ORIGINAL ARTICLE

Infect Dis Clin Microbiol 2026; 8(1): 54–69

Mapping Mucormycosis Research: A 25-Year Bibliometric Analysis of Medical Literature

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ABSTRACT

Objective: This bibliometric study aimed to analyze global research trends on mucormycosis using medical literature indexed in the Web of Science (WoS) database between 2000 and 2024. Publication output over time, country contributions, international collaboration, funding sources, influential keywords, leading institutions, active journals, and the most cited articles were evaluated.

Materials and Methods: A comprehensive search of Web of Science Core Collection (Science Citation Index Expanded and Emerging Sources Citation Index) was conducted using title-based keywords related to mucormycosis and its etiological agents. English-language articles within the medical domain were included. Statistical analysis was performed using Microsoft Excel, and bibliometric network visualizations were generated with VOSviewer (version 1.6.19).

Results: According to the inclusion and exclusion criteria a total of 2936 publications between 2000 and 2024 were included in the analysis. The number of publications on mucormycosis increased significantly over the past two decades, with pronounced peaks in 2021 and 2022, likely associated with the coronavirus disease 2019 (COVID-19) pandemic. The most frequently cited article was *Epidemiology and Clinical Manifestations of Mucormycosis,* with 872 citations. The United States, India, and China were the most prolific countries. The University of Texas MD Anderson Cancer Center was the most frequently cited institution, and *Cureus* was the journal with the highest number of publications. Keyword analysis showed strong associations between mucormycosis and COVID-19, diabetes, and antifungal therapeutics.

Conclusion: The COVID-19 pandemic was associated with a surge of mucormycosis cases and related research activity, particularly among patients with uncontrolled diabetes and those receiving corticosteroid therapy. The growing population of immunocompromised patients and the increasing use of immunosuppressive treatments are likely to continue to drive global research interest in mucormycosis. These findings highlight the need for interdisciplinary and international collaboration to address this emerging public health challenge.

Keywords: Mucormycosis, bibliometric analysis, fungal infections, diabetes, immunocompromised, Rhizopus

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Received: June 24, 2025
Accepted: September 17, 2025
Published: January 30, 2026

Suggested citation:
Güçlü-Kayta SB, Alkan S, Evlice O. Mapping mucormycosis research: A 25-year bibliometric analysis of medical literature. Infect Dis Clin Microbiol. 2026;1:54–69.

DOI: 10.36519/idcm.2026.753

INTRODUCTION

Mucormycosis is a fungal infection caused by members of the order *Mucorales*, including *Rhizopus, Mucor, Rhizomucor, Actinomucor, Apophysomyces, Cunninghamella, Lichtheimia, Saksenaea,* and *Syncephalastrum* (1). *Rhizopus, Mucor*, and *Lichtheimia* are the most common etiologic agents and together account for more than 90% of mucormycosis cases worldwide (2).

Invasive mucormycosis is a fatal fungal infection mostly reported in patients with comorbidities affecting the immunological status, such as uncontrolled diabetes, and immunocompromised patients (2,3). Predisposing conditions include neutropenia, corticosteroid therapy, transplantation, and immunosuppression. Concern about mucormycosis has intensified during the COVID-19 pandemic, underscoring the need for coordinated efforts between the scientific and clinical communities (4).

The present study aimed to assess global research trends in mucormycosis by analyzing publications in the medical field indexed in the Web of Science database between 2000 and 2025. Quantitative and qualitative indicators were used to evaluate temporal publication trends, country contributions, international collaboration, funding sources, subject areas, frequently used keywords, leading institutions, and the most productive journals.

MATERIALS AND METHODS

A descriptive bibliometric study design was employed. Publications related to mucormycosis were retrieved from the Web of Science database between January 1, 2000, and February 1, 2025. A predefined search strategy consistent with previously published bibliometric studies (5,6). The search was conducted within the Science Citation Index Expanded (SCIE) and the Emerging Sources Citation Index (ESCI) databases of the Web of Science Core Collection.

The following title-based search terms were used: Mucormycosis OR Mucorales Infections OR Zygomycoses OR Infection, Mucorales OR Mucorales OR phycomycosis OR Rhizopus OR Syncephalastrum OR Saksenaea OR Lichtheimia OR Cunninghamella OR Apophysomyces OR Actinomucor OR Rhizomucor.

The initial search yielded 9425 publications. After limiting the document type to "article", the number decreased to 6689. Restricting the language to English further reduced the number to 6605. As the year 2025 was ongoing at the time of data collection, publications from 2025 were excluded, resulting in 6579 articles.

Among these, 4916 articles published since 2000 accounted for 74.7% of the total. Articles outside the field of medicine were subsequently excluded, yielding a final dataset of 2936 articles. Based on the predefined inclusion and exclusion criteria, these 2936 articles constituted the study sample and were included in the final analyses.

Statistical Analysis and Bibliometric Mappings

Microsoft Office Excel 2016 was used to analyze annual publication trends. Bibliometric mapping was performed to visualize relationships and networks among publications, keywords, authors, institutions, and countries, facilitating the identification of research structures and emerging trends in the field (5,6). Bibliometric networks were generated and visualized using VOSviewer software (version

HIGHLIGHTS

- A sharp increase in publications was observed after 2020, peaking in 2021–2022, likely related to the COVID-19 pandemic.
- The most frequently studied topics were COVID-19-associated mucormycosis, diabetes mellitus, and antifungal treatments.
- The United States had the highest number of citations, while India produced the great-est number of publications.
- The University of Texas MD Anderson Cancer Center and *Cureus* were the leading in-stitution and journal, respectively, in terms of research output and visibility.
- COVID-19 and the increasing use of immunosuppressive therapies have sustained global research interest in mucormycosis.

