



Trend of Blastocystis Infection as an Opportunistic Infection: A Comprehensive Bibliometric Analysis

Jhons Fatriyadi Suwandi^{1*}, Noviany Noviany², Juspeni Kartika³ and Agnes Kurniawan⁴

¹ Department of Microbiology and Parasitologi, Faculty of Medicine, University of Lampung, Bandar Lampung, Indonesia

² Department of Chemistry, Faculty of Mathematics and Natural Sciences, University of Lampung, Bandar Lampung, Indonesia

³ Department of Internal Medicine, Faculty of Medicine, University of Lampung / Dr. H Abdul Moeloek General Hospital of Lampung Province, Bandar Lampung, Indonesia

⁴ Department of Parasitology, Faculty of Medicine, University of Indonesia, Jakarta, Indonesia
*vadisuwandi04@gmail.com / jhons.fatriyadi@fk.unila.ac.id

Abstract. Blastocystis, a common intestinal protozoan, has garnered significant attention over the past two decades due to its controversial role as an opportunistic pathogen. This study will examine the trend of Blastocystis infection, specifically as an opportunistic infection, through a comprehensive bibliometric analysis. Understanding these trends is crucial for recognizing the role of Blastocystis in public health, particularly among immunocompromised populations, and for guiding future research directions. This bibliometric review aims to systematically analyze the trends, research hotspots, and scientific contributions related to Blastocystis infections and their classification as opportunistic infections from 1990 to 2024. This study employs a bibliometric approach to analyze scientific publications on Blastocystis infection. Data were collected from the Scopus database, encompassing a wide range of articles published between 1990 and 2024. The analysis included quantifying publication output, identifying key research themes, and mapping collaboration networks among authors, institutions, and countries. Various bibliometric tools and software, such as VOSviewer and CiteSpace, were used to visualize trends, co-authorship networks, and keyword co-occurrence patterns. The bibliometric analysis revealed a significant increase in publications on Blastocystis infection, with notable peaks corresponding to key discoveries and public health concerns. This study identified research groups focusing on 5 Blastocystis research clusters. It was seen that there is an increasing trend of Blastocystis research with various topic groups such as patient-centered studies, animal studies of Blastocystis, studies of Blastocystis infection from irritable bowel syndrome patients, treatment-centered studies and studies of Blastocystis culture for screening or other testing purposes. Research collaborations and mutual citations also demonstrate strong international partnerships, between researchers in Europe, North America and Asia.

Keywords: *Blastocystis sp*, Opportunistic Infection, Blastocystosis.

INTRODUCTION

Blastocystis is an intestinal protozoa that can cause diarrhea [1]. Several studies have reported the pathogenicity of Blastocystis, especially in people with compromised immune systems, such as HIV/AIDS patients [2], cancer patients [3], organ transplant recipients [4] or immunosuppressed individuals [5]. Previous studies on Blastocystis have demonstrated the role of this protozoan as a potential pathogenic agent causing opportunistic infections [6]–[11].

Diarrhea in immunocompromised patients is usually caused by opportunistic microbial infections. Parasitic infections from the coccidian group are often the cause, especially in patients with HIV/AIDS. Cryptosporidium, Isospora, Cyclospora, Amoeba, Giardia, Blastocystis and helminth infections are also found in parasitologic stool examinations of immunodeficient patients. Opportunistic infections caused by these parasites are more often neglected [12], [13]. This protozoan parasite infection is common in tropical areas such as Indonesia. In immunocompetent individuals, symptoms may be mild or asymptomatic. Severe and fatal symptoms are more common in immunosuppressed or immunocompromised patients.[5], [14]–[16].

Many studies have investigated Blastocystis infection from different aspects. This study was conducted to complement the existing literature on Blastocystis infection by comprehensively analyzing various relevant and broader literature. By adopting a bibliometric approach, which analyzes the clustering of literature based on several indicators, this paper examines more deeply the trend of Blastocystis infection as a causative agent of opportunistic infections in at-risk groups. A collection of research documents obtained from the Scopus database is analyzed using bibliometric mapping by displaying several indicators such as publication trends, co-authorship patterns, and highlighting emerging topics that are relevant for future research.

A collection of research documents obtained from the Scopus database is analyzed using bibliometric mapping by displaying several indicators such as publication trends, co-authorship patterns, and highlighting emerging topics that are relevant for future research.

Bibliometric analysis is a research method that scientifically and objectively analyzes literature. This method aims to evaluate a scientific field based on a topic determined by the researcher, so that the researcher can get a complete picture of the historical growth and important features of the topic. The method will make it easier for researchers to see the history and evolution of the development of a scientific field [17], [18].

