Review article

Global research trends in labor analgesia: A bibliometric analysis from 2013 to 2023

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ABSTRACT

Objective: In the past decade, thousands of original articles focus on labor analgesia have published. However, little has been published in the literature that includes a bibliometric analysis of labor analgesia. Therefore, this study is designed to analyze the current status of research on labor analgesia over the past ten years and explore potential directions for the future.
Methods: We retrieved the Web of Science Core Collection (WOSCC) for labor analgesia articles published from 2013 to 2023 and extracted the data from the literature. To perform the bibliometric analysis, we used CiteSpace (6.2. R5) and VOS viewer (1.6.19) as our primary analysis tools.
Results: A total of 2406 articles were included, and the number of publications has increased steadily in the last ten years. The United States was the leading contributor to the area, and Harvard University was the most productive institution. The American Journal of Obstetrics and Gynecology was the most cited and influential journal. The most co-cited reference was "Epidural versus non-epidural or no analgesia for pain management in labour". The labels of the co-citation cluster have identified the characteristics of 5major clusters, such as "postpartum depression", "programmed intermittent epidural bolus", "childbirth experience" "intrapartum maternal fever" and "dural puncture", which play important roles in this field. Keywords co-occurrence and keywords burst detection showed that "vaginal birth", "postpartum depression", "maternal fever", "inflammation", "systematic review", "guidelines", "decreased risk" and "scale" were the most recent and most prominent topics of labor analgesia.
Discussion: This study provided a global review of labor analgesia using bibliometric and visual techniques to provide an intuitive understanding of this topic and identify hotspots and research trends. Notably, intrapartum fever and postpartum depression have emerged as hotpots and trends in labor analgesia research, reflecting the current research landscape.

1. Introduction

Labor pain is arguably one of the most severe types of pain that a woman will experience [1], childbirth pain is influenced by complex interactions between physiological and psychosocial factors [2]. Pain arises from different sites during laboring and birthing. In the initial stage of labor (defined as the period from the onset of labor to full dilatation of the cervix), the pain is produced by uterine contractions and cervical dilation, and it is transmitted via the spinal nerves T10-L1 to the corresponding regions of the cerebral cortex

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[2]. Pain during the second stage of labor (defined as from full cervical dilation to the delivery of the baby), is produced by continued cervical pain plus vaginal, perineal, and pelvic floor distension, which is transmitted via the pudendal nerves and S2-S4 nerve roots into the spinal cord [3]. With regard to psychosocial aspects, experience of labor and delivery, culture and ethnicity, education, and receptivity to pain are often cited as important mediating variables in the sensation of labor pain. Moreover, the level of emotional care given by clinical caregivers and family members also affects perceptions of pain [4].

Currently, a wide variety of non-pharmacologic interventions and pharmacologic agents are used to relieve maternal pain in labor [5]. Of the options for pain relief, epidural analgesia is considered to be the leading and most effective method of relieving labor and delivery pain compared to other modalities [5,6]. Throughout the history of labor analgesia, from its inception to the present day, the potential effects of anesthesia on the birthing process and the newborn have been a concern for obstetric practitioners and patients [1]. Ensuring the effectiveness and safety of labor analgesia is crucial for facilitating smooth labor progression and protecting the physical and mental well-being of mothers. Pain is a subjective experience, and the perception of pain can vary from person to person. The advancement of labor analgesia techniques enables mothers to have increasingly personal experience of pain relief during labor. Safety is fundamental to a medical technology. Since the safety of epidural analgesia had been proved decades ago for labor pain [7]. When evaluating the safety of labor analgesia, it is essential to consider the entire perinatal period, including the intrapartum and postpartum stages, to ensure the well-being of both mothers and infants.

Over the past decade, the field of labor analgesia has developed greatly, generating tens of thousands of original articles. There have been only a few bibliometric researches focused on labor analgesia [8,9]. Bibliometrics has great potential in healthcare research which is used to measure the interrelationships of the literatures, the impact of the publication, and the trend in a certain field of study
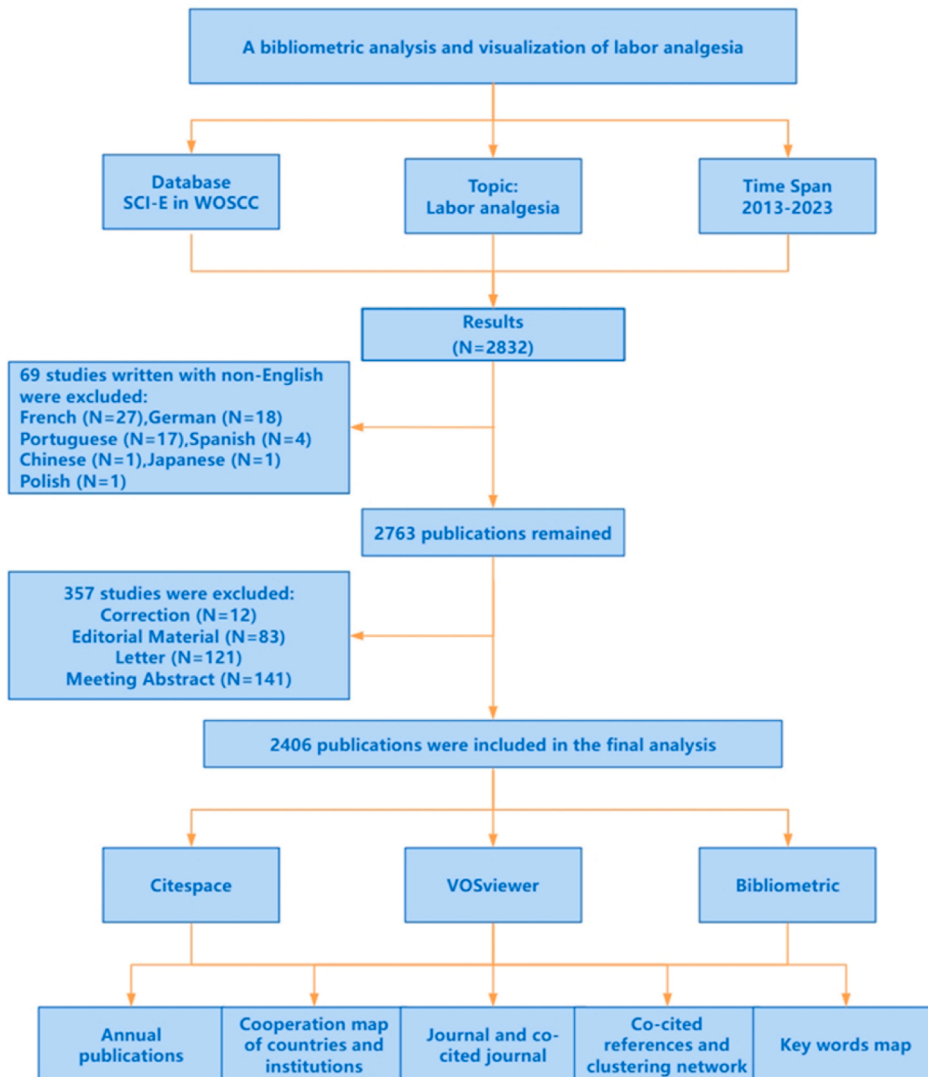

Fig. 1. Literature inclusion and exclusion flowchart.

[10]. We have outlined the research literature from 2013 to 2023 to demonstrate the outlook for labor analgesia. The main objective of this study was to quantify and identify the current state of labor analgesia through bibliometric analysis, to identify emerging issues, and to lay the foundation for subsequent research in the area.

