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Postoperative shivering: a bibliometric study

Asuman Çobanoğlu
Department of Fundamentals of Nursing, Faculty of Health Sciences, Giresun University, Giresun, Turkiye

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ABSTRACT

Aims: This study aimed to systematically review the current literature on postoperative shivering, analyze scientific publications on the subject, identify knowledge gaps in the field, and offer new perspectives that may guide clinical practice.
Methods: A descriptive and bibliometric analysis method was employed. The search was performed using the keywords "postoperative shivering*", "postoperative chills", and "postoperative." The study population consisted of 90 articles written on postoperative shivering in the "Web of Science" database. The study data were analyzed and illustrated using "VOSviewer".
Results: The first study on postoperative shivering was conducted in 1981. According to the Web of Science Citation Report, the average number of citations per publication was 18.27 for the 90 articles included in the analysis, with a total of 200 contributing authors. The author who published the highest number of articles on this subject was "Kazuhiro Shirozu" (n=5 article), the author who received the highest number of citations was "Kranke P" (188 citations), and the journals with the highest number of publications were "Anaesthesia" and "Anesthesia & Analgesia", with four articles each. The most frequently used keywords in publications on this subject were "shivering" (occurrences 79), "pethidine" (occurrences 25), and "postoperative" (occurrences 25).
Conclusion: In this study, it was determined that the number of publications on postoperative shivering has increased over the years and that there has been a significant increase in the number of citations in line with this increase. The growing interest in the clinical importance of postoperative shivering reveals the increasing demand for and awareness of scientific research in this field.
Keywords: Shivering, postoperative period, bibliometrics

INTRODUCTION

Postoperative shivering is a common complication following surgical interventions and can have clinically significant consequences. Postoperative shivering is defined as the re-elevation of the shivering threshold following the elimination of thermoregulatory inhibition caused by anesthesia and its return to normal levels (Lopez, 2018). Postoperative shivering depends on the type of anesthesia, perioperative care, and surgical procedure, and it has been reported to occur in 5% to 65% of cases of general anesthesia and 30% to 55% of cases of regional anesthesia (Abo-Zeid Salim et al., 2023; Liu et al., 2024). Although its etiology has not been fully elucidated (Hoshijima et al., 2016) it has been reported that numerous other causes and factors, such as cold-induced thermoregulation, reduced sympathetic activity, pain, elevated blood pressure and intracranial pressure, type of surgery and anesthesia, blood loss, respiratory alkalosis, and individual differences, may also contribute to postoperative shivering (Gupta et al., 2018; Khan et al., 2020; Rattanapittayaporn & Oofuvong, 2021; Shirozu et al., 2024). Furthermore, several studies have demonstrated that low body temperature significantly increases the risk of postoperative shivering (Aloysius et al., 2023; Rattanapittayaporn & Oofuvong, 2021). This finding is consistent with the increased incidence of postoperative shivering in patients for whom adequate intraoperative warming cannot be provided (Adinehmehr et al., 2018; Rattanapittayaporn & Oofuvong, 2021; Tu et al., 2023).

Postoperative shivering may appear as a thermoregulatory response to hypothermia or as clonic or tonic muscle contractions at different frequency ranges. Although this condition is a protective mechanism to increase body temperature, it can trigger various complications such as myocardial ischemia by increasing oxygen consumption and the risk of hypoxemia, increased wound pain, delayed wound healing, and impaired monitoring (Lopez, 2018; Tu et al., 2023; Zhang & Van Poucke, 2017). In addition, it can cause tension in surgical incisions, resulting in increased postoperative pain, increased intracranial pressure, and increased heart rate and arterial blood pressure. As a result, these pathophysiological changes increase the frequency of complications such as postoperative infection, bleeding, and pain, delay the recovery process, negatively affect patient comfort, and may prolong the length of hospital stay (Adinehmehr et al., 2018; Lopez, 2018).

