JOURNAL OF CLINICAL MEDICINE OF KAZAKHSTAN (E-ISSN 2313-1519)
Original Article DOI: https://doi.org/10.23950/jcmk/12677

Bibliometric analysis of amebiasis research

Ali Cihat Yıldırım[1], Emine Kübra Dindar Demiray[2], Sevil Alkan[3]

[1]General Surgery Department, Kutahya Health Sciences University, Kutahya, Turkey
[2]Department of Infection Disease and Clinical Microbiology, Bitlis State Hospital, Bitlis, Turkey
[3]Department of Infectious Disease, Faculty of Medicine, Canakkale Onsekiz Mart University, Canakkale, Turkey

Received: 2022-09-29.
Accepted: 2022-11-02

J Clin Med Kaz 2022; 19(6):38-42

Corresponding author:
Ali Cihat Yıldırım.
Email: alicihat.yildirim@ksbu.edu.tr;
ORCID: 0000-0001-5379-2804

Abstract

Aim: Amebiasis is a disease caused by protozoon *Entamoeba histolytica,* that results in amoebic dysentery. While intestinal parasites are the third leading cause of death, especially in developing countries, it has been of global concern. Bibliometric methods have been used in the parasitology discipline for more than 30 years, however there is not any bibliometric study on amebiasis in the literature. Our aim was to analyse the published literature on amebiasis by bibliometric methods.

Material and methods: A systematic evaluation of the literature using the Scopus database was made from inception to 2021. The search terms 'amebiasis', '*Entamoeba', 'Entamoeba histolytica'*, and 'amoebic dysentery' were used. The authors, publication year, title, publishing country/journal/institution, title, keywords, and citation numbers were acquired for each article. Descriptive data analysis was conducted via Microsoft Excel 2010 and Scopus database's graphics were used.

Results: Among 7,140 articles, 18.9 % of them were published open access, and 72.75 % of them were in the English language. Most of the articles were from the area of medicine. The USA, Mexico, and India were the top leading countries. The number of publications did not fall below 50 per year since 1950. There was an increasing number of citations on amebiasis research recently.

Conclusion: Amebiasis is a global concern as one of the leading infectious causes of mortality in developing countries. Bibliometric analysis has shown the growing attraction to the amebiasis research, so it will continue to be global public health issue.

Key words: amebiasis, bibliometric analysis, *Entamoeba histolytica*, bibliometrics

Introduction

Amebiasis (amoebic dysentery) is a disease caused by protozoon named *Entamoeba histolytica. E. histolytica* has morphological similarities with non-pathogenic *E. dispar,* and molecular methods should be used for identification [1]. These two parasites are thought to infect about 10% of the world's population, but 90% of these microorganisms are apathogenic *E. dispar*. Incidence of amebiasis in developing countries is quite high. Furthermore, of parasitic diseases, amebiasis is known to cause the second highest mortality in the world, after malaria [2]. In Turkey, the distribution of these two parasites was reported as 0.5–18% in different studies [2].

Amebiasis is becoming more widespread in nonendemic areas because of increased travel and emigration to developed countries. Although the majority of *Entamoeba* infections are asymptomatic, some people develop amoebic colitis and disseminated infection. Extraintestinal disseminated illness has been reported, such as liver abscess, purulent pericarditis, pneumonia, and even cerebral amoebiasis [3, 4].

According to our literature search, the bibliometric evaluations in the context of this emerging and re-emerging disease have never been discussed before. The findings of our study could be beneficial in determining amebiasis research priorities and determining the importance of scientific research on this infection.

Material and methods

Data sources

The Elsevier's Scopus bibliometric database was used in this study. A systematic evaluation of the literature resulted in extensive use of the Scopus database from inception to 2021. We used the search terms 'amebiasis', '*Entamoeba*', '*Entamoeba histolytica*', and 'amoebic dysentery'. Only research articles have been used for further analysis. All digital searches were done on February 13, 2021. The publications published in the year 2022 were excluded from the search because the year 2022 is not completed, and all data for that year were not available.

Data collection

A total of 8,135 publications records were obtained from the Scopus database. The following records were acquired for every article: authors, publication year, publishing institution/ country/journal/, title, keywords, and citation numbers.

Analyses and visualizations

Using Microsoft Excel 2010, the data in the tables were converted to absolute values (percentage and frequency). There were no relative frequencies utilized. There were no sophisticated statistical procedures applied, such as mean, median, and fashion, dispersion measures, standard deviation, or statistical tests. The visualizations from the Scopus database were also utilized.