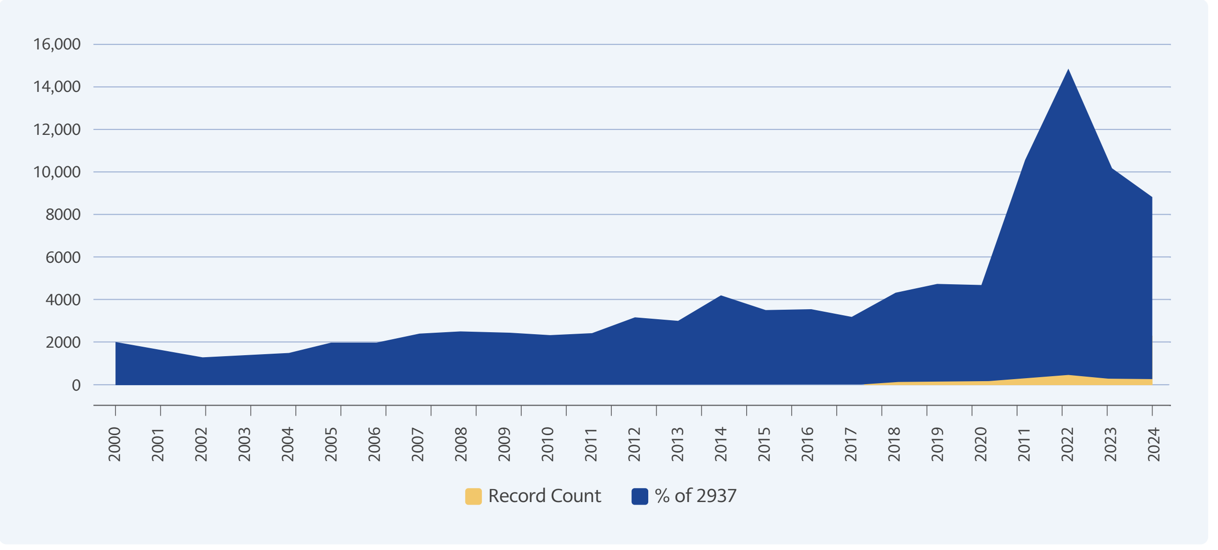

Figure 1. Number of publications by years.

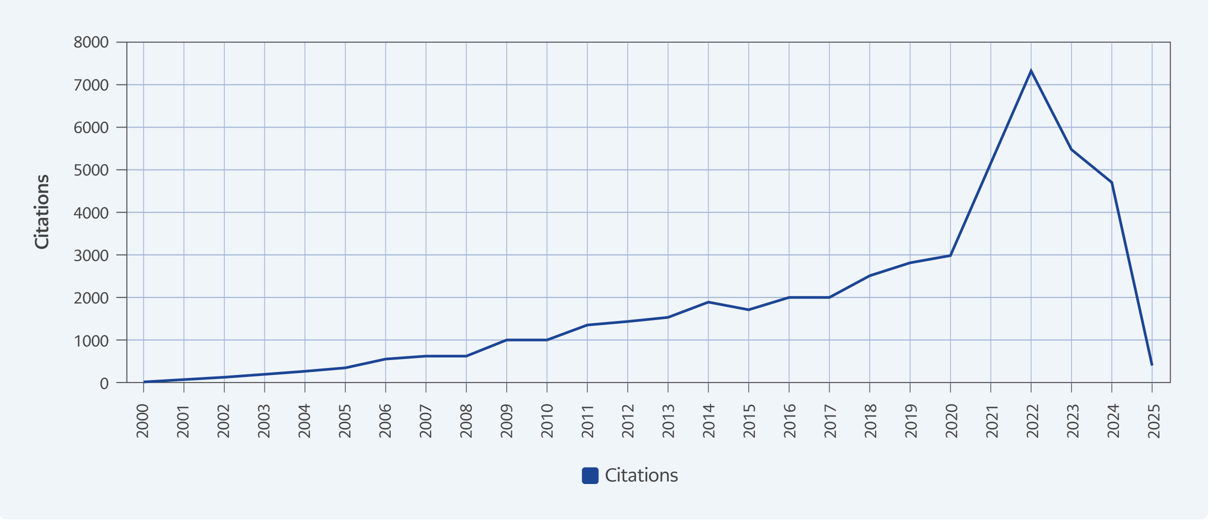

Figure 1. Number of citations

1.6.19) (7), which enables the construction of maps based on large-scale bibliographic data.

RESULTS

General Profile

According to the inclusion criteria, 2936 articles on mucormycosis between 2000 and 2024 were retrieved from the Web of Science database. Of these publications, 1035 were indexed in the ESCI and 1901 in the SCIE.

As shown in Figure 1, the annual number of publications increased markedly over the study period, with pronounced peaks in 2021 (10.35%) and 2022 (14.51%), accounting for a substantial proportion of the total output. Although modest declines were observed in 2023 and 2024 (approximately 9%–8%), publication levels remained considerably higher than in the pre-2020 period. The sharp rise in publications during the early 2020s suggests a strong external influence, most notably increased research activity during and following the COVID-19 pandemic. Overall, the data demonstrate a rapid and sustained growth in mucormycosis-related research.

Top-Cited Articles and Citation Analysis

The included publications received 47,688 citations, yielding a mean of 16.24 citations per article. Articles published in 2022 accounted for the highest number of citations (7270), making it the most cited year overall. The annual distribution of citations is illustrated in Figure 2.

Table 1 lists the most highly cited articles in the field of mucormycosis. The two leading publications were *Epidemiology and clinical manifestations of mucormycosis* (2012) by Petrikkos et al., and *Isavuconazole treatment for mucormycosis* (2016) by Marty et al. More recent studies, including *Rhino-orbital mucormycosis associated with COVID-19* (2020) and *Multicenter epidemiologic study of coronavirus disease-associated mucormycosis, India* (2021), demonstrated particularly high average citation rates, reflecting the rapidly growing interest in COVID-19-associated mucormycosis. In addition, clinical guidelines and review articles, such as ESCMID and ECMM *joint clinical guidelines for the diagnosis and management of mucormycosis* (2014) and *Pathogenesis of mucormycosis* (2012), were among the most frequently cited publications.

Funding Agencies

A total of 876 organizations provided financial support for the publications included in this analysis. Among the major funding organizations, the National Natural Science Foundation of China (NSFC) was the leading supporter, funding 92 publications (3.13%). The National Institutes of Health (NIH) of the United States also made a significant contribution, supporting 45 publications (1.53%).

Other notable funding institutions included Astellas Pharmaceuticals (33 publications, 1.12%), a Japan-based pharmaceutical company; the United States Department of Health and Human Services (HHS) (57 publications, 1.94%); and Merck & Co., Inc. (29 publications, 0.99%), a United States-based pharmaceutical company. Additionally, the Japan Society for the Promotion of Science (JSPS) (20 publications, 0.68%) and Japan's Ministry of Education, Culture, Sports, Science and Technology (MEXT) (21 publications, 0.76%) were identified as important contributors. Detailed information on funding agencies is presented in Table 2.