Based on this, the following research questions were formulated: 1. What is the publication trend of IEM research?; 2. Who are the most active contributors to published IEM research?; 3. Which IEM papers are the most cited?; 4. Which countries are the most productive in IEM publications?; 5. Which journals are the most important in IEM publications?; 6. Which affiliations are the most productive in IEM publications?; 7. What are the most frequently used author keywords in IEM studies?; 8. What is the pattern of collaboration and co-citation trends in IEM publications?; 9. What is the literature clustering focus in IEM publications?

SUBJECT AND METHOD

Bibliometric research begins with the definition of the topic to be studied, followed by the definition of search terms. The search strategy is guided by the keywords identified to obtain relevant literature. Publications on Blastocystis infection were obtained from the Scopus database. The search date was July 26, 2024. The selection of the Scopus database is based on its comprehensive and interdisciplinary coverage of bibliographic research data from various publications, including journals, books, and conference proceedings..

Table 1. Criteria and Description of Topic, Scope, Eligibility and Screening Methods

No	Criteria	Description
A	Topic, Scope and Eligibility	
1	Topic	Blastocystis Infection
2	Scope and Coverage	Database : Scopus Time Frame : All Source Type : Article Title, Abstract, Key word Search Field : All Language : All Document Type : All
3	Keyword and Search String	((TITLE("blastocystis infection" OR "Parasitic Opportunistic Infection") OR TITLE-ABS-KEY("blastocystis infection" OR "Parasitic Opportunistic Infection")))
B	Screening and Selection	
1	Date Extracted	July 26 th , 2024
2	Identified and Screened	955
3	Removed	0
4	Selected for Analysis	955

Data searches were performed using keywords contained in the title, abstract, and keywords of previous articles. The compiled search terms were ((TITLE("blastocystis infection" OR "Parasitic Opportunistic Infection") OR TITLE-ABS-KEY("blastocystis infection" OR "Parasitic Opportunistic Infection"))). The result of this search is 955 article documents, which are used to perform the bibliographic analysis. The document search flow is shown in Figure 1.

