Research in Health Science
ISSN 2470-6205 (Print) ISSN 2470-6213 (Online)
Vol. 10, No. 3, 2025
www.scholink.org/ojs/index.php/rhs

Original Paper

Bibliometric Analysis of Neonatal Pain Research over the Past 20 Years Based on CiteSpace

Meixiang Wang

School of International Nursing, Hainan Vocational University of Science and Technology, Haikou, Hainan, 571137, China

Received: September 28, 2025 Accepted: October 21, 2025 Online Published: October 29, 2025

doi:10.22158/rhs.v10n3p140 URL: http://dx.doi.org/10.22158/rhs.v10n3p140

Abstract

Objective: *This study aims to explore the development status, research hotspots, and frontiers in the field of neonatal pain research in China over the past two decades.* ***Methods:*** *Literature on neonatal pain research, published from October 2001 to October 2021 in the China National Knowledge Infrastructure (CNKI) database, was selected for analysis. CiteSpace and Excel software were used to analyze annual publication volumes, journal, keywords, and research hotspots, and to generate visual maps.* ***Results:*** *A total of 677 articles were included. The overall annual publication volume showed an increasing trend, the journals publishing literature are mainly nursing journals. The main research hotspots included the assessment and management of procedural pain in neonates (such as intravenous puncture and heel prick), with non-nutritive sucking, touch therapy, and kangaroo care being key interventions. The current frontier of research is focused on pain response assessment in neonatal intensive care units (NICUs), along with pain management measures such as music therapy and kangaroo care.* ***Conclusion:*** *Neonatal pain research in China has reached a mature stage. However, further attention should be given to neonatal pain, and efforts should be made to enhance training for healthcare professionals, as well as to innovate neonatal pain management theories and technologies to promote the development of neonatal pain research.*

Keywords

Neonatal, Pain, Bibliometric analysis, CiteSpace

1. Introduction

According to the latest definition of pain by the International Association for the Study of Pain, pain is an unpleasant emotional experience that occurs when the body is injured or potentially harmed (Raja, Carr, Cohen, et al., 2020). Research has shown that neonates perceive pain more intensely and

persistently than adults, and as they grow, they may become more sensitive to pain with lower pain tolerance, potentially affecting brain and neurological development (Barr, Opendak, Perry, et al., 2023). However, neonatal pain is often overlooked in clinical practice. Pain is currently classified as the fifth vital sign, which is one of the most important issues that need to be addressed for pediatric patients. Therefore, the assessment and management of neonatal pain have become critical areas of research. Timely and effective pain management interventions can prevent or alleviate the adverse effects of pain on both the body and psyche, promoting neonatal recovery. Bibliometrics, which relies on statistical and numerical methods for literature analysis, can reveal research hotspots and development trends within a field. CiteSpace software, which allows for visual analysis, can be used to map the evolution of research areas (Huang, Cai, & Xiang, 2023). This study, based on the CNKI database, uses CiteSpace to visualize and analyze literature on neonatal pain research from 2001 onwards, offering insights into the current state of research, emerging trends, and future directions, providing a reference for clinical studies on neonatal pain management.

2. Materials and Methods

2.1 Data Sources

The CNKI database was used as the search platform. The search terms were "neonate OR term infant OR preterm infant" AND "pain." The search was conducted for literature published from October 1, 2001, to October 1, 2021. The search results were filtered to include only academic journal articles, yielding 3903 papers. After reviewing titles, abstracts, and other information, 677 valid articles were included in the final analysis.

2.2 Literature Inclusion and Exclusion Criteria

Inclusion Criteria: ① The research topic must be neonatal pain; ② The subjects must be newborns, full-term infants, or preterm infants, with pain assessment, pain intervention, and pain management as outcome indicators;

Exclusion Criteria: Literature summaries and full texts will be screened to exclude non-relevant materials such as theses, notices, patents, conference papers, and announcements.