2. Method

2.1. Data collection

The Web of Science Core Collection (WOSCC) is online database that provide high quality, rapidly updated reference datasets for academic exploration and research. Among the databases, Science Citation Index Expanded (SCI-E) is considered the most appropriate for bibliometric analysis [11]. The current review systematically searched the literature on labor analgesia in SCI-E. To ensure the accuracy and reliability of the data, two authors conducted separate searches on December 11, 2023, and differences were discussed with a third colleague or with the whole research group. The search strategy included strategy A, which is labor or its synonyms (subject); strategy B, namely analgesia or its synonyms (subject); and strategy C, which equals to "strategy A AND strategy B" (detailed search strategy can be found in Supplemental Table 1). This study selected the period from 2013 to 2023 for inclusion, focusing exclusively on English language articles and reviews. The work followed the PRISMA guidelines, and the flow chart is presented in Fig. 1.

2.2. Data analysis and visualization

In this study, bibliometric analysis software, such as CiteSpace (6.2. R5) and VOS viewer (1.6.19), were used to analyze the general information, trends and emerging focuses of labor analgesia over the past ten years. CiteSpace, a bibliometric software developed by Professor Chaomei Chen of Drexel University in the United States, specializes in the tends and dynamics of scientific studies within a specific research area [12,13]. It was utilized to analyze and visualize of countries and institutions co-occurrence, citation bursts for institutions, a dual-map of journals, co-cited journals and references, co-citation clusters timeline view, and keywords co-citation bursts. The VOS viewer, developed by van Eck and Waltman from Leiden University, is a free computer program for constructing and viewing documentation of bibliometric charts [14]. In this study, the mapping of scientific knowledge and the display of keywords co-occurrence analysis of literature were achieved using relationship building and visual analysis tools Microsoft Office Excel 2019 and bibliometric (https://www.bibliometrix.org/home/) were used for database management and annual publication analysis. Additionally, we derived H-index, 2023 impact factor (IF), JCR classification of journals from the Web of Science's Incites Journal Citation Reports. The study used data derived from publicly available databases (WOSCC) and did not involve patients.

3. Result

3.1. Annual publication numbers and trends over the past decade

Based on the data collection strategy, 2406 publications from 2013 to 2023 were included in the final analysis. Fig. 2 illustrates the annual distribution of the number of publications. According to this figure, it can be divided into three phases. Prior to 2015, there was a period of stability. Subsequently, a growth phase emerged between 2016 and 2020, followed by a further increase in the annual number of published articles from 2021 to 2023.

3.2. Countries

A total of 93 countries participated in the study of labor analgesia in 2013–2023. Fig. 3A demonstrates contribution of publications on labor analgesia worldwide. The United States, China, the United Kingdom, Australia, and Canada have darker color blocks,
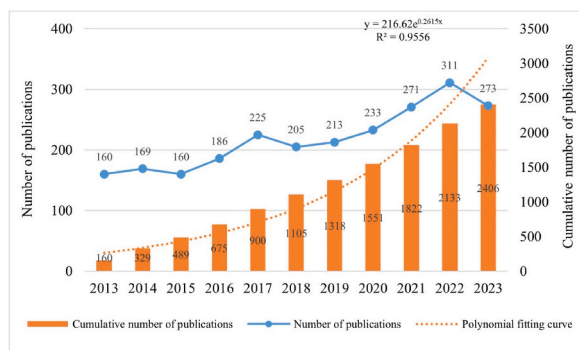
Fig. 2. Annual publications in the field of labor analgesia.

indicating a greater contribution to the research on labor analgesia compared with other countries and regions. The top 20 countries with the most publications are listed in Fig. 3B. The top five most published countries were the United States (622, 25.9 %), China (429, 17.8 %), the United Kingdom (199, 8.3 %), Australia (187, 7.8 %) and Canada (134, 5.6 %). In regard to the number of published articles, the United States is the largest contributor. However, Fig. 3C shows that China's annual publications have obviously increased over the last 10 years, while those of the United States and the United Kingdom have stabilized.

3.3. Institutions

There were 118 institutions present in the selected literature (See in Fig. 4A and B). The top 5 institutions were Harvard University (76), Harvard Medical School (54), Stanford University (53), Tel Aviv University (49), Brigham & Women's University (49), and Hebrew University of Jerusalem (49). Among the top ten institutions by publications (See in Fig. 4B), institutions belong to the United States, 3 institutions are located in Israel, 2 institutions are located in France, and 1 is affiliated with Canada. Fig. 4C shows the top 25 most cited institutions s. From this Figure, it is indicated that Peking University, Fudan University and Shanghai Jiao Tong University in China have become the main institutions for labor analgesia research from 2021 to 2023.

3.4. Journal analysis

The top ten journals in the area of labor analgesia were presented in Table 1. Journals with more than 1000 citations included American Journal of Obstetrics and Gynecology (1182), Anesthesia and Analgesia (1164), Cochrane Database of Systematic Reviews (1139) and Obstetrics and Gynecology (1119). Additionally, the top 5 journals with impact factors(IF) > 5 and H-index≥200 were from the United States. They were American Journal of Obstetrics and Gynecology (IF:9.8, H-index:225), Anesthesia and Analgesia (IF:5.7, H-index:201), Cochrane Database of Systematic Reviews (IF:8.4, H-index:273), Obstetrics and Gynecology (IF:7.2, H-index:220) and Anesthesiology (IF:8.8, H-index:234). Maps overlay of the journals analyzing the association between discipline categories and labor analgesia is shown in Fig. 5. The spline curves demonstrate a trajectory extending from the left to the right, delineating the distribution of the most cited journals. The 3 green bars indicate that the major portion of citations for studies in medicine and clinic were from studies which were published in health, nursing, genetics and molecular journals, biological, medicine journals, psychology, social and education journals.

