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Original Article

Recent update on cerebral sparganosis: A bibliometric analysis and scientific mapping

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Abstract

Human sparganosis, a parasitic infection prevalent in Asia, can progress to cerebral sparganosis, a severe condition with significant neurological symptoms. Diagnosis and treatment are challenging due to its clinical similarity to other infections, highlighting the need for improved detection and management strategies. The aim of this study was to observe research trends, key contributors, gaps in the existing knowledge, diagnosis challenges, effective treatment options, and prevention strategies, providing recommendations for future research directions and clinical practice improvements on cerebral sparganosis. A bibliometric analysis was conducted by extracting 139 documents from the Scopus database in June 2024. The retrieved data were analyzed using the R package's Bibliometrix (Biblioshiny) and VOSviewer. Spanning 97 different sources, the research exhibited an annual growth rate of 2.5%. Annual scientific production revealed fluctuating research activity with peaks in 2010 and 2011 and notable citation peaks in 1996 and 2005, indicating pivotal studies that significantly influenced subsequent research. Early studies focused on diagnosis and specific parasites, while recent studies (2010–2024) have increasingly addressed clinical outcomes, treatment strategies, and advanced diagnostic techniques. Trends revealed a shift towards clinical and diagnostic advancements, with recent emphasis on diagnostic imaging, immunoassays, and the relationship between cerebral sparganosis and brain tumors. In conclusion, the studies on cerebral sparganosis underscore the potential for enhancing clinical practice by improving diagnostic accuracy, informing treatment decisions, and implementing targeted screening efforts based on epidemiology and risk factors. Recommendation to further study needs to notify the cerebral sparganosis in high-risk countries with similar socioeconomic and cultural characteristics to endemic regions, including Indonesia.

Keywords: Bibliometrics, parasitic diseases, helminthiasis, sparganosis, *Spirometra*

Introduction

Human sparganosis is a parasite infection mainly observed in Asia, where China accounted for almost 80% of recorded cases, followed by Korea and Thailand [1,2]. Humans contract the disease through the ingestion of contaminated water, undercooked snake or frog meat, or by utilizing raw flesh in traditional poultices that contain plerocercoid or procercoid larva (sparganum) of tapeworms of the genus *Spirometra* [3,4]. The culture of consuming raw food infected with sparganosis is a significant risk factor for the transmission of the disease in several parts of Asia,

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particularly in China and Indonesia. Many people in southern China consume raw frog flesh as part of their traditional diet, which increases the risk of sparganosis transmission. In Indonesia, high prevalence rates of sparganosis are observed in relation to local wild animals, especially snakes and wild frog meat sold from food stalls [5,6]. The sparganum infiltrates the central nervous system (CNS) through the foramen magnum, invading both brain parenchyma and subarachnoid space, manifesting into cerebral sparganosis [7]. Locally, cerebral sparganosis occurs in 13.5% of the population in Thailand; meanwhile, in China, the diagnosis is made in 12.4% of the population [8,9]. However, limited data is available regarding the global distribution of cerebral sparganosis, giving a chance of misdiagnosed or underdiagnosed cases of cerebral sparganosis [2,10,11]. Despite its clinical significance, research on cerebral sparganosis remains fragmented and limited, posing difficulties for healthcare professionals in terms of diagnosis, treatment, and management.

The diagnostic procedure of cerebral sparganosis is challenging due to similarities in clinical and imaging features with other parasitic infections [2]. Cerebral sparganosis presents various devastating neurological symptoms, including confusion, headache, fatigue, limb weakness, loss of consciousness, fever, paresthesia, and sensory disturbance [7,12,13]. As the disease progresses, cerebral sparganosis could lead to the formation of granuloma lesions as a result of a chronic inflammatory response to the expanding infection to the cerebrum, manifesting into refractory seizures [14]. Computed tomography (CT) scan, and magnetic resonance imaging (MRI) could provide diagnostic clues, such as the tunnel sign or bead-shaped enhancement, primarily located on the border between the white and gray matter of the frontal and parietal lobes and the centrum semiovale. However, cerebral sparganosis is often mistaken as a dysembryoplastic neuroepithelial tumor (DNET), glioma, or a cerebral abscess regarding the lesion frequently manifests in space-occupying foci with enhancement, edema, and mass effects on CT or MRI [2,14]. Light microscope analysis of the excised tissue could demonstrate the distinctive features of *Spirometra* larva, such as the transverse fold and depression near the scolex.

Additionally, molecular sequencing of the mitochondrial COX1 and 28S rRNA genes can help validate cerebral sparganosis diagnosis [15]. The treatment option for cerebral sparganosis is primarily surgical removal of the sparganum from the location of the lesion or long-term administration of high-dose praziquantel [2,16,17]. The chance of delayed treatment or misdiagnosis, as the consequence of clinically unspecific features, can lead to significant morbidity and mortality due to the chronic and recurrent nature of the disease [7]. By detecting and treating cerebral sparganosis early, the morbidity associated with this disease can be significantly reduced, improving the overall quality of life. Thus, implementing an early warning system helps public health authorities identify and respond to outbreaks of cerebral sparganosis more effectively, reducing the risk of transmission and the overall burden on the healthcare system. Even more, a lack of public awareness of the risk factors and clinical manifestations recognition of cerebral sparganosis could hinder the development of effective treatment strategies [2]. By mapping the research landscape, the aim of this study was to identify research trends, key contributors, gaps in existing knowledge, and clinical advancements in the prevention, diagnosis, and treatment options for cerebral sparganosis, providing recommendations for future research directions and clinical practice improvements on cerebral sparganosis.

