

Hotspots and Frontiers in Labor Analgesia Nursing Research: A CiteSpace-Based Visual Analysis

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Abstract: *Background:* Labor analgesia nursing is an important component of intrapartum care, involving pain management, maternal experience, and health outcomes. However, the knowledge structure, research hotspots, and emerging trends in this field have not been systematically explored. This study aimed to analyze the current status, hotspots, and frontiers of labor analgesia nursing research using bibliometric methods. *Methods:* Relevant publications were retrieved from the Web of Science Core Collection using the search strategy TS = ((“labor analgesia” OR “labor pain relief” OR “obstetric analgesia”) AND (nursing OR midwifery OR “intrapartum care”)). The time span was from January 1, 2000, to December 31, 2025, and the search was conducted on March 1, 2026. After screening, 72 eligible publications were included. CiteSpace 6.4.R1 was used to analyze annual publication trends, collaboration networks of authors, institutions, and countries/regions, as well as keyword co-occurrence, clustering, and burst patterns. *Results:* The annual number of publications showed an overall upward trend and reached a peak in 2025. The United States occupied the central position in the country/region collaboration network, whereas collaboration among authors and institutions remained relatively scattered. Lim, Grace, was the most prominent author, and the Pennsylvania Commonwealth System of Higher Education was the leading institution. High-frequency keywords mainly included epidural analgesia, fentanyl, labor analgesia, anesthesia, obstetric analgesia, cesarean delivery, nitrous oxide, and bupivacaine. Keyword clustering indicated that the field mainly focused on analgesic drugs, analgesic techniques, obstetric outcomes, and related clinical research topics. Recent burst keywords included health, childbirth satisfaction, obstetric analgesia, and labor. *Conclusions:* Labor analgesia nursing research has expanded steadily over the past two decades. Current studies mainly focus on pharmacological analgesia, obstetric outcomes, and maternal experience, while recent frontiers emphasize health outcomes and childbirth satisfaction.

Keywords: Labor analgesia; Nursing; Intrapartum care; Bibliometric analysis; CiteSpace

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1. Introduction

Labor pain is one of the most intense forms of pain experienced by women and remains a central concern in intrapartum care ^[1,2]. Effective pain relief during childbirth is not only associated with maternal comfort, but also with childbirth satisfaction, perceived control, and the overall birth experience ^[2,3]. Contemporary labor analgesia encompasses pharmacological and non-pharmacological approaches, among which neuraxial techniques, especially epidural analgesia, are generally regarded as the most effective pharmacological methods ^[1,4]. At the same time, non-pharmacological strategies such as relaxation, massage, hydrotherapy, acupuncture, and continuous labor support continue to attract increasing attention because of their safety, acceptability, and alignment with woman-centered maternity care models ^[2,3,5,6].

Despite major advances in obstetric anesthesia, labor analgesia is not solely a technical or anesthetic issue; it is also a nursing and midwifery issue ^[5,7,8]. Nurses and midwives play indispensable roles in pain assessment, intrapartum support, analgesia-related education, monitoring of maternal and fetal responses, implementation of non-pharmacological interventions, and coordination of multidisciplinary care in the labor ward ^[6-8]. Previous evidence has shown that women's experiences of labor pain relief are shaped not only by analgesic efficacy, but also by professional support, communication, expectations, and the care environment ^[3,6]. Furthermore, barriers at the health system, facility, practitioner, and consumer levels may hinder the implementation of non-pharmacological pain management in maternity settings ^[6]. These findings highlight that labor analgesia nursing research has evolved into a multidimensional field involving clinical effectiveness, care models, patient experience, and organizational practice ^[3,5-7].

Over the past two decades, the literature on labor analgesia has expanded substantially, covering epidural techniques, systemic analgesics, non-pharmacological methods, maternal satisfaction, safety, and delivery outcomes ^[1,2,4,5,8]. However, most existing studies have focused on the efficacy and safety of specific interventions, while comparatively less attention has been paid to the overall intellectual structure, research collaboration patterns, evolving hotspots, and emerging frontiers of labor analgesia nursing research as a whole ^[1,3,5,8]. Traditional narrative reviews and systematic reviews are valuable for answering focused clinical questions, but they are less suited to identifying macro-level research trends and knowledge evolution across a broad interdisciplinary field ^[2,5,9].