***Corresponding Author:** Asuman Çobanoğlu, asuman.cobanoglu@giresun.edu.tr

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Various pharmacological and nonpharmacological methods are used for the prevention of postoperative shivering (Lopez, 2018; Nair et al., 2023). Heating the operating room, pressurized air heating systems, heating blankets, radiant devices, and infusion fluid warmers are considered the most effective approaches among nonpharmacological methods (Jain et al., 2018; Tu et al., 2023). In the "National Institute for Health and Care Excellence (NICE)" clinical guidelines, it has been emphasized that all patients undergoing surgical procedures should be warmed with a pressurized air heating system or heating blanket starting from anesthesia induction until the end of the operation (NICE, 2016). The pharmacological treatment often involves the use of opioid drugs, analgesics, and magnesium sulfate (Adinehmehr et al., 2018; Jain et al., 2018; Lopez, 2018). Although current practices and pharmacological treatments are effective in reducing shivering, their effectiveness may vary depending on the patient's characteristics, the type of surgery, and the anesthesia technique. Furthermore, the side effects of pharmacological agents and the inapplicability of nonpharmacological methods in every clinical condition pose a significant problem in this field. Therefore, identifying the subjects on which research is intensified, the relatively less studied areas, and the current knowledge gaps regarding postoperative shivering is of great importance in approaching the subject from a broad perspective. Although there is a considerable body of knowledge in the current literature regarding postoperative shivering, the lack of bibliometric analysis on the subject is noteworthy. This study aimed to systematically evaluate scientific publications related to postoperative shivering, fill gaps in the literature, and offer new perspectives that may guide clinical practice.

Research questions:

- What is the change in the number of publications on the subject over the years, and which journals publish the highest number of articles?
- Which countries, journals, and authors are the most effective in terms of the number of publications and citations?
- What are the most used keywords and collaborations?
- What are the fundamental research issues and thematic studies regarding the subject?

METHODS

In this study, the data were obtained from articles published in a database, and a bibliometric analysis of the articles was performed. Therefore, no ethics committee approval was necessary. All resources benefited from in the study are listed in the references section. The study was conducted in accordance with the relevant ethical principles and publication ethics standards.

The bibliometric data were analyzed, and bibliometric networks were constructed and visualized using VOSviewer software (version 1.6.19), developed by Nees Jan van Eck and Ludo Waltman at the Centre for Science and Technology Studies (CWTS), Leiden University, the Netherlands.

Analysis Process and Data Analysis

One of the first and most critical stages of bibliometric analysis is the choice of an appropriate database. In this study, the Web of Science (WoS) database was preferred due to its comprehensive and high-quality collection of literature. WoS has a wide range of content, including numerous peer-reviewed journals, scientific books, and other academic publications, and offers fast and reliable access to bibliometric metrics such as h-indexes and citation counts of authors. Due to these features, WoS is commonly used for bibliometric analyses and is recognized for its reliability (Çobanoğlu, 2024).

In the second stage of the analysis, data relevant to the research were selected from WoS and filtered according to specific criteria. Since bibliometric studies usually require the use of large data sets, the data set was limited to a specific time frame to ensure both the efficiency and validity of the search process. Such a limitation contributes to focused and manageable analysis results. The following search strategy was applied in the database using the Boolean keyword combination: ((TS=(postoperative shivering*) OR TS=(postoperative chills) AND TS=(postoperative)).

The bibliometric analysis included publication productivity, citation analysis, country and institutional contributions, collaboration networks, and keyword co-occurrence and temporal overlay analyses. VOSviewer (version 1.6.19) was used to construct and visualize the bibliometric networks. The analyses were based on bibliographic information, including authors, affiliations, publication years, citations, and keywords, retrieved from the Web of Science database. The resulting maps were interpreted according to the occurrence, citation, and link strength of the corresponding bibliometric units.

The step-by-step data collection process is presented in **Figure 1**, in which the inclusion and exclusion criteria used in the process are also illustrated. In the first step, a systematic search was performed in the database using keywords determined within the scope of the study (**Figure 1**). In this study, a search was conducted in the Web of Science (WoS) database using the predefined keywords, and a total of 145 publications were identified. The document type included in the scope of the research was limited to "article." Moreover, the language of the publications was specified as English, and the year of publication was limited to the range "1981-2025". According to the predefined inclusion and exclusion criteria applied during the filtering process, 90 publications were included in the analysis. The abstracts of the 90 publications were examined in detail, and the content containing the relevant keywords in the title and abstract of these studies was exported in .txt format on September 11, 2025. This file was uploaded to VOSviewer, one of the software programs for bibliometric analysis, to provide a visual representation of the analysis results. New studies added to the database after the data collection date were excluded from the evaluation. This approach is important in terms of ensuring consistency in the analysis and the validity of the study in terms of its timeframe.