2.3 Research Methodology

Data collection and knowledge map generation were performed using Excel and CiteSpace 5.6.R3 for statistical analysis and visualization. The following steps were undertaken:①Exported bibliographic data from CNKI in Refworks text format, including document titles, authors, journals, institutions, abstracts, keywords, years, and sources. ②Imported the data into CiteSpace 5.6.R3 for analysis, focusing on annual publication volumes, journals, keywords, and research hotspots, and generated visual maps.

3. Results

3.1 Annual Publication Volume

A total of 677 articles were included, with an average of 33.9 publications per year. Publications in 2001 and 2003 were sparse, with only 1 publication each. From 2004 to 2013, the average annual publication volume was 29.2. Between 2015 and 2017, this increased to 52 publications per year. In 2018, the publication volume began to decline to 46 publications, with an expected total of 46 for 2021. Detailed trends are shown in Figure 1.

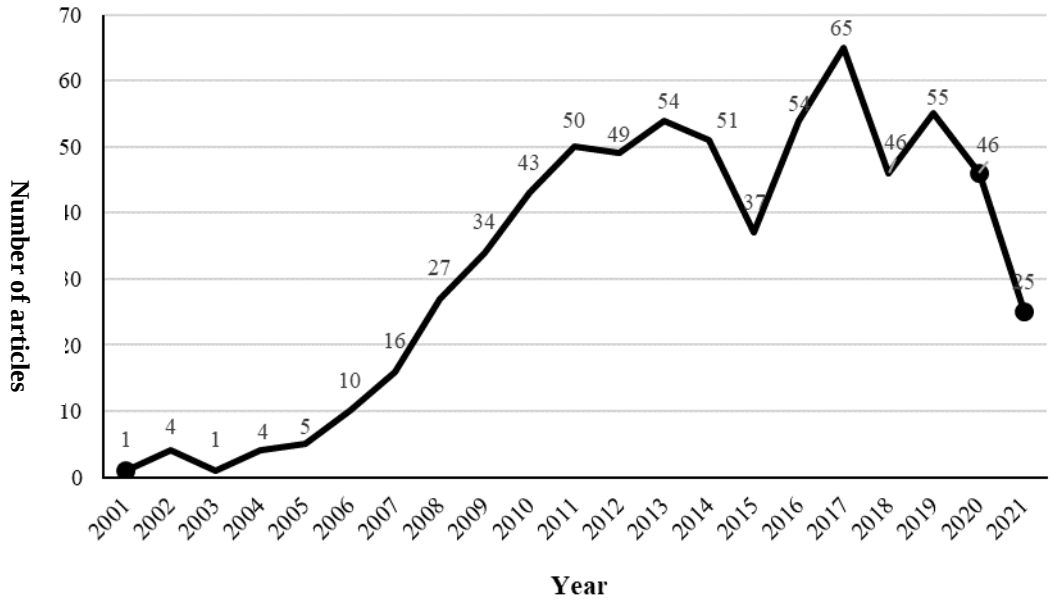

Figure 1. Annual Publication Volume in Neonatal Pain Research from 2001 to 2021

3.2 Journal Distribution

A total of 677 papers included in this study were published in 536 different journals. In terms of academic disciplines, the included literature covers a variety of fields, including nursing, hospital management, clinical medicine, and information technology. Among these, nursing journals account for 10 journals (50%), with the top 8 journals being nursing-related. The top three journals are Contemporary Nurse, Nursing Research, and Nursing Practice and Research, as detailed in Table 1.

Table 1. Publication Volume of Neonatal Pain Nursing Articles in China from 2001 to 2021

(Top 8 Ranked Journals) (n = 677)

Ranking	Journal Name	Number of Publications	Percentage (%)
1	Contemporary Nurse	29	4.3%
2	Nursing Research	23	4%
3	Nursing Practice and Research	21	3.6%

4	Chinese Journal of Practical Nursing	17	3%
5	General Nursing	16	2.8%
6	Journal of Nursing Science	13	2.2%
7	Chinese Nursing Journal	9	1.6%
8	Chinese Journal of Nursing Management	9	1.6%

3.3 High-Frequency Keyword Co-occurrence

The frequency of keyword occurrence is positively correlated with research intensity, while node centrality is positively correlated with the linking effect within its keyword network. Specifically, the higher the node's betweenness centrality, the more keywords it is associated with, and the stronger its mediating function within the network diagram. The co-occurrence network contained 284 nodes and 345 connections, with a connection density of 0.0086. The top ten keywords and their centrality are shown in Table 2. From Table 2, the major research hotspots from 2001 to 2021 were non-nutritive sucking, heel prick, nursing interventions, kangaroo care, intravenous puncture, procedural pain, glucose, pain assessment, touch therapy, and pain nursing.