Important Keywords

A total of 3179 keywords were extracted from the global mucormycosis literature. Among these, 88 keywords appeared more than ten times, providing insight into the major research trends. These keywords were analyzed using Vosviewer software.

The frequency and relevance of the most prominent keywords are summarized in Table 3 and visualized in Figures 3a and 3b. Figure 3a shows an overlay visualization of common keywords, illustrating temporal trends in keyword usage between 2000 and 2025, with color gradients indicating changes over time.

The analysis highlights the significant concern of COVID-19-associated mucormycosis, diabetes, and immunocompromised states (Table 3). It emphasizes treatment strategies, particularly antifungal therapies, as well as various manifestations of the disease. Frequent use of terms such as *Rhizopus* and *Mucorales* indicates specific fungal species, while amphotericin B and Posaconazole emerged as the most commonly referenced antifungal agents.

The Most Prolific Countries

Research on mucormycosis involved contributions from 89 countries. The United States had the highest number of citations (10,426), with 379 publications, indicating both high research output and strong global impact. As shown in Table 4, India produced the largest number of publications, but had a comparatively lower citation count (6496 citations), suggesting a relatively lower citation impact despite high productivity.

China ranked third, with 187 publications and 3154 citations. Several European countries, including Germany, France, Spain, Italy, and Greece, also made notable contributions to citation counts. In addition, South Korea and Japan demonstrated meaningful research output and impact.

Figure 4 illustrates international collaboration networks. Countries with higher publication output are represented with larger circles, while the thickness of the connecting lines reflects the strength of collaborative relationships. Countries connected to each other are shown in the same color.

Table 1. The top 20 most cited articles.

Article	Total citations	Average per year
Petrikkos G, Skiada A, Lortholary O, Roilides E, Walsh TJ, Kontoyiannis DP. Epidemiology and clinical manifestations of mucormycosis. Clin Infect Dis. 2012. [CrossRef]	872	62.29
Marty FM, Ostrosky-Zeichner L, Cornely OA, Mullane KM, Perfect JR, Thompson GR III, et al. Isavuconazole treatment for mucormycosis: a single-arm open-label trial and case-control analysis. Lancet Infect Dis. 2016. [CrossRef]	488	48.8
Ibrahim AS, Spellberg B, Walsh TJ, Kontoyiannis DP. Pathogenesis of mucormycosis. Clin Infect Dis. 2012. [CrossRef]	476	34
Cornely OA, Arikan-Akdagli S, Dannaoui E, Groll AH, Lagrou K, Chakrabarti A, et al. ESCMID and ECMM joint clinical guidelines for the diagnosis and management of mucormycosis 2013. Clin Microbiol Infect. 2014. [CrossRef]	475	39.58
Tissot F, Agrawal S, Pagano L, Petrikkos G, Groll AH, Skiada A, et al. ECIL-6 guidelines for the treatment of invasive candidiasis, aspergillosis and mucormycosis in leukemia and hematopoietic stem cell transplant patients. Haematologica. 2017. [CrossRef]	407	45.22
Lanternier F, Dannaoui E, Morizot G, Elie C, Garcia-Hermoso D, Huerre M, et al. A global analysis of mucormycosis in France: the RetroZygo study (2005–2007). Clin Infect Dis. 2012. [CrossRef]	357	25.5
Spellberg B, Edwards J Jr, Ibrahim A. Recent advances in the management of mucormycosis: from bench to bedside. Clin Infect Dis. 2009. [CrossRef]	345	20.29
Reed C, Bryant R, Ibrahim AS, Edwards J Jr, Filler SG, Goldberg R, et al. Combination polyene-caspofungin treatment of rhino-orbital-cerebral mucormycosis. Clin Infect Dis. 2008. [CrossRef]	340	18.89
Mehta S, Pandey A. Rhino-orbital mucormycosis associated with COVID-19. Cureus. 2020. [CrossRef]	333	55.5
Patel A, Agarwal R, Rudramurthy SM, Shevkani M, Xess I, Sharma R, et al. Multicenter epidemiologic study of coronavirus disease–associated mucormycosis, India. Emerg Infect Dis. 2021. [CrossRef]	304	60.8
Bitar D, Van Cauteren D, Lanternier F, Dannaoui E, Che D, Dromer F, et al. Increasing incidence of zygomycosis (mucormycosis), France, 1997–2006. Emerg Infect Dis. 2009. [CrossRef]	296	17.41
O'Mahony T, Guibal E, Tobin JM. Reactive dye biosorption by *Rhizopus arrhizus* biomass. Enzyme Microb Technol. 2002. [CrossRef]	282	11.75
Sen M, Honavar SG, Bansal R, Sengupta S, Rao R, Kim U, et al. Epidemiology, clinical profile, management, and outcome of COVID-19–associated rhino-orbital-cerebral mucormycosis in 2826 patients in India: Collaborative OPAI-IJO study on mucormycosis in COVID-19 (COSMIC), report 1. Indian J Ophthalmol. 2021. [CrossRef]	273	54.6
Werthman-Ehrenreich A. Mucormycosis with orbital compartment syndrome in a patient with COVID-19. Am J Emerg Med. 2021. [CrossRef]	258	51.6
Fanfair RN, Benedict K, Bos J, Bennett SD, Lo YC, Adebanjo T, et al. Necrotizing cutaneous mucormycosis after a tornado in Joplin, Missouri, in 2011. N Engl J Med. 2012. [CrossRef]	249	17.79
Pagano L, Offidani M, Fianchi L, Nosari A, Candoni A, Picardi M, et al. Mucormycosis in hematologic patients. Haematologica. 2004.	242	11.0
Walsh TJ, Gamaletsou MN, McGinnis MR, Hayden RT, Kontoyiannis DP. Early clinical and laboratory diagnosis of invasive pulmonary, extrapulmonary, and disseminated mucormycosis (zygomycosis). Clin Infect Dis. 2012. [CrossRef]	240	17.14
Walther G, Pawłowska J, Alastruey-Izquierdo A, Wrzosek M, Rodriguez-Tudela JL, Dolatabadi S, et al. DNA barcoding in *Mucorales*: an inventory of biodiversity. Persoonia. 2013. [CrossRef]	238	18.31
Patel A, Kaur H, Xess I, Michael JS, Savio J, Rudramurthy S, et al. A multicentre observational study on the epidemiology, risk factors, management and outcomes of mucormycosis in India. Clin Microbiol Infect. 2020. [CrossRef]	233	38.83
Ibrahim AS, Gebermariam T, Fu Y, Lin L, Husseiny MI, French SW, et al. The iron chelator deferasirox protects mice from mucormycosis through iron starvation. J Clin Invest. 2007. [CrossRef]	232	12.21