RESULTS

A bibliometric analysis was performed on a total of 90 articles published between 1981 and 2025. It was determined that the first article on the subject was published in 1981. The mean

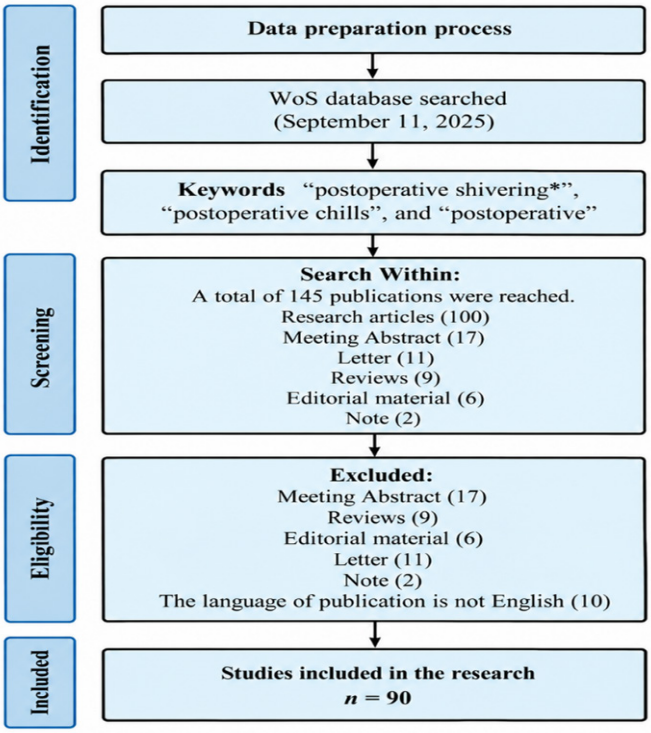


Figure 1. Publication selection flow diagram Web of Science
WoS: Web of Science

number of citations for the 90 articles included in the analysis was 18.27, and the total number of authors was 200 (Figure 2). Based on the publications examined, the mean number of co-authors per article was 5.14. In addition, the total number of keywords used in these articles was 80.

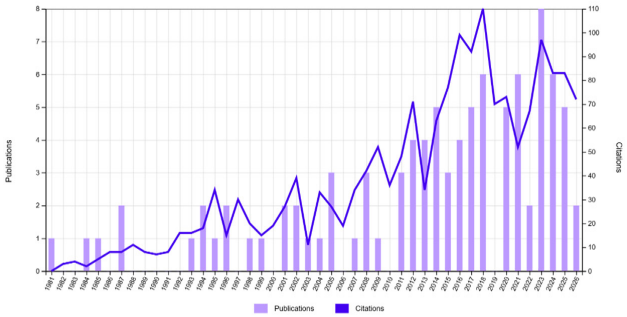


Figure 2. Number of publications and citations by years (1981-2025)

The number of articles published was 5 between 1981 and 1989, 8 between 1990 and 1999, 14 between 2000 and 2009, 34 between 2010 and 2019, and 29 between 2020 and 2025. The highest number of articles was determined in 2023, with a total of 8 articles. This was followed by 6 articles published in 2018, 2021, and 2024, and 5 articles published in 2014, 2017, and 2020 (Figure 2).

Most of the articles on the subject have been published in the journals "Anaesthesia" and "Anesthesia & Analgesia". The authors with the most publications and the top 10 journals in which the articles were published are listed in Table 1.

In Table 2, the top 10 countries with the highest number of publications and citations are listed. The author with the highest number of articles in the field was Kazuhiro Shirozu, with a total of 5 articles, who was followed by Ken Yamaura with 4 articles, and Di Sessler, Awa Crossley, and Kaoru Umehara, each with 3 articles (Table 1).

Table 2. Most productive and cited countries

Country name	Number of articles published n	Country name	Total citation
Iran	7	USA	410
Turkiye	6	Germany	233
Japan	6	Turkiye	221
USA	5	England	121
China	5	Switzerland	119
India	4	France	102
Germany	3	India	70
England	2	Austria	64
France	2	South Korea	52
South Korea	2	Iran	43

USA: United States of America

According to the table, Iran (7 articles) had the highest productivity, which was followed by Japan (6 articles), Turkiye (6 articles), China (5 articles), and the United States (5 articles). According to the citation rates among these countries, the United States had the highest number of citations (410 citations), which was followed by Germany (233 citations), Turkiye (221 citations), the United Kingdom (121 citations), and Switzerland (119) (Table 2).

