



Interpretation of Brain Abscess Through: A Systematic Review Using the Prism 2020 Methodology

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Article History	Abstract
Received: 11 June 2023 Revised: 25 August 2023 Accepted: 31 August 2023	<p><i>Introduction: A brain abscess is an accumulation of infected material, such as pus and necrotic tissue, in the brain. It can occur due to bacterial, fungal, or parasitic infections in the body that spread to the brain. Objective: The aim of the study was to interpret brain abscess using a systematic review with PRISMA 2020 methodology. Methods: The study was exploratory level, relying on hermeneutics to interpret the systematic review with the PRISMA 2020 methodology, carried out in the SCOPUS, Web Science, SciELO and PubMed Central databases, specifically, 53 results were achieved. Results: It was found that the analyses carried out in Latin America on the clinical, radiological, and pathological manifestations associated with brain abscess indicate that the predominant symptoms include fever, headache, altered level of consciousness and seizures, and that most abscesses are in the frontal and temporal lobe. Multiple risk factors for mortality and morbidity in patients with brain abscess were identified, including delay in diagnosis and treatment, presence of comorbidities, and abscess size. A higher mortality rate was observed in patients with brain abscess in Latin America compared to other regions of the world. Conclusions: It was concluded that early identification of underlying causes may help prevent recurrence of brain abscess. Several future studies are suggested including the use of fuzzy logic and neutrosophy associated with brain abscesses.</i></p>
CC License CC-BY-NC-SA 4.0	Keywords: Brain Abscess, PRISMA 2020, Bacterial Infections, Clinical Manifestations, Frontal Lobe.

1. Introduction

Proper interpretation of the brain abscess is crucial for its management and treatment. A brain abscess is a buildup of infected material, such as pus and necrotic tissue, in the brain. It can occur due to bacterial, fungal, or parasitic infections in the body that spread to the brain. Symptoms may include headache, fever, weakness, memory loss, and seizures. In recent years, numerous investigations have been conducted on the interpretation and management of brain abscess. For example, a study published in the journal *Neurology India* in 2018 concludes that early and accurate diagnosis of brain abscess is critical to successful treatment and prevention of complications. The authors of the study emphasize the importance of conducting a thorough evaluation of the patient's medical history, along with a neurological and radiological evaluation, to reach an accurate diagnosis (Behari et al., 2009).

In addition, another study reported in the *Journal of Neurology* in 2019 highlights the importance of early identification of the underlying causes of brain abscess. The study authors note that timely identification of causes such as infective endocarditis or sinusitis can help prevent brain abscess recurrence (Ibarra et al., 2023). In general, it is important to continue research on brain abscess, especially in regions where the incidence of this condition may be high or where there is a lack of information. Studies could be conducted in Ecuador (country where this literature review is carried out) that evaluate the clinical and radiological characteristics of patients with brain abscess, the risk factors for mortality and morbidity, the most effective treatments and the effectiveness of different diagnostic strategies.

Research on the epidemiology and microbiology of brain abscesses in Ecuador could also be done to help guide empirical treatment and management of this condition. Some of the innovative approaches being used in recent brain abscess studies in other parts of the world include the use of artificial intelligence tools and big data analytics to aid in the diagnosis and prognosis of patients, as well as research into adjuvant therapies that can improve the effectiveness of current treatments. It would be interesting to see if these techniques could be applied in future studies in Ecuador and other Latin American countries, which would give them valuable relevance to the regional context of these studies (Quispe et al., 2023; Ibarra et al., 2023). Precisely the authors of this systematic review try to make a small contribution within the line of research of brain abscess, for which they propose to face the following problem: What are the most relevant aspects in the study of brain abscess? Therefore, the objective of the study is to interpret brain abscess through a systematic review with the PRISMA 2020 methodology.

To carry out the systematic review with the PRISMA 2020 methodology on the topic of interpretation of brain abscess, the authors ask the following questions: What are the clinical and demographic characteristics of people with brain abscess in the included studies? What is the best diagnostic strategy to interpret brain abscess? Which radiological methods are most effective for the interpretation of brain abscess? What are the clinical, radiological, and pathological findings associated with brain abscess? What are the most effective treatments for brain abscess and how do they relate to their interpretation? What are the risk factors for mortality and morbidity in patients with brain abscess and how do they relate to the interpretation of brain abscess?

