-pharmacological pain treatment can both prevent and reduce the amount of analgesic required in stronger pain treatment. Therefore, monitoring the newborn and reacting sufficiently early to pain expressions is important (Juujärvi et al. 2021).

Although both non-pharmacological and pharmacological approaches can be used to relieve pain in neonates, non-pharmacological approaches are recommended as the first-line treatment in neonatal pain management guidelines (Shen et al. 2022).

There is little researched information on the long-term use of analgesic in children. This is a problem, because in the absence of researched data, pediatric patients often have to be treated with drugs that are not indicated for the treatment of pain in children or that do not have a marketing authorization for pediatric patients (Käypä hoito-suositus, 2017).

The goal of pain treatment is to use non-pharmacological pain management methods alongside analgesic treatment, while taking into account the side effects and risks of both, and to avoid overtreatment (Juujärvi et al. 2021).

3. THEORETICAL FRAMEWORK

3.1 Katharine Kolcaba's Theory of Comfort

In the 1990s, Katharine Kolcaba developed her Theory of Comfort. It is a middle-range theory for health care, education, and research. This theory has the potential to elevate the importance of comfort in healthcare. The model states that comfort is an immediate desirable outcome of nursing care. Kolcaba distinguished three types of comfort: relief, ease, and transcendence. When a patient's specific comfort needs are met, the patient feels comfort in the form of relief (Petiprin, 2020).

As comfort is a primary patient goal and central to the patient experience, maximizing comfort is a universal goal for healthcare. However, comfort is a complex concept that is difficult to operationalize and evaluate, resulting in a lack of scientific and standardized comfort care practices. The Comfort Theory devised by Kolcaba is the most generally known for its

systematisation and projection, and most global publications on comfort care are based on it. (Lin, Zhou and Chen, 2023)

Patient comfort can occur in four contexts: physical, psychospiritual, environmental, and sociocultural (Petiprin, 2020). A baby who receives pain management in post-operative care, for example, is receiving relief and comfort.

Nursing is defined in the model as the process of assessing the patient's comfort needs, developing and implementing appropriate nursing care plans, and evaluating the patient's comfort after the care plans have been implemented. Nursing encompasses the deliberate assessment of comfort needs, the design of comfort measures to address those needs, and the reassessment of comfort levels following implementation (Petiprin, 2020).

The approach of this theory has been used in this literature review. Observing and treating the infant's pain is an important part of the pediatric nurse's work, and it is necessary to respond to it in order to achieve comfort and provide good care.
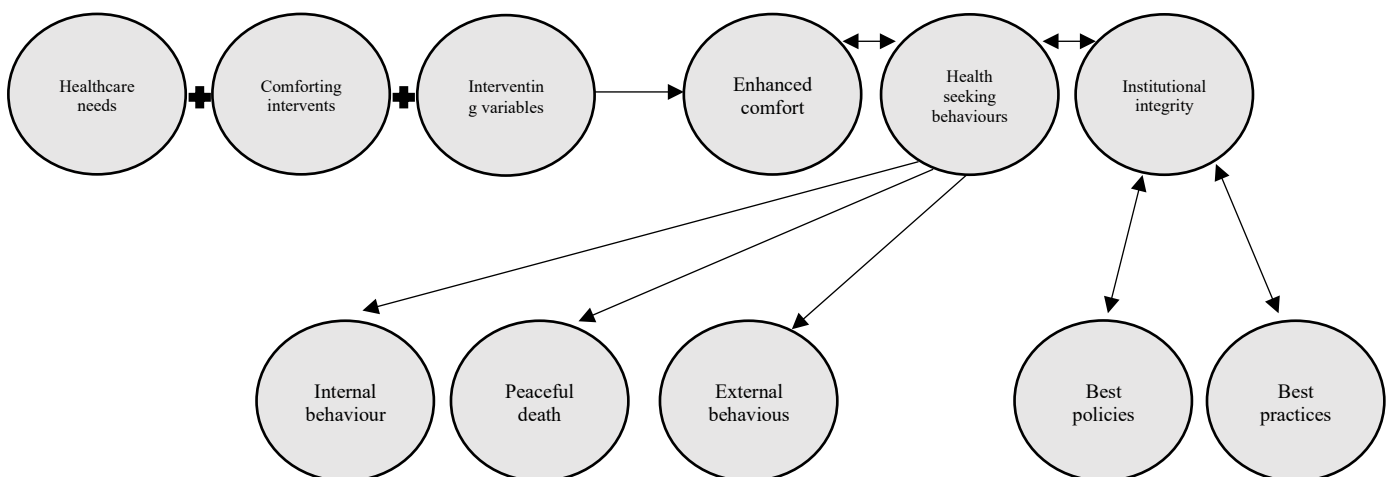
Figure 3, Conceptual Framework for Comfort Theopry (Lin, Zhou and Chen, 2023)

4. AIM AND RESEARCH QUESTIONS

The aim of this literature review is to collect some of the most used neonatal and infant pain scales and non-pharmacological pain management methods, describe them and explain their differences.

This literature review views the assessment and treatment of neonatal and infant pain from the nursing perspective, which in this case is non-pharmacological. The research questions used to guide this literature review was:

1. How to assess a baby's pain by using scales?

2. What non-pharmacological methods can be used to treat a baby's pain?

5. METHODOLOGY

This study was conducted as a descriptive literature review. According to the general definition, a literature review is a method and a research technique that examines previous research. In this study, the aim is to use ''research to conduct research'' and to compile the findings of studies done before (Salminen, 2011).

The purpose of this review is to use already existing research data to answer the research questions, and the literature review was the most suitable method for this purpose. According to Salminen (2011), this method can provide a broad picture of the chosen topic as well as describe its history and development.

According to Elo and Kyngäs (2008), "If there is insufficient previous knowledge about the phenomenon or if this knowledge is fragmented, the inductive approach is recommended." When the structure of analysis is operationalized on the basis of prior knowledge and the purpose of the study is theory testing, deductive content analysis is used. Deductive content analysis is often used in cases where the researcher wishes to retest existing data in a new context. This may also involve testing categories, concepts, models or hypotheses.

To carry out this literature review, a deductive content analysis was chosen. There is a reasonable amount of research information on pain management and assessment in infants and neonates. The main goal of this literature review is to compare different pain scales and pain management methods, rather than look for new methods.