Free versions of the Dimension programme (https://app.dimensions.ai/) and the VOSviewer were used for analysing and visualising the co-authorship between countries and co-citations.

Ethical aproval

The study complied with the Helsinki Declaration, which was revised in 2013. Ethics committee approval is not required, as there is no human or animal research.

Results

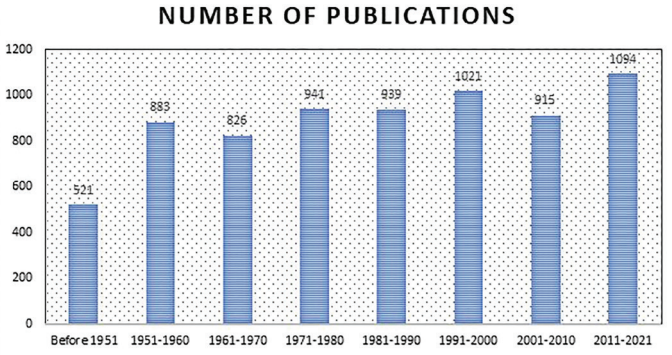
Our Scopus database search for publications on amebiasis research globally to 2021 yielded 7,140 articles. 1,351 (18.9%) of them were published open access, and 5,195 (72.75%) of them were in the English language.

The first publication was published in the United States of America (USA) in 1892 [5]. Fifty-one per cent (n=5264) of the articles were from the area of medicine. There were a further nine subject areas on amebiasis research. Immunology and microbiology (n=2464), biochemistry, genetics and molecular biology (n=1215), agricultural and biological sciences (n=483), and veterinary science (n=240) were other main subject areas.

The number of publications did not fall below 50 documents per/year from 1950. The year 2000 was the year with the most publications (213 publications) (Figure 1). 5,193 (72.73%) of the articles were in the English language. The other preferred languages were Spanish (n=573, 8.02%), French (n=431, 6.03%), German (n=132, 1.84%), and Portuguese (n=123, 1.72%).

The USA was found to be the most scientific country with 1,222 (17.11%) articles on amebiasis. Mexico (n=885, 12.39%), India (n=543, 7.6%), Japan (n=368, 5.15%), Germany (n=279, 3.9%), the United Kingdom (n=276, 386%), France (n=193, 2.7%), Canada (n=144, 2.01 %), Israel (n=143, 2%), and Brazil (n=118, 1.65%) were the top leading countries on amebiasis research. Turkey ranked 15th with 60 publications. The publications originated from over 100 countries.

Figure 1 - Number of publications by the years



Centro de Investigacion y de Estudios Avanzados from Mexico has been seen to be the leading institution in this field with 393 (5.5%) publications, and most of the leading institutions on amebiasis research were from Mexico. The other leading institutions are also summarized in Table 1. William A Petri (from the University of Virginia School of Medicine, United States) (n=147), Tomoyoshi Nozaki (from the Graduate School of Medicine, Japan) (n=126), and Alok Bhattacharya (from Jawaharlal Nehru University, India) (n=108) were the top researchers in the field.

Table 1 The leading instutions on amebiasis research.

Instutions/ Country	n (total=7140)	Frequency
Centro de Investigacion y de Estudios Avanzados/Mexico	393	5.5
Instituto Politécnico Nacional/Mexico	235	3.29
Instituto Mexicano del Seguro Social/ Mexico	185	2.59
Jawaharlal Nehru University	160	2.24
Bernhard Nocht Institut fur Tropenmedizin Hamburg/ Germany	130	1.82
University of Virginia/ USA	124	1.73
Universidad Nacional Autónoma de México, Facultad de Medicina/Mexico	120	1.68
London School of Hygiene & Tropical Medicine/Unıted Kingdom	118	1.65
National Institute of Infectious Diseases/ USA	108	1.51
Universidad Nacional Autónoma de México/Mexico	103	1.44

Archivos de Investigacion Medica (n=288), American Journal of Tropical Medicine and Hygiene (n=248), Molecular and Biochemical Parasitology (n=229), Experimental Parasitology (n=208), and Archives of Medical Research (n=140) were the top five journals on amebiasis research (Figure 2).