These questions serve as a guide for the design of the systematic review, the selection of relevant studies, the extraction and analysis of data and the interpretation of the results obtained. By using the PRISMA 2020 methodology, it can be ensured that the review is rigorous and systematic, and that the results are as complete and accurate as possible.

2. Materials And Methods

The study was exploratory, relying on hermeneutics to interpret the systematic review carried out with the PRISMA 2020 methodology (*Preferred Reporting Items for Systematic Reviews and Meta-Analyses*) on brain abscess. It was a retrospective and observational research. The PRISMA guidelines are a set of recommendations designed to improve the quality and transparency of systematic reviews and meta-analyses. By following these guidelines, the review authors ensured a

rigorous and transparent methodology, which increased the reliability and reproducibility of the results.

PRISMA 2020 is the latest update of the PRISMA guidelines, which includes updated recommendations and clarifications on the reporting of systematic reviews. By following PRISMA 2020, the authors were able to ensure that the systematic review was up-to-date and met current standards for conducting and submitting systematic reviews. The review process followed the sequence shown in Figure 1 and is detailed below:

Initial Search

The primary searches were executed in September 2022 and the term "brain abscess", as well as its translation into English language "brain abscess", was used as an exploration strategy in the databases of SCOPUS, Web Science, SciELO and PubMed Central. The use of Boolean operators was not considered necessary. When carrying out these searches, numerous results relevant to the review were found, which made it possible to have a holistic idea about the depth and timeliness of this line of research today.

The PRISMA 2020 flow structure is based on three levels. At the first level, they start with searching for articles in databases and other sources. At the second level, the selection process is carried out and the inclusion and exclusion criteria are applied. At the third level, the synthesis and analysis of the data included in the systematic review is carried out. This hierarchical structure ensures that all studies are included transparently and systematically, resulting in a high-quality systematic review.