Co-occurrence Keyword Analysis

In Figure 3, different colors were used to represent different words. The colors indicate the average publication year

Table 1. Top 10 journals in which the studies were published and the most productive authors

Journal name	Number of articles published n	Author name	Number of articles published n
Anaesthesia	4	Kazuhiro Shirozu	5
Anesthesia & Analgesia	4	Ken Yamaura	4
Therapeutic Hypothermia and Temperature Management	3	Di Sessler	3
International Journal of Advanced Biotechnology and Research	2	Awa Crossley	3
Southern African Journal of Anaesthesia and Analgesia	2	Kaoru Umehara	3
Journal of International Medical Research	2	Mahajan Rp	2
Journal of Anesthesia	2	Yu Zhu	2
European Journal of Anaesthesiology	2	Chengmao Zhou	2
British Journal of Anaesthesia	2	Emine Arzu Kose	2
Medicine	1	Didem Dal	2

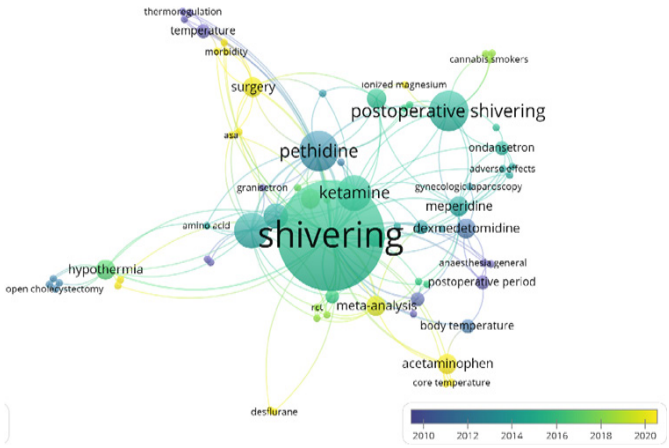


Figure 3. Keyword analysis

associated with each keyword. Among these circles, the four most important clusters determined by the number of elements they contained were "shivering" (cluster 79), "pethidine" (cluster 25), "postoperative" (cluster 25), and "ketamine" (Figure 3).

The "Overlay Visualization" technique was used in the VOSviewer software to display keywords in different colors corresponding to their publication year. The colors of the keywords were determined based on the time elapsed since their publication. In Figure 3, 2020 and later years are shown in yellow, earlier years darken from yellow to green, and 2010 is blue. Keywords used in articles published after 2020 were "acetaminophen, surgery, core temperature, ASA, desflurane, morbidity, recovery from anesthesia, meta-analysis, breast surgery, and flap" (Figure 3).

Citation Analysis (Journal, Author, Article, and Country)

Direct citations from one document to another are presented in the citation network analysis. An increase in the number of citations made to a document increases the strength of the citation network (Çobanoğlu, 2024). According to the Web of Science Citation Report, the total number of citing articles for the publications included in the bibliometric analysis was 1.088. According to the number of citations per year, the highest number of citations in the field was determined in 2018 (110 citations), followed by 2016 (99 citations) and 2023 (97 citations) (Figure 2).

The article titled "Postoperative hypothermia in adults: relationship of age, anesthesia, and shivering to rewarming" by Vaughan et al. in the journal "Anesthesia & Analgesia" was the most cited article in the field so far (176 citations). The second article was "Pharmacological treatment of postoperative shivering: a quantitative systematic review of randomized controlled trials" by Kranke et al. in the journal "Anesthesia & Analgesia" in 2002 (119 citations). The third article was The intensity of postoperative shivering is unrelated to axillary temperature by Crossley et al. in the journal "Anaesthesia" in 1994 (117 citations) (Table 3).

In bibliometric analysis, according to the citation analysis of journals by limiting the criteria to a minimum of one publication and one citation, it was determined that 32 out of 36 references met the threshold value. According to this analysis, the journal with the highest number of citations regarding postoperative shivering was the journal "Anesthesia & Analgesia" (4 articles and 391 citations). The second most cited journal was "Anaesthesia" (4 articles and 230 citations), and the third journal was "British Journal of Anaesthesia" (2 articles and 104 citations) (Table 3).