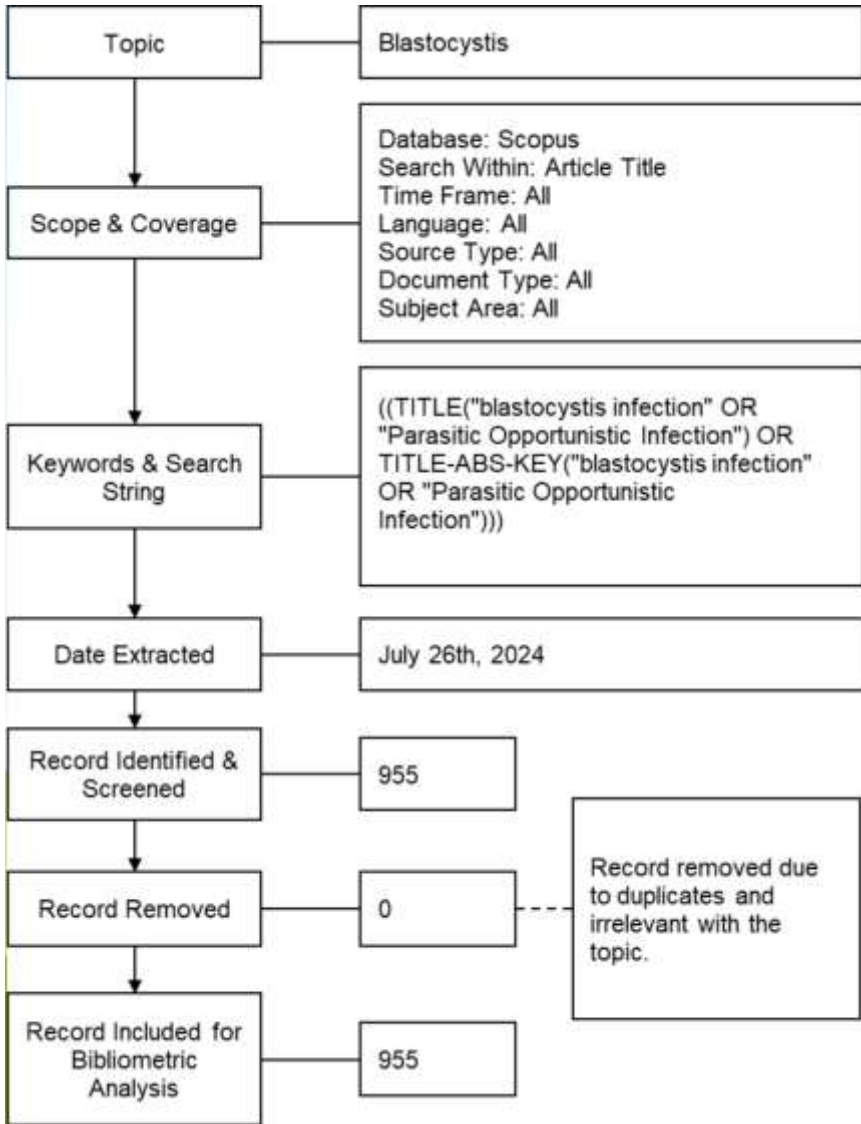


Fig 1. Flow Diagram of Search Strategy

The analysis was performed using Harzing Publish or Perish software to obtain metrics and other frequencies. In addition, Excel software was used to calculate other frequencies, create graphs and charts. Analysis was also done to map the relationship between authors, organizations and countries. This allowed visualization of the flow of knowledge distribution within the Blastocystis Infection research community. Clustering of articles or research topics was also performed to classify documents into thematic groups or specific research topics. The resulting categories reveal research trends, dominant research areas, and synergies between different subfields of Blastocystis infection.

RESULTS

The sample period for this study is 34 years, from 1990 to 2024. The document search was performed on July 26, 2024. The detailed characteristics of the 955 documents analyzed are shown in Table 2.

Table 2. Main Information Regarding Selected Articles

Description	Results
MAIN INFORMATION ABOUT THE DATA	
Timespan	1990 to 2023
Total Sources (Journals, Books, etc.)	3
Documents	955
Citations	27237
Cites per Year	801.09
Cites per Paper	28.52
Cites per Author	6861.74
h-Index	80
DOCUMENT TYPES	
Article	836
Review	62
Letter	34
Note	10
Short Survey	6
Conference Paper	2
Editorial	2
Erratum	2
Book Chapter	1
AUTHORS	
Total Author Appearances	1221
Papers per Author	250.00
Authors per Paper	5.43
LANGUAGE	
English	820
Spanish	36
Chinese	32
Turkish	27
Russian	21
French	9
Italian	8
German	3
Danish	1
Japanese	1
Moldavian	1
Moldovan	1
Persian	1
Polish	1
Portuguese	1
Romanian	1

Annual Publication Trends

The evolution of research publications related to Blastocystis is shown in Figure 2. From the analysis it can be seen that the publication trend has increased during the analyzed period with the highest increase in 2021 (69 documents). Although there are fluctuations in the number of articles published, the increase in the total number of publications up to 2024 is very significant compared to 1990 (1990 - 2024). Harzing's Publish or Perish software identified the first published article on Blastocystis in 1990 entitled "Blastocystis hominis infections" with authors A Castrillo de Tirado, A J González Mata and E Tirado Espinoza.

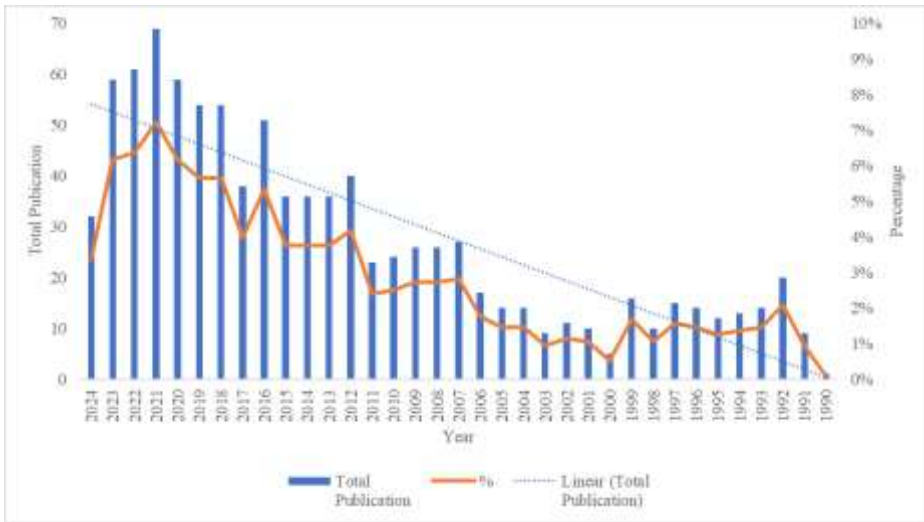


Fig 2. Annual Publication Trends

Most Active Contributors and Cited Paper

Table 3 shows the top 10 publications generated by these authors on the topic of Blastocystis. It appears that the most active author in producing publications is Stensvold, C.R. from Statens Serum Institut, Copenhagen Denmark with 50 total publications or 5.24% of the total publications on Blastocystis. The next author is Tan, K.S.W. (24 total publications or 2.51%) from Yong Loo Lin School of Medicine Singapore and the third is Yoshikawa, H. (21 total publications or 2.20%) from Nara Women's University, Kitauoya - Nishimachi Japan. These authors and co-authors have collectively contributed greatly to the development of Blastocystis research. This is evidenced by the publication of the authors' work in prestigious international journals..

