



GLOBAL BIBLIOMETRIC ANALYSIS OF POSTOPERATIVE COGNITIVE DYSFUNCTION (POCD) IN ANESTHESIA: MAPPING RISK FACTORS AND RESEARCH TRENDS

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ABSTRACT

Postoperative Cognitive Dysfunction (POCD) is a post surgical cognitive disorder and is at risk of worsening quality of life and triggering dementia. This study aimed to conduct a bibliometric analysis of scientific publications on postoperative cognitive dysfunction (POCD) published between 2014 and 2024. The analysis examined annual publication trends, the distribution of contributing countries and institutions, types of documents, publishers, and the most frequently occurring keywords, including “postoperative cognitive dysfunction,” “anesthesia,” “risk factors,” and “POCD,” based on data retrieved from the Scopus database. This study was conducted using data from the Scopus database, analysed with the help of the Publish or Perish, PRISMA flowchart, and VOS viewer tools to visually map patterns and relationships between keywords. A total of 254 articles were identified, of which 182 articles were included in the analysis. Publication trends showed a consistent increase, peaking in 2024 with 28 papers. China (53.3%) and the United States (15.3%) were the leading contributors, followed by Japan, Germany, and the United Kingdom. Most publications were original research articles (73.1%), indicating a dominance of empirical investigations. The most active journals included Frontiers in Aging Neuroscience, BMC Anesthesiology, and Neuroscience. Keyword mapping revealed five major clusters: (1) anesthesia and surgery type, (2) neuroinflammation mechanisms, (3) aging and cognitive impairment, (4) biomarkers and pharmacological interventions, and (5) postoperative care. Recent trends (2021–2024) show a shift from descriptive to mechanistic and evidence-based studies. However, research gaps persist in the areas of digital biomarkers, psychosocial factors, long-term outcomes, and younger populations. Based on data, POCD research trends have been consistently developing and showing maturity in terms of clinical and methodological approaches.

Keywords: anesthesia; bibliometrics; perioperative care; postoperative cognitive dysfunction; risk factors

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INTRODUCTION

Post operative cognitive dysfunction (POCD) is a common postoperative complication in the elderly, marked by impaired memory, focus, and thinking speed, and may progress to dementia or Alzheimer's (D. Chen et al., 2023; Zhao et al., 2024). As the number of elective surgeries in the elderly population increases worldwide, attention to POCD in clinical practice and academic research continues to grow (Huang et al., 2025). Despite the growing interest in the topic of POCD, there has been no comprehensive scientific mapping of the dynamics of global publications in this field (Mi et al., 2021). The existing literature is generally narrative or systematic, but rarely explores trends, collaborations between researchers, institutions, or influential journals (S. Chen et al., 2020; Wu et al., 2025). In addition, the absence of a standard nomenclature to define POCD is an obstacle to the preparation of robust meta-analyses and systematic reviews (Sinderen et al., 2020; Zhao et al., 2024). As a result, understanding the development of POCD research quantitatively and bibliometrically is still limited (X. Liu et al., 2025). In addition, bibliometrics can also identify the most influential works (highly cited papers) and journals that are the center of POCD publications (Mi et al., 2021).