Methods

Data sources and search strategy

The data was acquired online from the Scopus database. To avert the bias caused by daily database updates, the search process was conducted on June 2nd, 2024. Keywords utilized in this study were ("cerebral sparganosis" OR "sparganosis cerebr#") OR ((intracranial OR "central nervous system" OR encephalitis) AND sparganosis). The initial search revealed 171 studies. Only the literature written in English that had reached the final publication stage was included. Then, all the studies that met our requirements based on the title and abstract were screened, and any irrelevant studies were eliminated (n=32). Finally, 139 studies were downloaded and analyzed in total. The entire search strategy process is visualized in **Figure 1.**

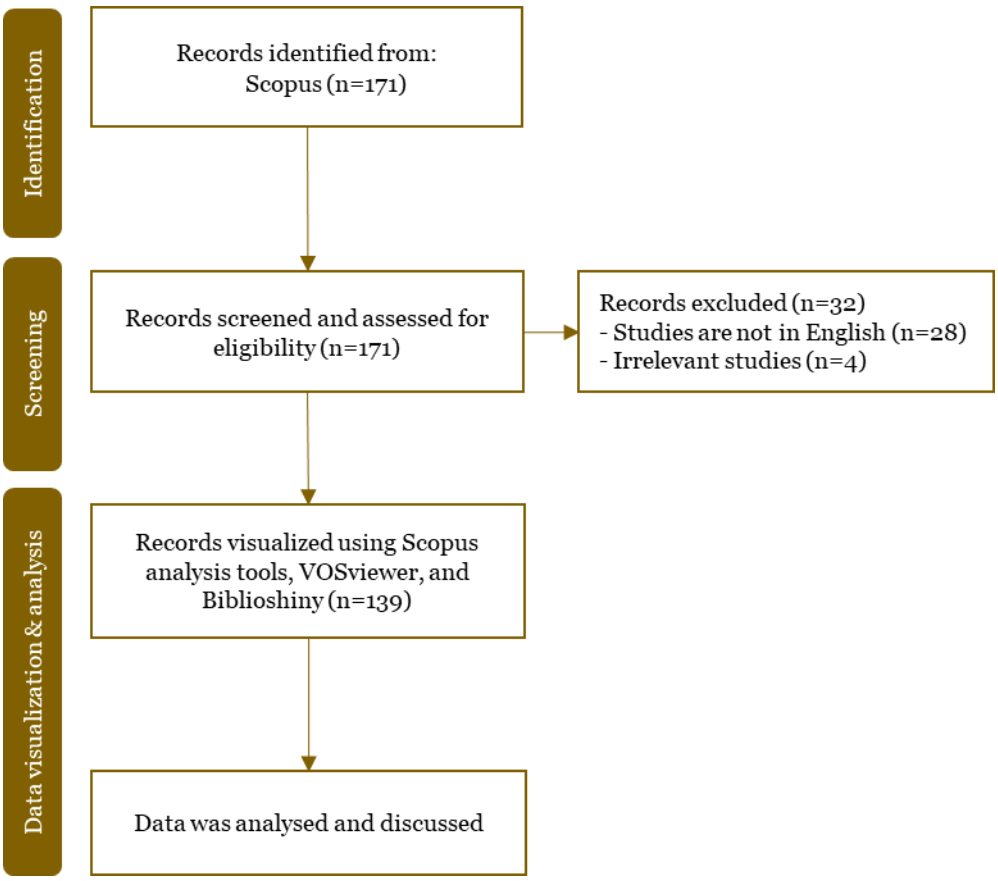

Figure 1. Flow diagram of literature searching and screening processes.

Data analysis

The publication output was then analyzed using Scopus analysis tools, R package's bibliometrics (Biblioshiny) [18-20], and VOSviewer (version 1.6.18) [21]. Scopus analysis tools were performed to obtain the top ten most relevant authors, affiliations, countries, funding sponsors, and the most influential publications. The R package's bibliometrics utility was designed for quantitative scientometrics and informetrics. Numerous tools of the Bibliometrix analysis enable researchers to conduct in-depth bibliometric studies [22-24]. In this study, Bibliometrix was used to describe included studies, annual scientific production, its impacts, and trend topics. In trend topics, the visualization was set for four topics per year. Subsequently, a bibliometric network of keywords co-occurrence for prominent or key topics was analyzed using VOSviewer. VOSviewer is a visualization software that displays cluster analysis and has excellent data visualization [25-29]. In this study, the visualization of prominent or key topics was set at a minimum occurrence of seven and a minimum total link of strength of ten using VOSviewer. It was also performed using word cloud analysis of the top 50 keywords using Biblioshiny.