Bibliometric analysis provides a quantitative approach for mapping a research field, identifying influential contributors and institutions, and detecting thematic evolution over time ^[9]. CiteSpace is a widely used visualization tool for knowledge-domain analysis that can reveal co-citation networks, keyword co-occurrence patterns, and burst terms, thereby helping researchers identify research hotspots and frontier topics ^[9]. Therefore, a bibliometric study of labor analgesia nursing research is warranted ^[3,5,9]. By using CiteSpace to analyze the relevant literature, the present study aims to systematically characterize publication trends, major contributors, research hotspots, and emerging frontiers in this field, and to provide evidence-based directions for future nursing practice and research in labor analgesia ^[9].

2. Method

2.1. Data source

The data for this study were obtained from the Web of Science Core Collection. Advanced search was conducted using the following strategy: TS = (("labor analgesia" OR "labor pain relief" OR "obstetric analgesia") AND (nursing OR midwifery OR "intrapartum care")); language limited to English; and a time

span from January 1, 2000, to December 31, 2025. The search was performed on March 1, 2026. To ensure the quality of literature selection, two researchers independently screened all retrieved records, and any disagreements were resolved through discussion. Conference papers and publications deemed irrelevant after reviewing the titles and abstracts were excluded. Finally, a total of 72 eligible publications were included in the analysis.

2.2. Research methods

The retrieved literature was saved in RefWorks format and imported into CiteSpace (version 6.4.R1) for bibliometric and visual analysis. The analysis included the annual publication output trend, country/region collaboration networks, author and institutional collaboration networks, keyword co-occurrence analysis, keyword clustering, and keyword burst detection. Parameter settings were as follows: for country/region, author, and institutional collaboration analysis, the time span was set to 2000–2025 with a one-year slice, and the node types were set to “country”, “author”, and “institution”, respectively, while other parameters remained at their default values. For keyword analysis, the slice length was set to two years, the node type was set to “keyword”, the top 100 keywords were selected for each slice, and the pruning options “pathfinder” and “pruning merged network” were applied. Keyword co-occurrence maps, clustering timeline views, and burst detection maps were generated, with all other settings kept as default.

3. Result

3.1. Annual publication numbers and trends over the past decade

As shown in Figure 1, the annual number of publications on labor analgesia nursing generally exhibited an upward trend, despite some fluctuations, from 2000 to 2025. In the early years, publication output was relatively low, with only 1 article published annually in 2000–2002. The number increased to 4 in 2003, then remained at a relatively modest level for several years. Since 2010, the number of publications has gradually increased. After a brief decline in 2013, publication output rose again and reached 5 in 2016. Although the number fluctuated between 2 and 4 during 2017–2019, a more obvious growth trend was observed in recent years. The annual number of publications reached 8 in 2021 and peaked at 12 in 2025. These results suggest that research on labor analgesia nursing has expanded steadily, with particularly increased attention during the last decade.

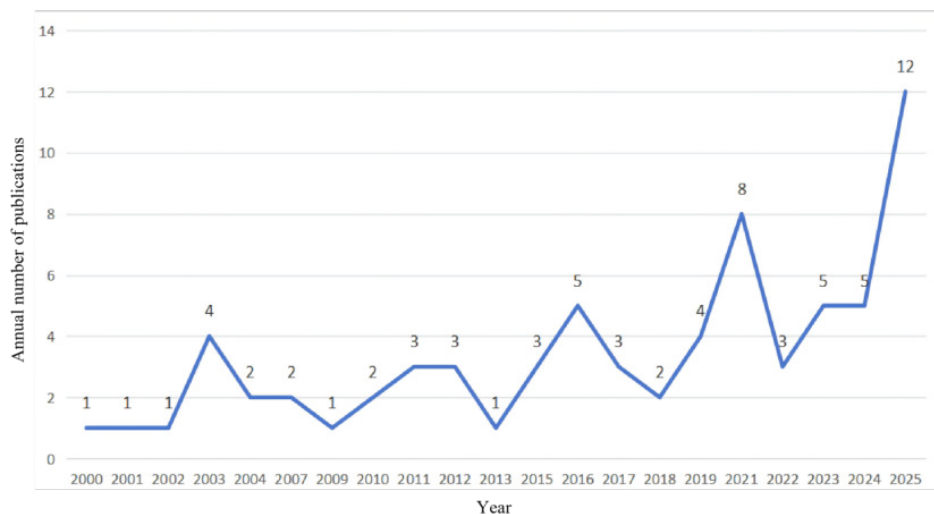


Figure 1. Annual number of publications on labor analgesia nursing from 2000 to 2025.