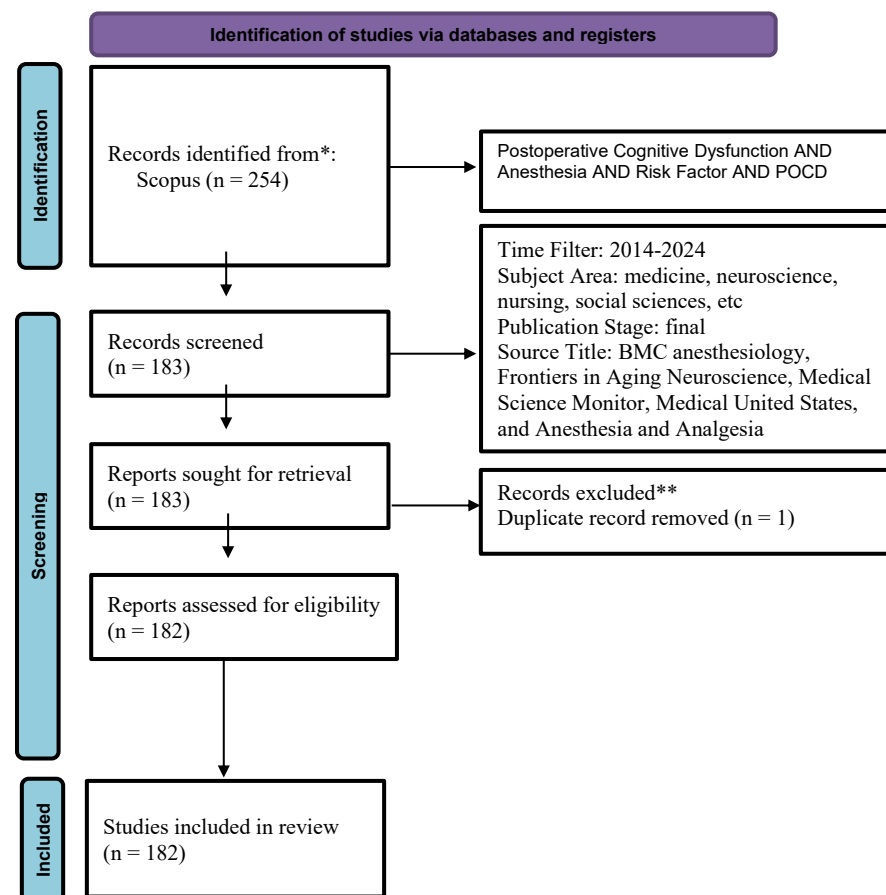
Therefore, this study aims to conduct a bibliometric analysis of the global literature on POCD in the last one decades (2014–2024), focusing on publication trends, most productive authors and institutions, dominant keywords, collaboration networks, and most influential journals. The results of this analysis are expected to provide a holistic picture of the scientific map of POCD, identify unexplored research gaps, and guide the direction of future research and clinical interventions. This study aimed to systematically map and evaluate global research trends on POCD in the context of anesthesia by identifying publication growth, key contributors, research hotspots, and emerging themes.

METHOD

Study Design

In this study, bibliometric analysis is employed as the primary method, representing a quantitative approach that utilizes statistical and mathematical techniques to evaluate patterns of relationships and linkages among studies within a specific field of research (Kilinc, 2024). Bibliometric analysis provides an objective and structured approach to exploring patterns within the knowledge structure of a field, identifying key themes and emerging trends, detecting various issues and challenges, and ultimately contributing to the advancement of knowledge in that field (Passas, 2024).

Data Collection and Analysis



Picture 1. PRISMA Flowchart

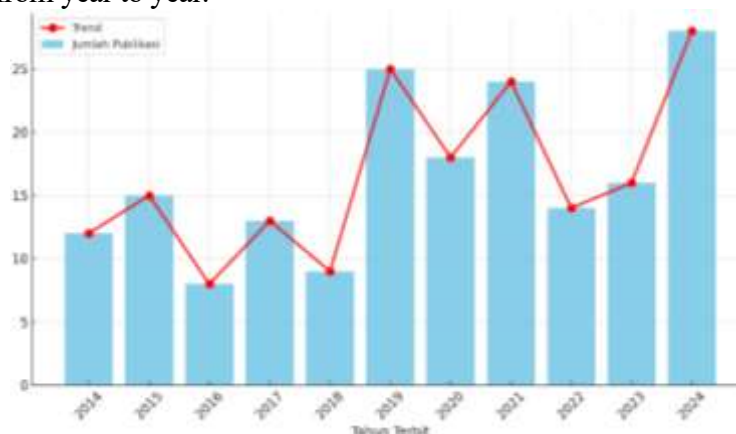
This research method uses data collection through the Publish or Perish (PoP) application in the period 2014–2024. Data searches focused on articles containing the keywords "Postoperative Cognitive Dysfunction", "Anesthesia", "Risk factor", and "POCD" available in the Scopus database. After conducting the search using those keywords and applying the publication year filter, a total of 182 articles were identified. The document screening and selection procedures followed the PRISMA 2020 framework, with the article inclusion flow presented in Picture 1. This systematic screening