Table 2. Top 10 Keywords in Neonatal Pain Research (2001-2021)

Rank	Frequency	Centrality	Keyword
1	80	0.27	Non-nutritive sucking
2	50	0.05	Heel prick
3	50	0.01	Nursing intervention
4	47	0.21	Kangaroo care
5	28	0.07	Intravenous puncture
6	26	0.21	Procedural pain
7	17	0.26	Glucose
8	15	0.02	Pain assessment
9	14	0.05	Touch therapy
10	13	0.35	Pain nursing

3.4 Keyword Burst Detection

Keywords obtained through burst detection are referred to as "burst words" which represent the forefront of research in a specific field. These keywords show the start and end years of high citation periods and reflect the active range of these keywords within the research community. The burst keywords (Table 3) indicate that the current research frontier is pain response assessment in neonatal intensive care units (NICU), with pain care measures such as music therapy and kangaroo care.

Table 3. Key Words of Mutation in Neonatal Pain Research in China from 2011 to 2021

Keywords	Strength	Begin	End	2011 - 2021
Meta-analysis	1.5439	2011	2014	
Neonatal disease screening	2.0665	2011	2016	
Positioning	1.6312	2013	2016	
Nesting care	1.3027	2015	2019	
Vital signs	1.3067	2015	2018	
Music therapy	1.5852	2015	2021	
Pain response	2.2191	2016	2021	
Pain care	2.7390	2016	2021	
Pain assessment	3.6153	2013	2019	
Arterial blood sampling	2.3032	2017	2019	
Kangaroo care	8.9423	2017	2021	
Intensive care unit	2.3942	2017	2021	

4. Discussion

4.1 Overall Trend of Annual Publication Volume

As shown in Figure 1, the total publication volume from 2001 to 2003 was only 6 articles, indicating that research on neonatal pain in China was in its early stages, with limited research output and slow development. From 2004 to 2013, 292 papers were published, showing a rapid and steady increase in publications as the exploration of neonatal pain by healthcare providers deepened. This marks the beginning of a period of rapid growth in neonatal pain research. From 2014 to 2017, the publication volume sharply increased, reaching 156 articles, marking the peak of this rapid development period. From 2018 to 2021, the publication volume began to decline and stabilize, indicating that neonatal pain research in China has entered a period of maturity. This is closely linked to national policies and societal development. For instance, in 2006, the International Association for the Study of Pain designated October 17th as International Children's Pain Day, with the theme focused on controlling pain in children. With the development of the national economy, improvements in living standards and quality of life, the opening of two-child and three-child policies, there has been increasing attention to neonatal psychological and mental development, with parents placing more emphasis on the harmonious physical and mental development of their newborns. As a result, neonatal pain research has rapidly advanced.

4.2 Limited Number of Specialized Journals on Neonatal Pain

An analysis of the distribution of literature and journals reveals that the 677 included studies were published in 536 different journals. Among these, journals in the field of nursing were the most frequent, indicating that the nursing community has already shown significant interest in this area.

However, a review of the overall volume of publications suggests that the journals in which these studies were published are quite diverse and span multiple disciplines. There is a lack of specialized, authoritative journals dedicated to pain management. Compared to the total number of published articles, both the quantity and variety of such publications remain insufficient. This highlights the need for the establishment of specialized neonatal pain journals.

4.3 Current Status of Neonatal Pain Research

In the late 1980s, analgesics began to be used for the postoperative recovery of premature infants, marking the beginning of a new understanding of neonatal pain. In 1995, the Joint Commission on Accreditation of Healthcare Organizations (JCAHO) in the United States officially recognized pain as the fifth vital sign, following body temperature, pulse, respiration, and blood pressure, and mandated pain assessment for all patients. In contrast, research on neonatal pain management in China began relatively late, and neonatal pain management guidelines have yet to be established, resulting in the lack of timely and effective management of neonatal pain.