3.2. Analysis of author collaboration network

Figure 2 presents the author co-occurrence network in labor analgesia nursing research. The network comprised 263 nodes and 498 links, with a density of 0.0156, indicating a relatively scattered collaboration pattern. Among the authors, Lim Grace was the most prominent node. Other visible authors included Garcia-Martinez, Olga, Ramos-Torrecillas, Javier, Plante, Lauren, Herrera-Gomez, Antonio, Tassew, Worku Chekol, Rooks, Judith P, Ruiz, Concepcion, De Luna-Bertos, Elvira, and Gonete, Yosef Aragaw. Overall, several small collaborative groups were observed, but no stable core author team had yet formed. The low network density suggests that collaboration among authors in this field remains relatively limited.

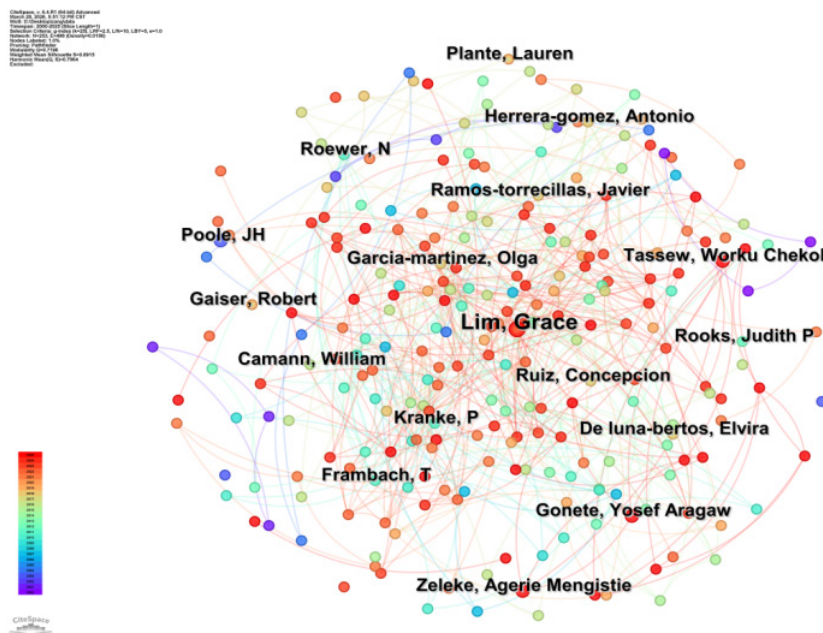


Figure 2. Author collaboration network in labor analgesia nursing research.

3.3. Institutional co-occurrence analysis

Figure 3 shows the institutional co-occurrence network of labor analgesia nursing research. The network included 128 institutions and 183 links, with a density of 0.0225, indicating relatively limited inter-institutional collaboration. Among all institutions, the Pennsylvania Commonwealth System of Higher Education (PCSHE) had the most prominent node. Other major institutions included Brigham & Women's Hospital, Harvard University, Harvard University Medical Affiliates, Columbia University, University of Pittsburgh, University of Pennsylvania, and Stanford University. Overall, several institutions formed collaborative links, but the network structure was relatively scattered, and no highly integrated institutional collaboration system was observed.

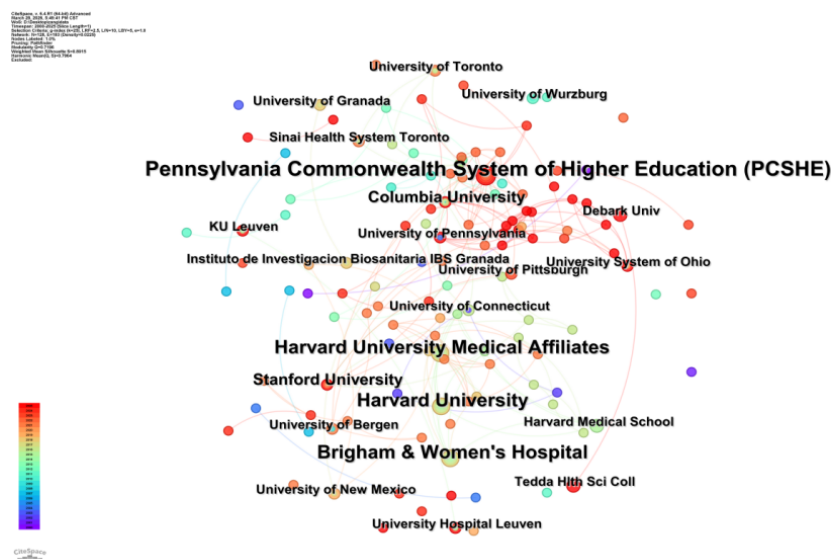


Figure 3. Institutional collaboration network in labor analgesia nursing research.