process ensures that the methodology employed is transparent and replicable in identifying the most relevant academic literature within the related field. Filtering bibliographic sources also uses supporting Rayyan tools for screening to view the similarity and delete duplicate publications. The selected data was exported in RIS format and also analyzed using VOSviewer to map the relationship between bibliometric elements such as annual trends, distribution of countries and institutions, types of publications, publishers, and keywords. The analysis used the full counting method to calculate the occurrence of keywords with relevance above 60%, resulting in 35 main terms. The visualizations used include Network Visualization, Overlay Visualization, and Density Visualization to illustrate connections, temporal developments, and research density in the fields of POCD and anesthesia.

RESULT

Publication Year

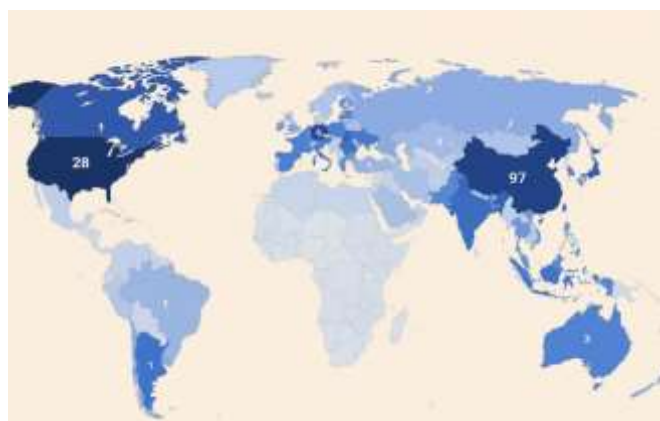
Based on the graph produced, it can be seen that the number of publications related to POCD and anesthesia fluctuates from year to year.



Picture 2. Publication Trends by Year of Publication

Between 2014–2018, the number of publications was relatively stable with a small spike in 2015 (15 articles). 2019 was a turning point with a significant increase to 25 publications, indicating an increasing interest in POCD research as science and medical awareness developed. After that, publications remained high with small variations, namely 18 in 2020 and 24 in 2021, focusing on anesthetic therapy and postoperative cognitive impairment management. The year 2024 recorded the highest number, namely 28 articles, indicating an increasing interest and new findings in the POCD and anesthesia literature. Overall, there is an increasing trend in publications reflecting a response to the need for research related to modern anesthetic techniques and postoperative patient care.

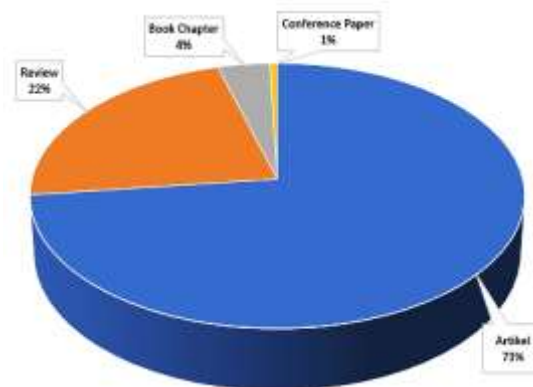
Country of Issue



Picture 3. Distribution of Publications by Country of Issue

The largest contribution came from China with a total of 97 publication. Analysis of POCD publication trends shows China's dominance with 97 out of 182 articles, followed by the United States (28), Japan (8), and Germany (6). Other countries such as the United Kingdom, India, Turkey, and Poland are also active, although in smaller numbers. Contributions from Europe, Asia, and Oceania, including countries such as Ukraine, the Netherlands, Australia, and Indonesia, reflect the growing global interest. These findings indicate that POCD is becoming an international health issue with major attention from Asian countries, especially China, as well as increasing global awareness of the importance of research in the field of anesthesia and postoperative cognitive impairment.