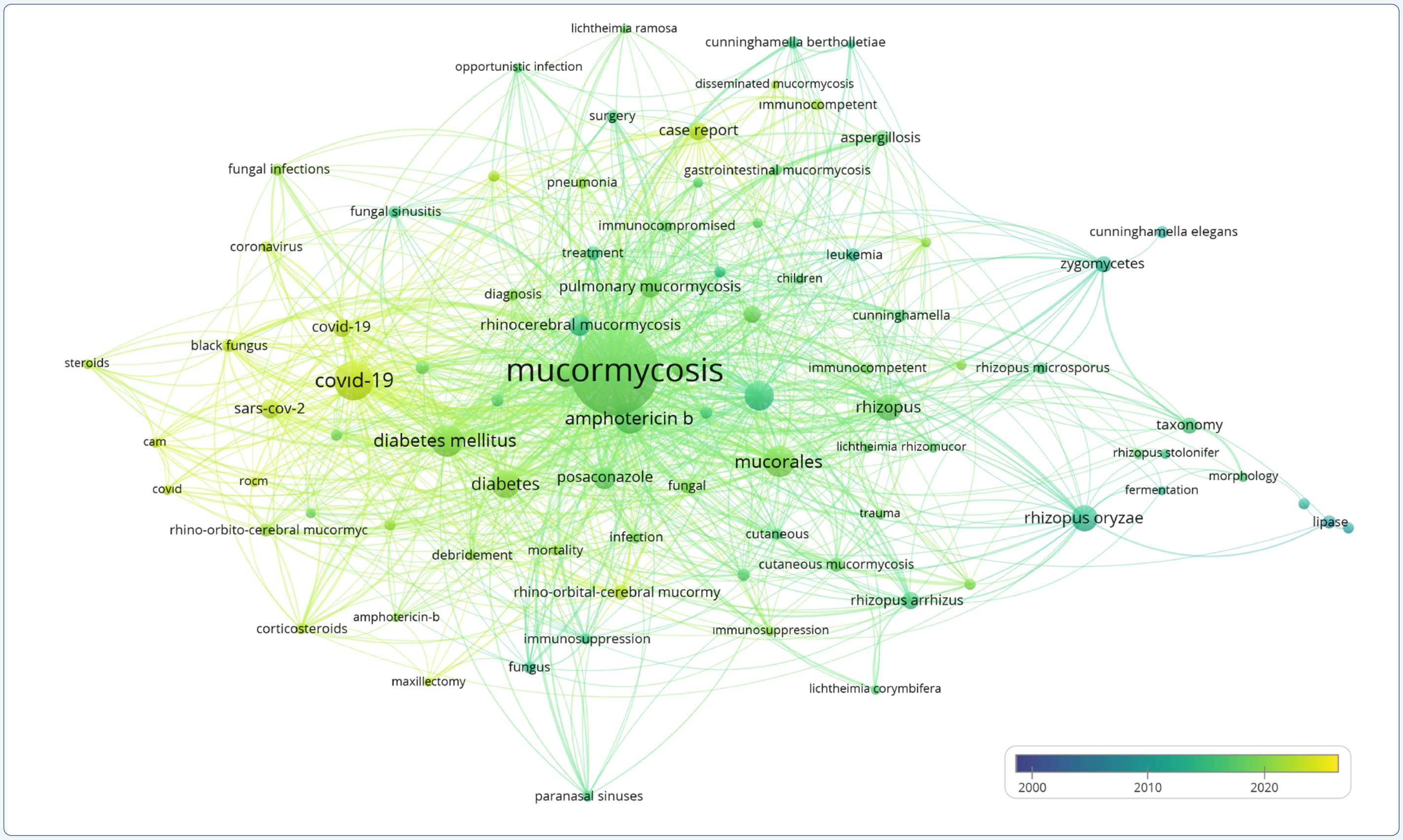

Figure 3.a. Overlay visualization of common keywords.