3.4. Country/region co-occurrence analysis

Figure 4 shows the country/region co-occurrence network of labor analgesia nursing research. The network consisted of 10 nodes and 10 links, with a density of 0.2222, suggesting a moderate level of collaboration among countries/regions. The USA was the most prominent country in the network and occupied the central position. Other active countries/regions included the People's Republic of China, Canada, Japan, England, and Germany. In addition, Norway, Spain, Belgium, and Ethiopia also appeared in the network. Overall, the USA maintained the closest collaborative links with multiple countries/regions, indicating its leading role in this field. Although international collaboration was observed, the number of participating countries/regions remained relatively limited.

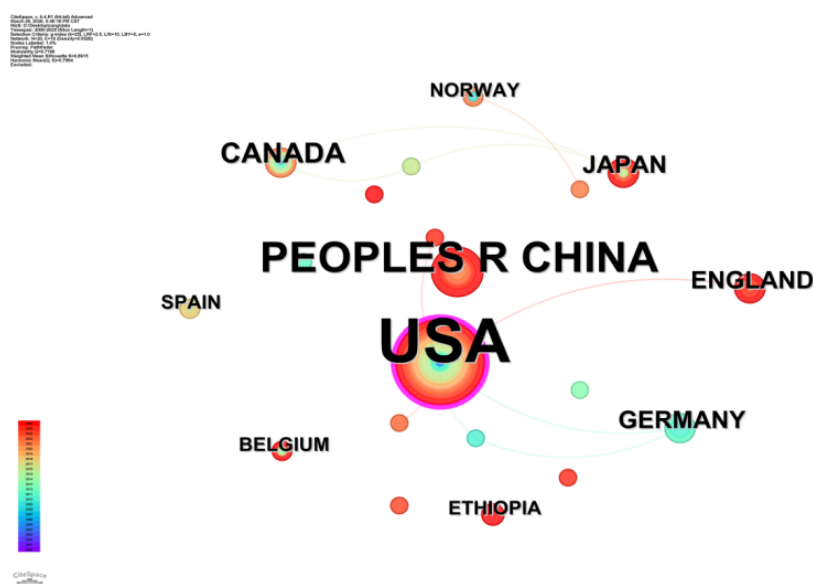


Figure 4. Country/region collaboration network in labor analgesia nursing research.

3.5. Keyword co-occurrence analysis

Figure 5 shows the keyword co-occurrence network of labor analgesia nursing research. The network contained 254 nodes and 851 links, with a density of 0.0265, indicating close relationships among keywords in this field. The high-frequency keywords mainly included epidural analgesia, fentanyl, labor analgesia, anesthesia, obstetric analgesia, cesarean delivery, nitrous oxide, bupivacaine, randomized controlled trial, delivery, pain, childbirth, and expectations. These keywords reflected the major research topics in labor analgesia nursing, including analgesic methods, drug use, obstetric outcomes, and maternal experience. Overall, epidural analgesia, fentanyl, labor analgesia, and anesthesia were the most prominent keywords in the network, indicating that they were the main focus of this research field.

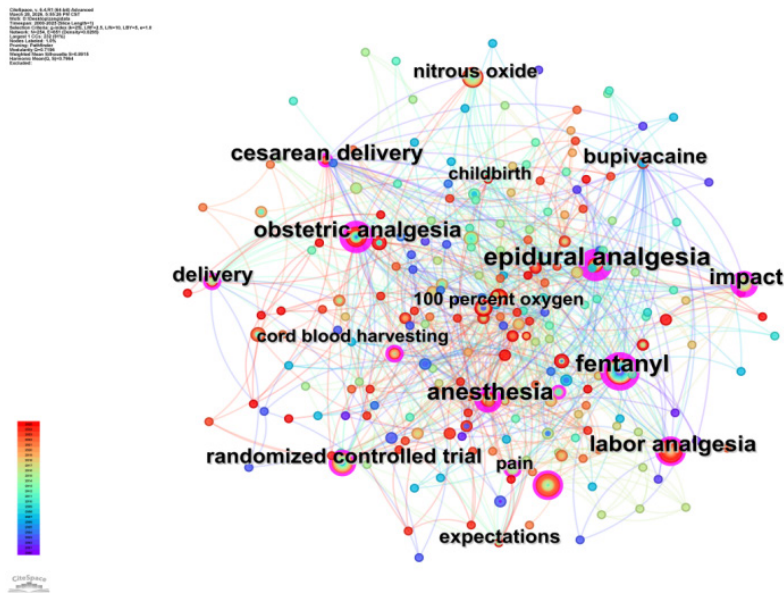


Figure 5. Keyword co-occurrence network in labor analgesia nursing research.