Table 3. Top 10 Most Productive Authors

Author Name	TP	%	Affiliation	Country
Stensvold, C.R.	50	5.24%	Statens Serum Institut, Copenhagen	Denmark
Tan, K.S.W.	24	2.51%	Yong Loo Lin School of Medicine	Singapore
Yoshikawa, H.	21	2.20%	Nara Women's University, Kitauoya-Nishimachi	Japan
Viscogliosi, E.	20	2.09%	Institut Pasteur de Lille	France
Singh, M.	17	1.78%	Faculty of Medicine, National University of Singapore,	Singapore
Delbac, F.	15	1.57%	Université Lille Nord de France	France
Poirier, P.	15	1.57%	Université Blaise Pascal de Clermont-Ferrand, Aubière, France	France
Yap, E.H.	15	1.57%	National University of Singapore	Singapore
Asghari, A.	14	1.47%	Shiraz University of Medical Sciences, Shiraz, Iran	Iran
Maloney, J.G.	14	1.47%	Agricultural Research Service, United States Department of Agriculture	United States
Maravilla, P.	14	1.47%	Hospital General "Dr. Manuel Gea Gonzalez", Direccion de Investigacion, Mexico	Mexico
Mirjalali, H.	14	1.47%	Shahid Beheshti University of Medical Sciences, Tehran, Iran.	Iran
Nielsen, H.V.	14	1.47%	Statens Serum Institut, Copenhagen S, Denmark	Denmark

Table 4 shows the most cited articles on Blastocystis. The most cited article was an article entitled New insights on classification, identification, and clinical relevance of Blastocystis spp by K.S.W. Tan published in 2008 with a first year citation (C/Y) of 35.13 and a total citation (TC0) of 562. The citation value was almost 20 times the average citation per article during the period 1990 to 2024. The citation value is almost 20 times the average citations per article over the period 1990 to 2024. This published article also wrote that the average citations per year of 35.13 was still higher than the average articles per year for all articles.

Another article with a high number of citations is M.A. Alfellani et al with a total of 308 citations and an average annual citation of 28.00. In third place was C.R. Stensvold et al with 255 total citations and an average annual citation of 31.88. This shows that the popularity and impact of the article on Blastocystis research is quite high.

Table 4. Top 10 Most Cites Papers

Authors	Title	Year	C/Y	TC
K.S.W. Tan	New insights on classification, identification, and clinical relevance of <i>Blastocystis</i> spp.	2008	35.13	562
M.A. Alfellani, C.R. Stensvold, A. Vidal-Lapiedra, E.S.U. Onuoha, A.F. Fagbenro-Beyioku, C.G. Clark	Variable geographic distribution of <i>Blastocystis</i> subtypes and its potential implications	2013	28.00	308
C.R. Stensvold, C.G. Clark	Current status of <i>Blastocystis</i> : A personal view	2016	31.88	255
C.R. Stensvold, M.A. Alfellani, S. Nørskov-Lauritsen, K. Prip, E.L. Victory, C. Maddox, H.V. Nielsen, C.G. Clark	Subtype distribution of <i>Blastocystis</i> isolates from synanthropic and zoo animals and identification of a new subtype	2009	16.73	251
U. Parkar, R.J. Traub, S. Vitali, A. Elliot, B. Levecke, I. Robertson, T. Geurden, J. Steele, B. Drake, R.C.A. Thompson	Molecular characterization of <i>Blastocystis</i> isolates from zoo animals and their animal-keepers	2010	16.93	237
C. Noël, F. Dufernez, D. Gerbod, V.P. Edgcomb, P. Delgado-Viscogliosi, L.-C. Ho, M. Singh, R. Wintjens, M.L. Sogin, M. Capron, R. Pierce, L. Zenner, E. Viscogliosi	Molecular phylogenies of <i>Blastocystis</i> isolates from different hosts: Implications for genetic diversity, identification of species, and zoonosis	2005	12.16	231
C.G. Clark, M. van der Giezen, M.A. Alfellani, C.R. Stensvold	Recent Developments in <i>Blastocystis</i> Research	2013	20.55	226
D. El Safadi, L. Gaayeb, D. Meloni, A. Cian, P. Poirier, I. Wawrzyniak, F. Delbac, F. Dabboussi, L. Delhaes, M. Seck, M. Hamze, G. Riveau, E. Viscogliosi	Children of Senegal River Basin show the highest prevalence of <i>Blastocystis</i> sp. ever observed worldwide	2014	21.10	211
H. Yoshikawa, Z. Wu, I. Kimata, M. Iseki, I.K.M.D. Ali, M.B. Hossain, V. Zaman, R. Haque, Y. Takahashi	Polymerase chain reaction-based genotype classification among human <i>Blastocystis hominis</i> populations isolated from different countries	2004	10.35	207
J.D. Ramírez, L.V. Sánchez, D.C. Bautista, A.F. Corredor, A.C. Flórez, C.R. Stensvold	<i>Blastocystis</i> subtypes detected in humans and animals from Colombia	2014	20.00	200