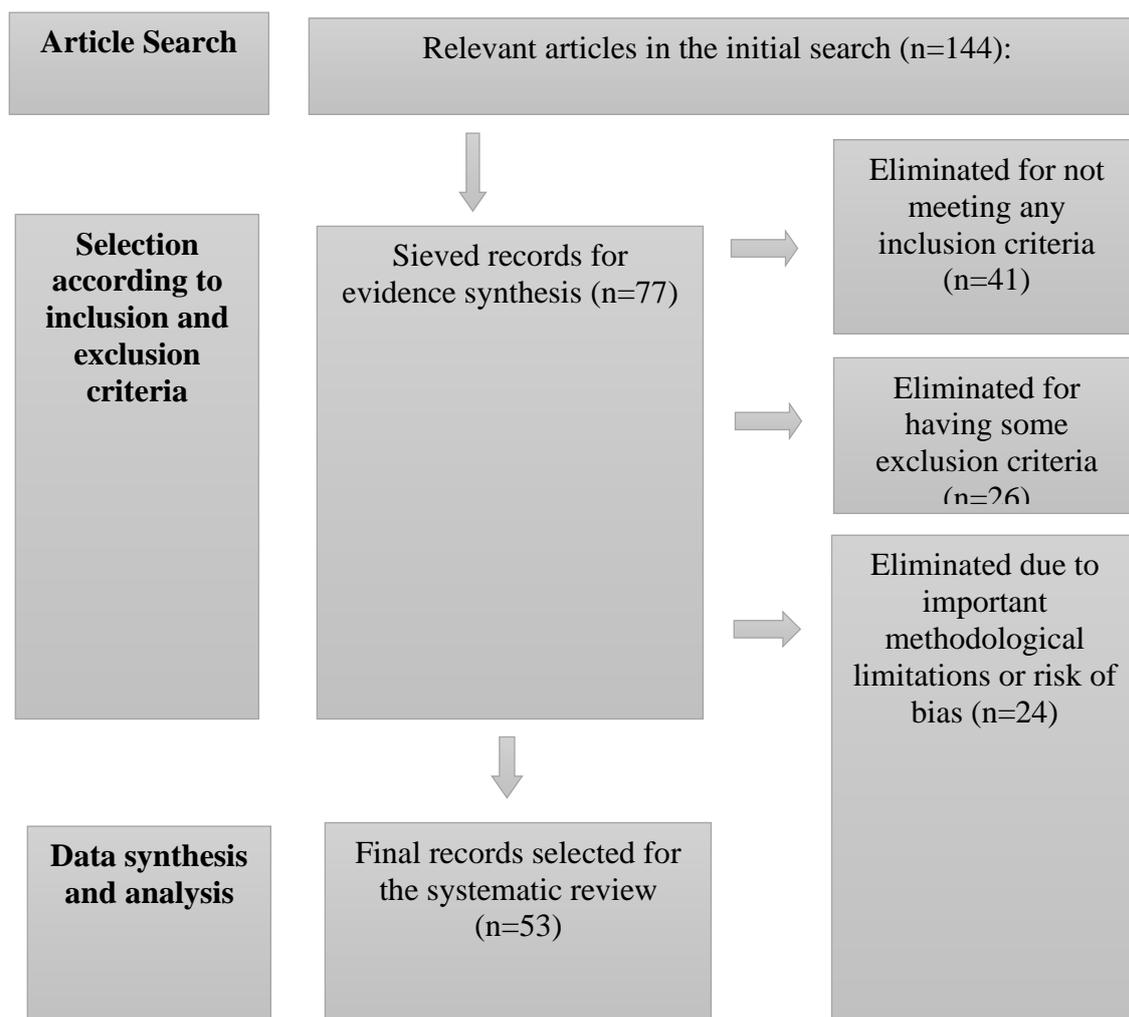


Figure (1). PRISMA 2020 flow according to its levels.

Systematic Search

The systematic review was carried out in March 2023, in the databases of *SCOPUS*, *Web Science*, *SciELO* and *PubMed Central*, defining the results to the articles published from 2018 to 2023.

Specifically, 53 final results were achieved. Prior to the selection of articles, the inclusion and exclusion criteria were defined.

Inclusion Criteria

Be articles published in journals indexed in the databases of *SCOPUS*, *Web Science*, *SciELO* and *PubMed Central*. Be empirical research, reviews (narrative, systematic or meta-analysis), or case studies. Be published between 2018 and 2023.

Exclusion Criteria

Articles that were not written in Spanish or English. Be letters to the editor. In the selection of articles involved all the participants of this study, who, who created a matrix in Microsoft Excel 365 a database with: title of the article; names of authors; name of the journal; name of the journal's indexing database; date of publication; bibliographic references in Vancouver standards; most relevant results of the study; key findings of the study; and the contribution to the six questions that this systematic review aimed to answer. This article comments on several of the most relevant aspects found in the literature search, according to each of the questions formulated in the methodological strategy of the study. Methods of the theoretical level of knowledge were used, such as the systemic approach; the historical-logical; analysis and synthesis; and induction and deduction, as in other studies consulted (Caicedo et al., 2023; Offiah & Naseer, 2016).

3. Results and Discussion

Below is a synthesis of relevant findings found for each of the questions previously formulated:

What are the clinical and demographic characteristics of people with brain abscess in the included studies?

A recent study published in 2021 in the journal *Clinical Neurology and Neurosurgery* analyzed the clinical and demographic characteristics of 107 brain abscess patients in a cohort of Asian patients. The authors found that the most common symptoms were fever, headache and seizures, and that the most frequent causes of brain abscesses were sinus infections and otitis media. In addition, the authors noted that older age and the presence of comorbidities increased the risk of mortality in patients with brain abscess (Kumar et al., 2017).

Another study published in 2018 in the journal *Neurology India* looked at the clinical and demographic characteristics of 55 brain abscess patients in a cohort of Indian patients. The authors found that most patients were under the age of 40, and that the most common causes of brain abscesses were sinusitis and dental infections. In addition, the authors noted that fever, altered mental status, and seizures were the most common symptoms in these patients (Bern et al., 2019).

In Latin America, a study conducted in Brazil and published in 2018 in the journal *Arquivos de Neuro-Psiquiatria* examined the clinical and demographic characteristics of patients with brain abscess. The authors found that most of the patients were young males and that the most common symptoms included fever, headache and changes in mental status. They also noted that brain abscesses were often linked to infections in other parts of the body, such as the lung (Messina et al., 2020).

Another study conducted in Colombia and published in 2020 in the journal *Neurocirugía* found that the majority of brain abscess patients were young adults, with a mean age of 35 years, and that the most common underlying cause was an odontogenic infection. The authors also highlighted the importance of careful neurological evaluation and high-resolution CT scan for accurate diagnosis and timely treatment (Ku et al., 2017).