3.5. Co-cited references

Co-cited references is one in which two (or more) papers are simultaneously cited by one or more subsequent papers. The more co-citations two references have, the closer they are to each other. Table 2 lists the top 10 co-cited references in labor analgesia, among which nine references originated from the United States. The study conducted by Anim-Somuah M in 2011 [15] demonstrated the
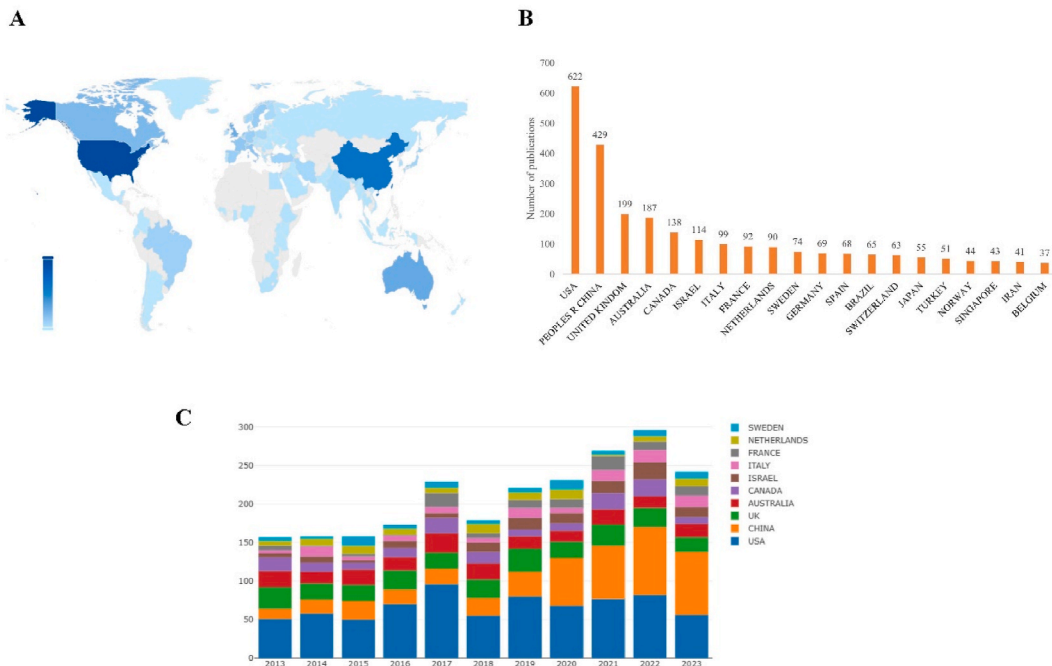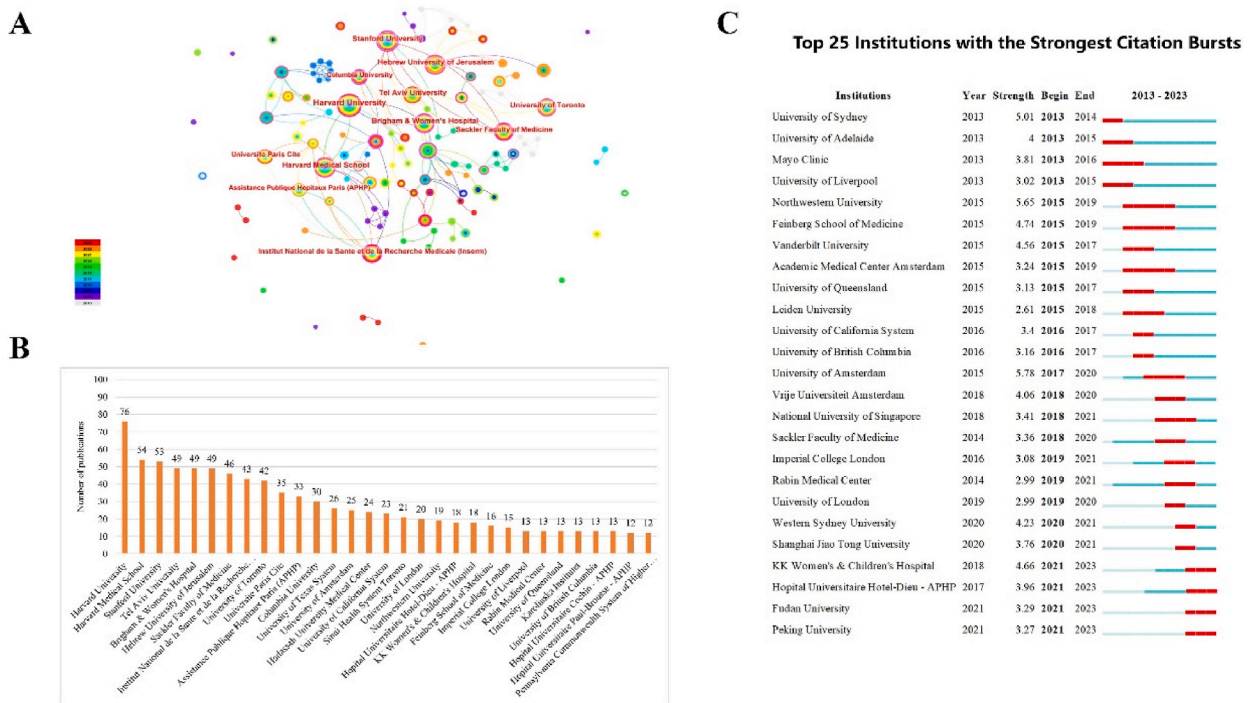

Fig. 3. Publication of countries.
A. The regional distribution of publications. B. The top 20 countries with the most publications. C. Annual publications of the top 10 countries.

A

B

C

Top 25 Institutions with the Strongest Citation Bursts

Institutions	Year	Strength	Begin	End	2013 - 2023
University of Sydney	2013	5.01	2013	2014	
University of Adelaide	2013	4	2013	2015	
Mayo Clinic	2013	3.81	2013	2016	
University of Liverpool	2013	3.02	2013	2015	
Northwestern University	2015	5.65	2015	2019	
Feinberg School of Medicine	2015	4.74	2015	2019	
Vanderbilt University	2015	4.56	2015	2017	
Academic Medical Center Amsterdam	2015	3.24	2015	2019	
University of Queensland	2015	3.13	2015	2017	
Leiden University	2015	2.61	2015	2018	
University of California System	2016	3.4	2016	2017	
University of British Columbia	2016	3.16	2016	2017	
University of Amsterdam	2015	5.78	2017	2020	
Vrije Universiteit Amsterdam	2018	4.06	2018	2020	
National University of Singapore	2018	3.41	2018	2021	
Sackler Faculty of Medicine	2014	3.36	2018	2020	
Imperial College London	2016	3.08	2019	2021	
Rabin Medical Center	2014	2.99	2019	2021	
University of London	2019	2.99	2019	2020	
Western Sydney University	2020	4.23	2020	2021	
Shanghai Jiao Tong University	2020	3.76	2020	2021	
KK Women's & Children's Hospital	2018	4.66	2021	2023	
Hopital Universitaire Hotel-Dieu - APHP	2017	3.96	2021	2023	
Fudan University	2021	3.29	2021	2023	
Peking University	2021	3.27	2021	2023	

Fig. 4. Publications of intuitions.
A. Institutions network of Labor analgesia. B. Number of publications for top 30 institutions. C. The top 25 institutions with the strongest citation bursts.

Table 1
The top 10 journals of labor analgesia research.

Journal	Cited number	IF(2023)	H-index	JCR	Country
American Journal Of Obstetrics And Gynecology	1182	9.8	225	Q1	United States
Anesthesia And Analgesia	1164	5.7	201	Q1	United States
Cochrane Database of Systematic Reviews	1139	8.4	273	Q1	United States
Obstetrics And Gynecology	1119	7.2	220	Q1	United States
Anesthesiology	994	8.8	234	Q1	United States
International Journal of Obstetric Anesthesia	913	2.8	54	Q2	United States
BJOG-An International Journal of Obstetrics and Gynaecology	841	5.8	164	Q1	United Kingdom
British Journal of Anesthesia	782	9.8	181	Q1	United Kingdom
Acta Obstetricia Et Gynecologica Scandinavica	654	4.3	102	Q1	United Kingdom
Birth-Issues In Perinatal Care	652	2.5	83	Q1	United Kingdom

strongest citation burst among the analyzed references, with a citation burst strength of 36.79. The 2018 updated version of the study titled "Epidural versus non-epidural or no analgesia for pain management in labor", by the same author, emerged as the most co-cited reference with a citation burst strength of 25.13. Furthermore, the publication by Jones L in 2012 [16] demonstrated a citation burst strength of 20.42.

Additionally, we used CiteSpace software to cluster co-cited documents and divided the retrieved original articles into 13 clusters (Modularity Q = 0.83, Weighted Mean Silhouette S = 0.929, see in Fig. 6A and B). The cluster labeled "postpartum depression", "programmed intermittent epidural bolus", "programmed intermittent epidural bolus", "childbirth experience" "intrapartum maternal fever", and "dural puncture" played significant roles in this field. Fig. 6C depicts the 25 most frequently co-cited references with significant citation bursts, ordered in chronological sequence according to the publish time the citation burst commenced.