Numerous clinical studies have found that neonatal pain is primarily caused by painful medical procedures, such as intravenous punctures, arterial blood sampling, heel pricks, venous and arterial catheterization, intubation, and lumbar puncture. A study by Wang Jingya et al. (2019) on 120 cases in neonatal intensive care units (NICUs) revealed that these 120 infants underwent a total of 8,200 painful procedures during their hospitalization, with a median of 20 procedures, and a median of 5 procedures per day. Among these, 82.6% of procedures could cause severe pain in neonates. Although the publication volume suggests that Chinese scholars are gradually paying more attention to neonatal pain management, neonatal pain remains a widespread issue, and there is still a severe lack of clinical management, particularly in the knowledge of pain recognition and assessment by medical staff, which leads to inadequate pain intervention.

4.4 Development Trends in Neonatal Pain Research

4.4.1 Exploring the Development of Neonatal Pain Assessment Tools Suitable for China

Currently, the assessment of neonatal pain in China mainly relies on scales. Commonly used scales include the Neonatal Infant Pain Scale (NIPS), which is applicable for both full-term and preterm infants in operative and postoperative pain assessment; the Neonatal Pain, Agitation, and Sedation Scale (NPASS), suitable for evaluating postoperative pain or persistent pain in both full-term and preterm infants on mechanical ventilation; the Neonatal Acute Pain Assessment Scale (NIAPAS), designed for use in Neonatal Intensive Care Units (NICU) for pain assessment in neonates; the Premature Infant Pain Profile (PIPP), which is used for preterm infants in operational and postoperative pain assessment; the Neonatal Facial Coding System (NFCS), which is more sensitive than PIPP in evaluating acute procedural pain in full-term infants; the Neonatal Pain and Discomfort Scale (EDIN), used to assess chronic or persistent pain in both preterm and full-term infants; and the CRIES Scale, which is used to evaluate postoperative pain in neonates. Among the aforementioned pain assessment tools, only the N-PASS and NIAPAS scales have undergone standardized Chinese translation and

validation of their reliability and validity. The remaining scales have not been subjected to a standardized Chinese translation process, which poses significant challenges for clinical nurses when selecting appropriate neonatal pain assessment tools (Benbrook, Manworren, Zuravel, et al., 2023). Therefore, researchers should continue to explore the development of neonatal pain assessment tools suitable for China by standardizing the translation of foreign scales and combining the strengths of existing tools to promote the development of neonatal pain assessment in the country.

4.4.2 Exploring Non-Pharmacological Pain Management Interventions for Neonates

Regarding the management of neonatal pain, scholars have proposed a pain management ladder: for severe pain, such as perioperative pain, opioids like fentanyl and morphine are recommended; for moderate pain, such as during retinopathy of prematurity screening or venous/arterial puncture, local anesthetics are used; for mild pain, such as during fingerstick and heelstick blood sampling, environmental measures and non-pharmacological interventions are primarily employed. Non-pharmacological treatments offer advantages such as simplicity, ease of implementation, and high safety, making them more practical for clinical nursing. As a result, neonatal pain care research primarily focuses on non-pharmacological nursing interventions.

Current research on neonatal pain care is particularly focused on music therapy and kangaroo care. Non-nutritive sucking involves placing a pacifier in the infant's mouth before invasive procedures to encourage sucking, which has been shown to increase pain thresholds, release serotonin, and alleviate pain. Kangaroo care, first proposed by Dr. Rey and Martinelli in 1983, involves placing a preterm infant in an upright position on the chest of the mother (or father), providing warmth and comfort through familiar heartbeats. Studies have shown that kangaroo care helps maintain physiological stability and alleviates pain, acting as an effective pain reliever (Wang, Zhang, Ni, et al., 2022). Music therapy refers to the practice of playing music for 10 minutes before and after a procedure, with specific content including piano pieces, lullabies, simulated uterine sounds, maternal heartbeats, and other types of music. Research results indicate that music therapy can reduce heart rate, respiratory fluctuations, and effectively alleviate pain. Other neonatal pain care interventions include the use of sweeteners such as glucose and sucrose, breastfeeding, white noise, nesting care, positional support, comfort care, developmental care, olfactory soothing, and hugging comfort. Researchers have been continuously exploring more convenient, practical, low-cost, and effective neonatal pain care interventions. This remains an important area for further research, with opportunities to combine various nursing interventions or adopt pain management practices from other countries.