3.6. Keyword clustering analysis

Figure 6 shows the keyword clustering network of labor analgesia nursing research. A total of 12 major clusters were identified, including labor analgesia, bupivacaine, delivery outcome, prenatal employment, obstetric analgesia, double blind, nitrous oxide, drug-drug interactions, human microbiome, complementary, and opioid use disorder. The modularity Q was 0.7196, and the weighted mean silhouette S was 0.8915, indicating good clustering quality. Among them, labor analgesia was the largest cluster. The clustering results suggest that this field mainly focuses on analgesic drugs, analgesic techniques, obstetric outcomes, and related clinical research topics.



Figure 6. Keyword clustering network in labor analgesia nursing research.

3.7. Keyword burst analysis

Figure 7 presents the top 25 keywords with the strongest citation bursts in labor analgesia nursing research from 2000 to 2025. The burst keywords varied across different periods. Early burst terms mainly included fetal heart rate, maternal mortality, and fetal bradycardia. In the middle period, keywords such as delivery, pain, impact, instrumental delivery, and labor analgesia showed strong burst activity. In recent years, health, childbirth satisfaction, obstetric analgesia, and labor emerged as the latest burst keywords and remained active through 2025. Overall, the burst analysis shows that the research focus in this field has changed over time, with recent attention concentrated on health, childbirth satisfaction, and obstetric analgesia.

Top 25 Keywords with the Strongest Citation Bursts

Keywords	Year	Strength	Begin	End	2000 - 2025
fetal heart rate	2001	0.68	2001	2001	
maternal mortality	2003	1.25	2003	2003	
united states	2000	1.18	2003	2003	
fetal bradycardia	2003	1.16	2003	2004	
duration	2010	0.68	2010	2010	
circadian changes	2010	0.68	2010	2010	
childbirth	2011	1.07	2011	2012	
patient simulation	2013	0.68	2013	2013	
simulation	2013	0.68	2013	2013	
serious games	2013	0.68	2013	2013	
problem-based learning	2013	0.68	2013	2013	
community networks	2013	0.68	2013	2013	
medical education	2013	0.68	2013	2013	
delivery	2003	2.06	2015	2016	
metaanalysis	2015	1.1	2015	2016	
pain	2004	0.81	2015	2016	
impact	2001	1.26	2016	2018	
instrumental delivery	2017	1.23	2017	2018	
women	2003	1.1	2017	2017	
labor analgesia	2002	0.87	2019	2019	
cesarean delivery	2001	0.72	2021	2021	
health	2023	1.14	2023	2025	
childbirth satisfaction	2024	1.06	2024	2025	
obstetric analgesia	2003	0.94	2024	2025	
labor	2011	0.89	2024	2025	

Figure 7. Top 25 keywords with the strongest citation bursts in labor analgesia nursing research from 2000 to 2025.

4. Discussion

The present bibliometric analysis showed that research on labor analgesia nursing has increased overall during the past two decades, although the annual output fluctuated across years. This trend suggests that labor analgesia has gradually evolved from a relatively narrow anesthetic topic into a broader field involving intrapartum nursing, midwifery care, maternal experience, and health-service quality^[10,11]. This interpretation is consistent with international recommendations that emphasize both effective pain relief and a positive childbirth experience, as well as with clinical guidance supporting equitable access to labor analgesia and the active participation of trained labor nurses in analgesia management^[10,11].

In the present study, epidural analgesia, anesthesia, fentanyl, bupivacaine, and obstetric analgesia were among the most prominent keywords, indicating that pharmacological analgesia remains the core knowledge domain in this field. This finding is unsurprising because neuraxial techniques continue to represent the main clinical approach to labor pain relief in modern obstetric practice^[11,12]. A meta-analysis of randomized controlled trials showed that epidural labor analgesia with low concentrations of local anesthetics was not associated with a significant increase in cesarean delivery, instrumental birth, or prolongation of the second stage of labor, which may explain why bupivacaine-related and obstetric outcome-related themes remained central in the keyword clusters^[12]. The persistence of clusters such as double blind and randomized controlled trials further indicates that labor analgesia nursing research is still strongly driven by intervention-based clinical evaluation^[12].