According to the citation analysis of publications related to postoperative shivering by limiting the criteria to at least one publication per author and at least one citation per publication, 180 out of 200 authors met the threshold value. The author with the highest number of citations was "Kranke P" from Duke University (2 articles and 188 citations), followed by "Vaughan RW" (1 article and 176 citations), "Vaughan MS" (1 article and 176 citations), "Cork RC" (1 article and 176 citations), and "Sessler Di" (3 articles and 171 citations) (Figure 4).

Table 3. The top 10 most cited articles, author, and journals

Article (author, year)	Total citation	Author	Total Citation	Journal	Total citation
Postoperative hypothermia in adults-relationship of age, anesthesia, and shivering to rewarming (Vaughan et al., 1981)	176	Kranke, P.	188	Anesthesia and Analgesia	391
Pharmacological treatment of postoperative shivering: a quantitative systematic review of randomized controlled trials (Kranke et al., 2002)	119	Vaughan, R. W.	176	Anaesthesia	230
The intensity of postoperative shivering is unrelated to axillary temperature (Crossley & Mahajan, 1994)	117	Vaughan, M. S.	176	British Journal of Anaesthesia	104
Effect of pethidine, fentanyl and morphine on postoperative shivering in man (Pauca et al., 1984)	102	Cork, R. C.	176	Acta Anaesthesiologica Scandinavica	102
Efficacy of prophylactic ketamine in preventing postoperative shivering (Dal et al., 2005)	83	Sessler, D. I.	171	European Journal of Anaesthesiology	90
Dexmedetomidine and postoperative shivering in patients undergoing elective abdominal hysterectomy (Elvan et al., 2008)	75	Crossley, A. W. A.	142	Anesthesiology	64
Independent risk factors for postoperative shivering (Eberhart et al., 2005)	69	Mahajan, R. P.	138	Annals of Thoracic Surgery	63
The effects of meperidine and sufentanil on the shivering threshold in postoperative patients (Alfonsi et al., 1998)	64	Tramèr, M. R.	119	Anaesthesia and Intensive Care	49
Suppression of shivering decreases oxygen-consumption and improves hemodynamic stability during postoperative rewarming (Zwischenberger et al., 1987)	63	Roewer, N.	119	International Journal of Medical Sciences	27
Tramadol for postoperative shivering: a double-blind comparison with pethidine (Bhatnagar et al., 2001)	49	Eberhart, L. H.	119	Korean Journal of Anesthesiology	25

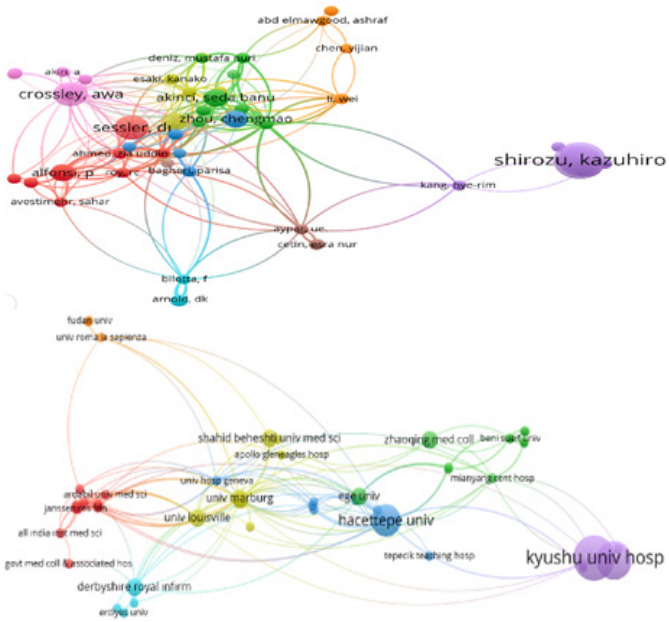


Figure 4. Citation analysis (author and organization)

According to the citation analysis of publications related to postoperative shivering by limiting the criteria to at least one publication per institution and at least one citation per publication, 52 institutions out of 64 met the threshold value. The institution with the highest number of citations was "Hacettepe University" (190 citations), followed by "Wurzburg University" (188 citations), "Marburg University" (188 citations), and "Arizona University" (176 citations) (**Figure 4**).