Results

Description of the included studies

This study included 139 studies on cerebral sparganosis, spanning from 1980 to 2024, revealing significant insights into the research landscape of this field. Published across 97 sources, the studies exhibited an annual growth rate of 2.5%, indicating a steady increase in research activity. With an average document age of 14.4 years and 17.63 citations per document, the relevance and impact of these studies are notable. The documents collectively contain 3,263 references, 1,325 keywords plus, and 238 author keywords, reflecting the diversity of themes explored. Authored by 543 researchers, including 8 who have published single-authored papers, the field shows a robust collaborative nature, with an average of 4.65 co-authors per study and 18.71% of studies involving international co-authorship. The types of studies included are 100 articles, nine book

chapters, 10 letters, four notes, 15 reviews, and one short survey, showcasing a range of formats for disseminating research findings.

Annual scientific production and impacts

The annual scientific production on cerebral sparganosis, from 1980 to 2024, demonstrated fluctuating research activity, with notable peaks in 2010 and 2011 when 11 and 9 articles were published, respectively. The average citations per year indicated varying degrees of impact, with certain years, such as 1996 and 2005, showing exceptionally high average citations per year at three and six, respectively. These peaks suggested pivotal studies that significantly influenced subsequent research. Despite occasional years with no publications, the overall trend shows a sustained interest and steady growth in scholarly output. The mean total citation per year and the number of citable years also reflect the enduring relevance of earlier studies, with articles from 1986 and 1992 maintaining high citation rates over decades. Annual scientific production and average citations per year are visualized in **Figure 2**.

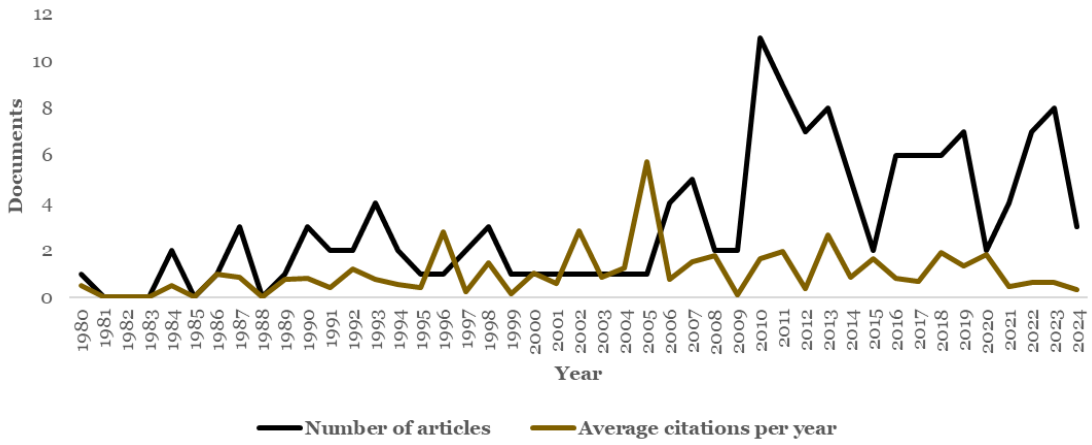

Figure 2. Annual scientific production and average citations per year.

Top ten most relevant authors, affiliations, countries, and funding sponsors

The analysis of the most relevant contributors to cerebral sparganosis research highlights key authors, affiliations, and countries. Leading authors such as Chang K.H., Chi J.G., and Wiwanitkit V. have each contributed five studies demonstrating their significant influence in this field. Prominent affiliations include Central South University and Khon Kaen University, each with six studies, and Wiwanitkit House, Nanchang University, Samsung Medical Center, Universidad Peruana Cayetano Heredia, Xiangya Hospital, and Universidad Espiritu Santo were featured in four studies. The research is globally distributed, with China leading with 37 studies, followed by South Korea (26), the United States (22), and Thailand (19). Japan, India, and Taiwan have also made substantial contributions with 12, 8, and 8 studies, respectively. Subsequently, the top funding sponsors are the National Natural Science Foundation of China with 7 studies; as well as Khon Kaen University and National Institutes of Health, each with 3 studies. The top ten of each most relevant authors, affiliations, countries, and funding sponsors are visualized in **Figure 3**.

Most influential publications

The most influential publications on cerebral sparganosis, ranked by total citations, highlight key research contributions and their ongoing impact. "A review of human sparganosis in Thailand," published in 2005, leads with 115 citations, averaging 6.05 citations per year, followed by "Infectious causes of seizures and epilepsy in the developing world," published in 2011 with 103 citations, and a higher annual average of 7.92. Notable studies such as "CT and MR characteristics of cerebral sparganosis" (2007), with 81 citations and "Cerebral sparganosis: Clinical manifestations, treatment, and outcome" (1996), with 80 citations, have per-year averages of 4.76 and 2.86 citations, respectively. Other significant contributions include research on helminth infections in Southeast Asia and CNS parasitic diseases (**Table 1**), reflecting the diverse and far-reaching impact of these studies within the academic community.