5.1 Data Collection

This literature review data search was guided by the research questions developed earlier. Central concepts from the research questions were derived, which were then used to generate search words for the data search. In the data collection process, the first step was to choose and limit the articles for research from databases such as PubMed, EBSCO, and Sage Journals. Variety of keywords and phrases were used related to research questions during the data collection retrieval process. Here the exclusion and inclusion criteria was also set. These criterias are shown in Table 1.

Inclusion criteria	Exclusion criteria
- Year of publication 2013 or later - Written in English language - Available in full text - Available for free - Non-pharmacological methods - Related to the research questions	- Year of publication 2012 or earlier - Language other than English - Not available in full text - Only available for a fee - Pharmacological methods - Does not answer to the research questions

Table 1, inclusion and exclusion criteria

Data collection search started from the PubMed database with search words 'infant pain assessment pain scale' which yielded 1401 hits. After restriction the results to 'Free full text' and the 'Publication years 2013-2023'. After this, 278 hits remained.

Next, CINAHL with Full Text (EBSCO) database was included in the data search. Entering the search words 'non pharmacological pain management' AND 'infant' AND 'neonatal' into the search field got 71 hits. After limiting the results by selecting 'Full text' 'Peer reviewed' and 'Publication years 2013-2023', 28 hits remained.

Lastly, data search from Sage Journals Advanced Search was conducted. Entering the search words 'neonatal infant pain assessment and management', 17276 results came up. After narrowing down the results by selecting 'Reviewed Article' and 'Publication years 2013-2023', 667 hits remained.

After this phase, the remaining articles were browsed by the titles of the articles that appeared as search results and selecting the ones that best corresponded to research questions. After selecting the titles, the articles were read by the abstracts of the studies while making the cut based on inclusion and exclusion criteria.
Following that, the entire research articles were read and based on that even more articles were eliminated. The final articles and details selected for this review are shown in Table 3.

The majority of the articles for this review were discovered in PubMed during the search. Other databases yielded only two articles. Due to the lack of articles, the search words had to be changed, which deviates from the usual line. Strength and limitations after the conclusions explains this in more detail.

PubMed	**Sage Journals**	**EBSCO**

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┌─────────────────┐   ┌─────────────────┐   ┌─────────────────┐
│ 'infant pain    │   │ 'neonatal infant│   │ 'non pharmaco-  │
│ assessment pain │   │ pain assessment │   │ logical pain    │
│ scale'          │   │ and management' │   │ management' AND │
│                 │   │                 │   │ 'infant' AND    │
│ 1401 hits       │   │ 17276 hits      │   │ 'neonatal'      │
│                 │   │                 │   │ 71 hits         │
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│ First inclusion and exclusion criteria: 'Free full text'     │
│ 'Peer reviewed' and 'Publication year 2013-2023'             │
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┌─────────────────┐   ┌─────────────────┐   ┌─────────────────┐
│                 │   │                 │   │                 │
│ 278 hits        │   │ 667 hits        │   │ 28 hits         │
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┌─────────────────────────────────────────────────────────────┐
│ Second inclusion and exclusion criteria: 'Related to the     │
│ research questions' and 'Non-pharmacological methods'        │
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│ 29 hits         │   │ 3 hits          │   │ 2 hits          │
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┌─────────────────────────────────────────────────────────────┐
│ Articles reviewed by title, abstract and full text           │
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┌─────────────────┐   ┌─────────────────┐   ┌─────────────────┐
│ 13 articles     │   │ 1 article       │   │ 1 article       │
└─────────────────┘   └─────────────────┘   └─────────────────┘
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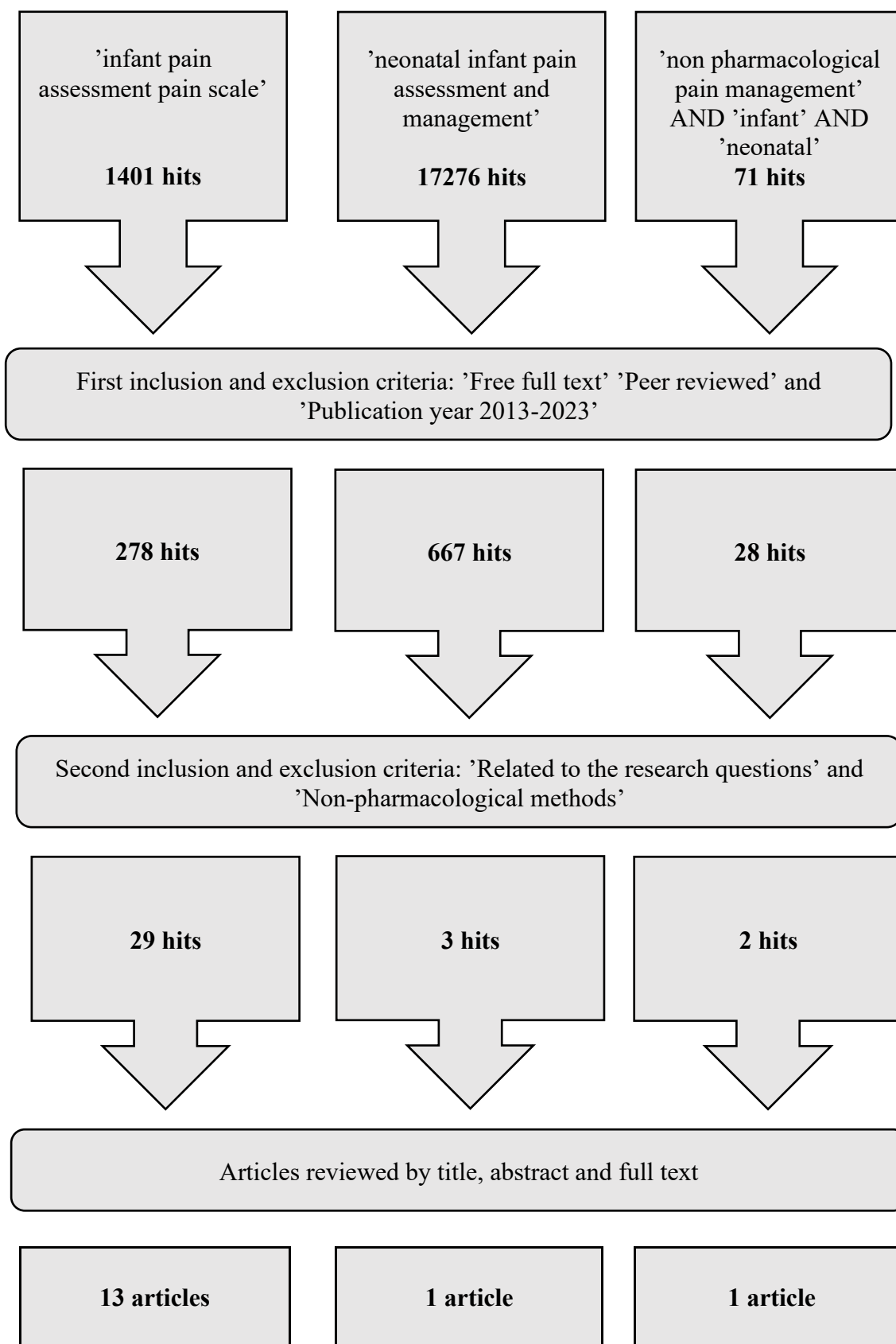
Table 2. Data collection process