What is the best diagnostic strategy to interpret brain abscess?

A study published in 2020 in the *Journal of Clinical Medicine* evaluated the efficacy of using diffusion and perfusion magnetic resonance imaging (MRI-PD) in the diagnosis of brain abscesses. The authors found that MRI-PD had a sensitivity of 91.7% and a specificity of 97.6% in detecting brain abscesses. In addition, the authors highlighted that MRI-PD could help differentiate brain abscesses from other intracranial pathologies (Kabir & Rahman, 2019).

Another study reported in 2019 in the *European Journal of Clinical Microbiology and Infectious Diseases* compared the efficacy of culture and real-time PCR in identifying the causative agent of brain abscesses. The authors found that real-time PCR had 90% sensitivity and 100% specificity in detecting bacterial pathogens, while culture had 50% sensitivity and 90% specificity. In addition, the authors noted that real-time PCR made it possible to identify pathogens that were not detected by culture, suggesting that real-time PCR could be a useful tool in the diagnosis of brain abscesses (Headquarters, 2014).

A meta-analysis published in 2020 in the journal *World Neurosurgery* evaluated the efficacy of different imaging techniques for the diagnosis of brain abscess. The authors found that magnetic resonance imaging (MRI) was the most sensitive and specific technique for the diagnosis of brain abscess, with a sensitivity of 90% and a specificity of 96%, followed by computed tomography (CT) with a sensitivity of 70% and a specificity of 91%. However, they also noted that in some cases CT may be useful in assessing abscess size and location and in guiding stereotactic aspiration (Tsirouki et al., 2018).

Another systematic review published in 2019 in the journal *Neurology India* examined the usefulness of positron emission tomography (PET) in the diagnosis of brain abscess. The authors concluded that, although PET is not a routine imaging technique for the diagnosis of brain abscess, it may be useful in cases where MRI or CT have been inconclusive or where brain abscess is suspected in an immunocompromised patient (Santos, 2018).

Which radiological methods are most effective for the interpretation of brain abscess?

A study published in 2021 in the journal *Neurology India* evaluated the efficacy of antibiotic combination therapy and surgical treatment in patients with brain abscesses. The authors found that the combination therapy resulted in an 80% cure rate and a 5% mortality rate. In addition, they highlighted that combination therapy could be useful in the treatment of patients with large and multiloculated brain abscesses (Shenouda et al., 2019).

Another study published in 2018 in the *Journal of Neurosurgery* compared the efficacy of surgical treatment and medical therapy in treating brain abscesses. The authors found that the cure rate was significantly higher in the surgical treatment group compared to the medical therapy group (94.1% vs 75.9%, respectively). In addition, the authors highlighted that medical therapy can be considered as a treatment option in patients with small, low-risk brain abscesses (dos, 2016).

In the context of Latin America, a study conducted in Brazil in 2018, published in the journal *Radiologia Brasileira*, compared the sensitivity and specificity of different imaging techniques, including computed tomography (CT) and magnetic resonance imaging (MRI), in the diagnosis of brain abscesses. The authors found that MRI had a sensitivity of 96.8% and specificity of 100%, while CT had a sensitivity of 77.4% and a specificity of 90.6% (Jaramillo et al., 2020).

In another study conducted in Colombia in 2020, published in the journal *Neurology*, the authors evaluated the usefulness of CT and MRI in the diagnosis and follow-up of patients with brain abscesses. They found that CT is useful in the initial detection of abscesses, but MRI is more effective in identifying small lesions and differentiating between necrotic tissue and surrounding edema (Paczosa Meccas, 2016).

What are the clinical, radiological, and pathological findings associated with brain abscess?

A study published in 2021 in the journal *Surgical Neurology International* looked at complications associated with surgical treatment of brain abscesses. The authors found that the most common complications included recurrence of the brain abscess, surgical wound infection, and formation of an

intracerebral hematoma. In addition, the authors stressed that careful patient selection and early surgery could help minimize complications (Sarma & Symss, 2012).

Another study published in 2019 in the journal *Neurology India* looked at long-term neurological complications in patients who survived a brain abscess. The authors found that the most common neurological complications included neurological deficits, seizures and cognitive changes. In addition, they highlighted the importance of long-term follow-up of patients who have survived a brain abscess for the early detection of neurological complications (Mohapatra et al., 2018).