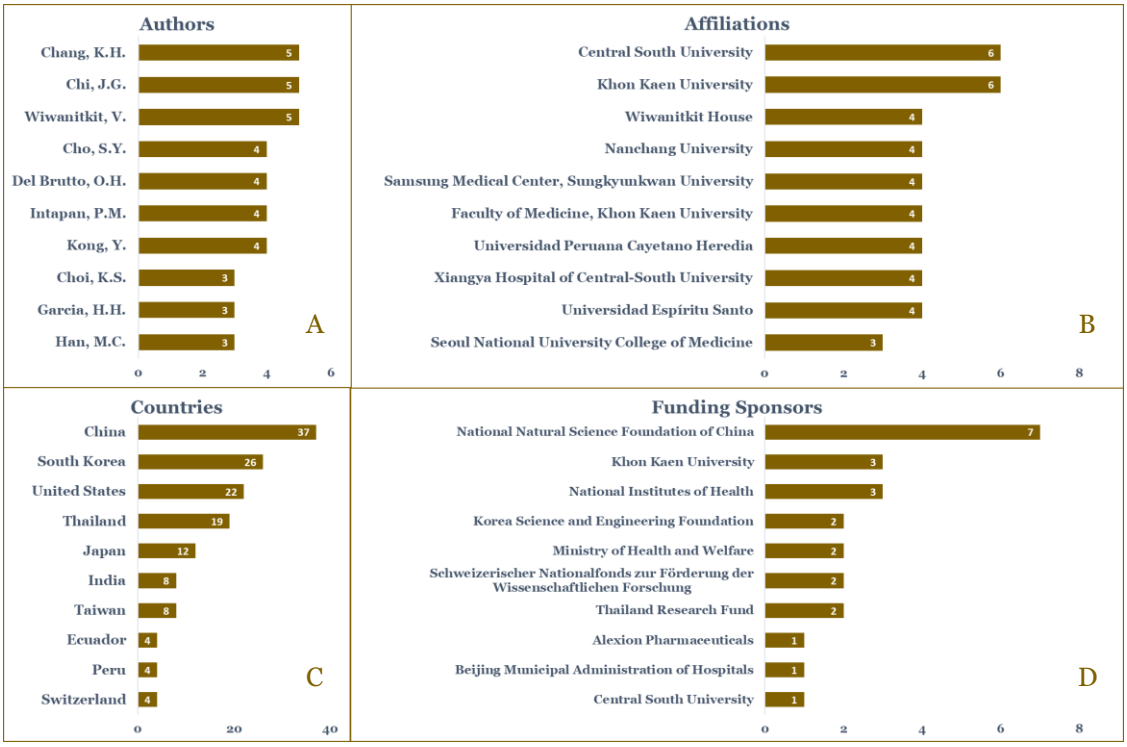

Figure 3. Top ten of most relevant authors (A), affiliations (B), countries (C), and funding sponsors (D).

Table 1. Top ten most influential publications

Rank	Title	Journal	Year	Total citations	Total citations per year
1	A review of human sparganosis in Thailand [30]	International Journal of Infectious Diseases	2005	115	6.1
2	Infectious causes of seizures and epilepsy in the developing world [31]	Developmental Medicine and Child Neurology	2011	103	7.9
3	CT and MR characteristics of cerebral sparganosis [32]	American Journal of Neuroradiology	2007	81	4.8
4	Cerebral sparganosis: Clinical manifestations, treatment, and outcome [16]	Journal of Neurosurgery	1996	80	2.9
5	Important helminth infections in Southeast Asia diversity, potential for control, and prospects for elimination [33]	Advances in Parasitology	2010	72	5.1
6	Cerebral sparganosis: analysis of 34 cases with emphasis on CT features [34]	Neuroradiology	1992	72	2.3
7	Parasitic diseases of the central nervous system [35]	Neuroimaging Clinics of North America	2011	70	5.4
8	MRI of CNS parasitic diseases [36]	Journal of Magnetic Resonance Imaging	1998	69	2.7
9	Helminth infections of the central nervous system occurring in Southeast Asia and the Far East [37]	Advances in Parasitology	2010	66	4.7
10	Parasitic worms of the central nervous system: An Australian perspective [3]	Internal Medicine Journal	2002	65	3.0

CNS: central nervous system; CT: computed tomography; MR/MRI: magnetic resonance imaging

Trend topics

Over time, the analysis of term frequencies revealed evolving trends in cerebral sparganosis research. Early studies focused on fundamental aspects such as diagnosis, computer analysis, and

specific parasites like *Spirometra mansonoides* and nematodes during the late 1980s and early 1990s. As the field progressed, the focus expanded to clinical and diagnostic techniques, particularly computer-assisted tomography and brain surgery, becoming prominent in the mid-1990s and 2000s. The use of advanced imaging techniques like nuclear magnetic resonance imaging and magnetic resonance imaging gained traction from 2010 onwards. Recent research from 2010 to 2023 has increasingly addressed clinical outcomes and specific conditions related to cerebral sparganosis, such as brain infections, granulomas, and central nervous system infections. There has also been a notable rise in studies on treatment outcomes, follow-up strategies, and the use of diagnostic imaging and immunoassays. Additionally, recent studies have focused on diagnostic test accuracy, the relationship between cerebral sparganosis and brain tumors, and the role of immunoglobulin G antibodies, reflecting ongoing efforts to refine diagnostic methods and understand the broader implications of the disease. Trend topics are presented in **Figure 4**.