5.2 Table of Articles

This section contains the articles chosen for this review. The articles are organized alphabetically by the author. For this review, some articles that depart from the norm in a qualitative literature review were chosen. These exceptions are detailed in the section on strengths and limitations.

	Author(s)	Year	Title	Source of Journal	Method
1	Boles, Jessika	2017	Non-Pharmacological Strategies For Addressing Infant Pain	Pediatric Nursing, EBSCO	Case study
2	Chan, A.Y., Ge, M., Harrop, E., Johnson, M., Oulton, K., Skene, S.S., Wong, I.C., Jamieson, L., Howard, R.F. and Liossi, C.	2021	Pain assessment tools in paediatric palliative care	Palliative Medicine, PUBMED	Systematic review
3	Desai, S., Nanavati, R., Jasani, B. and Kabra, N.	2017	Comparison of Neonatal Pain, Agitation, and Sedation Scale with Premature Infant Pain Profile for the assessment of acute prolonged pain in neonates on assisted ventilation	Indian Journal of Palliative Care, PUBMED	A prospective observational study
4	Failo, A., Giannotti, M. and Venuti, P.	2019	Associations between attachment and pain: From infant to adolescent	Open Medicine, Sage Journals	Review article
5	García-Valdivieso, I., Yáñez-Araque, B., Moncunill-Martínez, E., Bocos-Reglero, M.J. and Gómez-Cantarino, S.	2023	Effect of NonPharmacological Methods in the Reduction of Neonatal Pain	International Journal of Environmental Research and Public Health, PUBMED	Systematic Review and Meta-Analysis
6	Koukou, Z., Theodoridou, A.,	2022	Effectiveness of Non-	Children, PUBMED	Review

	Taousani, E., Antonakou, A., Panteris, E., Papadopoulou, S.-S., Skordou, A. and Sifakis, S.		Pharmacological Methods, Such as Breastfeeding, to Mitigate Pain in NICU Infants		
7	Llerena, A., Tran, K., Choudhary, D., Hausmann, J., Goldgof, D., Sun, Y. and Prescott, S.M.	2022	Neonatal pain assessment: Do we have the right tools?	Frontiers in Pediatrics, PUBMED	Systematic review
8	Mangat, A., Oei, J.-L., Chen, K., Quah-Smith, I. and Schmölzer, G.	2018	Non-Pharmacological Treatments for Pain Management in Newborn Infants	Children, PUBMED	Review
9	Mazur, A., Radziewicz Winnicki, I. and Szczepański, T.	2013	Pain management in children	Annals of agricultural and environmental medicine, PUBMED	Review article
10	Mencía, S., Alonso, C., Pallás-Alonso, C. and López-Herce, J.	2022	Evaluation and Treatment of Pain in Fetuses, Neonates and Children	Children, PUBMED	Review
11	Moore, E.R., Bergman, N., Anderson, G.C. and Medley, N.	2016	Early skin-to-skin contact for mothers and their healthy newborn infants	Cochrane Database of Systematic Reviews, PUBMED	Review
12	Oliveira, N.C.A.C., Gaspardo, C.M. and Linhares, M.B.M.	2017	Pain and distress outcomes in infants and children	Brazilian Journal of Medical and Biological Research, PUBMED	Systematic Review
13	Olsson, E., Ahl, H., Bengtsson, K., Vejayaram, D. N., Norman, E., Bruschettini, M., & Eriksson, M.	2020	The use and reporting of neonatal pain scales	Pain, PUBMED	Systematic Review and Meta-analysis
14	Talebi, M., Amiri, S.R.J., Roshan, P.A., Zabihi, A., Zahedpasha, Y. and Chehrazi, M.	2022	The effect of concurrent use of swaddle and sucrose on the intensity of pain during venous	BMC Pediatrics, PUBMED	Randomized Controlled Trial

			blood sampling in neonate		
1 5	Thrane, S.E., Wanless, S., Cohen, S.M. and Danford, C.A.	2016	The Assessment and NonPharmacologic Treatment of Procedural Pain From Infancy to School Age Through a Developmental Lens	Journal of Pediatric Nursing, PUBMED	A Synthesis of Evidence With Recommendations

Table 3, List of Articles

5.3 Data Analysis

The content analysis of this literature review is conducted as a qualitative content analysis. Content analysis is a research method that uses both quantitative and qualitative data in an inductive or deductive way. Quantitative research is concerned with counting and measuring, whereas qualitative research is concerned with interpreting, understanding and comprehending (Elo at el. 2008).

This is a particularly important factor in this literature review. The goal of using content analysis is to create a model to conceptually describe the phenomenon. Inductive content analysis is used when there have been no previous studies on the phenomenon or when they are fragmented. If the overall goal was to test a previous theory in a different situation or to compare categories at different time periods, a deductive approach would be useful (Elo at el. 2008).