DISCUSSION

In this study, a bibliometric analysis of the 90 articles published between 1981 and 2025 was performed to reveal the current research on postoperative shivering. It was found that the first study on postoperative shivering was conducted in 1981, and that the number of studies on postoperative shivering has shown an increasing trend, especially in recent years. This suggests that this subject is attracting increasing interest and attention worldwide and that shivering is being recognized not only as a simple postoperative side effect but also as a clinical problem with significant effects on patient comfort, hemodynamic stability, and the recovery process. It can be suggested that the increase in research on postoperative shivering results from advances in surgical interventions, practices focused on patient comfort, patient satisfaction, education, and increased awareness.

According to the bibliometric findings, Iran, Japan, Türkiye, China, and the United States were among the most productive countries in postoperative shivering research. Differences in publication productivity may be associated with research capacity, institutional support, clinical priorities, and the availability of resources for perioperative care. However, publication volume should not be interpreted as a direct indicator of clinical burden or treatment preferences. In resource-limited settings, restricted access to equipment-intensive warming technologies and temperature-monitoring systems may influence research priorities, potentially increasing interest in pharmacological interventions (World Health Organization, 2018). Furthermore, the widespread use of spinal anesthesia in cesarean delivery may contribute to research focusing on the prevention and management of shivering in this patient population (Afzal et al., 2024). Nevertheless, these explanations remain hypothetical, as the bibliometric design does not establish causal relationships between national healthcare characteristics and research productivity.

Research findings revealed that the research networks between Germany and Iran and between Turkiye and South Korea were more collaborative than those between other pairs of countries. This indicates that these countries share a common interest in specific research areas and are mutually dependent, and that their scientific collaboration networks are relatively stronger and more productive. Such intense academic interactions enhance countries' research capacity and global scientific impact by increasing information exchange, joint publications, and international scientific visibility.

Research findings indicate that the highest number of publications on postoperative shivering were published in the journal "Anaesthesia". This demonstrates that the impact of postoperative shivering on anesthetic practices and its significance have been frequently emphasized in the literature. In addition, it reveals that the journal is a pioneering source in the field, attaching particular importance to relevant research. The contributions of the journal "Anaesthesia" to current literature on perioperative care and anesthetic practice clearly demonstrate its central role in the generation of knowledge in the field. The studies with the highest number of citations on postoperative shivering have been published in journals with high impact factors in the field, such as "Anesthesia & Analgesia" and "Anaesthesia". The study conducted by Vaughan et al. (1981) provided clinically important information by examining the relationship between postoperative hypothermia and age, type of anesthesia, and shivering, and it laid the foundation for the subsequent research (Vaughan et al., 1981). In the systematic review performed by Kranke et al. (2002), the results of randomized controlled trials on pharmacological treatments for postoperative shivering were presented comprehensively, guiding both clinical practice and further research (Kranke et al., 2002). In the study of Crossley & Mahajan (1994), it was demonstrated that the severity of shivering is not associated with axillary temperature, indicating that shivering cannot be reduced solely to body temperature (Crossley & Mahajan, 1994). The high number of citations for these three studies indicates that postoperative shivering is not only a clinical symptom but has also been addressed as a multidisciplinary issue concerning anesthetic practice and patient safety. In addition, it demonstrates that researchers have used the pathophysiological dimension (Vaughan et al., 1981) and treatment approaches (Kranke et al., 2002) as well as measurement and assessment methods (Crossley & Mahajan, 1994) as fundamental reference points. These findings therefore demonstrate that research on postoperative shivering has evolved from descriptive studies to evidence-based treatment recommendations.

According to research findings, the most frequently used keywords in studies on postoperative shivering were 'shivering', 'pethidine', and 'postoperative'. This indicates that postoperative shivering has been considered a clinically significant problem in the relevant literature, and pethidine has been highlighted as a treatment approach. The abundance

of studies in which the effectiveness of pethidine and other analgesics on shivering in the postoperative period has been examined (Geresu & Betelihem, 2021; KamailPour & AvestiMehr, 2019; Khan et al., 2020; Saheban Maleki et al., 2021), and the fact that pethidine has been intensively preferred in studies aimed at preventing shivering seen after spinal anesthesia (Afzal et al.,2024; Girma et al., 2022; Ramanathan et al., 2022; Rao & Shankar, 2019) and childbirth (Afzal et al., 2024; Agamia et al., 2020; Gholami et al., 2018; Gupta et al., 2018), has led to the emergence of this drug as a key concept in the relevant literature. The prominent occurrence of 'pethidine' in the co-occurrence network may underscore a notable gap between clinical practice in resource-limited settings and contemporary evidence-based guidelines advocating opioid-sparing recovery strategies. Furthermore, the temporal overlay analysis indicates a distinct shift after 2020, with research attention progressively moving away from conventional opioid monotherapy toward non-opioid pharmacological options, such as intravenous acetaminophen, proactive core temperature monitoring, and systematic meta-analyses. This evolution reflects a growing emphasis on multidisciplinary and preventive thermal care rather than reactive symptom management.