3.6. Key words

Key words show the core of a thesis. They reflect the concentration of a research area. A total of 6476 keywords were identified and divided into the three major clusters based on the title and author of 2406 publications (See in Fig. 7A). Cluster 1 (red) includes 59 items, such as bupivacaine, fentanyl, ropivacaine, lidocaine, spinal-anesthesia, management and efficacy, which focuses on the management of neuraxial labor analgesia. Cluster 2 (green) contains 51 items, which were associated with obstetric outcomes and
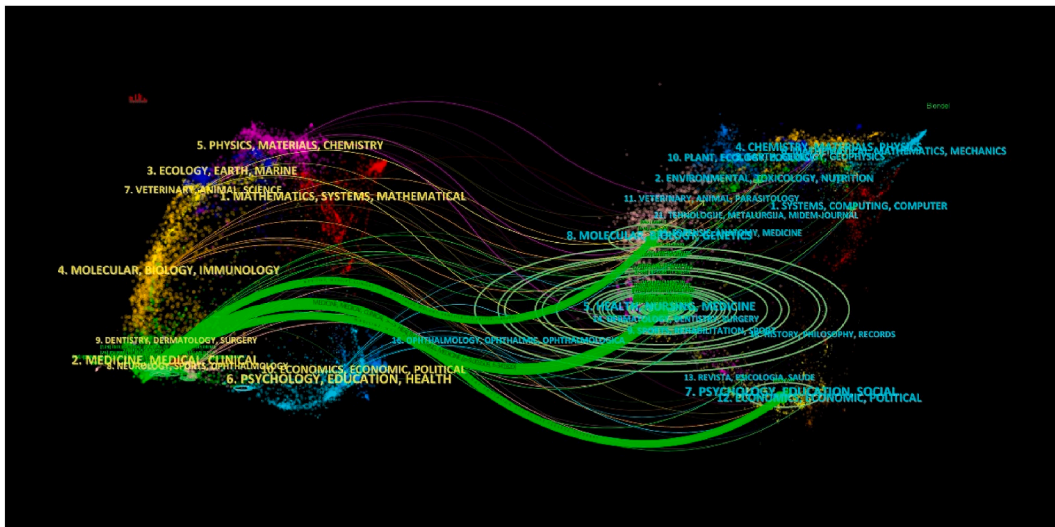
Fig. 5. The dual-map overlay of journals related to labor analgesia research.

Table 2
The top 10 co-cited references in the field of labor analgesia.

Rank	Titles	Citation counts	Year	Journal	Country	IF	H-index
1	Epidural versus non-epidural or no analgesia for pain management in labour	176	2018	Cochrane Database Of Systematic Reviews	USA	8.4	273
2	Epidural versus non-epidural or no analgesia in labour	80	2011	Cochrane Database Of Systematic Reviews	USA	8.4	273
3	Pain management for women in labour: an overview of systematic reviews	56	2012	Cochrane Database Of Systematic Reviews	USA	8.4	273
4	Proceedings of the 51st annual hawaii international conference on system sciences (hicss), v0, p913	43	2018	HISS	USA	–	–
5	United States state-level variation in the use of neuraxial analgesia during labor for pregnant women	39	2018	Jama Network Open	USA	13.8	39
6	Dural puncture epidural technique improves labor analgesia quality with fewer side effects compared with epidural and combined spinal epidural techniques: a randomized clinical trial	38	2017	Anesthesia And Analgesia	USA	5.7	201
7	A review of the impact of obstetric anesthesia on maternal and neonatal outcomes	37	2018	Anesthesiology	USA	8.8	234
8	Women's experiences of pharmacological and non-pharmacological pain relief methods for labour and childbirth: a qualitative systematic review	34	2019	Reproductive Health	UK	3,4	52
9	Practice guidelines for obstetric anesthesia an updated report by the American society of anesthesiologists task force on obstetric anesthesia and the society for obstetric anesthesia and perinatology	33	2016	Anesthesiology	USA	8.8	234
10	Programmed intermittent epidural bolus for labor analgesia during first stage of labor: A biased-coin up-and-down sequential allocation trial to determine the optimum interval time between boluses of a fixed volume of 10 ml of bupivacaine 0.0625 % With Fentanyl 2 μg/ml	32	2017	Anesthesia and Analgesia	USA	5.7	201

delivery complications, including risk factors, 2nd-stage, delivery, impact, fever, dystocia and mortality. Cluster 3 (blue) refers to postpartum management, such as postpartum depression, fear, anxiety, childbirth and women.

Keywords exhibiting the most significant citation indicate a high frequency of occurrence in a given time frame, helping researchers analyze trends and highlight topic in labor analgesia studies. Fig. 7B displayed that "postpartum depression", "fever", "inflammation" were the most recent hotpots of labor analgesia. As shown in Fig. 7C, vaginal birth (strength, 7.3; time span, 2021–2023), postpartum depression (strength, 6.13; time span, 2020–2023), systematic review (strength, 6.34; time span, 2020–2023), maternal fever (strength, 4.81; time span, 2019–2023), intravenous remifentanil (strength, 4.1; time span, 2015–2017), and controlled epidural analgesia (strength, 3.93; time span, 2013–2015) are the most recent major research hotspots.
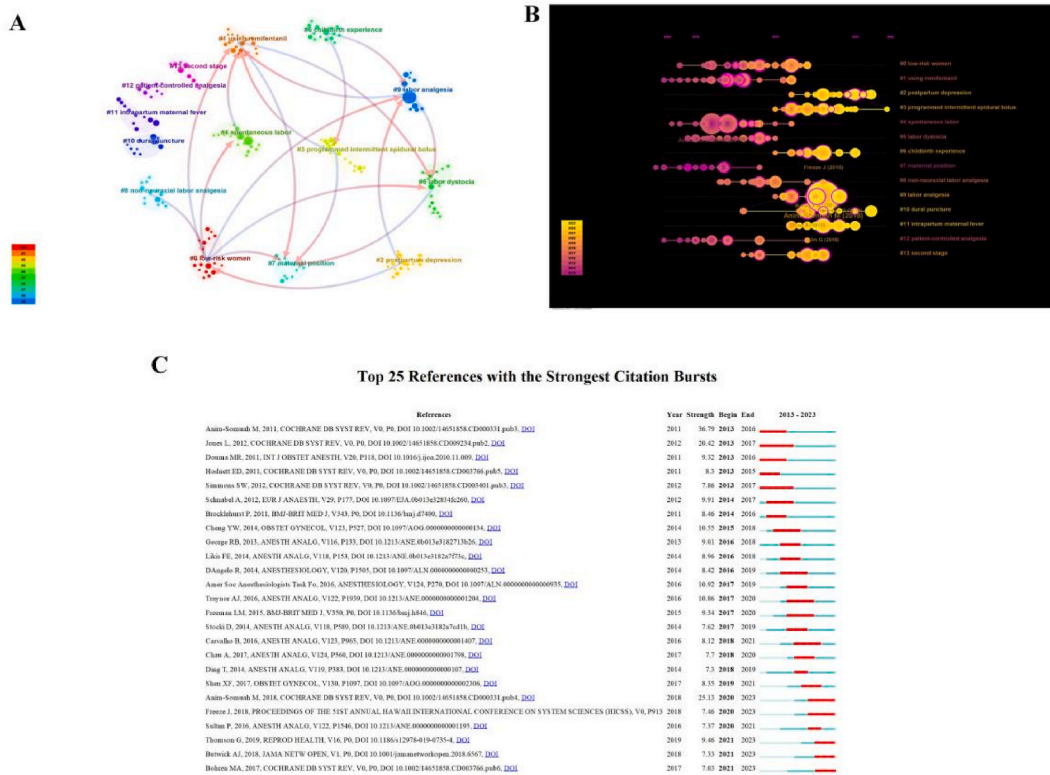
Fig. 6. The analysis of co-cited references in the labor analgesia research
A. The clusters of co-cited references in the labor analgesia research. B. The timeline view of co-cited references. C. The top 25 references with the strongest citation bursts.