There is a lot of research about the assessment and management of pain in babies, thus a deductive approach was chosen. Deductive analysis means applying theory to data in order to test the theory. It's a "top-down" method of data analysis.
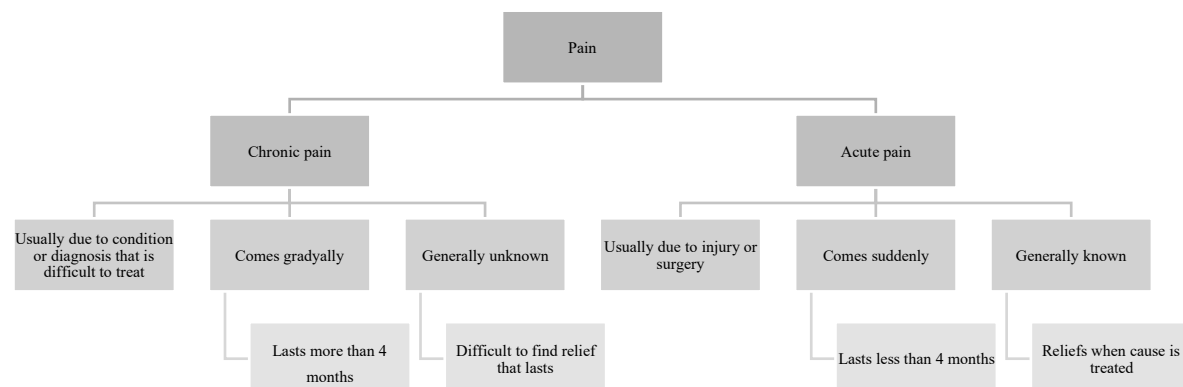

Figure 2, An example of categorization matrix

Both inductive and deductive analysis processes are divided into three stages: preparation, organization, and reporting (Elo at el. 2008). In the deductive content analysis, the first phase, i.e. the preparation phase starts with selecting the unit of analysis. The unit of analysis can be a single word or several sentences with multiple meanings. In this review, a sentence that formed a coherent meaning was chosen as the unit of analysis. The preparation phase also includes a thorough familiarization with the material and reading it through multiple times (Elo at el. 2008).

In the second stage, i.e. the organization stage, the material is coded, classified and conceptualized (Figure 2) (Elo at el. 2008). Content analysis for this review was conducted completely digitally, using a separate Word-template. After reading the articles, concepts, words and phrases from the articles which was found relevant to this study, were color coded, after which a table of themes, generic categories and subcategories were created. (Table 4) This table displays the coding results. Pain assessment and management are divided in the main themes category. Pain assessment methods for neonates and infants, as well as pain management methods for neonates and infants, are separated under the generic category. The final subcategory lists and categorizes pain assessment scales and non-pharmacological methods based on purpose and objective.

Themes	Pain management		Pain assessment	
Generic categories	Pain management for neonates	Pain management for infants	Pain scales for neonates	Pain scales for infants
Subcategories	Acupuncture/Noninvasive acupuncture Breastfeeding Facilitated tucking Musical therapy/ White noise Nutritive/nonnutritive sucking Oral sucrose/glucose Skin-to-skin treatment Swaddling Therapeutic massage	Acupuncture/Non-invasive acupuncture Attention modification Breastfeeding Musical therapy/ White noise Therapeutic massage	ALPS-neo BPSN CHIPPS COMFORT COMFORTneo COVERS CRIES EDIN NFCS NIAPAS NIPE NIPS N-PASS PAT PIPP PIPP-R PPP	CHEOPS CHIPPS COMFORT COMFORT-B COVERS CRIES FLACC NFCS NIPS
Unit of analysis	1,5,6,8,11,12,14	1,5,8,15	2,3,5,7,9,10,13	2,3,5,7,9,10,13, 15

Table 4, Categorization

Conceptualization occurs at the end of the planning phase (Elo at el. 2008). Theoretical concepts are formed in conceptualization based on essential information selected from the material.

The research question is answered by combining the generated concepts. Concepts are used to construct a description of the research object during the conceptualization process. The findings present a model, conceptual system, concepts, or themes that describe the material derived from the empirical data.

5.4 Ethical Considerations

Ethics is a branch of philosophy that investigates concepts such as right and wrong and moral behavior. The operating methods that the researcher must follow in order to produce sustainable information and to treat the people they study well are referred to as research ethics. The Finnish scientific community is committed to good scientific practice, which includes research ethics (Tietoarkisto, n.d.).

According to general ethical principles, the research must respect the human dignity, privacy, self-determination, and other rights. A fundamental general ethical principle is to avoid posing significant risks, damages, and harm to the people, communities, and other research subjects being studied. This must be considered carefully when examining small children. The selection of data sources is critical to ensuring the research's dependability. The author must assess the dependability of the data sources chosen, as well as whether the number and quality of the sources are adequate for their own research (Tietoarkisto, n.d.). If participation in the study is not in accordance with the minor subject's interest and will, the researcher should withdraw this person from the study (TENK, 2019).

Participation of children and infants in scientific research raises ethical concerns.
There has been a lot of research done on pain management and assessment in infants. However, we will never know how newborns and infants truly feel pain. A significant portion of children's medical care is based on estimates and assumptions rather than evidence. Because of their special status, children have been exempted from examination (Lötjönen at el. 2001).

The ability of a newborn or infant to express his or her feelings and experiences is extremely limited. Child's parents should consider what is best for the child and, based on that, consider whether participating in the study is beneficial. The child's parents or guardians give consent for the newborn's participation in the study. Making solutions is frequently complicated by parents' lack of basic knowledge about the unique characteristics of the newborn's vital functions (Lötjönen at el. 2001).

This literature review is based on previous research, not new research and thus these ethical considerations do not apply directly in this study. However, the aforementioned points should be considered.

6. RESULTS

6.1 Pain Scales

There are a variety of pain tools available for the assessment of pain in neonates and infants. In total of 19 neonatal and infant pain scales were evaluated in this literature review (Table 5, Appendix). The scales are listed alphabetically. The list includes the scale's name, intended use (acute pain, chronic pain, or postoperative pain), age validation, parameters, and scale metrics. These scales are based on the observation of physiological and behavioral changes in neonates and infants as a result of pain. The pain scales turned out to be different in terms of purpose and usability. Some of the scales are only appropriate for neonates, while others can also be used to assess infant pain. Some of the scales are only useful for assessing acute pain.

According to studies, the most used scales in assessing neonatal pain were N-PASS, PIPP, NIAPAS and NIPS. Most used scale for infants was FLACC. According to Desai et al. (2017) the N-PASS is a clinically reliable and valid tool to assess acute prolonged pain in ventilated term neonates. When compared to the other tools, the N-PASS tool performed the best on the assessment of neonatal pain (Llerena et al. 2022).

The Neonatal Infant Acute Pain Assessment Scale (NIAPAS) is a pain assessment tool that assesses both behavioral and physiological pain markers. It distinguished distress or pain situations, was highly usable, but lacked high inter-rater reliability. NIAPAS is used to assess acute pain (Llerena et al. 2022).