In the literature, the use of drugs such as pethidine, fentanyl, tramadol, ketamine, and acetaminophen has been shown to be beneficial as pharmacological treatment for preventing postoperative shivering (Amsalu et al., 2022; Hameed et al., 2022; Shirozu et al., 2024; Zhou et al., 2019). Therefore, this finding indicates that research has focused on both symptom management and the development of clinical practices. Nevertheless, the bibliometric prominence of pethidine should not be interpreted as evidence that it represents the preferred contemporary strategy for perioperative shivering management. This distinction is important because research trends may reflect historical clinical practice and the continued investigation of an established drug rather than current guideline priorities. Evidence indicates that intrathecal pethidine can reduce the incidence and severity of post-spinal shivering during cesarean delivery, but it is also associated with increased risks of adverse effects such as pruritus and vomiting (Afzal et al., 2024). Contemporary perioperative recommendations increasingly emphasize normothermia, active warming, and multimodal, opioid-sparing approaches rather than reliance on a single opioid-based intervention (NICE, 2016; Oodit et al., 2022). At the same time, resource-limited settings may face barriers to the routine implementation of equipment-dependent warming strategies, and pharmacological options therefore remain relevant in clinical research and practice (Amsalu et al., 2022; World Health Organization, 2018). Thus, the high frequency of pethidine in the literature may represent a tension between an established, readily studied pharmacological intervention and the evolving emphasis of contemporary perioperative care on multimodal and opioid-sparing strategies. Future research should therefore evaluate pethidine alongside non-pharmacological warming and opioid-sparing alternatives, with particular attention to effectiveness, adverse effects, feasibility, and resource requirements across different healthcare settings.

Limitations

The study may not cover all studies related to postoperative shivering published in other databases, as it was based only on articles indexed in the WoS database. In addition, the search of the database on September 11, 2025, may have caused a temporal bias, as studies published or indexed later than this date were not included in the analysis. Another limitation of the study was the inclusion of articles with the document type of "article," publication language of "English," and publication year of "1981-2025." Therefore, the results of the study may not reflect all studies conducted in this field.

CONCLUSION

This bibliometric study provides an overview of the scientific literature on postoperative shivering published between 1981 and 2025, identifying major publication trends, influential authors, journals, countries, and emerging research themes. The findings indicate increasing research activity over time, with particular emphasis on pharmacological interventions and anesthesiology-related studies. The prominence of pethidine in the keyword analysis reflects its substantial representation in the literature, while more recent research themes highlight growing attention to non-opioid interventions, core temperature monitoring, and evidence synthesis.

The findings also suggest opportunities for future research focusing on nursing-led interventions, non-pharmacological warming strategies, and interdisciplinary approaches to postoperative shivering prevention and management. Further multicenter and methodologically rigorous studies are needed to evaluate the effectiveness, feasibility, and safety of these interventions across different clinical settings. Integrating evidence-based temperature monitoring, early assessment of shivering, and preventive warming measures into perioperative nursing protocols and professional education may contribute to improved patient comfort, safety, and postoperative recovery.

ETHICAL DECLARATIONS

Ethics Committee Approval

In this study, the data were obtained from articles published in a database, and a bibliometric analysis of the articles was performed.

Informed Consent

Since this study is a bibliometric study, informed consent is not required.

Peer Review Process

This manuscript was subject to external peer review.

Conflict of Interest

The author declares no conflicts of interest related to this study.

Financial Disclosure

The author received no financial support for the conduct or publication of this research.

Author Contributions

The author is solely responsible for the conception, data collection, analysis, and writing of this manuscript.

Data Availability Statement

The bibliometric data analyzed In this study were retrieved from the Web of Science Core Collection on September 11, 2025. The dataset comprises bibliographic records of 90 articles published between 1981 and 2025. The bibliometric data used for the analyses may be made available by the corresponding author upon reasonable request, subject to the data-sharing and licensing conditions of Web of Science.

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