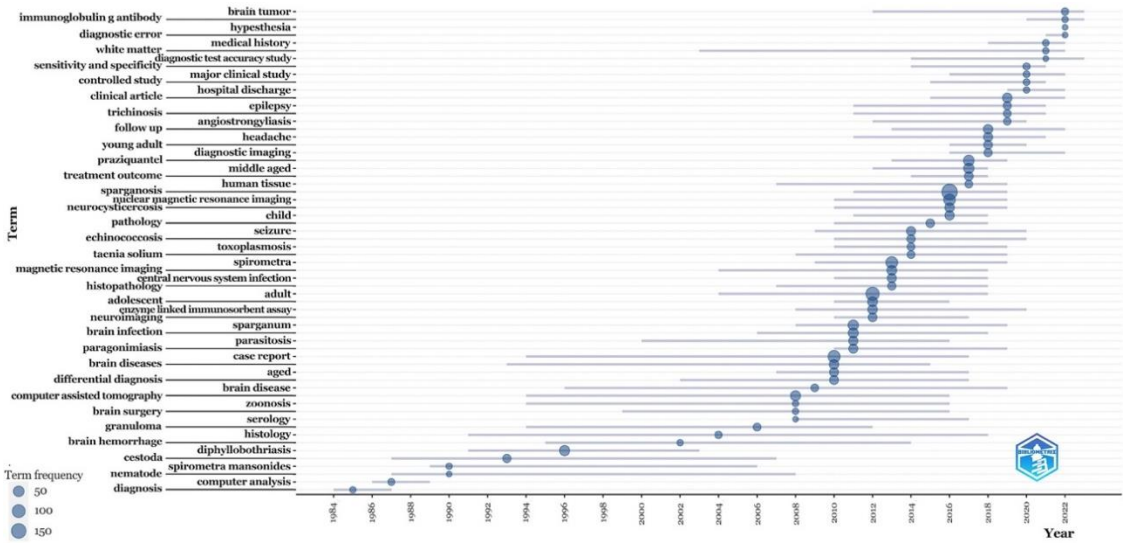

Figure 4. Trend topics of cerebral sparganosis studies.

Prominent key topics

The analysis of key topics in cerebral sparganosis research reveals distinct clusters of frequently discussed subjects (**Figure 5**). Cluster 1 includes highly recurring topics such as "adult" (79 occurrences), "brain infection" (39), "clinical article" (32), "headache" (23), "craniotomy" (23), and "follow-up studies" (29). This cluster predominantly focuses on the clinical and procedural aspects of cerebral sparganosis, emphasizing the prevalence of adult cases, common symptoms, surgical interventions, and the importance of follow-up in patient management. Additionally, topics like "cerebrospinal fluid analysis" (13), "epilepsy" (11), "dexamethasone" (11), and "seizures" (26) underscore the significance of diagnostic and therapeutic approaches in managing the disease. Cluster 2 encompasses topics such as "angiostrongyliasis" (13 occurrences), "echinococcosis" (17), "central nervous system infections" (25), "cysticercosis" (22), and "parasitology" (23). This cluster indicates a broad focus on other parasitic infections affecting the central nervous system and their diverse etiologies. The inclusion of "neurocysticercosis" (26), "parasitosis" (26), and "paragonimiasis" (23) highlights the variety of parasitic diseases studied within this field in accordance with studies focused on sparganosis.

Subsequently, Cluster 3, with topics like "magnetic resonance imaging" (39), "pathology" (20), "child" (19), and "neuroimaging" (21), points to the broader epidemiological, demographic, and diagnostic landscape of cerebral sparganosis. Last, Cluster 4 focuses on technical and diagnostic aspects with topics such as "computer-assisted tomography" (39 occurrences), "diphyllobothriasis" (41), "histology" (10), "diagnosis" (8), and "case report" (74). This cluster emphasized the utilization of advanced imaging techniques and histological analysis in diagnosing and studying cerebral sparganosis, along with a significant number of case reports contributing to the literature. Collectively, these clusters illustrated the comprehensive and

multifaceted research efforts aimed at understanding, diagnosing, and treating cerebral sparganosis.

Nevertheless, the analysis highlighted several underdeveloped topics in cerebral sparganosis research, evidenced by their low occurrence in the literature. For instance, areas such as "2-dimensional immunoblot," "adjuvant therapy," "age factors," "antigenic variation," "astrocytoma," "ataxic aphasia," "biological monitoring," "computer-assisted surgery," "Creutzfeldt-Jakob disease," "Europe," "extrapyramidal syndrome," "brain cortex atrophy," "brain pseudotumor," and "glioma" have limited exploration.