4. Discussion

As a subfield of information science, bibliometrics employs quantitative analysis of document characteristics and indicators to uncover trends, development, and influence in scientific research. Bibliometrics differs from traditional retrospection, paired analysis, and experimental studies by focusing on large-scale analysis and scholarly evaluation. It plays a crucial role in helping newcomers to enter a field quickly [17]. Labor analgesia refers to using drugs or non-drug methods to relieve pain during childbirth. Since the 19th century, when ether was first used for labor pain relief, we have consistently been at the forefront of research into the potential risks and adverse effects of labor pain relief methods have on mothers and newborns [1]. Yu [8] and Zheng [9] conducted bibliometric analysis of labor analgesia research from 1988 to 2018 and from 2002 to 2021, respectively. Their analysis identified important research trends on this topic over the past 40 years. Given the accelerated pace of labor analgesia research, with nearly 600 new papers published in the last two years, new research hotspots are emerging. Here, we conducted this bibliometric analysis to identify emerging hotspots and to provide an analysis of future research directions.

4.1. General information

Based on annual publication, there was a notable increase in the number of papers published in last decade. During the years 2019–2023, there was a significant increase in publications from China, possibly due to the country's new policy to encouraging childbirth. According to the distribution map and the statistical chart showing the cumulative number of articles published by country, China ranks second with 395 published papers, while the United States ranks first with 622 papers. Moreover, in accordance with the number of publications, we can see that four of the top ten publishing institutions from the United States, suggesting the country's significant presence in labor analgesia research. The analysis of the strongest citation bursts, shown in Fig. 4, reveals a steady growth of China's influence in the field of labor analgesia. Notably, Peking University, Fudan University, and Shanghai Jiao Tong University have emerged as significant contributors with the strongest citation bursts in recent years, highlighting their substantial impact on the scholarly discourse in this area. Table 1 shows that four anesthesiology journals, namely Anesthesia and Analgesia, Anesthesiology, International Journal of Obstetric Anesthesia, and British Journal of Anesthesia, hold notable positions within the top 10 cited journals for labor analgesia. Their rankings at 2nd, 5th, 7th, and 8th, respectively, highlight the substantial contributions of anesthesiology to the field of labor analgesia. The American Journal of Obstetrics and Gynecology is the top citation journal in the field of obstetric pain management.

A

B

C
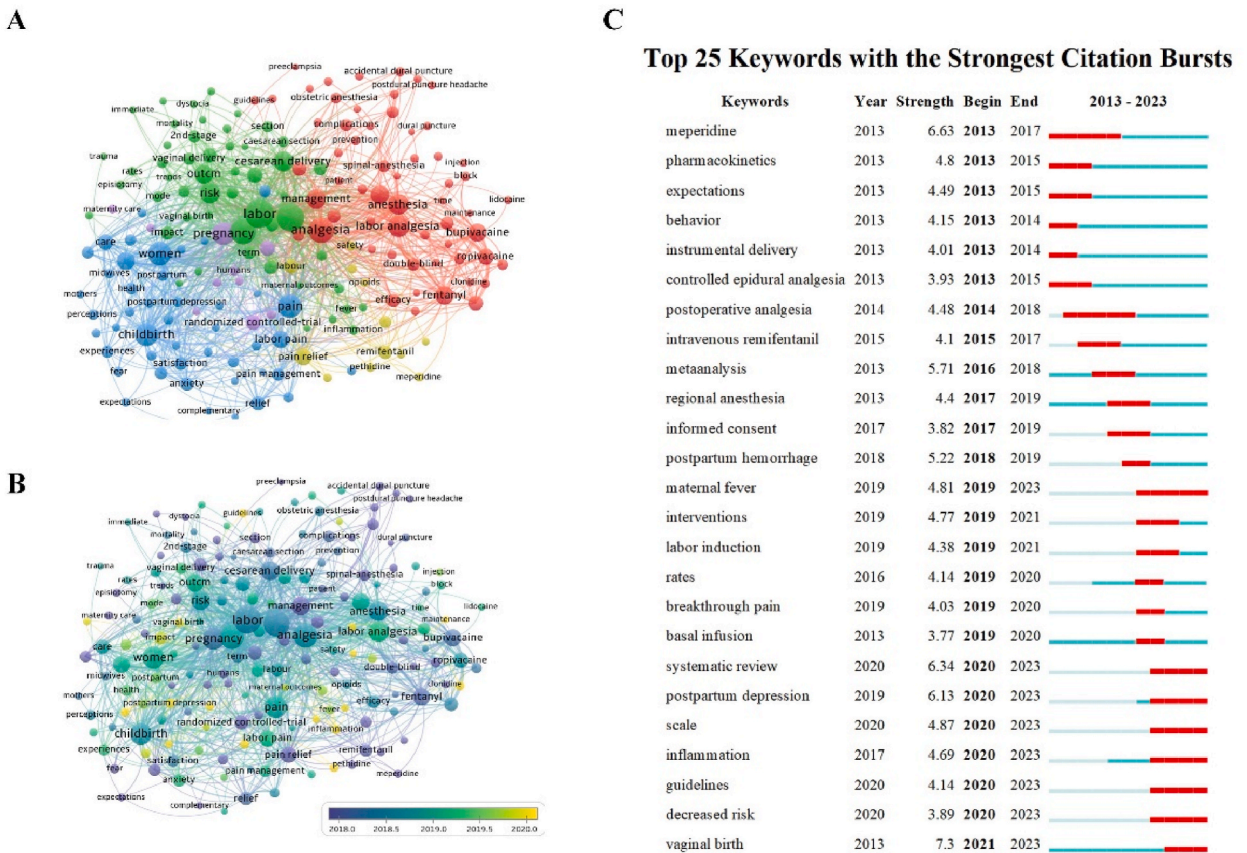
Fig. 7. The analysis of keywords related to the research of labor analgesia.
A. The clusters of keywords in the labor analgesia research. B. The timeline view of keywords. C. The top 25 keywords with the strongest citation bursts.