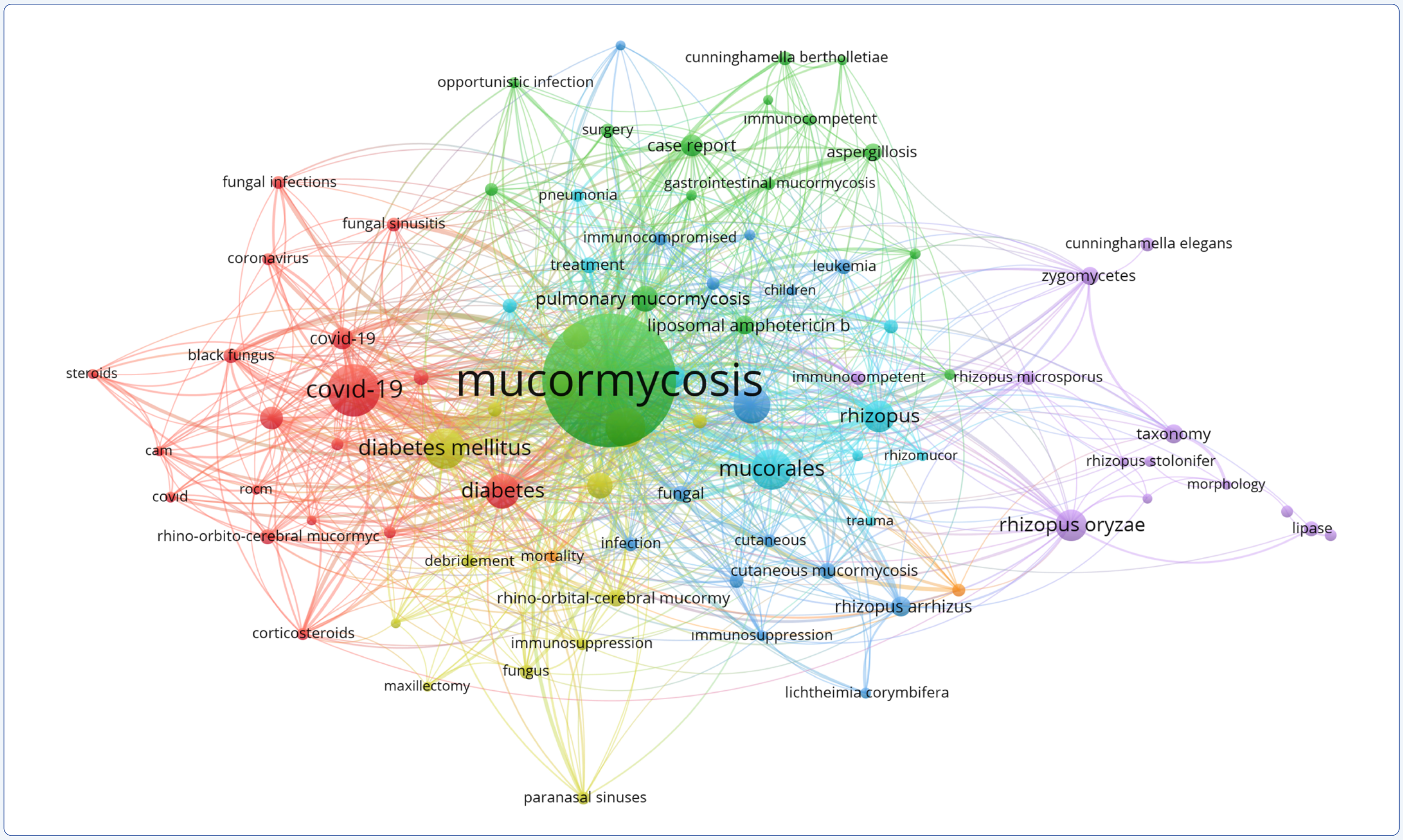

Figure 3.b. Keyword analysis.

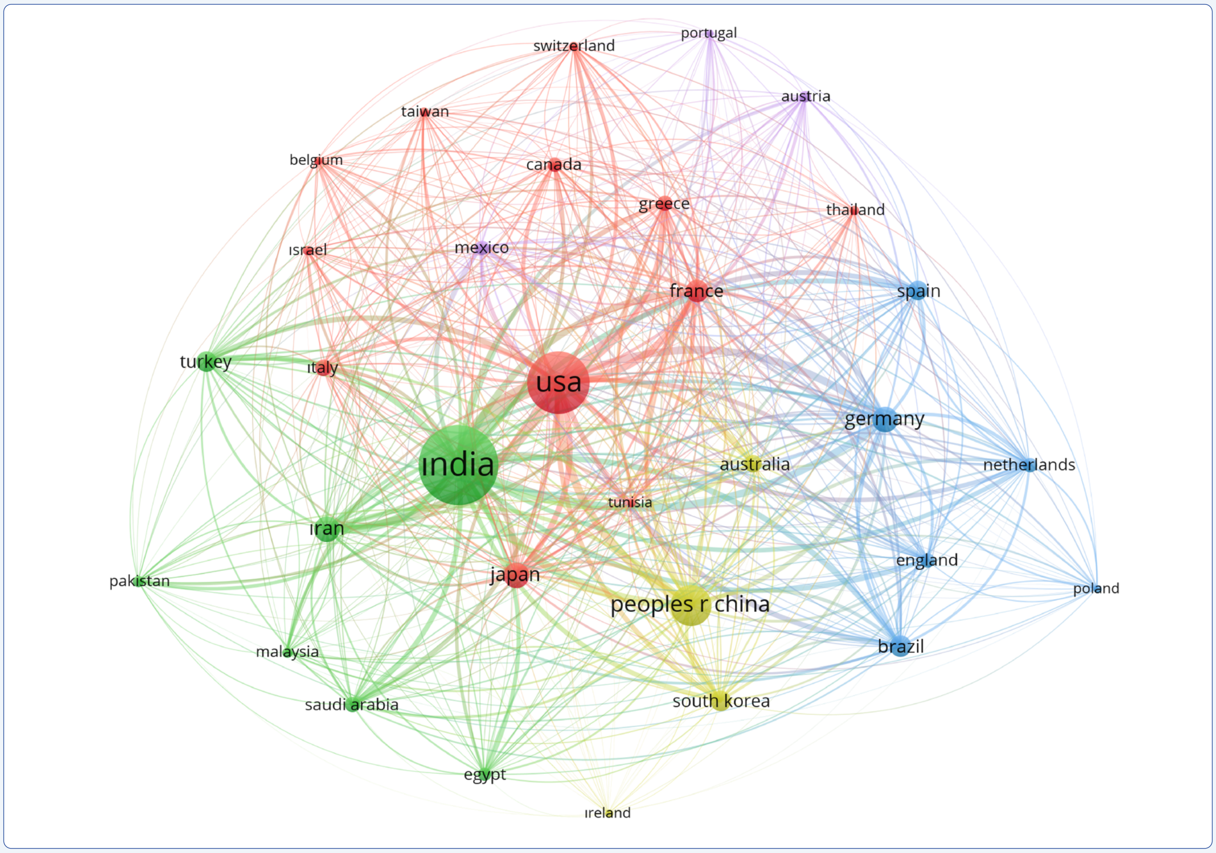

Figure 4. International collaborations between countries.