Note: C/Y: citation per year; TC: Total citations

The Most Productive Countries

Table 5 shows the list of countries that are most productive in producing articles on Blastocystis. It appears that articles from the Asian region have the highest number of total publications with 327, with China having a total publication of 112 articles. Europe is the second most productive continent (240 articles), followed by the Americas with 69 articles. The number of articles produced is consistent with the prevalence of Blastocystis infection in local communities.

Table 5. Top 10 Most Productive Countries

Country	TP	%	Continent
China	112	11.73%	Asia
Turkey	91	9.53%	Europe
United States	69	7.23%	North America
Malaysia	66	6.91%	Asia
Iran	61	6.39%	Asia
Denmark	52	5.45%	Europe
United Kingdom	50	5.24%	Europe
Spain	47	4.92%	Europe
Singapore	46	4.82%	Asia
Thailand	42	4.40%	Asia

A regional mapping of the distribution of articles on Blastocystis is shown in Figure 3. The top 3 countries producing articles on Blastocystis are located on all three continents.

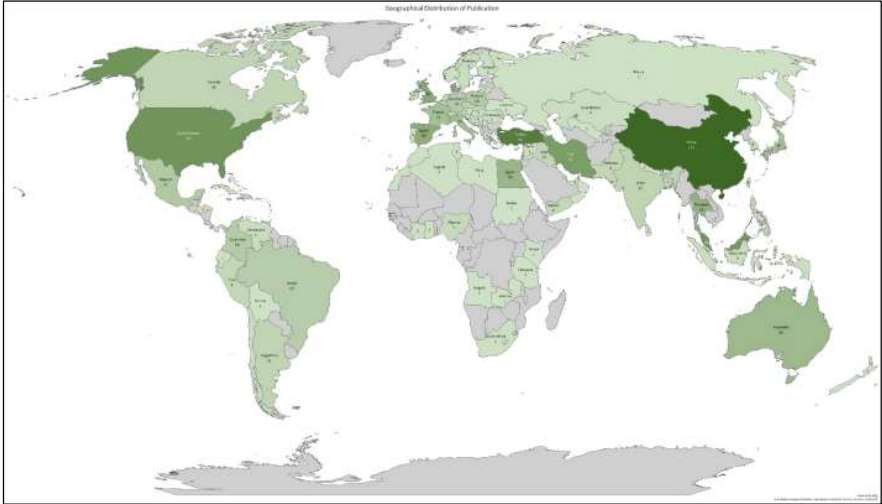


Fig 3. Total Publication Based on Countries

The Most Important Journals

The journal that is the main destination in the publication of Blastocystis topics is Parasitology Research, with 130 articles published (13.61%). As shown in Table. 6, 6 of the top 10 journals are specific parasitology journals, while 3 journals are topical infection or tropical disease journals and only 1 journal is a journal in the field of medicine and health in general. The journals included in the top 10 journals that frequently publish Blastocystis research are the best journals in the field of medicine and health, especially parasitology and infectious diseases.

Table 6. Top 10 Journal Frequently Publishing Blastocystis Studies

Source Title	TP	%
Parasitology Research	130	13.61%
Parasites And Vectors	42	4.40%
Acta Tropica	23	2.41%
Parasitology International	22	2.30%
Plos One	21	2.20%
Turkiye Parazitolojii Dergisi Turkiye Parazitoloji Dernei Acta	21	2.20%
Parasitologica Turcica Turkish Society For Parasitology		
Infection Genetics And Evolution	20	2.09%
Acta Parasitologica	19	1.99%
American Journal Of Tropical Medicine And Hygiene	17	1.78%
Journal Of The Egyptian Society Of Parasitology	16	1.68%

The Most Productive Affiliations

Table 7 shows the most productive affiliations or institutions producing articles on Blastocystis. This is consistent with the most countries (Table 5) and the most productive authors (Table 3) that institutions or authors from China, Japan, Denmark, Singapore, Iran, France and Malaysia are included in the top 10 most productive publications on Blastocystis. Based on affiliation, the University of Malaya was the largest institution (51 total publications, 5.34%) that produced Blastocystis publications. Statens Serum Institut is the next institution with the most publications (49 total publications, 5.13%). Singapore has 2 institutions (National University of Singapore and NUS Yong Loo Lin School of Medicine) in the next order with a total of 105 publications (9.95%). Based on Table 7, it appears that institutions located in Asian and European countries contribute significantly to the study of Blastocystis.