Figure 2 - Comparison of number of the documents

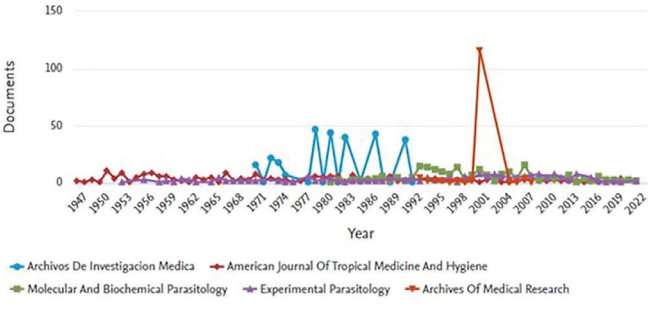


Table 2 The examination of the top 10 documents in terms of citations (6-15).

Document title /Reference number	Authors; Year	Source	Number of citations
A new medium for the axenic cultivation of entamoeba histolytica and other entamoeba [6]	Diamond et al.,1978	Transactions of the Royal Society of Tropical Medicine and Hygiene	1537
The genome of the protist parasite Entamoeba histolytica [7]	Loftus et al.,2005	Nature	676
Problems in recognition and diagnosis of amebiasis: Estimation of the global magnitude of morbidity and mortality [8]	Walsh, J.A.,1986	Reviews of Infectious Diseases	513
A clonal theory of parasitic protozoa: The population structures of Entamoeba, Giardia, Leishmania, Naegleria, Plasmodium, Trichomonas, and Trypanosoma and their medical and taxonomical consequences [9]	Tibayrenc et al,1990	Proceedings of the National Academy of Sciences of the United States of America	498
A Redescription of Entamoeba Histolytica Schaudinn, 1903 (Emended Walker, 1911) Separating It From Entamoeba Dispar Brumpt, 1925 [10]	Diamond et al.,1993	Journal of Eukaryotic Microbiology	449
The analysis of 100 genes supports the grouping of three highly divergent amoebae: Dictyostelium, Entamoeba, and Mastigamoeba [11]	Bapteste et al.,2002	Proceedings of the National Academy of Sciences of the United States of America	310
Simultaneous Detection of Entamoeba histolytica, Giardia lamblia, and Cryptosporidium parvum in Fecal Samples by Using Multiplex Real-Time PCR [12]	Verweij et al.,2004	Journal of Clinical Microbiology	303
The mitosome, a novel organelle related to mitochondria in the amitochondrial parasite Entamoeba histolytica [13]	Tovar et al.,1999	Molecular Microbiology	282
Role of adherence in cytopathogenic mechanisms of Entamoeba histolytica. Study with mammalian tissue culture cells and human erythrocytes [14]	Ravdin &Guerrant, 1981	Journal of Clinical Investigation	265
Techniques of axenic cultivation of Entamoeba histolytica Schaudinn, 1903 and E. histolytica-like amebae [15]	Diamond, L.S.,1968	The Journal of parasitology	262

National Institute of Allergy and Infectious Diseases (n=451), National Institutes of Health (n=316), Consejo Nacional de Ciencia y Tecnología (n=243), U.S. Department of Health and Human Services (n=159), Japan Society for the Promotion of Sciences (n=451) were the top funding sponsors. Table 2 summarized the top 10 documents in terms of citations [6-15].