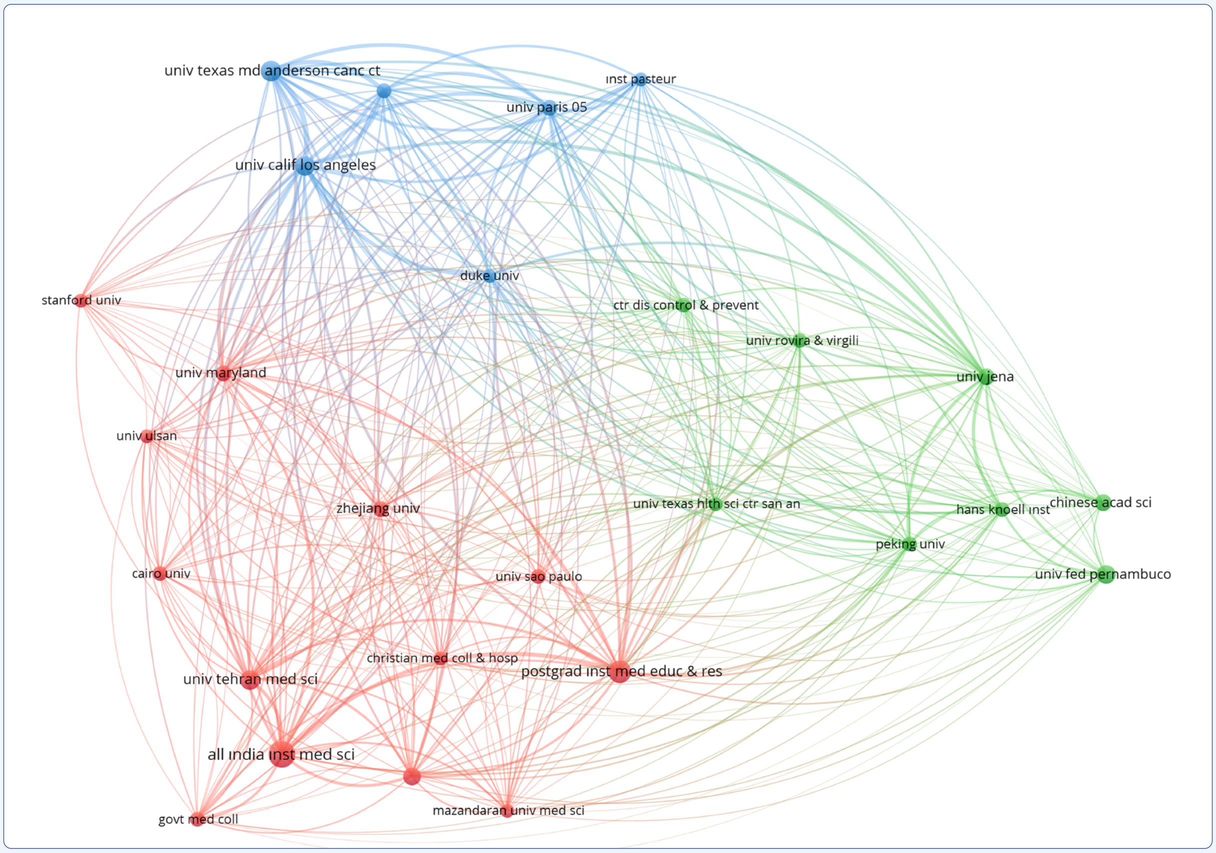

Figure 5. International collaborations between organizations.

Table 2. Top funding agencies.

Funding Agency	n	Country
National Natural Science Foundation of China (NSFC)	92	China
U.S. Department of Health and Human Services (HHS)	57	United States
National Institutes of Health (NIH)	45	United States
Astellas Pharmaceuticals	33	Japan
Pfizer	30	United States
Gilead Sciences	29	United States
Merck & Co., Inc.	29	United States
Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq)	27	Brazil
National Institute of Allergy and Infectious Diseases (NIAID)	26	United States
Ministry of Education, Culture, Sports, Science & Technology (MEXT), Japan	21	Japan
Japan Society for the Promotion of Science (JSPS)	20	Japan
National High Technology Research and Development Program of China	18	China
Grants-in-Aid for Scientific Research (KAKENHI)	16	Japan
German Research Foundation (DFG)	14	Germany
Indian Council of Medical Research (ICMR)	14	India
U.S. Public Health Service (USPHS)	14	United States
Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES)	13	Brazil
National Basic Research Program of China	12	China
Department of Science & Technology, India	11	India
Merck Sharp & Dohme (MSD)	11	United States
Schering Plough Corporation	11	United States
Spanish Government	11	Spain
Consejo Nacional de Ciencia y Tecnología (CONACYT)	10	Mexico
Henry Schueler 41&9 Foundation	10	United States

Table 3. Most common keywords.

Keyword	Number of occurrences	Total link strength
mucormycosis	843	1250
covid-19	170	370
diabetes mellitus	112	243
mucorales	108	225
amphotericin b	103	224
zygomycosis	91	203
diabetes	85	214
rhizopus	73	136
rhizopus oryzae	73	50
fungal infection	70	151
posaconazole	52	132
rhinocerebral mucormycosis	51	77
pulmonary mucormycosis	49	72
sars-cov-2	41	117
case report	38	86
covid-19	38	97
mucor	35	79
rhizopus arrhizus	33	53
liposomal amphotericin b	31	69
taxonomy	29	24
zygomycetes	28	39
aspergillosis	27	51
rhino-orbital-cerebral mucormycosis	25	59
cutaneous mucormycosis	23	38
fungal	23	35
treatment	23	47
rhino-orbital mucormycosis	20	38

Keyword	Number of occurrences	Total link strength
black fungus	19	64
leukemia	19	38
lipase	19	9
rhino-orbito-cerebral mucormycosis	19	37
cunninghamella	18	29
cunninghamella bertholletiae	18	23
diagnosis	18	47
fungal sinusitis	18	36
immunocompetent	18	31
immunocompromised	18	41
amphotericin	17	34
cunninghamella elegans	17	1
diabetic ketoacidosis	17	33
fungus	17	32
infection	17	44
neutropenia	17	40
rhizopus microsporus	17	23
surgery	17	25
fungal infections	16	32
pneumonia	16	36
cutaneous	15	37
debridement	15	43
epidemiology	15	36
invasive fungal infection	15	32
mortality	15	29
paranasal sinuses	15	31
sinusitis	15	32

Table 4. Most prolific countries.

Country	Number of documents	Number of citations	Total link strength
India	573	6496	242,919
USA	379	10426	235,129
China	187	3154	92,914
Germany	83	3306	79,875
Iran	82	819	67,034
Japan	81	1052	43,619
France	68	3963	70,315
Brazil	60	809	44,244
Türkiye	58	758	35,290
South Korea	56	624	33,331
Spain	54	1581	35,347
Australia	42	803	25,928
Italy	38	1065	16,250
Saudi Arabia	37	299	27,471
Greece	34	2366	38,322
Mexico	32	637	23,211
Netherlands	32	1448	33,675
England	31	635	30,174
Canada	30	285	20,095
Egypt	29	278	17,666
Austria	21	645	14,850
Pakistan	21	194	10,281
Malaysia	19	281	10,451
Switzerland	16	332	14,340
Taiwan	14	280	8754
Thailand	14	124	7744
Israel	14	382	10,247
Belgium	12	256	11,259
Poland	12	524	7068
Tunisia	12	172	9562
Ireland	12	472	946
Portugal	10	93	6139

The Most Productive Organizations

There are 2553 organizations that have contributed to the global mucormycosis literature. The most productive institutions, ranked by publication count, are presented in Table 5. India showed the highest institutional representation, with four actively contributing organizations: All India Institute of Medical Sciences, Postgraduate Institute of Medical Education and Research, Government Medical College, Christian Medical College and Hospital.