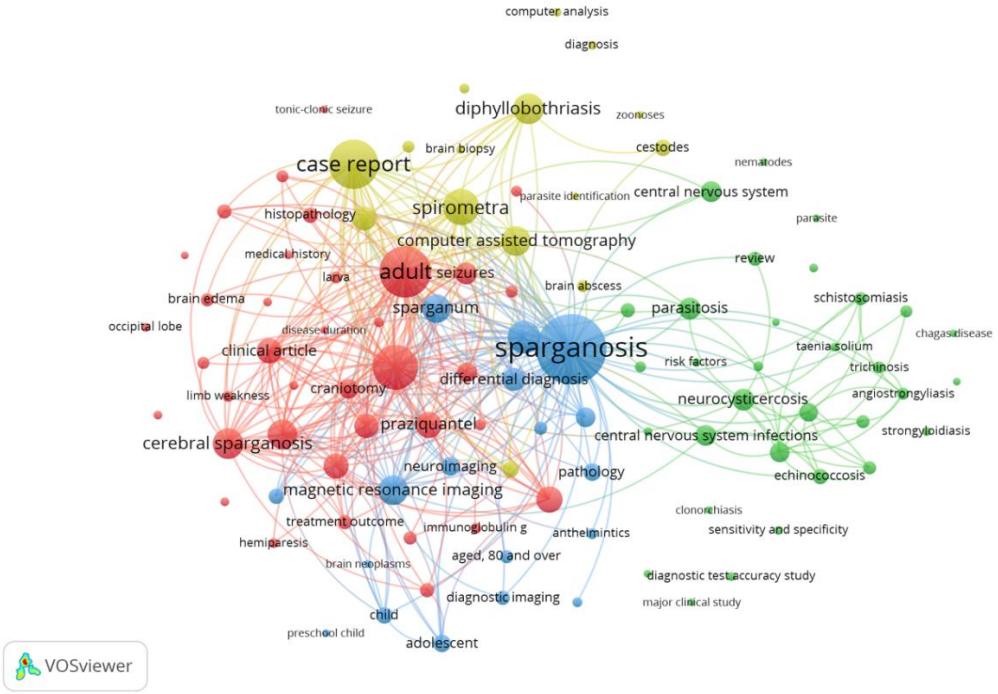

Figure 5. Key topics in cerebral sparganosis research.

Discussion

Overview of findings

This review highlighted a changing landscape characterized by varying levels of scholarly activity. Particularly, 2010 and 2011 saw notable spikes in publication volume, suggesting increased research interest or major advancements at that time. The average yearly citations show a mixed picture of the impact, with exceptional years such as 1996 and 2005 displaying notably high average citations per year. These spikes suggested that key studies published in those years profoundly influenced subsequent research, possibly introducing novel insights or methodologies that shaped the field's trajectory.

Even though cerebral sparganosis is predominantly found in Asian regions, studies have reported cases in other parts of the world, such as Europe and the United States [13,38-41]. The research has been distributed globally, with China holding the lead with 37 studies, followed by South Korea (26), the United States (22), and Thailand (19) [2,8,14,15,17,31,42-62]. Japan, India, and Taiwan have made significant contributions with 12, 8, and 8 studies, respectively, whereas Ecuador, Peru, and Switzerland each made four contributions [63-66]. These findings emphasize the necessity for renewed efforts in re-emerging awareness and addressing this medical condition globally. Expanding research efforts beyond endemic regions could also foster a more comprehensive understanding of the disease and its global impact.

Trends and challenges of diagnosing cerebral sparganosis

Sparganosis is a zoonotic parasite infection transmitted through the tapeworm of the genus *Spirometra* belonging to the *Diphyllobothriidae* family [5,67]. The condition is found worldwide

and is a severe threat to human health. Sparganosis is considered one of the most harmful foodborne yet neglected parasite infections in the world [68,69]. Spargana has the ability to penetrate several regions of the human body, including the brain, eyes, breast, subcutaneous tissues, and rarely the CNS, which might lead to the development of cerebral sparganosis [12,70]. This invasion leads to potentially fatal consequences, posing a significant risk to human health [17,71]. Thus, conducting a bibliometric analysis on cerebral sparganosis is vital for advancing our understanding of diagnosing this rare but serious condition.

The evolving trends were recognized in cerebral sparganosis research, as revealed by term frequency analysis, underscoring the dynamic nature of this field and its response to emerging challenges and technological advancements. Initially, research in the late 1980s and early 1990s centered on fundamental diagnostics and identifying specific parasites [72,73]. These early efforts were crucial in establishing a baseline understanding of the disease. Moving into the mid-1990s and 2000s, there was a noticeable shift from basic identification to more advanced diagnostic and treatment methodologies, reflecting an increasing complexity in managing the disease [74-76]. From 2010 onwards, the adoption of imaging technologies represented a significant leap forward, facilitating more accurate diagnoses and a detailed understanding of the disease's impact on the brain [77-79].