The Neonatal Infant Pain Scale (NIPS) is a single-dimensional scale that assesses six behavioral parameters. This scale distinguished between distress and pain and measured acute pain, but it did not assess chronic or prolonged pain (Llerena et al. 2022).

The Premature Infant Pain Profile (PIPP) is a multidimensional pain scale that takes into account both behavioral, physiological, and environmental factors. The PIPP-R (PIPP-revised) was found to be capable of measuring behavioral and physiological parameters, distinguishing distress and pain, and measuring continuous, chronic, and acute pain, but it lacked inter-rater reliability (Llerena et al. 2022).

The majority of the scales assess neonates or infant's behavior during, after, or before the painful process. Restlessness, loud crying, facial expression, restless movement of the limbs, and physiological changes, such as an increase in heart rate, are all signs of pain, according to these pain scales.

Facial expression measures appear most useful and specific in infants and neonates. Typical facial signs of pain and physical distress in infants are: eyebrows lowered and drawn together, a bulge between the eyebrows and vertical furrows on the forehead, eyes slightly closed, cheeks raised, nose broadened and bulging, deepened nasolabial fold, open and squarish mouth, tense tongue (Mazuri at el. 2013) (Picture 1) However, in toddlers these same behaviors are not necessarily indication of pain (Thrane et al. 2016).
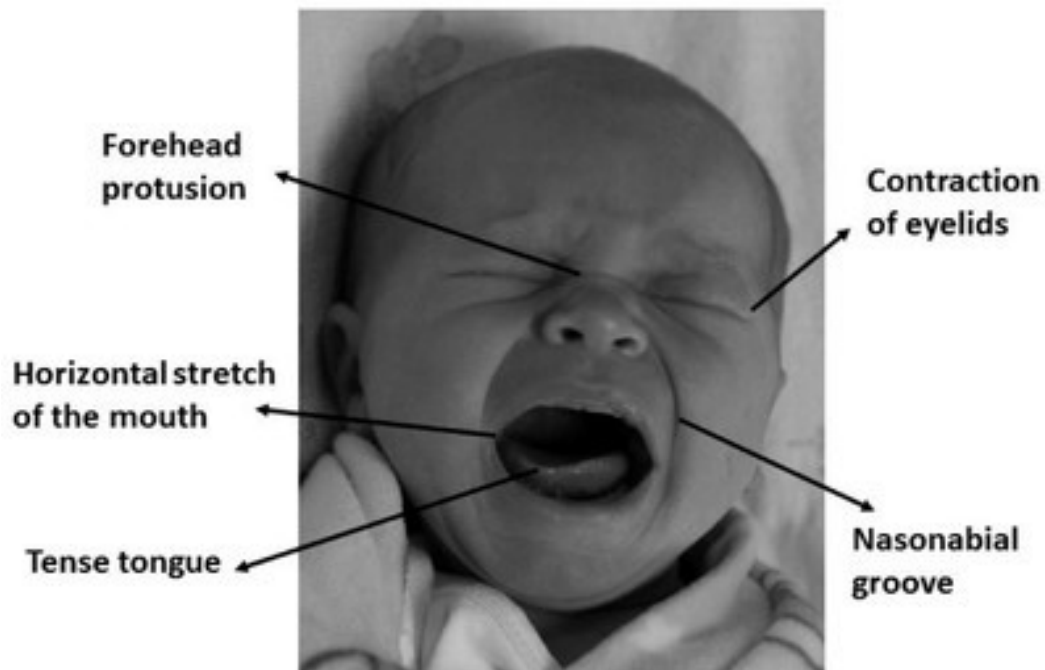
Picture 1. Facial expression of a baby (Neonatal Pain Assessment, n.d.)

Pain assessment tools should be selected with consideration of the age (full-term vs. preterm), context and type of pain (procedural, prolonged vs. postoperative) (Mencía et al. 2022). Oliveira, Gaspardo, and Linhares (2017) found that newborns delivered vaginally had higher pain and distress scores during heel puncture operations than infants delivered via elective cesarean section.

When caregivers predictably do not respond to infant's emotional distress or show discordant and negative responses, infants often organize inhibitory strategies. As a result, when parents positively reinforce inhibition, infant lowers his or her own arousal, reducing the presentation of negative emotion. Although attachment quality is not fully defined during the first year of life, it is important to consider a dyadic pattern of interaction that includes bodily contact,

emotional synchrony, and the use of temporal contingencies in response to pain expression. As a result, it may be important for professionals in the context of pain to acquire information about parental attachment and emotional states in relation to a child's pain (Failo, Giannotti and Venuti, 2019).

6.2 Non-Pharmacological Pain Management Methods

In total, 10 non-pharmacological pain management methods were evaluated and explained in this literature review. Several non-pharmacological methods for reducing pain in neonates and infants undergoing painful procedures have been demonstrated to be effective.

Neonates and infants undergo many painful procedures in early life. Pain is commonly felt during routine medical procedures such as heel sticks and vaccinations, as well as in more severe cases of postoperative pain or pain from traumatic injuries (Thrane et al. 2016).

The most commonly used method is pharmacological pain relief, which may be ineffective and has side effects, including long-term neurodevelopmental sequelae (Mangat et al. 2018).

Non-pharmacological pain relief techniques have the potential to help preterm and term infants. The majority of the studies included in this review showed that non-pharmacological pain management methods had improvement in behavioral pain responses such as facial expressions, crying duration or latency to first cry, and physiological parameters (e.g., heart rate, oxygen saturation). This suggests that non-pharmacological pain-reduction techniques are beneficial and effective (Mangat et al. 2018).

Picture 2. Facilitated Tucking (Axelin et al. 2010)

Non-pharmacological analgesia seeks to improve patient comfort and reduce stress associated with diagnostic or therapeutic procedures. It should not be used as a substitute for pharmacological treatment, but rather in conjunction with it. Although the mechanisms of action are not fully understood, such interventions are likely to reduce the sensitivity of the nociceptive system. Some of these methods release endogenous endorphins, which activate opioid-enhancing neuropeptides and cause pain distraction (Mencía et al. 2022).