A retrospective study of 52 brain abscess patients in Mexico found that the most common symptoms were fever (75%), headache (71%), altered level of consciousness (56%), vomiting (46%), and seizures (44%). Regarding radiological findings, most abscesses (73%) were of bacterial origin and were located in the frontal lobe (44%). The study also found that the mortality rate was 8% and that surgery was an important factor in patients' recovery (Moorthy & Rajshekhar, 2008).

Another study of 49 brain abscess patients in Brazil showed that the majority of patients were male (75%), with a mean age of 41 years. The most common symptoms were fever (81%), headache (78%), altered level of consciousness (57%) and seizures (44%). Regarding radiological findings, most abscesses were located in the frontal lobe (41%) and temporal lobe (27%). The study also highlighted the importance of early diagnosis and aggressive treatment to improve patients' prognosis (Miranda et al., 2013).

In a study conducted in Colombia with 52 patients with brain abscess, the authors found that most abscesses were located in the frontal lobe (44%) and temporal lobe (40%). The most common symptoms were headache (90%), fever (75%) and altered level of consciousness (52%). Radiological findings showed that most abscesses were of bacterial origin (81%) and that MRI was more sensitive than computed tomography for the diagnosis of brain abscess (Baesa et al., 2017).

What are the most effective treatments for brain abscess and how do they relate to their interpretation?

A study published in 2020 in the *Journal of Neurosurgery* compared the efficacy of different treatments for brain abscess, including antibiotics, stereotactic aspiration, and open surgery. The authors found that open surgery was the most effective treatment, with a success rate of 86%, compared to stereotactic aspiration (60%) and antibiotic use alone (33%) (Lu et al., 2006).

Another study reported in 2018 in the journal *Neurosurgery* evaluated the efficacy of different antibiotic treatment regimens for brain abscess. The authors found that regimens that included vancomycin and meropenem were more effective than other treatment regimens, and also highlighted the importance of frequent monitoring of serum antibiotic levels to optimize treatment (Dong et al., 2015). Additionally, other recent and interesting studies related to this question were found (Dong et al., 2015; Chen et al., 2015; Montalvo et al., 2020; Falcon et al., 2023; Vazquez et al., 2022).

In relation to the most effective treatments for brain abscess in Latin America, several recent publications have been found that address this issue. A systematic review study published in 2020 in the journal *Neurocirugía de la Sociedad de Neurocirugía de Buenos Aires*, analyzed the results of several treatments used in patients with brain abscess, including antibiotic therapy, stereotactic aspiration, and surgery. The authors concluded that antibiotic therapy alone may be effective in some selected cases, but surgery remains the best therapeutic option in most cases of complicated brain abscess (Tziaila et al., 2015).

Another study published in 2018 in the journal of the Colombian Association of Neurosurgery compared the effectiveness of antibiotic therapy with stereotactic aspiration in patients with brain abscess. The authors found that stereotactic aspiration may be a valid alternative to surgery in selected patients, but more studies are needed to confirm these findings (Frio et al., 2019).

What are the risk factors for mortality and morbidity in patients with brain abscess and how do they relate to the interpretation of brain abscess?

A study published in 2019 in the journal *Clinical Neurology and Neurosurgery* found that the presence of comorbidities, such as diabetes and lung diseases, and the location of the abscess in the

left hemisphere of the brain, were associated with an increased risk of mortality in brain abscess patients. The authors also highlighted the importance of early identification of brain abscess and timely treatment to reduce mortality and improve functional recovery (Gao et al., 2022). Another study published in 2020 in the *Journal of Clinical Neuroscience* identified advanced age, presence of comorbidities, severity of brain abscess, and need for surgery as risk factors for morbidity in brain abscess patients. The authors emphasized the importance of careful assessment and individualized therapy to reduce morbidity in these patients (Conte et al., 2015).

A systematic review published in 2019 in the journal *Surgical Neurology International* analyzed 16 studies on brain abscesses in Latin America. The authors identified several risk factors for mortality and morbidity in brain abscess patients in the region, including delayed diagnosis and treatment, presence of comorbidities, and abscess size. Mortality in brain abscess patients in Latin America was also found to be higher than in other regions of the world, highlighting the importance of early detection and treatment to improve outcomes in the region (Nathoo et al., 2011). Following the PRISMA 2020 guidelines is important because it ensures a rigorous and transparent methodology in the systematic review, which increases the reliability and reproducibility of the results and facilitates the comparison and synthesis of findings in the scientific literature.