Another notable finding was the appearance of nitrous oxide, complementary approaches, and childbirth-related experience terms in the keyword network and clusters, suggesting that the field is no longer confined to epidural techniques alone. Previous evidence has shown that nonpharmacologic interventions, including support-based, behavioral, and sensory approaches, may reduce epidural use and obstetric intervention while improving maternal satisfaction^[13]. Similarly, continuous support during childbirth has been associated with increased spontaneous vaginal birth, shorter labor, reduced use of regional analgesia, and fewer negative birth experiences^[14]. The growing visibility of nitrous oxide in our analysis also reflects the expanding interest in alternative analgesic options that may offer greater mobility and perceived control during labor^[15]. Importantly, maternal satisfaction with nitrous oxide has been reported to remain relatively high even when analgesic effectiveness is lower than that of neuraxial analgesia, indicating that pain relief is only one component of women's evaluation of labor care^[15,16].

The burst analysis further showed that recent frontier topics have shifted toward health, childbirth satisfaction, obstetric analgesia, and labor. This shift is clinically meaningful because contemporary intrapartum care increasingly values patient-reported outcomes rather than focusing solely on technical success or pain scores^[10,17]. A classic systematic review found that women's satisfaction with childbirth is strongly influenced by caregiver support, the quality of the caregiver-patient relationship, involvement in decision-making, and whether expectations are met^[17]. A later systematic review and meta-analysis likewise showed that supporting women during birth and minimizing unnecessary intervention were among the most effective strategies for creating a positive childbirth experience^[18]. In addition, lower birth satisfaction has been associated with a higher risk of postpartum depression, suggesting that childbirth experience is closely linked to maternal mental health outcomes^[19]. Notably, a recent systematic review did not demonstrate a clear overall correlation between pharmacological pain relief alone and women's birth experience because of marked methodological heterogeneity, further supporting the need for future research to integrate analgesic

efficacy with communication, support, and shared decision-making ^[20].

The collaboration maps in this study showed that the USA occupied a central position, whereas author- and institution-level collaboration remained relatively scattered. The prominent position of the USA may be related to the fact that major practice guidance and a substantial body of obstetric anesthesia research have been generated in North America ^[11,15]. At the same time, the low-density collaboration networks suggest that labor analgesia nursing research has not yet formed a stable, highly integrated international research community. This fragmentation may reflect the inherently interdisciplinary nature of the field, which now requires coordination among obstetrics, anesthesiology, nursing, midwifery, and, in selected populations, addiction medicine ^[11,21]. The emergence of opioid use disorder as a cluster term in our analysis is particularly noteworthy because recent multidisciplinary consensus statements have highlighted the complexity of peripartum pain management in pregnant patients with opioid use disorder and the need for individualized, team-based care ^[21]. Moreover, evidence from low-risk pregnancy populations suggests that midwife-led models are associated with fewer obstetric interventions and favorable maternal and neonatal outcomes, underscoring the importance of strengthening collaborative care pathways in future labor analgesia nursing research ^[22].

This study also has several limitations. First, only articles indexed in the Web of Science Core Collection and published in English were included, which may have led to the omission of relevant studies from other databases and languages. Second, bibliometric analysis mainly reflects publication characteristics, co-occurrence relationships, and citation patterns, but does not directly assess study quality or clinical effect size. Third, some cluster labels were generated automatically by the software and may not fully capture the complete clinical meaning of the underlying literature. Despite these limitations, the present study provides a structured overview of the development, core themes, and emerging trends of labor analgesia nursing research.

5. Conclusion

Overall, our findings suggest that labor analgesia nursing research is moving from a predominantly technique- and drug-centered paradigm toward a more integrated model that combines analgesic effectiveness, maternal satisfaction, health outcomes, and woman-centered care. Future studies should strengthen multicenter and multidisciplinary collaboration, focus on high-quality comparative research, and pay greater attention to patient-reported outcomes and special populations, so as to provide stronger evidence for optimizing labor analgesia nursing practice.

Data availability statement

The data used in this study were retrieved from the Web of Science Core Collection. All bibliographic records included are publicly available and can be accessed using the described search strategy.

Ethics statement

This study did not involve human participants, animals, or identifiable personal data. All data were obtained from publicly accessible bibliographic databases; therefore, ethical approval and informed consent were not

required.

Disclosure statement

The authors declare no conflict of interest.

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