6.2.1 Swaddling

Swaddling is one of the alternatives to analgesic that was previously overlooked but is now gaining prominence. It is a method for reducing pain in premature and term newborns, promoting central body system development, reducing physiological behaviors and infant crying, and improving infant sleep quality (Talebi et al. 2022). Infants' vital signs are shown to recover more quickly when swaddled during a painful procedure (Thrane et al. 2016).

According to studies, swaddling alone or in combination with a non-nutritive sucking has the potential to reduce pain in preterm and term infants (Mangat et al. 2018).

Swaddling the neonate is performed as follows: the baby is laid on a triangular cloth on a flat surface, naked except for a diaper. First, one side of the sheet is folded up over the baby, then the bottom, and finally the other side. The baby is able to move the pelvic joints effortlessly in this method, known as Frog Flexible, and the arms are bent and placed along the line under the chin, similar to the baby's position in the mother's uterine (Talebi et al. 2022).

The effectiveness of swaddling with older infants is less well understood. Swaddling or holding would most likely be most comforting for infants who are used to these conditions in their home and family environment. Furthermore, swaddling, tucking, and holding are most soothing when done by a parent or a trusted and familiar caregiver (Boles, 2017).

6.2.2 Skin-to-Skin Treatment

Skin-to-skin contact or in other words, a Kangaroo treatment, is a treatment where the infant is placed naked on the mother's or other caregiver's bare chest. Skin-to-skin contact with a parent for 30 minutes before and during the painful procedure has been shown to reduce infant pain and distress (Thrane et al. 2016).

6.2.3 Sucrose/Glucose Solutions

The most well-known non-pharmacological intervention, oral sucrose, is widely used in clinics to relieve pain in babies (Talebi et al. 2022). Oral sucrose solution can activate the body's own natural opioid system to provide pain relief in infants under three months of age. This happens quickly, as soon as 10 seconds after ingestion.
Furthermore, because oral sucrose is a simple mixture of sucrose and water, it is a relatively safe intervention that is widely commercially available (Boles, 2021).

According to studies, sucrose in combination with other non-pharmacological interventions is more effective than sucrose alone in relieving pain (Talebi et al. 2022).
Serotonin and endorphin are released as a result of the sweet taste of sucrose and the oral-tactile stimulation of non-nutritive sucking, producing an analgesic effect (García-Valdivieso et al. 2023).

The main disadvantage of this method is that the effects of oral sucrose are typically brief, lasting no more than five to ten minutes. Oral sucrose, on the other hand, can be an appropriate intervention for brief procedural pain, such as heel sticks or IV placements (Boles, 2017).

6.2.4 Breastfeeding

Breastfeeding increases baby's cortical activation, which is a multisensory experience that reduces pain perception (Thrane et al. 2016). Breastfeeding for more than 2 minutes before a painful procedure is an effective non-pharmacological pain management technique. Breastfeeding infants during painful procedures resulted in statistically lower heart rates and less total crying time when compared to swaddling, holding, and pacifier interventions (Thrane et al. 2016).

Direct breast-feeding was deemed the most efficient non-pharmacological pain management method when compared to all others and was even preferred over glucose/sucrose administration in full-term infants (Koukou et al. 2022).

Direct breast feeding refers to suckling on the breast regardless of milk delivery, whereas expressed breast feeding refers to milk extraction and storage for later delivery with a bottle. Since it has been compared to all other methods and found to be more effective, direct breastfeeding is the unequivocal best practice in non-pharmacological pain management methods.

It performed far better in pain management than swaddling, maternal holding or skin-to-skin care, topical anesthetics and cooling sprays, non-nutritive sucking, and music (Koukou et al. 2022).

Neonates and infants require contact with their mothers as well as proper nutrition for their future development. According to studies, even the smell of breast milk reduced pain scores by 50% during venipuncture and decreased the percentage of time spent crying (Mangat et al. 2018).

Although these non-pharmacologic pain treatment strategies show promise on their own, recent research suggests that combining techniques such as breastfeeding, pacifiers, swaddling, and rocking may be more effective than using one technique alone (Thrane et al. 2016).

6.2.5 Nutritive and Non-Nutritive Sucking

Non-nutritive sucking is defined as the use of a pacifier or the sucking of the finger or hand. Non-nutritive sucking is regarded as a safe and effective form of pain management during painful neonatal treatments. However, it is more effective when combined with glucose sucking (Koukou et al. 2022).

The pain relief effect of sucrose administration was reported to be short-lived, approximately 5 minutes (Koukou et al. 2022).

A case-control study compared infants who sucked on an adult's little finger with and without analgesia during venipuncture. Overall results with analgesia and non-nutritive sucking were comparable, indicating a similar efficacy in analgesia. While non-nutritive sucking has some effect on pain relief, more research is needed to investigate different approaches to nonnutritive sucking (e.g., use of finger or pacifier) or combination with glucose (Mangat et al. 2018).

6.2.6 Therapeutic Massage and Touching

Massage has the potential to saturate the senses and reduce the pain signals sent to the central nervous system. Upper limb massage significantly reduced pain responses during venipuncture in preterm and term infants, according to studies. In addition, studies on infants found a 60% reduction in pain and a significant reduction in heart rate after venipuncture. These studies suggest that a gentle massage prior to a heel prick is safe and can reduce pain (Mangat et al. 2018).

6.2.7 Musical Therapy and White Noise

Musical therapy refers to a pain management method in which music is played for the baby. The music can be a calm melody, the humming of the mother or another caregiver, or so-called white noise. A case study with five infants in a cardiac intensive care unit using musical therapy revealed a decreased average heart rate in 4/5 infants in 66% of the sessions. Furthermore, some of the infants' respiratory rate and blood pressure were reduced, while their oxygen saturation increased. Furthermore, Olischar et al. found that newborn infants exposed to music had more mature sleep-wake cycles than controls, indicating that music has a calming effect on quiet sleep. These findings suggest that musical therapy has a calming effect on physiological parameters and sleep, which could translate to a reduced pain response. However, the evidence that is currently available is contradictory (Mangat et al. 2018).

6.2.8 Acupuncture and Non-Invasive Acupuncture

Acupuncture pain management is well-known with spinal pain pathways being recruited for pain signaling attenuation in needle acupuncture. Acupuncture stimulates various afferent fibers, and these signals primarily ascend to the brain via the spinal ventrolateral funiculus (Mangat et al. 2018).

Acupuncture effects include autonomic re-regulation and regulatory changes in functional connectivity centrally, mitigating the effects of physical and emotional trauma in the individual (Mangat et al. 2018).