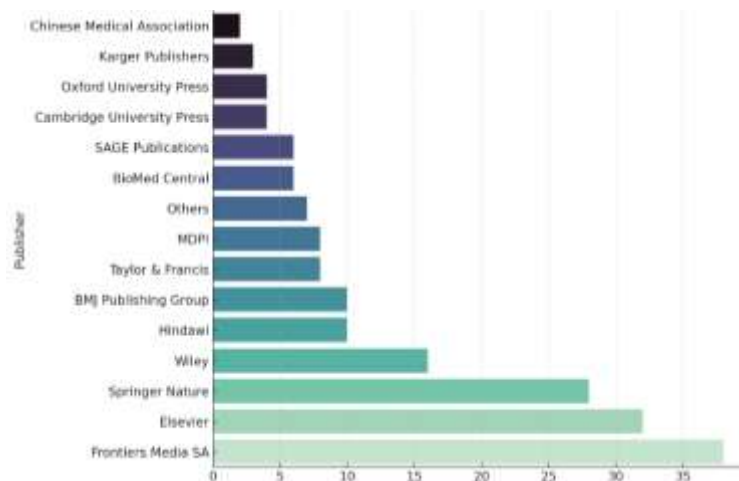
Publication Type



Picture 4. Distribution by Publication Type

Of the total 182 publications, scientific articles dominate with 133 publications, indicating researchers' preference for this format as the primary medium for conveying research results in depth and systematically. Of the 182 publications on POCD and anesthesia, 73.1% were scientific articles, indicating a predominance of empirical approaches. Reviews comprised 22.5%, reflecting the need for data synthesis. Book chapters (3.8%) and conference papers (0.5%) were still minimal, indicating a primary focus on reputable journals and systematic research.

Publisher



Picture 5. Distribution of Publications by Publisher

Publication distribution shows that the topic of POCD and anesthesia is widely published by a variety of global publishers focused on medical science, neuropsychology, and anesthesiology, reflecting the diversity and dynamics in the scientific ecosystem. Mapping shows that the topic of Postoperative Cognitive Dysfunction (POCD) is cross-disciplinary, involving neurology, geriatrics, and anesthesiology. Research is spread across journals with a trend towards open access publication, which encourages wider dissemination of knowledge. Although major publishers such as Elsevier, Springer Nature, and Frontiers are still dominant, the

emergence of alternative publishers such as MDPI and Hindawi reflects a more inclusive and adaptive publishing system. This diversity reflects the global contribution to the development of medical knowledge related to POCD.

Open Access Publisher Domination

Frontiers Media SA is the leader with 38 publications. This dominance shows researchers' preference for open access offered by Frontiers. Journals such as Frontiers in Aging Neuroscience and Frontiers in Neuroscience dominate because they offer space for interdisciplinary publications involving geriatrics, neurocognition, and anesthesia.

Strengths of Elsevier and Springer Nature

Elsevier and Springer Nature, with 32 and 28 publications respectively, have made major contributions in terms of quality and reputation. Journals such as BMC Anesthesiology (Springer) and Neuroscience (Elsevier) offer a high-standard platform for both empirical and review publications.

The Role of Clinical Medicine Publishers

Wiley and BMJ Publishing Group play a role in providing evidence-based medicine journals, which are highly relevant in the fields of anesthesiology and surgery. BMJ publications, for example, are oriented towards direct clinical impact and health policy, making the research results from this journal an important reference in hospital anesthesia practice.