Diagnosing this disease throughout the year is still challenging since it overlaps clinical and imaging manifestations with more common parasite infections as well as other neurological disorders [80,81]. Several studies reported the initial symptoms of cerebral sparganosis, such as altered mental status, general seizure, limb weakness, and headache [64,82-84]. While the presence of peripheral eosinophilia may lead to suspicion of a parasite infection, it should be highlighted that it does not represent a reliable indicator. Yu *et al*. revealed increased eosinophils in 5 of 9 patients [85]. Another study also showed a mild elevation of cell count with an increase in eosinophilic count [84]. In contrast to the studies, Kleebayoon and Wiwanitkit (2023) showed that peripheral eosinophilia was absent, with an eosinophil count of -1% [83].

While the definitive diagnosis of sparganosis could exist by surgically removing the worms and identifying the parasite in a tissue specimen, an enzyme-linked immunosorbent assay (ELISA) along with antigen-specific immunoglobulin G antibodies from a peripheral blood test can also be used to detect the condition. The ELISA test and anti-sparganosis antibody are reported to have a high sensitivity and specificity and thus may serve as a reliable indicator for detecting sparganosis. Gong *et al*. reported a 100% positive rate for the ELISA test, anti-sparganosis antibody, which is consistent with other reports [84]. Yu *et al*. revealed a positive for CSF anti-sparganosis antibody in four of six patients [85].

Clinicians suggest the use of diagnostic imaging techniques such as CT and MRI for detecting and confirming diagnoses, assessing any infection-related consequences, and monitoring progress over time [86]. From the CT scan examination, two studies found that cerebral sparganosis might detected with the solitary ring-shaped enhancements of the lesion [64,83]. The pathognomonic features found in cerebral sparganosis using CT scan are (a) unilateral involvement; (b) extensive or multifocal areas of low density along white matter bundles, with ipsilateral ventricular dilatation and localized cortical atrophy; (c) nodular or irregular enhancement with spotty calcification; and (d) change in location of enhancing nodules on sequential scans [87]. In addition, the MRI scans show distinct lesions that appear as column or fusiform tunnels and clustered ring-shaped enhancements that exhibit migrating lesions (referred to as the tunnel sign) [64,82,83]. Hence, the identified migrating lesions or tunnel signs observed on the MRI examination might serve as crucial indicators for diagnosing cerebral sparganosis [17,88]. Another study stated that a pattern of string-knots enhancement lesions in cortical-subcortical areas indicates cerebral sparganosis [88]. We concluded that combining information with MRI and the positive ELISA and/or anti-sparganosis antibody results is a reliable diagnosis for cerebral sparganosis before the surgery [82,84].

Treatment of cerebral sparganosis

Surgical removal of the sparganum from the site of infection is the conventional treatment for cerebral sparganosis. Four studies reported a total of 15 cases of cerebral sparganosis treated with stereotactic surgery which led to the remission of symptoms and no recurrence [40,63,89,90].

Complete removal of the sparganum is necessary to prevent disease recurrence since the existence of any remaining scolex can contribute to its reoccurrence.

Furthermore, we also found that the recent research trend between 2010 and 2023 has expanded to encompass clinical outcomes, the effectiveness of various treatment outcomes, and follow-up strategies [8,45,68,69,91,92]. Recent research has shown that some patients responded successfully to long-term, high-dose praziquantel, with outcomes that were comparable to surgical intervention [14,50,63,90,92-94]. Praziquantel has been identified to enhance the exposure of the worm's surface antigens by inducing damage to the parasite's skin, leading to erosion of the outer layer. The drug may trigger spastic paralysis in the parasite by disintegrating bundles of smooth muscle [92,93]. A study recorded 42 patients underwent surgical removal of lesions, whereas 54 patients were given long-term, high-dose praziquantel (50 mg/kg/day for 10 days, repeat monthly). The efficacy of praziquantel treatment was similar to the surgical removal of lesions for cerebral sparganosis in terms of achieving the total disappearance of active lesions, reducing the symptoms, the occurrence of seizures, and antibody titer [92]. Zhang *et al*. revealed ten inoperable patients with cerebral sparganosis who were treated with repeated sessions of high-dose praziquantel therapy (25 mg/kg thrice daily for ten days). This treatment resulted in clinical improvement and the radiological outcomes of motile lesions are crucial indicators [50]. Gonzenbach *et al*. also reported the same outcome in one patient with the administration of a high-dose regimen of praziquantel (3×25 mg/kg body weight daily) in seven days. Considering the patient's clinical recovery and the normalization of brain imaging and anti-sparganum antibody levels, it could be concluded that the parasite was effectively eliminated by administering high-dose praziquantel therapy [93].

Recommendation for preventing cerebral sparganosis

The genus *Spirometra* involves freshwater *cyclopoid* copepods as the primary intermediate host and several kinds of amphibians, reptiles, birds, and mammals as the subsequent intermediate hosts or paratenic hosts [95,96]. Human infection occurs by consuming raw or undercooked meat of the second intermediate hosts, including frogs and snakes. Infection can also occur by drinking water polluted with infected *cycloploid* copepods or using frog meat as a poultice. The most influential publication on cerebral sparganosis, "A review of human sparganosis in Thailand" in 2005, highlighted the investigation of the risk factors and manifestations of sparganosis, particularly in endemic regions like Thailand [30]. In Southeast Asian countries, behaviors such as drinking impure water and consuming frog or snake meat are significant risk factors for ingesting *Spirometra* larvae, leading to this parasitic infection [12,30,58-60,66]. This study might serve as a crucial recommendation for prevention in other Southeast Asian countries with similar cultural practices and social backgrounds, including Indonesia.