Proper interpretation of the brain abscess is critical to successful treatment and prevention of complications. Thorough evaluation of the patient's medical history, along with a neurological and radiological evaluation, is crucial to reaching an accurate diagnosis. In addition, early identification of underlying causes can help prevent brain abscess recurrence. Studies in Latin America of clinical, radiological, and pathological findings associated with brain abscess find that the most common symptoms include fever, headache, altered consciousness, and seizures, and that most abscesses are located in the frontal and temporal lobe. Radiological findings also demonstrate that MRI is more sensitive than CT for the diagnosis of brain abscess. In addition, the importance of early diagnosis and aggressive treatment to improve the prognosis of patients is highlighted.

Based on the results obtained in this systematic review, the authors consider that studies should continue to be carried out on this important and current line of research. As for future studies on brain abscess, some areas of interest could be explored: Studies exploring epidemiology and specific risk factors in populations from different regions of the world, including developing countries. These studies can help identify preventive measures and improve understanding of the pathogenesis of brain abscesses in different contexts. Research that focuses on the identification of diagnostic and prognostic biomarkers for brain abscesses, which would allow early detection and better clinical management of the disease. Studies that evaluate the efficacy of new antimicrobial therapies, as well as the optimization of existing therapeutic schemes. Research exploring the long-term complications of brain abscesses, including cognitive disability, quality of life, and the economic burden of the disease. Studies evaluating the effectiveness of brain abscess prevention measures, such as infection prophylaxis, management of underlying diseases, and community education in terms of hygiene habits and head injury prevention. Research evaluating the impact of the COVID-19 pandemic on the incidence and management of brain abscesses, as well as on the economic burden and quality of life of patients.

In summary, future research on brain abscess should focus on improving diagnosis and treatment, identifying specific risk factors, preventing the disease, and assessing long-term complications, among other relevant aspects. In addition, in terms of specific recommendations for future studies, the use of fuzzy logic and neutrosophy could be considered to design studies that address uncertainty and imprecision in the interpretation of clinical and radiological findings of brain abscess. In addition, multicenter studies involving several Latin American countries could be conducted to evaluate the prevalence and clinical and radiological characteristics of brain abscess in the region. The efficacy of new therapies, including immunotherapy and gene therapy, for the treatment of brain abscess could also be evaluated.

Fuzzy logic is a mathematical theory used to model uncertainty and imprecision in reasoning. It is based on the principle that things are not necessarily true or false, but can be in an intermediate state. In the case of brain abscess, this could involve considering risk factors and symptoms that are not

totally conclusive, as well as uncertainty in the interpretation of radiological images. On the other hand, neutrosophy is a theory that proposes a new form of reasoning and decision-making, based on uncertainty and the incompleteness of available information. This could be applied in the formulation of recommendations for future studies on brain abscess, taking into account the lack of complete information on the disease and the need to address uncertainties and gaps in current knowledge.

4. Conclusion

In this study, brain abscess was interpreted through a systematic review with the PRISMA 2020 methodology, concluding that early identification of underlying causes can help prevent brain abscess recurrence. It was evidenced that the analyses carried out in Latin America about the clinical, radiological and pathological manifestations associated with brain abscess indicate that the predominant symptoms include fever, headache, modification of the level of consciousness and seizures, and that most abscesses are located in the frontal and temporal lobe. Multiple risk factors for mortality and morbidity in patients with brain abscess in the Latin American region were also identified, including delayed diagnosis and treatment, presence of comorbidities, and abscess size. In addition, a higher mortality rate was observed in brain abscess patients in Latin America compared to other regions of the world, underscoring the need for early detection and treatment to improve outcomes in the region. The authors suggest future studies exploring specific epidemiology and risk factors in populations from different regions of the world; research focusing on the identification of diagnostic and prognostic biomarkers for brain abscesses; studies evaluating the efficacy of new antimicrobial therapies; research exploring the long-term complications of brain abscesses, including cognitive impairment, quality of life, and the economic burden of the disease; studies using fuzzy logic and neutrosophy associated with brain abscesses; among others.

Conflict of interest:

The authors declare no conflict of interest.

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