The United States followed with seven institutions, including the University of Texas MD Anderson Cancer Center, the University of California, Los Angeles, the University of Maryland, the Centers for Disease Control and Prevention, the University of Texas Health Science Center San Antonio, Duke University, and Stanford University. These institutions demonstrated the highest overall citation counts and total link strength, reflecting substantial international visibility and research influence.

Institutions from China (Chinese Academy of Sciences, Zhejiang University, Peking University), Iran (University of Tehran Medical Sciences, Isfahan University of Medical Sciences), and Brazil (Federal University of Pernambuco, University of São Paulo) were among the leading contributors.

Among all institutions, the University of Texas MD Anderson Cancer Center was the most frequently cited (2611 citations), indicating a particularly academic impact. Other highly cited institutions included the Postgraduate Institute of Medical Education and Research (India) and the University of California, Los Angeles (United States).

Top Journals

Research articles on mucormycosis were published across 716 different journals. The leading journals, based on publication volume and citation counts, are summarized in Table 6. *Cureus* published the highest number of articles (100 publications), although it had a moderate citation count (618 citations). *Mycoses* demonstrated a higher citation impact (1210 citations) despite a lower number of publications. Other journals, including *Indian Journal of Otolaryngology* and *Head & Neck Surgery* and *Medical Mycology Case Reports*, had fewer citations.

DISCUSSION

This bibliometric study provides an extensive analysis of global research activity on mucormycosis over the past 25 years. The pronounced increase in publications after 2020 coincides with the COVID-19 pandemic, which not only led to a substantial rise in reported mucormycosis cases but also drew heightened scientific attention. COVID-19-associated mucormycosis (CAM), particularly reported from India, emerged as a dominant research focus, reflecting the convergence of poorly controlled diabetes, widespread corticosteroid use, and SARS-CoV-2 infection.

Our findings are broadly consistent with previous bibliometric analyses (8–12), all of which identify the COVID-19 pandemic as a major driver of increased publication activity. Similar to these reports, India was the most prolific country in terms of publication volume, while the United States had the highest citation impact. This divergence between productivity and citation impact highlights differences in research visibility, funding structures, and journal selection across countries.

The higher citation impact of publications from the United States may partly be explained by preferences for journals indexed in SCIE, which generally have broader international visibility. In contrast, the vast majority of publications from India appeared in ESCI journals, which may limit citation exposure despite high research output. As a result, despite high productivity, these studies may receive fewer citations. These observations emphasize the role of journal accessibility and indexing in shaping global research impact.

Funding patterns further support these findings, with the NIH and NSFC emerging as leading funding agencies. At the institutional level, the University of Texas MD Anderson Cancer Center ranked highest in citation counts, which was not surprising given its extensive expertise in the field of infectious complications of cancer and transplantation. Indian institutions demonstrated high productivity, likely reflecting the significant national disease burden.

Table 5. Most prolific organizations.

Organization	Country	Number of documents	Number of citations	Total link strength
All India Institute of Medical Sciences	India	55	939	9967
Postgraduate Institute of Medical Education and Research	India	36	1588	9768
University of Texas MD Anderson Cancer Center	United States	27	2611	12,260
Tehran University of Medical Sciences	Iran	26	318	6451
University of California Los Angeles	United States	25	2415	14,184
Federal University of Pernambuco	Brazil	21	299	2869
Isfahan University of Medical Sciences	Iran	18	126	5740
Chinese Academy of Sciences	China	17	244	1548
Friedrich Schiller University Jena	Germany	16	1219	8661
Zhejiang University	China	15	186	3307
University of Maryland	United States	14	496	7009
Université Paris Cité	France	14	1019	8604
Peking University	China	13	690	5429
University of São Paulo	Brazil	13	105	2207
Aristotle University of Thessaloniki	Greece	12	1352	9745
Cairo University	Egypt	12	99	2513
Centers for Disease Control and Prevention	United States	12	651	3281
Government Medical College	India	12	115	2814
Hans Knöll Institute	Germany	12	357	5047
Rovira i Virgili University	Spain	12	422	2765
University of Texas Health Science Center San Antonio	United States	11	504	3792
Institut Pasteur	France	11	951	5519
Christian Medical College and Hospital	India	10	363	1882
Duke University	United States	10	379	7055
Mazandaran University of Medical Sciences	Iran	10	79	3071
Stanford University	United States	10	136	2296
University of Ulsan	South Korea	10	130	2624

Differences between our results and other bibliometric studies can be attributed to variations in data sources and methodological approaches. While our analysis was limited to medical articles in the Web of Science database, other studies incorporated broader databases or extended time frames. For example, Gupta et al. (9) analyzed 5658 publications retrieved from Scopus, which resulted in the United States as the leading contributor (30.6%), whereas India ranked first in publication output in our study. Sivankalai and Sivasekaran (11) examined the evolution of mucormycosis research over a longer historical period (1923–2021), providing the most extensive historical coverage to date. Despite methodological differences, all studies consistently highlight the limited research impact from

Table 6. Top publishing journals.

Journal	Documents	Citations
Cureus	100	618
Mycoses	72	1210
Indian Journal of Otolaryngology and Head & Neck Surgery	66	253
Journal of Fungi	50	418
Mycopathologia	45	413
Medical Mycology Case Reports	44	288
Journal of Clinical Microbiology	38	1640
Enzyme and Microbial Technology	31	1206
Journal of Clinical and Diagnostic Research	30	37
Applied Microbiology and Biotechnology	27	952
IDCases	27	74
Indian Journal of Ophthalmology	26	241
Journal of Medical Mycology	25	201
Journal of Family Medicine and Primary Care	25	13
Clinical Infectious Diseases	23	3479
BMJ Case Reports	22	204
World Journal of Microbiology and Biotechnology	22	329
Clinical Case Reports	20	27
Biotechnology Letters	18	287
Journal of Maxillofacial and Oral Surgery	18	41
BMC Infectious Diseases	17	360
Journal of Applied Microbiology	17	419
Case Reports in Infectious Diseases	15	34
Brazilian Journal of Microbiology	14	218
Biocatalysis and Agricultural Biotechnology	14	226
Journal of Laryngology and Otology	14	502
Journal of Industrial Microbiology and Biotechnology	14	338
Transplant Infectious Disease	14	136
Applied and Environmental Microbiology	13	632
Frontiers in Microbiology	13	89
Journal of Biotechnology	13	705
Ophthalmic Plastic and Reconstructive Surgery	13	429
Journal of Medical Microbiology	12	219
Journal of Pediatric Hematology/Oncology	12	86