Research gaps and future directions

The analysis of cerebral sparganosis research revealed several underdeveloped topics that warrant further investigation, as evidenced by their limited occurrence in the existing literature. The results recognized that the studies of cerebral sparganosis are primarily found in regions sharing a similarly high risk of transmission of this disease, such as China, Thailand, and Korea. These topics encompassed a wide range of areas, including immunoblotting techniques, adjuvant therapy approaches, the influence of age factors on disease progression, antigenic variation in parasite strains, and neurological conditions such as astrocytoma and Creutzfeldt-Jakob disease [31,48,86]. Despite the comprehensive exploration of certain aspects of cerebral sparganosis, these underrepresented topics present clear gaps in current knowledge, as detailed in the results above, accompanying the analysis. Addressing these gaps through future research endeavors holds significant promise for advancing our understanding and treatment of cerebral sparganosis, ultimately leading to improved patient outcomes.

A lack of studies has also been noticed concerning cerebral sparganosis in Indonesia, a country sharing similar socioeconomic and cultural characteristics with other endemic regions of Southeast Asia, including Thailand. In Southeast Asian countries, engaging in activities such as consuming contaminated water and frogs or snakes creates major risks for developing the disease [30,58]. Therefore, to effectively address their common risk factors, it is crucial to emphasize and

prioritize future research by publishing studies that thoroughly investigate and enhance our awareness of this particular issue.

We also note that research on cerebral sparganosis is limited by a scarcity of high-level evidence, such as randomized controlled trials (RCTs), systematic reviews, and meta-analyses. This is due to the rarity of the disease and the ethical and practical challenges of conducting RCTs for rare parasitic infections [80]. Current studies, often small-sample trials, evaluate the effectiveness of various diagnostic and therapeutic approaches but lack comprehensive data. To date, there may not be well-developed and widely approved guidelines specifically for the treatment of cerebral sparganosis. Consequently, clinical guidelines for cerebral sparganosis are based on expert consensus and observational studies rather than robust evidence [40,50,90,92,93]. There is a need for more high-quality RCTs and systematic reviews to develop evidence-based guidelines for diagnosis and treatment, ultimately enhancing patient care and understanding of the disease. Future research can build on past achievements by focusing on these areas, driving forward the knowledge and treatment of cerebral sparganosis to enhance patient care and outcomes worldwide.

Clinical implications and public health implications

Recent findings in cerebral sparganosis research could enhance clinical practice by improving diagnostic accuracy and guiding treatment decisions. Novel diagnostic markers or imaging techniques may facilitate early disease detection, while insights into epidemiology and risk factors could inform targeted screening and surveillance efforts, especially in endemic regions [71,74]. Healthcare providers can utilize these findings to streamline patient care pathways, ensuring timely diagnosis and management of cerebral sparganosis cases.

Following the bibliometric study in cerebral sparganosis, healthcare providers and public health authorities can adopt several recommendations to enhance disease prevention and control. First, raising awareness among healthcare professionals about clinical manifestations and diagnostic challenges is essential for early case recognition. Community education initiatives can also inform the public about transmission risks associated with contaminated water or undercooked meat, mitigating disease spread. Collaborations between clinicians, researchers, and public health experts can further develop evidence-based disease management and surveillance guidelines, facilitating coordinated efforts to improve patient outcomes.

Second, promoting health and preventing diseases like cerebral sparganosis requires a multidirectional approach that integrates cultural, hygienic, and educational strategies [68,69]. Emphasizing the importance of hygiene and safe food practices is crucial, as the infection is often linked to consuming undercooked or raw meat and contaminated water [12,30,58-60,66]. Collaborations between health organizations, governments, and community leaders can enhance the reach and impact of these initiatives. By adopting a comprehensive approach that includes improving sanitation, promoting safe eating habits, and increasing awareness, we hope the incidence of cerebral sparganosis can be significantly reduced.

Limitations

This study has several limitations, including reliance on data from the Scopus database, which may not encompass all relevant literature on cerebral sparganosis, potential language bias due to the inclusion of only English-language studies, and the exclusion of unpublished or non-peer-reviewed research.

Conclusion

The studies on cerebral sparganosis research highlight the potential for enhancing clinical practice through improved diagnostic accuracy, informed treatment decisions, and targeted screening efforts based on epidemiology and risk factors. Efforts are needed to study cerebral sparganosis in high-risk countries with similar socioeconomic and cultural characteristics to endemic regions, including Indonesia. Recommendations for raising awareness among healthcare professionals, conducting more research on this issue in high-risk countries such as Indonesia, and developing evidence-based disease management and surveillance guidelines are crucial for improving patient outcomes.

Ethics approval

Not required.

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None.

Competing interests

All the authors declare that there are no conflicts of interest.

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Underlying data

Derived data supporting the findings of this study are available from the corresponding author on request.

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