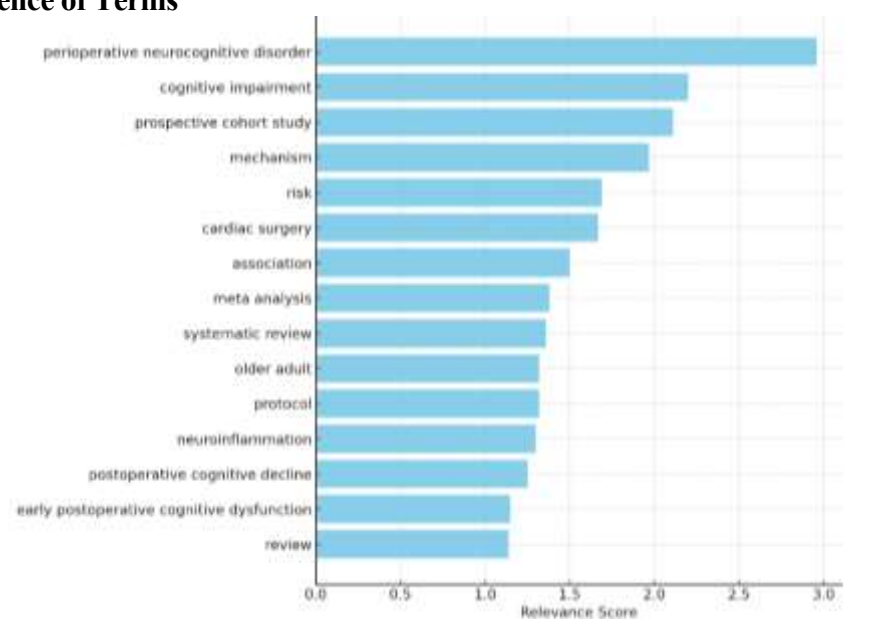
The Rise of Alternative Open Publishers

Publishers such as MDPI, Hindawi, and Taylor & Francis have also shown significant growth, especially in the last decade. They offer fast review processes and open access, which are attractive to researchers from developing countries who want to publish early findings or experimental studies on POCD.

Global Distribution and Diversification of Knowledge

The presence of a number of national and regional institutional publishers (such as the Chinese Medical Association, Turkish Journal of Medical Sciences, and Indian Journal of Anaesthesia) shows that the topic of POCD is not only a concern of developed countries, but has become a global concern. This also indicates the increasing awareness and capacity of local research on postoperative cognitive complications.

Article Occurrence of Terms

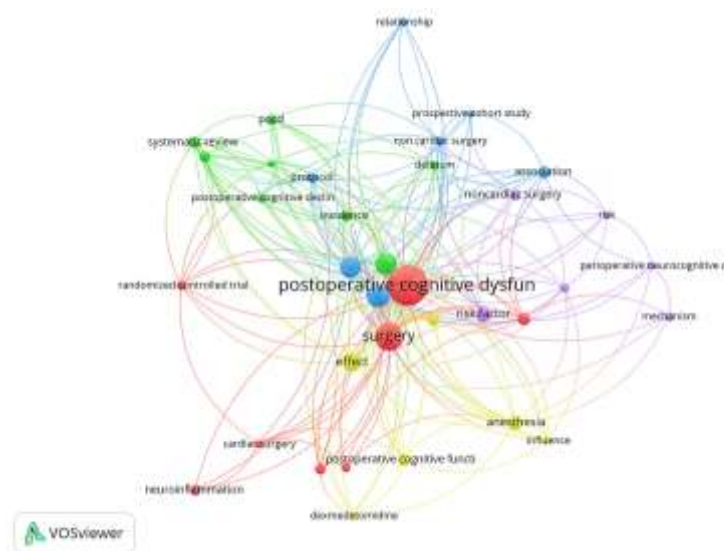


Picture 6. Relevant Keywords

Keyword analysis of POCD publications showed a strong focus on clinical, methodological, and pathophysiological aspects of postoperative cognitive impairment. The term “postoperative cognitive dysfunction” appeared most frequently (84 times), confirming it as a major theme of the study. Other keywords such as postoperative cognitive function, postoperative cognitive decline, and early POCD reflect the temporal variation of this disorder, while the terms elderly patient and older adult indicate that the elderly are the most studied population.

Research on POCD has highlighted major surgery such as cardiac and noncardiac surgery as a major risk factor (Huang et al., 2025; Yang et al., 2022). The scientific approach used is robust, dominated by systematic reviews, meta-analyses, and randomized controlled trials. The main focus includes risk factors, biological mechanisms such as neuroinflammation, and associations with neuropsychiatric disorders such as delirium and cognitive impairment. The term dexmedetomidine appears frequently, indicating interest in pharmacological strategies for postoperative cognitive protection. The presence of terms such as protocol, association, and relationship emphasizes that causal and correlational relationships continue to be explored. Overall, POCD research is multidisciplinary and highly relevant to modern clinical practice, especially with the increasing elderly population and the number of major surgery.