Figure 3 - Number of the citations by the years

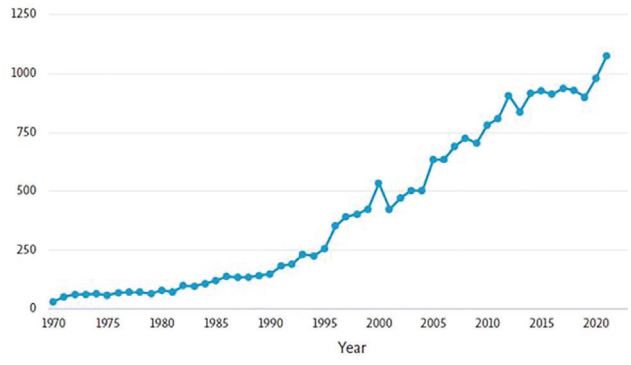


Figure 4 - Co-authorship analysis

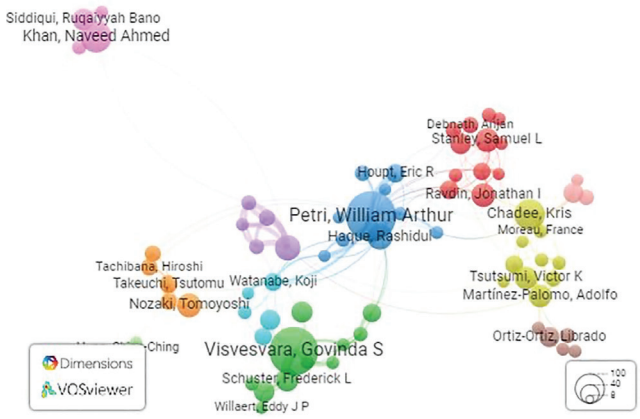
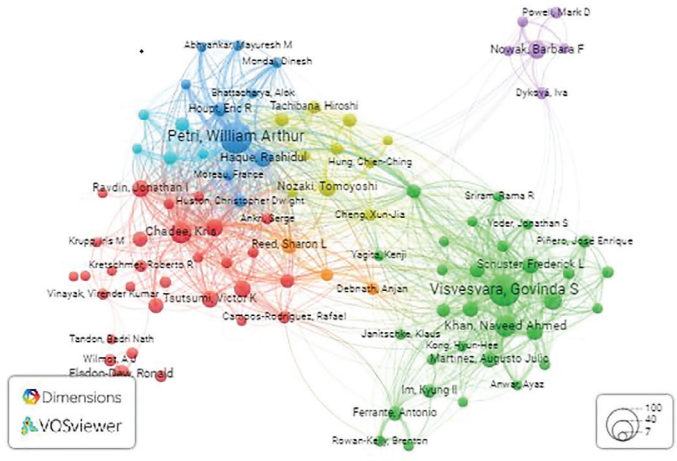


Figure 5 - Citation Analysis



There was an increasing number of citations on amebiasis research recently (Figure 3). Furthermore, Figure 4 demonstrates the co-authorship analysis and Figure 5 shows co-citation analysis.

Discussion

Our study analysed the bibliometric data on amebiasis, primarily in the literature. According to our analysis, the research on amebiasis is active, interdisciplinary, and collaborative in nature.

Entamoeba histolytica is a unicellular extracellular protozoan parasite that infects the human intestinal tract and results in bloody diarrhea and colitis. Amebiasis can also cause extraintestinal abscess formation in the liver, lung, and brain. Intestinal parasites are the third leading cause of death, especially in developing countries. Developed countries have also been affected since high-risk groups including tourists and

immigrants are candidates for infection. Therefore, amebiasis has been of global concern [16, 17].

Bibliometric analysis has analysed the published literature using quantitative and qualitative metrics, so that academic productivity might be revealed objectively [18]. Bibliometric methods have been used in the parasitology discipline for more than 30 years, but it is still at an early stage considering the available literature. Its primary aim is to reveal trending research topics via searching major literature databases [19].

Analysis of the literature research on amebiasis shows that most of the articles were written in English. English is accepted as the de facto universal language of science, and so most of the cited articles are from English written journals [20].

Another highlighted point of our bibliometric analysis reveals that entamoeba research is primarily the subject of the medical field; however, nine other health disciplines including the veterinary field have analysed this parasite infection according to the literature. Research on parasite infections has been the subject of many health disciplines due to the characteristics of the disease. Humans are natural hosts of the entamoeba histolytica, and there is not a unique animal model that mimics the cycle of the disease. However, animal models and experimental ex vivo systems are the only solution to conduct research on amebiasis. Furthermore, it is a disease in which innate and adaptive immune responses play a key role in the course of the disease, from asymptomatic disease to its fatal form. Technological advancements have resulted in progress for diagnostic tools and a better understanding of the pathogenesis of the infection [16, 21]. For instance, recently it has shown the interaction of human microbiota and entamoeba histolytica, which plays a major role in the disease course [22].

These developments are closely related to interdisciplinary collaborative studies, which also reflect the results of our bibliometric analysis.

Amebiasis has been highly examined since 1950, and over 50 publications per year have been published. Since the modern pathogenesis of the infectious disease was developed in the early 50s, dating to the post-World War II era, entamoeba research might also be popular [21]. In particular, the years from 2011 to 2021 represent the most prolific era in that field regarding publications.

Considering contributions of literature, the USA is the leading country regarding publications. In general, the USA is one of the most productive countries in parasitology [23]. According to our results, the second and third prolific countries in this field are Mexico and India. The most prolific centre in the field is also from Mexico, which consists of 5.5% of all publications. Parallel to our results, Mexico and India are the most prolific countries regarding studies on amoebic liver abscess [24]. These results are compatible with the epidemiological data of amebiasis, which is commonly seen in developing countries and tropical areas [17]. Researchers of the most affected countries have also contributed significantly to the literature.