Non-invasive acupuncture modalities such as low-level laser and magnet application are more autonomically driven to gain direct access to central pain control centers. Acupuncture's central re-regulatory capacity has been confirmed by neuroimaging studies. Several studies have been conducted to investigate the effects of non-invasive acupuncture on neonatal pain. To reduce infant pain during heel pricks, Chen et al. randomly assigned 30 term infants to either auricular non-invasive magnetic acupuncture or a placebo. The study found that magnetic acupuncture reduced pain by 30% in infants. Acupuncture with a needle or laser, on the other hand, would necessitate training and experience with the specific acupuncture points, and lasers may not be readily available (Mangat et al. 2018).

Future research should distinguish between the optimal points and duration of treatment (e.g., duration of acupuncture placement) and elucidate the long-term implications of various acupuncture methods (Mangat et al. 2018).

6.2.9 Attention Modification

Distraction is a cognitive technique used to divert an infant's attention away from a painful stimulus. This can be accomplished through the use of passive video or active engagement with toys or sensory items, for example (Boles, 2017).

Although more research is needed to confirm these findings, current literature suggests that video-based distraction can be an effective way to relieve pain in older infants. Distraction is a difficult phenomenon to investigate because what is distracting to one child may not be distracting to another. To increase the likelihood that distraction will successfully manage an infant's pain, it is critical to provide a diverse range of age-appropriate toys and sensory items (Boles, 2017).

Correspondingly, in infants, administering injections quickly or working from least painful to most painful is associated with reduced injection pain. These strategies, like distraction, alter the infant's ability to fully attend to the pain stimulus (Boles, 2017).

6.2.10 Facilitated Tucking

Facilitated tucking is similar to swaddling method. It is a method of holding that keeps the baby's arms, legs, and head tucked into a "folded" position. (Picture 2) The baby may or may not be clothed, and a blanket or wrap may or may not be used. In each of these cases, the baby is theoretically comforted by gentle, contained pressure similar to that experienced in a gentle embrace or while in the womb. These interventions have been shown to reduce pain reactivity and increase pain regulation in neonates and preterm infants (Boles, 2017).

Axelin et al. randomly assigned 20 preterm infants to either a control or a facilitated tucking flexed position by their parents. Overall, facilitated tucking reduced pain by 40% and significantly reduced crying time when compared to no tucking (Mangat at el. 2018).

7. DISCUSSION

In the last decades, it has been reliably established that babies feel pain. It was previously assumed that infants and neonatals could not feel pain since the nervous system's myelination process had not yet completed. There is now sufficient evidence for neonatal and infant pain because the neurophysiological and anatomical components required for the transmission of the pain stimulus develop before 24 weeks of gestation (García-Valdivieso et al. 2023). The treatment and evaluation of pain in babies is constantly being researched, and new studies are being conducted all the time.

There is currently enough information on the perception of pain in babies; however, this treatment at this critical developmental stage requires a better approach.

The Declaration of the Rights of the Child, adopted by the United Nations General Assembly in 1959, defines children's rights to protection, education, health care, shelter, and adequate nutrition. The child has the right to the best possible health care, as well as services for illness treatment and rehabilitation (Unicef, n.d.).

Pain assessment is difficult, especially in neonates and infants. Babies are unable to express their emotions and needs nor they do not understand pain in terms, its location or intensity. Attachment processes may also influence how infants experience and express pain. The better understood the neonates and infant's unique way of expressing pain, the better it can be alleviated. The most common painful procedure for infants is blood sampling. Pain management is critical in preventing negative physical and psychological effects.

Nurse's work is distinguished by their ability to recognize, connect, specify, and interpret the patient's condition and experiences. Recognizing the patient's pain is required before providing

pain management. This process includes identifying the patient's pain, understanding the the baby's age-appropriate development, determining pain management goals, selecting and implementing methods of assistance, and continuous evaluation.

Non-pharmacological pain management methods are safe and have no side effects when used to manage pain. Parents can also use non-pharmacological pain relief after guidance. Menca et al. (2022) advocate multimodal analgesia with non-pharmacological and pharmacological interventions for pain treatment, as well as the development of pharmacotherapeutic protocols for analgesia that are tailored to the patient's acute or chronic pain, type and intensity of pain, and age. In certain situations, such as after surgery, patient-controlled analgesia is an adequate alternative for adolescents and older children. Patients experiencing severe or persistent pain should seek treatment from specialized pain services.

Non-pharmacological interventions such as non-nutritive sucking and sucrose used concurrently in pain relief during painful procedures were found to be more effective than using each of those interventions alone. In general, based on the findings, it can be concluded that pain in neonates can be reduced prior to blood sampling by using a combined nonpharmacological intervention (Talebi et al. 2022).

Non-nutritive and/or glucose suckling are well-studied and recognized strategies for managing minor pain. Breastfeeding, especially direct breastfeeding, has been demonstrated to be the most effective non-pharmacological pain management method when compared to all other methods (Koukou et al. 2022). Both the infant and the mother benefit from breastfeeding. It would be beneficial to emphasize breastfeeding's significance in health care, such as in neuvola. Nonetheless, additional research is required to determine the best non-pharmacological intervention, duration of the intervention, and dose response for optimal pain relief in newborn infants (Mangat et al. 2018).

Untreated pain in infants and young children can lead to hypersensitivity to pain and chronic pain in adolescents and adults. Ongoing research into non-pharmacological pain treatment is an important part of the national agenda (Thrane et al. 2016).

Infancy and childhood pain experiences may result in long-term changes in physiological and behavioral responses to pain. Children who experienced traumatic pain were 1.5 times more

likely to develop chronic pain as adults, while children who experienced frequent headaches were 2.2 times more likely to develop frequent headaches as adults (Thrane et al. 2016).

Katharine Kolcaba's Theory of Comfort was chosen as the theoretical framework for this review. Katharine Kolcaba developed the Theory of Comfort after conducting a concept analysis of comfort literature from several disciplines, including nursing, medicine, psychology, psychiatry and ergonomics. Following the introduction of the three types of comfort and four contexts of holistic human experience, a taxonomic structure was developed to guide the assessment, measurement, and evaluation of patient comfort. Kolcaba defines comfort as the result of holistic nursing art (Petiprin, 2020). According to Kolcaba, good patient care includes proper pain assessment, management and recording. This perspective supports the topic and findings of this literature review.