4.2. Knowledge base

In general, co-citation research is an efficient and convenient way for researchers to identify knowledge that is shared across multiple studies. As shown in Table 2 and Fig. 6C, the top three cited papers were all from the Cochrane Database of Systematic Reviews, which showed that epidural analgesia, as a widely used method of pain relief during labor, may be more effective in alleviating labor pain and increasing maternal satisfaction compared with other methods. However, there is still controversy about the relationship between epidural analgesia and an increase in assisted vaginal birth. Additionally, evidence suggested that epidural analgesia does not influence the likelihood of cesarean section or long-term back pain. Furthermore, no short-term effect on the status of newborn, as indicated by Apgar scores or admissions to the neonatal intensive care unit, has been observed [18]. Various non-pharmacological techniques for labor analgesia, such as water immersion, relaxation, acupuncture, and massage, have been found to alleviate pain and improve satisfaction. Moreover, immersion and relaxation have been shown to improve satisfaction with childbirth [4]. The 6th and 10th papers in the top 10 co-cited references focus on advancements in the technique of epidural analgesia for the management labor pain. In a study conducted by Anthony Chau et al. [19], the dural puncture epidural (DPE) technique, which involves the creation of a dural perforation without administering intrathecal medication, was compared with the combined spinal-epidural (CSE) technique and the epidural technique (EPL), the study indicated that the DPE technique had an improved quality of block as compared to the EPL technique, with less maternal and fetal adverse effects as compared to the CSE technique. Marcelo et al. [20] conducted a study to investigate the optimal interval for programmed intermittent epidural bolus using a specific drug formulation during the first stage of labor. The findings of the study indicated that a 40-min interval was identified as the optimal interval. The programmed intermittent epidural bolus (PIEB) technique involves the periodic bolus injection of local anesthetic into the epidural space for analgesia. In comparison with continuous epidural infusion (CEI), PIEB offers higher quality analgesia. PIEB has been shown to increase duration of analgesia, decrease motor block, reduces the prevalence of breakthrough pain. Additionally, it has been shown to increase parturients satisfaction, and decrease the consumption of local anesthetics [20–24].

4.3. Hotpot evolution and emerging topics

Keywords represent the central topics and primary content of papers, providing a concise representation of current research trends and hotspots in an area of scholarship [25], and the emergence of new hotspots can be illustrated in a timeline view of keyword clustering. A burst keyword indicates the frequent emergence of a specific keyword during a particular time period, and it provides insight into the evolving research hotspots, present trends, and possible future trends.

As shown in Fig. 7, cluster 1 (red) focuses on management of neuraxial labor analgesia, which is anesthesia-assisted management of labor pain. Cluster 2 (green) represents obstetric outcomes and delivery complications, of which intrapartum fever in labor analgesia is still a hot topic that continues to attract attention because of its impact on mother and fetal well-being. A maternal body temperature of ≥38 °C is commonly defined as intrapartum fever, which is assessed through oral or tympanic temperature measurements. However, research conducted by Greenwell EA et al. indicates that even temperatures of ≥37.5 °C are related to an elevated risk of fetal adverse outcomes [26]. Fever during labor has been shown to correlated with a range of unfavourable obstetric and gynecologic outcomes, including postpartum hemorrhage, prolonged duration of labor, labor dystocia, cesarean section and instrumental delivery [27,28]. In addition, there are reports of potential risk factors for adverse neonatal outcomes, such as low Apgar scores, apnea, hypotonia, and cerebral palsy [29,30]. In most studies, epidural related maternal fever (ERMF) manifests within 6 h of the commencement of epidural analgesia, exhibiting a gradual increase in temperature over several hours [31]. The underlying mechanism of ERMF is still unclear. As an important noninfectious factor leading to the progression of intrapartum maternal fever, ERMF is gaining increasing attention. Potential mechanisms have been proposed to be multifactorial, involving sterile inflammation and changes in thermoregulatory mechanisms. Future research in this field can be divided into two main directions. The first direction involves identifying the underlying cause of ERMF and implementing targeted treatments to minimize the occurrence of non-infectious intrapartum fever. This is crucial to improving maternal and neonatal outcomes. The second direction focuses on accurately distinguishing intrapartum fever caused by ERMF from infectious causes. This differentiation aims to reduce the overuse of antibiotics and unnecessary obstetric interventions, thereby promoting more targeted and efficient healthcare practices [32].

Cluster 3 (blue) refers to postpartum management, the relationship between labor analgesia and postpartum depression has also attracted much attention in recent years. Postpartum depression (PPD) is a prevalent and important psychological health problem that affecting 8 %–26 % of women globally [33]. The American Psychiatric Association's Diagnostic and Statistical Manual of Mental Disorders defines postpartum depression as symptoms that meet the criteria for major depression and can occur either during pregnancy or within 4 weeks after delivery [34]. In clinical practice and research, the time range for defining postpartum depression varies, with some studies using different time periods, such as 4 weeks, 3 months, 6 months, or even up to 12 months after childbirth [35]. The symptoms of postpartum depression (PPD) are characterised by a combination of depressed mood, loss of interest, lack of pleasure, insomnia and fatigue, as well as psychomotor difficulties, inattention, and self-harm thoughts. These symptoms result in clinically significant distress or impaired function and are associated with a significant burden of disease [36]. Postpartum depression not only impacts the well-being of the mother but also negatively affects the emotional, cognitive, and behavioral development of the child Additionally, it may contribute to increased paternal depression and parenting stress [37,38]. In recent years, there has been a notable increase in clinical research attention to perinatal pain-induced PPD. Studies have demonstrated that the intensity of labor pain is positively associated with the development of postpartum depression, and this association may be attributed to the intense stress caused by severe pain, which subsequently contributes to negative psychophysiological results after delivery [39–41]. Epidural analgesia, regarded as the most effective method for the management of labor pain, has been widely studied for its potential to reduce postpartum depression. Potential mechanisms may include the alleviation of stress, the minimisation of risk for the development of persistent or chronic pain, and the regulation of emotions [39]. Yet, there is currently no consensus and research results remain inconsistent. In a study by Riazanova and colleagues, 4.67 % of women who had epidural analgesia during labour were diagnosed with postpartum depression. This figure was significantly lower than the 6.79 % diagnosed in women who had no analgesia during delivery [42]. Liu and colleagues reported that intrathecal analgesia was correlated with a decreased incidence of postpartum depression after two years [43]. However, other findings showed an elevated risk of postpartum depression at six months in women who had undergone spontaneous deliveries and had received anesthesia [44]. The two prospective studies by Ahmad HMY et al. and Tan, H S et al. indicate that epidural analgesia is not related to the incidence of PPD [34,45]. To gain a clearer understanding of the topic and explore the practical effect of labor analgesia on postpartum depression, it is essential to conduct well-designed intervention studies in the future. Additionally, conducting multicenter studies to increase sample diversity and representation could help verify the congruency of the benefits of labor analgesia on postpartum depression in different regions and populations. Another crucial step is to explore the mechanism of labor analgesia on postpartum depression and explore the physiological, psychological, and social factors involved. Understanding these factors will contribute to a better understanding of how labor analgesia relieves postpartum depression and provide a theoretical basis for the development of related interventions. Moreover, a long-term follow-up study is necessary to comprehend the continuous effect of labor analgesia on postpartum depression. Such studies can track a woman's mental health from weeks to months or even years after delivery to assess the long-term impact of labor analgesia on postpartum depression.

4.4. Limitation

The study had several limitations. The reliance solely on data from the WOSCC database, with a publication timeframe of near 10 years, meant that no statistical analysis was conducted on papers published prior to 2012, potentially resulting in data incompleteness. Additionally, the bibliometric analysis results may lag behind the current research progress because of the continuous updating of the WOSCC database. Moreover, the inclusion of only English language papers may have limited the number of searchable articles. Finally,

the time-bound nature of the study means that the number of relevant articles may change over time. Moreover, the literature search was conducted on December 11th, 2023, and may not fully represent the landscape of labor analgesia for the entire year of 2023.

5. Conclusion

We conducted a systematic analysis of labor analgesia-related publications using bibliometric methods. We used tools such as VOSviewer and Citespace to analyze the data extracted from the relevant literature. Current global research trends in labor analgesia have shifted from effectiveness to safety. Intrapartum fever and postpartum depression have emerged as hot topics and trends in labor analgesia research.