Table 7. Top 10 Affiliations of Most Productive Authors

Institution	TP	%
Universiti Malaya	51	5.34%
Statens Serum Institut	49	5.13%
National University of Singapore	46	4.82%
NUS Yong Loo Lin School of Medicine	38	3.98%
Chinese Center for Disease Control and Prevention	23	2.41%
Shahid Beheshti University of Medical Sciences	21	2.20%
Nara Women's University	20	2.09%
Institut Pasteur de Lille	19	1.99%
Université de Lille	17	1.78%
USDA ARS Beltsville Agricultural Research Center	16	1.68%
Center for Infection and Immunity of Lille CIIL	16	1.68%

The Most Frequently Keywords

Table 8 shows the top 10 keywords used by authors in Blastocystis publications. Out of 955 articles, the most frequently used keyword was "Blastocystis infections" in 844 articles (88.38%). Similar keywords were "blastocystosis" and "blastocystitis" with 686 articles (71.83%) and 603 articles (63.14%), respectively. In addition to these three keywords, the second most frequently used keywords were "human" (754; 78.95%) and "humans" (700; 73.30%). This shows that Blastocystis research in human patients is the most frequently used keyword. The keywords shown in Table 8 are keywords that are used repeatedly more than 50% of the time, which shows the suitability of the specific topic of the article.

Table 8. Top 10 Most Frequently Used Keywords in Blastocystis Studies

Keywords	TP	%
Blastocystis Infections	844	88.38%
Human	754	78.95%
Humans	700	73.30%
Article	694	72.67%
Blastocystis	686	71.83%
Blastocystosis	603	63.14%
Feces	543	56.86%
Animals	530	55.50%
Parasitology	500	52.36%
Nonhuman	457	47.85%

Collaboration and Co-Citation Trends

In order to see the collaboration and co-citation trends of different Blastocystis publications, the analysis was performed using the VOSViewer software. By using this software, the data are grouped into a field of study and trends of co-citation are identified. The grouping of collaboration patterns and citation trends is based on grouping techniques previously used in social research [19]. This analysis looks at papers that are often cited together, such that they have related concepts.

Using the vosviewer software, the full count method, and the minimum number of citations for an author is 20, 1183 authors fall within the threshold. Figure 4 shows the co-citation overview of the authors. The color formed shows the grouping of authors in the same or similar clusters. There are 4 colors or clusters. The green cluster is dominated by Santin, M., Maloney, J.G., and Ramirez, J.D. with a research focus on the study of molecular aspects, subtypes and comorbidities as well as zoonotic infections and Blastocystis infections in animals. The blue cluster is dominated by Stensvold, C.R. with research on Blastocystis subtypes in humans and animals, public health aspects, molecular aspects, clinical aspects and diagnostic methods. The purple cluster is dominated by Viscogliosi, E with the study of molecular aspects, phylogenetic diversity and public health aspects of Blastocystis infection. The red cluster is by Yoshikawa, H., Mungthin, M., Singh, M., and Tan, K.S. with a focus on molecular aspects of genotyping subtypes of Blastocystis infections in humans and animals. In addition, there is a small yellow cluster o by Stensvold, C.R. It appears that although clusters are forming, they still have overlap and proximity of research topics. This can certainly deepen the study of Blastocystis comprehensively.

Literature Clustering Focus

The focus grouping of the literature in Blastocystis publications is shown in Figure 5. The analysis criteria, carried out with the full count method and a minimum number of term occurrences of 9, resulted in 14139 documents that met the threshold, but only 458 articles were selected. The results of the analysis are 5 clusters based on 5 different colors on the visualization map, namely cluster 1 is an article that discusses from the patient aspect (blue color), cluster 2 is an article that presents Blastocystis studies in animals (red color), cluster 3 is an article that contains Blastocystis infection studies in IBS patients (yellow color), cluster 4 is an article that discusses from the treatment aspect (green color), and cluster 5 is an article that presents Blastocystis culture for examination or other testing purposes.

DISCUSSION

Blastocystis infection is an intestinal protozoan infection that is often neglected. This infection is generally asymptomatic and has even been reported as an apatogenous protozoan. Clinical symptoms appear in certain conditions such as immunosuppression, irritable bowel disease or other immune disorders. Based on the results of bibliometric analysis, it appears that the trend of research continues to increase from year to year. This is in line with the development of molecular technology to determine the subtype of *Blastocystis* sp species, so that subtypes that attack humans, animals or even those that are apatogenous can be identified. Based on the research topic, it appears that research on *Blastocystis* has been studied from different aspects.

Another study that used bibliometric to see the trend of *Blasticystis* research was conducted and published in 2023 [20]. The results of this study showed the same as this study. The trend of *Blastocystis* research from year to year is increasing compared to several years ago. The research conducted in 2023 uses Web of Science (WoS) databases, while the research conducted now uses Scopus databases. The distribution of countries producing articles is also not much different, only the order is different.