(Continued to Table 6)

Journal	Documents	Citations
International Journal of Infectious Diseases	12	107
Frontiers in Medicine	11	16
Transplantation Proceedings	11	73
Current Fungal Infection Reports	10	111
Current Microbiology	10	210
Diagnostic Microbiology and Infectious Diseases	10	60
Frontiers in Cellular and Infection Microbiology	10	43
The Pediatric Infectious Disease Journal	10	142
Indian Journal of Medical Microbiology	10	61
Internal Medicine	10	31

low-income countries. Dayal et al. (12) emphasized that although India produces 61.2% of global CAM publications, the mean citation rate per article (7.8) remains significantly lower than that of France (28.2) and the United States (17.8). Similarly, in our analysis, the USA had the highest academic impact, with 10,426 citations. Gupta et al. (9) showed that only 11.2% of studies reported external funding, identifying limited resources as a major constraint in this research field.

In our study, the representation of keywords such as diabetes mellitus, amphotericin B, *Rhizopus*, and pulmonary mucormycosis highlights the clinical and therapeutic challenges encountered with this infection. These findings are consistent with previous reports identifying diabetes and immunosuppression as major risk factors and amphotericin B as the main antifungal therapy. The position of *Rhizopus oryzae* in the keyword map also mirrors global epidemiologic data, which recognize this species as the most common causative agent of mucormycosis worldwide.

Keyword analyses revealed that COVID-19, diabetes, and amphotericin B were the most frequently occurring terms in the studies. The high frequency of the keyword mucormycosis (> 843 occurrences) underscores its strong association with the COVID-19 pandemic, during which a dramatic rise in mucormycosis cases was observed. Diabetes mellitus and diabetic ketoacidosis emerged as recurrent concepts, underscoring their established role as risk factors. In addition to *Rhizopus* spp., other members of the order *Mucorales*, including *Cunninghamella* and *Cunninghamella bertholletiae*, were also represented. Antifungal treatment keywords primarily focused on amphotericin B and Posaconazole, reflecting current therapeutic practices, while terms related to clinical presentation (rhinocerebral, pulmonary, cutaneous, and rhino-orbital-cerebral mucormycosis) emphasized the heterogeneous nature of the disease.

Keywords such as “invasive fungal infection,” “immunocompromised,” and “neutropenia” highlighted the vulnerable patient populations, whereas "mortality" and "diagnosis" emphasize the severe nature of the infection and the challenges associated with timely detection and effective management. Notably, Dayal et al. (12) reported that only a few Indian studies addressed applied research themes, such as pathophysiology (3.1%) and pediatrics. Similarly, our findings indicate that early diagnosis and antifungal resistance were underexplored yet critical research areas. Strengthening international collaboration, increasing research funding, and integrating basic and clinical research are essential future priorities.

Cureus, *Mycoses*, and *Clinical Infectious Diseases* served as major publication platforms for the distribution of the mucormycosis research output, encompassing a wide spectrum of article types ranging from case reports to clinical trials and guidelines.

This bibliometric review provides an overview of evolving research trends in mucormycosis. The unprecedented surge in publications during the COVID-19 pandemic demonstrates how emerging public health crises can transform scientific landscapes. Given the expanding use of immunosuppressive therapies and increasing global prevalence of diabetes, mucormycosis is likely to remain a high-priority research topic in infectious diseases.

Mucormycosis cases are rising overall, but the intensive care unit (ICU) has emerged as a setting of particularly elevated risk. Patients who are seriously ill, especially those who are mechanically ventilated, receiving broad-spectrum antibiotics, or corticosteroid treatment, are at greater risk for opportunistic fungal infections. COVID-19 increased disease severity and risk profile even further, with a large proportion of ICU patients getting secondary fungal infections, such as mucormycosis, because of immune dysregulation, prolonged hospitalization, and metabolic complications such as hyperglycaemia. The increasing number of case reports and cohort studies describing ICU-acquired invasive fungal infections during the pandemic highlights the importance of enhanced surveillance, early diagnosis, and antifungal stewardship in critically ill patients (13–15).

Consistent with previous reports (8–12), our findings emphasize the growing importance of this infection, particularly among immunocompromised patients. India's high research productivity is indicative of a substantial national disease burden, as reflected in academic productivity; however, improving research quality and fostering international collaboration remain essential for advancing the field.

Our study has several limitations. It was primarily based on the Web of Science database and English-language medical articles, which may have introduced language and database-related bias. Publications from 2025 were not included, potentially excluding the most recent developments. Geographic and institutional concentration was evident, with the United States, India, and China dominating publication outputs. In addition, the bibliometric design limited the qualitative assessment of study methodology and clinical content. A more detailed analysis of changes in the clinical manifestations of mucormycosis across patient populations (immunosuppressed or diabetic individuals vs. CAM cases) could have provided valuable insights into the disease spectrum; however, this study focused on overall publication trends. Such analyses would require a separate study based on clinical data and may represent an important direction for future research.

CONCLUSION

This bibliometric analysis reveals a significant global increase in research on mucormycosis, particularly in the post-COVID-19 era. The pandemic-driven surge in cases, largely associated with poorly controlled diabetes and widespread corticosteroid use, has renewed scientific attention to this severe and often fatal fungal infection. Beyond increased publication volume, our findings highlight disparities between research productivity and citation impact across countries, underscoring the importance of research visibility, funding, and international collaboration. As the global burden of immunosuppression and diabetes continues to rise, mucormycosis is likely to remain a priority topic in infectious diseases and clinical mycology. Accordingly, sustained global collaboration, targeted investment, and the integration of basic and clinical research will be essential to address the evolving epidemiology and clinical challenges of mucormycosis.

Ethical Approval: N.A.

Informed Consent: N.A.

Peer-review: Externally peer-reviewed

Author Contributions: Concept – S.B.G.K, S.A.; Design – S.B.G.K, S.A.; Supervision – O.E.; Materials – S.B.G.K, S.A.; Data Collection and/or Processing – S.B.G.K, S.A.; Analysis and/or Interpretation – S.B.G.K, S.A., O.E.; Literature Review – S.B.G.K, S.A., O.E.; Writer – S.B.G.K, S.A., O.E.; Critical Reviews – O.E.

Conflict of Interest: The authors declare no conflict of interest.

Financial Disclosure: The authors declared that this study has received no financial support.

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