Network Visualization

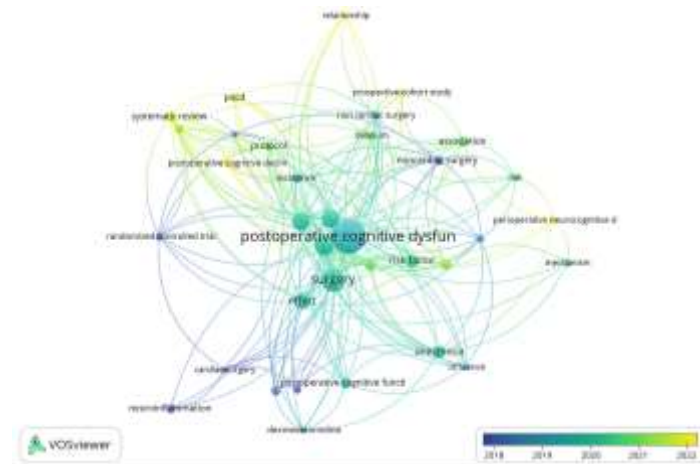


Picture 7. Publication Network Visualization Overview

Network visualization with VOSviewer shows the interrelationship of terms that frequently appear in POCD publications, forming several intersecting thematic clusters. Bibliometric analysis identified several major clusters in POCD research. The red cluster is central with the term “postoperative cognitive dysfunction” and related keywords such as “surgery,” “cardiac surgery,” “neuroinflammation,” and “dexmedetomidine,” indicating a focus on surgical interventions and inflammatory mechanisms tested through randomized controlled trials. The green cluster highlights evidence-based approaches such as “systematic review” and “meta-analysis,” with particular attention to the elderly population as a vulnerable group. Meanwhile, the blue cluster contains observational terms such as “prospective cohort study,” “delirium,” and “noncardiac surgery,” indicating a broader focus on POCD risk factors beyond cardiac surgery. The yellow cluster emphasizes preventive aspects with keywords such as “risk factor,” “anesthesia,” and “postoperative cognitive function,” which are closely related to evaluating the impact of clinical interventions. The purple cluster highlights the theoretical and biological dimensions, with terms such as “mechanism” and “perioperative neurocognitive disorder,” reflecting a deeper understanding of the pathophysiology and the development of terminology in the field.

These findings underscore the need to expand the scope of POCD research into technological, social, temporal, and demographic dimensions to produce a more comprehensive and relevant understanding in the future.

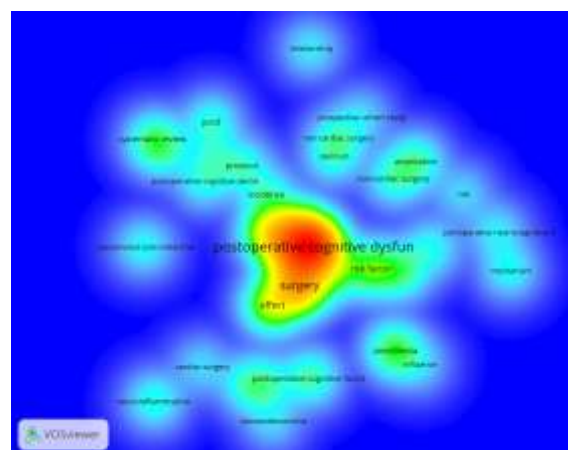
Overlay Visualization



Picture 8. Publication Visualization Overlay Overview

VOSviewer overlay visualization shows the development of POCD research trends from 2018 (blue) to 2022 (yellow). The node size represents the keyword frequency, while the color shows the average year of occurrence. Overlay visualization shows the shift in focus of POCD research since 2018, from issues related to anesthesia and cardiac surgery to evidence-based approaches such as systematic reviews and prospective cohort studies. The topic has also expanded to non-cardiac surgery, although risk factors remain a major concern. A decline in interest was seen in studies of biological mechanisms and specific pharmacological therapies. These results reflect the maturity of POCD research, which now places greater emphasis on methodological validity. However, the analysis also reveals research gaps, such as the lack of integration of advanced technologies (neuroimaging, machine learning), lack of exploration of psychosocial aspects, and limited age range of respondents. These findings open up opportunities for the development of more innovative, multidisciplinary, and inclusive POCD research.