Another study using bibliometric analysis in the field of parasitology was conducted by Aydemir, S et al published in 2024 with the topic of postgraduate thesis writing in the field of medical parasitology in Turkey. It appears that research on *Blastocystis* is one of the top 10 most researched topics, although only 3.8%. The most researched topics were *Toxoplasma gondii*, *Leishmania spp.* and *Echinococcus spp* [21]

The use of bibliometric analysis in the field of medicine and health is indeed a new thing. Not many articles have been found that use bibliometric analysis, especially in the study of *Blastocystis*. Some researchers using bibliometric analysis to discuss parasites have been published [22]–[24]. This analysis can map research topics in a particular field, making it easier for other researchers to continue or find gap knowledge in determining further research.

CONCLUSION

It can be seen that there is an increasing trend of *Blastocystis* research with different groups of topics such as discussions from the patient aspect, *Blastocystis* studies in animals, *Blastocystis* infection studies in IBS patients, studies from the treatment side and *Blastocystis* culture studies for examination or other testing purposes. Research collaborations and co-citations also demonstrate strong international partnerships between researchers in Europe, North America and Asia.

Acknowledgments. We would like to thank all those who have helped in this research, especially the HETI Project at the University of Lampung, which has funded this research.

Disclosure of Interests. The authors have no competing interests to disclose that are relevant to the content of this article.

References

- [1] L. Deng *et al.*, “Epidemiology of Blastocystis sp. infection in China: A systematic review,” *Parasite*, vol. 26, 2019, doi: 10.1051/parasite/2019042.
- [2] A. Wondmieneh, G. Gedefaw, B. Alemnew, A. Getie, M. Bimerew, and A. Demis, “Intestinal parasitic infections and associated factors among people living with HIV/AIDS in Ethiopia: A systematic review and meta-analysis,” *PLoS One*, vol. 15, no. 12 December, pp. 1–17, 2020, doi: 10.1371/journal.pone.0244887.
- [3] V. Kumarasamy, W. M. Atroosh, D. Anbazhagan, M. M. I. Abdalla, and M. Azzani, “Association of Blastocystis hominis with colorectal cancer: A systematic review of in vitro and in vivo evidences,” *World J. Gastrointest. Oncol.*, vol. 14, no. 3, pp. 734–745, 2022, doi: 10.4251/wjgo.v14.i3.734.
- [4] C. Fusaro *et al.*, “Molecular Prevalence and Subtypes Distribution of Blastocystis spp. in Humans of Latin America: A Systematic Review,” *Trop. Med. Infect. Dis.*, vol. 9, no. 2, pp. 1–22, 2024, doi: 10.3390/tropicalmed9020038.
- [5] A. Esteghamati, K. Khanaliha, F. Bokharaei-Salim, S. Sayyahfar, and M. Ghaderipour, “Prevalence of intestinal parasitic infection in cancer, organ transplant and primary immunodeficiency patients in Tehran, Iran,” *Asian Pacific J. Cancer Prev.*, vol. 20, no. 2, pp. 495–501, 2019, doi: 10.31557/APJCP.2019.20.2.495.
- [6] T. Roberts, D. Stark, J. Harkness, and J. Ellis, “Update on the pathogenic potential and treatment options for Blastocystis sp,” *Gut Pathog.*, vol. 6, no. 1, pp. 1–9, 2014, doi: 10.1186/1757-4749-6-17.
- [7] M. Bednarska *et al.*, “Prevalence of Cryptosporidium, Blastocystis, and other opportunistic infections in patients with primary and acquired immunodeficiency,” *Parasitol. Res.*, vol. 117, no. 9, pp. 2869–2879, 2018, doi: 10.1007/s00436-018-5976-6.
- [8] F. Sarzhanov *et al.*, “Investigation of neglected protists blastocystis sp. And Dientamoeba fragilis in immunocompetent and immunodeficient diarrheal