Another important finding of our research revealed that more than 100 countries have contributed to the literature on amebiasis, which has shown the global importance of this parasite infection. Turkey is amongst those countries, contributing to the field with a growing number of publications recently [25].

Considering journals that were published mostly on amebiasis research, most of them are parasitology journals. Furthermore, most of the funding centres are national institutes of the countries. This result has shown that local authorities in the countries have attached importance to this global health issue. Since the early 1970s, the number of citations has increased regularly. In the most cited studies, there is not a regular pattern of data and year distribution regarding citations. The most cited study is from 1976, with the next most highly cited studies mainly occurring after the 1990s. While the oldest most cited studies have analysed the pathogenesis and diagnosis of amebiasis, the newest studies have examined the genomic profile of this parasite. Technological advancement in molecular biology might steer the more recent studies [26].

Additionally, the most cited articles were written by a group of researchers. This has shown the importance of collaborative work in the field.

Although amebiasis research is still developing and being contributed to by many fields, there are still relatively few studies of bibliometric analysis of parasitology. Hence, there is no documented study on amebiasis or entamoeba histolytica using bibliometric analysis. Only one bibliometric analysis searching for liver abscess has emphasized this infective agent amongst risk factors [24].

Conclusion

Amebiasis has been the subject of a wide range of health disciplines. Since the cumulative data on molecular biology has increased in the last 50 years, the diagnostic and therapeutic developments on amebiasis research have changed the content of the studies so recently, the most cited articles are related to these developments. Amebiasis is still a global concern as one of the leading infectious causes of mortality in developing countries, so it will continue to be a prominent topic of global public health.

Disclosures: There is no conflict of interest for all authors.

Acknowledgements: None.

Funding: None.

References

1. Beyhan YE, Yılmaz H, Taş Cengiz Z. Prevalence of Entamoeba spp. in Stool Samples of Patients with Amebiasis Suspect by Native-Lugol and ELISA. *Turkiye Parazitol Derg.* 2016;40(2):59-62. https://doi.org/10.5152/tpd.2016.4424
2. Sugeçti S. Entamoeba histolytica patojenitesi ve moleküler tanı yöntemleri. *FNG & Bilim Tıp Dergisi*. 2018;4(4):203-207. https://doi.org/10.5606/fng.btd.2018.036
3. Kantor M, Abrantes A, Estevez A, Schiller A, Torrent J, Gascon J, et al. Entamoeba Histolytica: Updates in Clinical Manifestation, Pathogenesis, and Vaccine Development. *Can J Gastroenterol Hepatol.* 2018; 2018:4601420. https://doi.org/10.1155/2018/4601420
4. Cheepsattayakorn A, Cheepsattayakorn R. Parasitic pneumonia and lung involvement. *Biomed Res Int.* 2014;2014:874021. https://doi.org/10.1155/2014/874021