Density Visualization



Picture 9. Publication Network Visualization Overview

This density map visualization image from VOSviewer presents an overview of research intensity on the topic of POCD based on keywords that frequently appear in scientific publications. Bibliometric visualization with VOSviewer shows that Postoperative Cognitive Dysfunction (POCD) and surgery are the focus of attention in the literature, supported by keywords such as risk factor, anesthesia, neuroinflammation, and cardiac surgery. This reflects the research focus on risk factors and biomedical aspects of postoperative care. Although approaches such as systematic reviews and randomized controlled

trials are emerging, they are not yet dominant. The analysis also reveals research gaps, such as low utilization of the latest technologies (e.g. digital biomarkers and AI-based neuroimaging), lack of studies on psychosocial dimensions (e.g. mental health and social support), and limited studies on young age groups and long-term effects of POCD. These findings highlight the need for more comprehensive and multidisciplinary.

Table 1.
Descriptive General Data of Included Studies

General Information About Data	Results
Time Interval	2014:2024
Sources (article, review, book chapter, etc)	182
Document	254
Annual Growth Rate %	0,5
Average Number of Citations per Document	27,8
Authors	160
Coauthors per Document	1,2

DISCUSSION

This study aims to identify general patterns in research related to POCD, including the countries, journals, publications, and authors that have made the greatest contributions, as well as the dynamics of the intellectual, conceptual, and social structure within this field (Kilinc, 2024). The analysis includes 182 scientific publications obtained from the Scopus database. To provide a systematic, objective, and comprehensive review of POCD-related research, the data were analyzed using Bibliometric and VOSviewer software, supported by visual mapping techniques to present the overall performance along with the intellectual, conceptual, and social structures of the field (Passas, 2024). This analysis was further complemented by the application of the PRISMA protocol and the use of the Rayyan tool to remove duplicate documents. The findings demonstrate that POCD research has gained significant momentum in the last decade, reflecting heightened awareness of postoperative neurological complications among elderly populations. The dominance of China and the United States highlights strong government and institutional investment in neurocognitive research.

Based on the analysis of country contributions, several countries with the highest number of publications in POCD research include China and the United States. The dominance of these countries can be attributed to advances in anesthesiology, neuropsychology, and the growing attention to postoperative cognitive complications due to the high burden of surgical procedures among the elderly population. For instance, China and the United States have shown rapid growth in POCD related publications in line with the increasing number of major surgeries and the rising focus on aging research.

The network visualization revealed five main research clusters, indicating an evolving focus from clinical characterization toward biomolecular and neuroinflammatory mechanisms. Similar to bibliometric patterns in anesthesia-related cognitive studies, the emphasis on biomarkers and inflammation suggests a transition from observational to translational research. However, most studies remain observational, there is a need for prospective and interventional studies addressing mechanisms and prevention of POCD. This bibliometric analysis contributes to identifying key research gaps, such as the limited exploration of postoperative rehabilitation strategies and long-term cognitive outcomes.

CONCLUSION

Bibliometric analysis shows a significant increase in research on POCD in the past decade. China and the United States are the main contributors, with publications spread across reputable journals such as BMC Anesthesiology, Frontiers in Aging Neuroscience, and PLoS ONE. Most of the articles are original research and systematic reviews, reflecting a focus on theory development and

scientific evaluation of POCD. Keyword analysis reveals a shift from a procedural approach to data-driven risk analysis, indicating methodological progress. However, research still focuses on postoperative risks and outcomes, while exploration of cutting edge technologies such as digital biomarkers, AI-based neuroimaging, and psychosocial aspects and non-elderly populations is limited. Longitudinal studies on the long-term impact of POCD are also limited. These findings emphasize the need for an interdisciplinary approach that integrates clinical, psychosocial, and advanced technological aspects to develop more comprehensive and adaptive POCD management strategies that meet the demands of modern medical practice.

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