4.4.3 Strengthening Training for Clinical Healthcare Professionals on Pain Knowledge

With the shift in medical models and the advocacy of holistic nursing concepts, neonatal pain research has begun to evolve towards a more comprehensive, integrated, humanistic, and individualized approach. Although clinical healthcare workers in China have made improvements in pain management knowledge and attitudes, these are still at a relatively low level. A study by Zhong Chunxia et al. (2016) showed that 50% of nurses have not recognized that hospitalized neonates face various procedural

pains. Research by Qiu Lvqian et al. (2015) indicated that 33.69–47.11% of neonatal nurses believe they understand neonatal pain intervention methods, but only 10.42–36% actually implement these interventions. Most neonatal pain arises from repeated nursing procedures, and nurses are the primary caregivers for pain management. Therefore, enhancing nurses knowledge of neonatal pain is crucial. Regular training in neonatal pain management should be conducted, with effect tracking and integration into quality care evaluation metrics.

5. Conclusion

In summary, recent literature on neonatal pain management quality in China has shown a fluctuating yet steady upward trend. However, the number of specialized journals dedicated to neonatal pain management remains limited. Therefore, it is crucial to further increase the attention given to neonatal pain in China, enhance the training of healthcare professionals on neonatal pain knowledge, with a particular focus on pain management for neonates in intensive care units, and foster the innovation of neonatal pain theories and techniques to advance the field. Additionally, the formulation of national guidelines for neonatal pain management should be prioritized.

References

Barr, G. A., Opendak, M., Perry, R. E., et al. (2020). Infant pain vs. pain with parental suppression: Immediate and enduring impact on brain, pain and affect. *PLoS One*, *18*(11), e290871. https://doi.org/10.1371/journal.pone.0290871

Benbrook, K., Manworren, R., Zuravel, R., et al. (2023). Agreement of the Neonatal Pain, Agitation, and Sedation Scale (N-PASS) With NICU Nurses' Assessments. *Adv Neonatal Care*, *23*(2), 173-181. https://doi.org/10.1097/ANC.0000000000000968

Huang, H., Cai, G., & Xiang, H. (2023). A bibliometric analysis of chemotherapy and pain in pediatric patients over the last decade. *Front Pediatr*, *11*, 1269736. https://doi.org/10.3389/fped.2023.1269736

Qiu Luqin. (2015). Application of 'Medical-Nursing Collaboration' Pain Management in Headache Control of Patients with Traumatic Subarachnoid Hemorrhage. *Qilu Journal of Nursing*, *21*(24), 32-34.

Raja, S. N., Carr D. B., Cohen, M., et al. (2020). The revised International Association for the Study of Pain definition of pain: concepts, challenges, and compromises. *Pain*, *161*(9), 1976-1982. https://doi.org/10.1097/j.pain.0000000000001939

Wang, F., Zhang, Q., Ni, Z. H., et al. (2022). Effects of kangaroo care on pain relief in premature infants during painful procedures: A meta-analysis. *J Spec Pediatr Nurs*, *27*(4), e12390. https://doi.org/10.1111/jspn.12390

Wang Yajing, Li Yang, Sun Jing, et al. (2019). Survey on the Current Status of Operative Pain in Neonatal Intensive Care Unit Patients. *Journal of Nursing*, *34*(11), 20-23.

Zhong Chunxia, Liao Xiaomei, Liu Fuliangzhu, et al. (2016). Effectiveness Analysis of Pain Knowledge Training for Neonatal Intensive Care Unit Nurses. *Journal of Nursing of the PLA*, *33*(05), 74-76.