Data availability statement

This study utilized data from The Web of Science Core Collection (WOSCC) and Science Citation Index Expanded (SCI-E). The data mentioned in this article is accessible through the database using the provided search formula.

Ethics statement

Informed consent was not required for this study since all the data utilized were obtained exclusively from the WOSCC and SCI-E databases, and did not involve any animal or human subjects.

CRediT authorship contribution statement

Yang Xiao: Writing – original draft, Visualization, Software, Methodology, Formal analysis, Data curation, Conceptualization. **Yunkai Tao:** Validation, Software. **Yajiao Hu:** Visualization, Validation, Methodology. **Zhimin Liao:** Writing – review & editing, Supervision, Project administration, Investigation.

Declaration of competing interest

All authors declare that there are no conflicts of interest regarding the publication of this research.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.heliyon.2024.e36960.

References

[1] W. Camann, Pain relief during labor, N. Engl. J. Med. 352 (2005) 718–720, https://doi.org/10.1056/NEJMe048350.
[2] L. Matthews, G. Lim, Analgesia in pregnancy, Obstet. Gynecol. Clin. North Am. 50 (2023) 151–161, https://doi.org/10.1016/j.ogc.2022.10.016.
[3] S. Rowlands, M. Permezel, Physiology of pain in labour, Baillieres Clin. Obstet. Gynaecol. 12 (1998) 347–362, https://doi.org/10.1016/s0950-3552(98)80071-0.
[4] L. Jones, M. Othman, T. Dowswell, Z. Alfirevic, S. Gates, M. Newburn, S. Jordan, T. Lavender, J.P. Neilson, Pain management for women in labour: an overview of systematic reviews, Cochrane Database Syst. Rev. 2012 (2012) CD009234, https://doi.org/10.1002/14651858.CD009234.pub2.
[5] S. Zuarez-Easton, O. Erez, N. Zafran, J. Carmeli, G. Garmi, R. Salim, Pharmacologic and nonpharmacologic options for pain relief during labor: an expert review, Am. J. Obstet. Gynecol. 228 (2023) S1246–S1259, https://doi.org/10.1016/j.ajog.2023.03.003.
[6] J.A. Nanji, B. Carvalho, Pain management during labor and vaginal birth, Best Pract. Res. Clin. Obstet. Gynaecol. 67 (2020) 100–112, https://doi.org/10.1016/j.bpobgyn.2020.03.002.
[7] R.D. Vincent, D.H. Chestnut, Epidural analgesia during labor, Am. Fam. Physician 58 (1998) 1785–1792.
[8] K. Yu, Z. Ding, J. Yang, X. Han, T. Li, H. Miao, Bibliometric analysis on global analgesia in labor from 2002 to 2021, J. Pain Res. 16 (2023) 1999–2013, https://doi.org/10.2147/JPR.S416142.
[9] H. Zheng, B.-X. Zheng, X.-M. Lin, The trend of labor analgesia in the world and China: a bibliometric analysis of publications in recent 30 years, J. Pain Res. 13 (2020) 517–526, https://doi.org/10.2147/JPR.S232132.
[10] D.F. Thompson, C.K. Walker, A descriptive and historical review of bibliometrics with applications to medical sciences, Pharmacother. J. Hum. Pharmacol. Drug Ther. 35 (2015) 551–559, https://doi.org/10.1002/phar.1586.
[11] Y. Duan, P. Zhang, T. Zhang, L. Zhou, R. Yin, Characterization of global research trends and prospects on platinum-resistant ovarian cancer: a bibliometric analysis, Front. Oncol. 13 (2023) 1151871, https://doi.org/10.3389/fonc.2023.1151871.
[12] M.B. Synnestvedt, C. Chen, J.H. Holmes, CiteSpace II: visualization and knowledge discovery in bibliographic databases, AMIA Annu. Symp. Proc. AMIA Symp. 2005 (2005) 724–728.
[13] C. Chen, Searching for intellectual turning points: progressive knowledge domain visualization, Proc. Natl. Acad. Sci. U. S. A. 101 (Suppl 1) (2004) 5303–5310, https://doi.org/10.1073/pnas.0307513100.
[14] N.J. van Eck, L. Waltman, Software survey: VOSviewer, a computer program for bibliometric mapping, Scientometrics 84 (2010) 523–538, https://doi.org/10.1007/s11192-009-0146-3.
[15] M. Anim-Somuah, R.M. Smyth, L. Jones, Epidural versus non-epidural or no analgesia in labour, Cochrane Database Syst. Rev. (2011), https://doi.org/10.1002/14651858.CD000331.pub3. CD000331.
[16] L. Jones, M. Othman, T. Dowswell, Z. Alfirevic, S. Gates, M. Newburn, S. Jordan, T. Lavender, J.P. Neilson, Pain management for women in labour: an overview of systematic reviews, Cochrane Database Syst. Rev. 2012 (2012) CD009234, https://doi.org/10.1002/14651858.CD009234.pub2.

[17] K. Wang, J. Cai, R. Du, J. Wu, Global trends in research related to emergence delirium, 2012–2021: a bibliometric analysis, Front. Psychol. 14 (2023) 1098020, https://doi.org/10.3389/fpsyg.2023.1098020.

[18] M. Anim-Somuah, R.M. Smyth, A.M. Cyna, A. Cuthbert, Epidural versus non-epidural or no analgesia for pain management in labour, Cochrane Database Syst. Rev. 2018 (2018), https://doi.org/10.1002/14651858.CD000331.pub4.

[19] A. Chau, C. Bibbo, C.-C. Huang, K.G. Elterman, E.C. Cappiello, J.N. Robinson, L.C. Tsen, Dural puncture epidural technique improves labor analgesia quality with fewer side effects compared with epidural and combined spinal epidural techniques: a randomized clinical trial, anesth, Analg 124 (2017) 560–569, https://doi.org/10.1213/ANE.0000000000001798.

[20] M. Epsztein Kanczuk, N.M. Barrett, C. Arzola, K. Downey, X.Y. Ye, J.C.A. Carvalho, Programmed intermittent epidural bolus for labor analgesia during first stage of labor: a biased-coin up-and-down sequential allocation trial to determine the optimum interval time between boluses of a fixed volume of 10 mL of bupivacaine 0.0625% with fentanyl 2 μg/mL, Anesth. Analg. 124 (2017) 537–541, https://doi.org/10.1213/ANE.0000000000001655.

[21] G. Capogna, M. Camorcia, S. Stirparo, A. Farcomeni, Programmed intermittent epidural bolus versus continuous epidural infusion for labor analgesia: the effects on maternal motor function and labor outcome. A randomized double-blind study in nulliparous women, Anesth. Analg. 113 (2011) 826–831, https://doi.org/10.1213/ANE.0b013e31822827b8.

[22] P.D.W. Fettes, C.S. Moore, J.B. Whiteside, G.A. McLeod, J.a.W. Wildsmith, Intermittent vs continuous administration of epidural ropivacaine with fentanyl for analgesia during labour, Br. J. Anaesth. 97 (2006) 359–364, https://doi.org/10.1093/bja/ael157.

[23] C.A. Wong, J.T. Ratliff, J.T. Sullivan, B.M. Scavone, P. Toledo, R.J. McCarthy, A randomized comparison of programmed intermittent epidural bolus with continuous epidural infusion for labor analgesia, Anesth. Analg. 102 (2006) 904–909, https://doi.org/10.1213/01.ane.0000197778.57615.1a.