5. Gerry E. A case of amœbıc dysentery. *Journal of the American Medical Association*. 1892; 19(4): 101-104. https://doi.org/10.1001/jama.1892.02420040013001d
6. Diamond LS, Harlow DR, Cunnick CC. A new medium for the axenic cultivation of Entamoeba histolytica and other Entamoeba. *Trans R Soc Trop Med Hyg*. 1978;72(4):431-2. https://doi.org/10.1016/0035-9203(78)90144-x
7. Loftus B, Anderson I, Davies R, Alsmark UC, Samuelson J, Amedeo P, et al. The genome of the protist parasite Entamoeba histolytica. *Nature*. 2005;433(7028):865-8. https://doi.org/10.1038/nature03291
8. Walsh J. A. (1986). Problems in recognition and diagnosis of amebiasis: estimation of the global magnitude of morbidity and mortality. Reviews of infectious diseases. 8(2):228–238. https://doi.org/10.1093/clinids/8.2.228
9. Tibayrenc M, Kjellberg F, Ayala FJ. A clonal theory of parasitic protozoa: the population structures of Entamoeba, Giardia, Leishmania, Naegleria, Plasmodium, Trichomonas, and Trypanosoma and their medical and taxonomical consequences [published correction appears in Proc Natl Acad Sci U S A 1990 Oct;87(20):8185]. *Proc Natl Acad Sci U S A*. 1990;87(7):2414-2418. https://doi.org/10.1073/pnas.87.7.2414
10. Diamond LS, Clark CG. A redescription of Entamoeba histolytica Schaudinn, 1903 (Emended Walker, 1911) separating it from Entamoeba dispar Brumpt, 1925. *J Eukaryot Microbiol*. 1993;40(3):340-4. https://doi.org/10.1111/j.1550-7408.1993.tb04926.x
11. Bapteste E, Brinkmann H, Lee JA, Moore DV, Sensen CW, Gordon P, et al. The analysis of 100 genes supports the grouping of three highly divergent amoebae: Dictyostelium, Entamoeba, and Mastigamoeba. *Proc Natl Acad Sci U S A*. 2002;99(3):1414-9. https://doi.org/10.1073/pnas.032662799
12. Verweij JJ, Blangé RA, Templeton K, Schinkel J, Brienen EA, van Rooyen MA, et al. Simultaneous detection of Entamoeba histolytica, Giardia lamblia, and Cryptosporidium parvum in fecal samples by using multiplex real-time PCR. *J Clin Microbiol.* 2004;42(3):1220-3. https://doi.org/10.1128/JCM.42.3.1220-1223.2004
13. Tovar J, Anke F, C. Graham C. The mitosome, a novel organelle related to mitochondria in the amitochondrial parasite Entamoeba histolytica. *Molecular microbiology.*1999; 32(5): 1013-1021. https://doi.org/10.1046/j.1365-2958.1999.01414.x
14. Ravdin JI, Guerrant RL. Role of adherence in cytopathogenic mechanisms of Entamoeba histolytica. Study with mammalian tissue culture cells and human erythrocytes. *J Clin Invest.* 1981;68(5):1305-13. https://doi.org/10.1172/jci110377
15. Diamond LS. Techniques of axenic cultivation of Entamoeba histolytica Schaudinn, 1903 and E. histolytica-like amebae. *J Parasitol*. 1968;54(5):1047-56. https://doi.org/10.2307/3277143
16. Uribe-Querol E, Rosales C. Immune Response to the Enteric Parasite Entamoeba histolytica. *Physiology* (Bethesda). 2020; 35(4):244-260. https://doi.org/10.1152/physiol.00038.2019
17. Carrero JC, Reyes-López M, Serrano-Luna J, Shibayama M, Unzueta J, León-Sicairos N, et al. Intestinal amoebiasis: 160 years of its first detection and still remains as a health problem in developing countries. *Int J Med Microbiol.* 2020;310(1):151358. https://doi.org/10.1016/j.ijmm.2019.151358
18. Sgrò A, Al-Busaidi IS, Wells CI, Vervoort D, Venturini S, Farina V, et al. Global Surgery: A 30-Year Bibliometric Analysis (1987-2017). *World J Surg*. 2019;43(11):2689-2698. https://doi.org/10.1007/s00268-019-05112-w
19. Ellis JT, Ellis B, Velez-Estevez A, Reichel MP, Cobo MJ. 30 years of parasitology research analysed by text mining. *Parasitology*. 2020;147(14):1643-1657. https://doi.org/10.1017/S0031182020001596
20. Drubin DG, Kellogg DR. English as the universal language of science: opportunities and challenges. *Mol Biol Cell.* 2012;23(8):1399. https://doi.org/10.1091/mbc.E12-02-0108
21. Lewnard JA, Reingold AL. Emerging Challenges and Opportunities in Infectious Disease Epidemiology. *Am J Epidemiol.* 2019;188(5):873-882. https://doi.org/10.1093/aje/kwy264
22. Ankri S. Entamoeba histolytica-Gut Microbiota Interaction: More Than Meets the Eye. *Microorganisms*. 2021;9(3):581. https://doi.org/10.3390/microorganisms9030581
23. Falagas ME, Papastamataki PA, Bliziotis IA. A bibliometric analysis of research productivity in Parasitology by different world regions during a 9-year period (1995-2003). *BMC Infect Dis*. 2006;6:56. https://doi.org/10.1186/1471-2334-6-56
24. González-Alcaide G, Peris J, Ramos JM. Areas of research and clinical approaches to the study of liver abscess. *World J Gastroenterol.* 2017;23(2):357-365. https://doi.org/10.3748/wjg.v23.i2.357
25. Rashidi A, Rahimi B, Delirrad M. Bibliometric analysis of parasitological research in iran and Turkey: a comparative study. *Iran J Parasitol.* 2013;8(2):313-22.
26. Saidin S, Othman N, Noordin R. Update on laboratory diagnosis of amoebiasis. *Eur J Clin Microbiol Infect Dis*. 2019;38(1):15-38. https://doi.org/10.1007/s10096-018-3379-3