To identify pain in babies, numerous pain scales have been developed. However, the baby's pain is frequently untreated. The pain of newborns should be given special consideration because it can have long-term consequences. Identifying pain in small children necessitates additional research, and more precise measures will be required in the future (Mangat et al. 2018).

Composing this review has expanded the author's thoughts on the subject and deepened the author's interest in better care and assessment of baby's pain in author's own work. Nursing requires a broad and diverse knowledge base as well as practical abilities.

Sometimes babies cries for hunger, tiredness or distress, sometimes for the attention. There is not always an obvious reason for crying. A baby's cry should always be answered. Nurse's task is to identify and assess the baby's pain and treat the pain appropriately. It's critical to take the baby's age and developmental stage into account while evaluating a baby's pain. It takes experience to gain and apply this expertise in work.

8. CONCLUSION

During hospital stays, newborn infants endure a number of painful but necessary operations. It has a significant impact on both short- and long-term outcomes, how much pain the infants experience throughout these procedures and how they are offered pain relief. To avoid the longterm impact of insufficient pain management, current treatment approaches must be critically examined and continually improved. Non-pharmacological analgesia has limited empirical support, which calls for more research. Although the majority seem to be safe and comparatively efficient, it is unknown how they will affect the infants' long-term prospects, particularly when combined with pharmacological analgesia. Studies have shown that nonpharmacological pain management methods are adequate for managing minor pain, but analgesic treatment is required for managing more severe pain.

Since new data and study findings are continually being produced in this field, it will be crucial for healthcare workers to embrace new pain management and observation techniques going forward to ensure the best possible care for patients.

Thus, we can say that despite extensive research on pain assessment and pain management in neonates and infants over the past few decades, we may never fully understand how babies truly experience and perceive pain. Healthcare professionals must have the ability to identify and manage infant discomfort to provide good, holistic care, and ongoing research is required in this area.

8.1 Strengths and Limitations

This chapter discusses the strengths and limitations of this review. The topic of this review has been researched relatively extensively. Despite this, the data search revealed that only PubMed provided the articles needed for this review. When searching from other databases, such as EBSCO and Sage Journals, search words had to be changed to find suitable articles for this literature review. This differs from the search criteria for qualitative research. In this review, other reviews have also been used as sources, which deviates from the usual line.

According to the initial plan, studies that would have been conducted in the Nordic countries were to be selected for this literature review. However, in the data search, it was revealed that

such studies were not found in accordance with the desired exclusive and inclusive criteria. For this reason, studies that were conducted elsewhere than in the Nordic countries were selected for this review.

In the articles of this review, 19 different pain scales were found, which were summarized into Table 5. This table can be found in the appendix. However, because not enough information was discovered on all of the scales, some of the scales are presented with insufficient information.

Furthermore, all pain scales and non-pharmacological pain management method approaches included in the results do not include research findings, but rather a narrative explanation of how to utilize that meter or pain management strategy. The absence of research outcomes is attributable to the articles chosen for review having incomplete research results.

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APPENDIX

Abbreviation and full name of the scale	Age validation		Type of pain			Scale metric	Parameters
	Neonatal	Infant	Acute	Postoperative	Prolonged		

Scale						Score	Indicators
ALPS-neo (Astrid Lindgren and Lund children's hospital's pain and stress assessment scale for preterm and sick newborn infants) (7,13)	X		X				Facial expression, breathing pattern, tone, hand/foot activity, and level of activity
BPSN (Bernese pain scale for neonates) (7,10)	X		X			0-27	Respiratory pattern, heart rate, oxygen saturation, alertness, duration of cry, time to calm, skin color, brow bulge with eye squeeze and posture
CHEOPS (Children's hospital of Eastern Ontario Pain Scale) (15)		X	X				Crying, facial expression, child verbalizations, torso, legs
CHIPPS (Children and infants postoperative pain scale) (7,15)	X	X		X			Crying, facial expression, posture of the trunk, posture of the legs and motor restlessness
COMFORT (2)	X	X		X		1-5	

Scale						Range	Description
COMFORTneo (10,13)	X				X	8-40	Respiratory response, blood pressure, heart rate, alertness, agitation, physical movements, muscle tone and facial tension
COVERS (Crying, Oxygen requirement, vital signs, expression, resting, and signaling distress) (7)	X	X	X				Crying, oxygen requirement, vital signs, expression, resting, and signaling distress
CRIES (Cries, requires oxygen, increased vital signs, expression, sleeplessness) (10,13)	X	X	X	X		0-10	Blood pressure, heart rate, oxygen saturation,cry, expression and sleeplessness
EDIN (échelle de la douleur inconfort noveau-né) (10,13)	X		X		X	0-15	Facial activity, body movements, quality of sleep, quality of contact with nurses and consolability
FLACC (Face, Legs, Activity, Cry, and Consolability) (10,13)	X	X	X			0-10	Facial expression, Legs, Activity, Crying, and Consolability

NFCS (Neonatal facial coding system)

(10,13) | X | | X | | | 0-10 | Brow bulge, eye squeeze, nasolabial furrow, open lips, stretched mouth, lip purse, taut tongue and chin quiver |
| **NIAPAS** (Neonatal Infant Acute Pain Assessment Scale) (7) | X | | X | | | | |
| **NIPE** (Newborn infant parasympathetic evaluation)

(7) | X | | X | | X | | Short term heart rate variability surrounding painful procedures |
| **NIPS** (Neonatal infant pain scale)

(6,10,13) | X | X | X | | | 0-7 | Breathing pattern, facial expression, cry, arms, legs and alertness |
| **PAT** (Pain Assessment Tool) (7) | X | | X | | | | |
| **N-PASS** (Neonatal pain, agitation and sedation scale)

(3,7,10,13) | X | X | X | X | X | 0-10 | Heart rate, respiratory rate, blood pressure, oxygen saturation, crying or irritability, behavior state, facial expression, extremities or tone |

PIPP (Premature Infant Pain Profile) (3,7)	X		X		X	0-21	Heart rate, oxygen saturation, brow bulge, eye squeeze and nasolabial furrow
PIPP-R (Premature Infant Pain Profilerevised) (7,10,13)	X		X	X	X	0-21	Heart rate, oxygen saturation, alertness, brow bulge, eye squeeze and nasolabial furrow
PPP (Pediatric Pain Profile) (2)		X				0-60	

Table 5. Neonatal and infant pain scale comparison