- patients using both conventional and molecular methods,” *PLoS Negl. Trop. Dis.*, vol. 15, no. 10, pp. 1–23, 2021, doi: 10.1371/JOURNAL.PNTD.0009779.
- [9] O. Matos and L. Xiao, “Editorial: Recent Advances in the Controversial Human Pathogens Pneumocystis, Microsporidia and Blastocystis,” *Front. Microbiol.*, vol. 12, no. August, pp. 10–13, 2021, doi: 10.3389/fmicb.2021.701879.
- [10] H. M. Rahimi, S. A. Karamati, S. Nemati, H. Mirjalali, and M. R. Zali, “Molecular Identification, Subtypes Distribution, and Alleles Discrimination of Blastocystis sp., Isolated from Immunocompromised Subjects in Iran,” *Iran. J. Parasitol.*, vol. 17, no. 2, pp. 184–193, 2022, doi: 10.18502/ijpa.v17i2.9534.
- [11] L. D. N. Nguyen *et al.*, “First Epidemiological Survey on the Prevalence and Subtypes Distribution of the Enteric Parasite Blastocystis sp. in Vietnam,” *Microorganisms*, vol. 11, no. 3, pp. 1–10, 2023, doi: 10.3390/microorganisms11030731.
- [12] M. A. A. Namaji, S. Pathan, and A. Balki, “Profile of intestinal parasitic infections in human immunodeficiency virus/acquired immunodeficiency syndrome patients in Northeast India,” *Indian J. Sex. Transm. Dis. AIDS*, vol. 41, no. 1, pp. 93–96, 2020, doi: 10.4103/ijstd.IJSTD_115_17.
- [13] M. Osman *et al.*, “Prevalence and Risk Factors for Intestinal Protozoan Infections with Cryptosporidium, Giardia, Blastocystis and Dientamoeba among Schoolchildren in Tripoli, Lebanon,” *PLoS Negl. Trop. Dis.*, vol. 10, no. 3, pp. 1–17, 2016, doi: 10.1371/journal.pntd.0004496.
- [14] S. Boughattas *et al.*, “Molecular analysis of the enteric protozoa associated with acute diarrhea in hospitalized children,” *Front. Cell. Infect. Microbiol.*, vol. 7, no. AUG, pp. 1–10, 2017, doi: 10.3389/fcimb.2017.00343.
- [15] X. Giannakopoulos *et al.*, “Impact of enterococcal urinary tract infections in immunocompromised – neoplastic patients,” *J. B.U.ON.*, vol. 24, no. 5, pp. 1768–1775, 2019.
- [16] D. A. Laksemi *et al.*, “Opportunistic parasitic infections in patients with human immunodeficiency virus/acquired immunodeficiency syndrome: A review,” *Vet. World*, vol. 13, no. 4, pp. 716–725, 2020, doi: 10.14202/vetworld.2020.716-725.
- [17] O. Ellegaard and J. A. Wallin, “The bibliometric analysis of scholarly

- production: How great is the impact?,” *Scientometrics*, vol. 105, no. 3, pp. 1809–1831, 2015, doi: 10.1007/s11192-015-1645-z.
- [18] N. Donthu, S. Kumar, D. Mukherjee, N. Pandey, and W. M. Lim, “How to conduct a bibliometric analysis: An overview and guidelines,” *J. Bus. Res.*, vol. 133, pp. 285–296, 2021, doi: <https://doi.org/10.1016/j.jbusres.2021.04.070>.
- [19] F. Radicchi, C. Castellano, F. Cecconi, V. Loreto, and D. Paris, “Defining and identifying communities in networks,” *Proc. Natl. Acad. Sci. U. S. A.*, vol. 101, no. 9, pp. 2658–2663, 2004, doi: 10.1073/pnas.0400054101.
- [20] A. Bilden *et al.*, “Global trends on Blastocystis spp. research: A scientometric study,” *Parasitol. United J.*, vol. 16, no. 2, pp. 114–122, 2023, doi: 10.21608/puj.2023.195093.1201.
- [21] S. Aydemir, F. Barlık, E. Abdurrahman, H. Yılmaz, and K. Kaçak, “The Bibliometric Analysis of the Postgraduate Theses Written on Medical Parasitology in Türkiye,” *Türkiye parazitolojii Derg.*, vol. 48, no. 2, pp. 105–110, 2024, doi: 10.4274/tpd.galenos.2024.60948.
- [22] M. Soosaraei, A. A. Khasseh, M. Fakhari, and H. Z. Hezarjaribi, “A decade bibliometric analysis of global research on leishmaniasis in Web of Science database,” *Ann. Med. Surg.*, vol. 26, no. December 2017, pp. 30–37, 2018, doi: 10.1016/j.amsu.2017.12.014.
- [23] C. Yona, R. Bakari, S. George, and A. David, “Bibliometric analysis and current status of Leishmaniasis research indexed in Scopus , 2010 -2023,” *Qeios*, 2024.
- [24] L. Miao *et al.*, “Research Priorities on One Health: A Bibliometric Analysis,” *Front. Public Heal.*, vol. 10, no. May, pp. 1–12, 2022, doi: 10.3389/fpubh.2022.889854.

Open Access This chapter is licensed under the terms of the Creative Commons Attribution-NonCommercial 4.0 International License (<http://creativecommons.org/licenses/by-nc/4.0/>), which permits any noncommercial use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license and indicate if changes were made.

The images or other third party material in this chapter are included in the chapter's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the chapter's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder.