[24] Y. Lim, A.T.H. Sia, C. Ocampo, Automated regular boluses for epidural analgesia: a comparison with continuous infusion, Int. J. Obstet. Anesth. 14 (2005) 305–309, https://doi.org/10.1016/j.ijoa.2005.05.004.

[25] C. Li, C. Zhao, J. Zhao, M. Wang, F. Luo, J. Zhou, Global research trends of acupuncture therapy on cancer pain: a bibliometric and visualized study, Front. Oncol. 13 (2023) 1077961, https://doi.org/10.3389/fonc.2023.1077961.

[26] E.A. Greenwell, G. Wyshak, S.A. Ringer, L.C. Johnson, M.J. Rivkin, E. Lieberman, Intrapartum temperature elevation, epidural use, and adverse outcome in term infants, Pediatrics 129 (2012) e447–e454, https://doi.org/10.1542/peds.2010-2301.

[27] B. Zhao, B. Li, Q. Wang, X. Song, The relationship between epidural analgesia and intrapartum maternal fever and the consequences for maternal and neonatal outcomes: a prospective observational study, J. Matern.-Fetal Neonatal Med. Off. J. Eur. Assoc. Perinat. Med. Fed. Asia Ocean. Perinat. Soc. Int. Soc. Perinat. Obstet. 35 (2022) 5354–5362, https://doi.org/10.1080/14767058.2021.1879042.

[28] U.P. Dior, L. Kogan, S. Eventov-Friedman, M. Gil, R. Bahar, Z. Ergaz, S. Porat, R. Calderon-Margalit, Very high intrapartum fever in term pregnancies and adverse obstetric and neonatal outcomes, Neonatology 109 (2016) 62–68, https://doi.org/10.1159/000440938.

[29] E. Lieberman, J. Lang, D.K. Richardson, F.D. Frigoletto, L.J. Heffner, A. Cohen, Intrapartum maternal fever and neonatal outcome, Pediatrics 105 (2000) 8–13, https://doi.org/10.1542/peds.105.1.8.

[30] A. Petrova, K. Demissie, G.G. Rhoads, J.C. Smulian, S. Marcella, C.V. Ananth, Association of maternal fever during labor with neonatal and infant morbidity and mortality, Obstet, Gynecol. 98 (2001) 20–27, https://doi.org/10.1016/s0029-7844(01)01361-8.

[31] X. Chen, Y. Zhang, X. Ni, Z. Liu, Effects of labour analgesia with different concentrations of ropivacaine on maternal body temperature and inflammatory factor: a randomised controlled study, Anaesth, Crit. Care Pain Med. 41 (2022) 101030, https://doi.org/10.1016/j.accpm.2022.101030.

[32] S. Patel, S. Ciechanowicz, Y.J. Blumenfeld, P. Sultan, Epidural-related maternal fever: incidence, pathophysiology, outcomes, and management, Am. J. Obstet. Gynecol. 228 (2023) S1283–S1304.e1, https://doi.org/10.1016/j.ajog.2022.06.026.

[33] S. Shorey, C.Y.I. Chee, E.D. Ng, Y.H. Chan, W.W.S. Tam, Y.S. Chong, Prevalence and incidence of postpartum depression among healthy mothers: a systematic review and meta-analysis, J. Psychiatr. Res. 104 (2018) 235–248, https://doi.org/10.1016/j.jpsychires.2018.08.001.

[34] C.W. Tan, R. Sultana, H.Y. Chen, T. Chua, N. Rahman, M. Gandhi, A.T.H. Sia, B.L. Sng, The association between epidural labour analgesia and postpartum depression: a randomised controlled trial, Anaesthesia (2023) 16178, https://doi.org/10.1111/anae.16178 anae.

[35] D.E. Stewart, S. Vigod, Postpartum depression, N. Engl. J. Med. 375 (2016) 2177–2186, https://doi.org/10.1056/NEJMcp1607649.

[36] D.E. Stewart, S.N. Vigod, Postpartum depression: pathophysiology, treatment, and emerging therapeutics, Annu. Rev. Med. 70 (2019) 183–196, https://doi.org/10.1146/annurev-med-041217-011106.

[37] M. Mazza, G.D. Kotzalidis, C. Avallone, M. Balocchi, I. Sessa, I. De Luca, D. Hirsch, A. Simonetti, D. Janiri, E. Loi, G. Marano, G. Albano, V. Fasulo, S. Borghi, A. G. Del Castillo, A.M. Serio, L. Monti, D. Chieffo, G. Angeletti, L. Janiri, G. Sani, Depressive symptoms in expecting fathers: is paternal perinatal depression a valid concept? A systematic review of evidence, J. Pers. Med. 12 (2022) 1598, https://doi.org/10.3390/jpm12101598.

[38] E. Netsi, R.M. Pearson, L. Murray, P. Cooper, M.G. Craske, A. Stein, Association of persistent and severe postnatal depression with child outcomes, JAMA Psychiatr. 75 (2018) 247–253, https://doi.org/10.1001/jamapsychiatry.2017.4363.

[39] G. Lim, M.D. Levine, E.J. Mascha, A.D. Wasan, Labor pain, analgesia, and postpartum depression: are we asking the right questions? Anesth. Analg. 130 (2020) 610–614, https://doi.org/10.1213/ANE.0000000000004581.

[40] G. Lim, L.M. Farrell, F.L. Facco, M.S. Gold, A.D. Wasan, Labor analgesia as a predictor for reduced postpartum depression scores: a retrospective observational study, Anesth. Analg. 126 (2018) 1598–1605, https://doi.org/10.1213/ANE.0000000000002720.

[41] J. Mo, Z. Ning, X. Wang, F. Lv, J. Feng, L. Pan, Association between perinatal pain and postpartum depression: a systematic review and meta-analysis, J. Affect. Disord. 312 (2022) 92–99, https://doi.org/10.1016/j.jad.2022.06.010.

[42] O.V. Riazanova, Y.S. Alexandrovich, A.M. Ioscovich, The relationship between labor pain management, cortisol level and risk of postpartum depression development: a prospective nonrandomized observational monocentric trial, Romanian J. Anaesth. Intensive Care 25 (2018) 123–130, https://doi.org/10.21454/rjaic.7518.252.rzn.

[43] Z.-H. Liu, S.-T. He, C.-M. Deng, T. Ding, M.-J. Xu, L. Wang, X.-Y. Li, D.-X. Wang, Neuraxial labour analgesia is associated with a reduced risk of maternal depression at 2 years after childbirth: a multicentre, prospective, longitudinal study, Eur. J. Anaesthesiol. 36 (2019) 745–754, https://doi.org/10.1097/EJA.0000000000001058.

[44] N. Suzumori, T. Ebara, H. Tamada, H. Matsuki, H. Sato, S. Kato, S. Saitoh, M. Kamijima, M. Sugiura-Ogasawara, Japan environment, children's study group, relationship between delivery with anesthesia and postpartum depression: the Japan environment and children's study (JECS), BMC Pregnancy Childbirth 21 (2021) 522, https://doi.org/10.1186/s12884-021-03996-y.

[45] H.M.Y. Ahmad, L.A. Althagafi, G.Z. Alblluwe, S.M. Kadi, R.I. Alhassani, N.M. Bahkali, Association between the use of epidural analgesia during labour and incidence of postpartum depression, PLoS One 18 (2023) e0289595, https://doi.org/10.1371/journal.pone.0289595.