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Original Article

Research trends and hotspots of osteoarticular involvement in brucellosis

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Summary
Human brucellosis causes a variety of clinical symptoms and osteoarticular involvement is the most common involvement. We conducted a bibliometric analysis study on osteoarticular involvement in brucellosis. The study's aim was to investigate the impact of publications in this field and to discover research development and clusters. We used the Web of Science (Wos) database to obtain the data. The titles, document types, publication years, authors, organizations, keywords, abstracts of each record, H-index, and citations were analyzed. We analyzed 642 documents (research articles and review articles). 83.178% of them were published in Science Citation Index Expanded (Sci-Expanded) indexed journals. English (88.785%) was the most preferred language. Researchers from 70 countries contributed to the growth of scientific studies. Turkey was ranked first with a total of 177 publications. The United States of America (11.059%), Peoples' Republic of China (8.411%), Iran (6.698%), and Spain (6.698%) were the top five countries according to the number of publications. The publications were cited 11118 times (17.32 per item) and the mean of the H-index was 51. The publications published between 2000- 2009 received the highest number of citations and had the highest H indexes. H indexes and citation numbers of publications have decreased since 2010. This is the first report that shows the trends of osteoarticular involvement in brucellosis. In conclusion, financial support for scientific studies in regions where brucellosis is endemic may increase the number of articles to be published in the future from these regions.
Keywords: Brucellosis, zoonotic disease, osteoarticular, bibliometrics.

Introduction

Brucellosis is a prevalent systemic zoonotic disease that causes a variety of clinical symptoms all around the globe (Esmaeilnejad-Ganji et al., 2019). Brucellosis is caused by *Brucella spp*. bacteria, which are tiny, Gram-negative coccobacilli and mainly spread through the bloodstream (Özlü, 2021). It is transmitted to humans by contact with the meat, milk, fetal tissues, urine, and other body fluids of infected animals through the skin, respiratory, mucous membranes, and conjunctival routes (Arkun & Mete, 2011). The disease was first identified in the Mediterranean basin, giving it the name "Malta fever" (Papathanassiou et al., 1972). *Brucella* bacteria are Gram-negative, non-motile, and spore-forming coccobacilli that live inside cells. *B. melitensis* primarily infects small ruminants, *B.*

abortus big ruminants and wildlife, *B. suis* infects pigs, and *B. canis* infects dogs; nevertheless, infections in non-preferred hosts are possible, and these species may participate as reservoir hosts (Diaz, 2013; Godfroid, 2002; Jamil et al., 2021; Wernery, 2014). The occurrence of brucellosis in humans indicates a disease burden in animals since humans are dead-end hosts. As a result, controlling the disease in animals is the most cost-effective way to combat brucellosis in humans (Hull & Schumaker, 2018).

Most patients with brucellosis have an undulant fever, sweating, chronic malaise, and musculoskeletal pain hosts (Diaz, 2013; Godfroid, 2002; Jamil et al., 2021; Wernery, 2014). Osteoarticular involvement is the most common brucellosis involvement, affecting 10-85% of the brucellosis cases. The most commonly affected joints are the sacroiliac (up to 80%) and spinal (up to 54%) joints. The most common consequences of brucellar spinal involvement are spondylitis and spondylodiscitis. Other osteoarticular manifestations include peripheral arthritis, osteomyelitis, discitis, bursitis, and tenosynovitis, all of which have a lesser prevalence (Arkun & Mete, 2011; Esmaeilnejad-Ganji et al., 2019; Özlü, 2021; Sanaei Dashti & Karimi, 2013).

In this work, we conducted a bibliometric analysis of the current literature on osteoarticular involvement in brucellosis. The study's overall purpose was to investigate the impact of publications in this field and to discover research development and clusters.

Materials and methods

In this bibliometric analysis study, we used the Web of Science (Wos) (Clarivate Analytics, Philadelphia, PA, USA) database to obtain the data. We used 'human' and 'Brucella' or 'brucellosis' and 'spondylitis' or 'spondylodiscitis' or 'osteoarticular manifestations' or 'arthritis' or 'osteomyelitis' or 'discitis' or 'bursitis' or 'tenosynovitis' as the search terms in WoS topic (title, abstract, author keywords, and *KeyWords Plus*). The titles, document types, publication years, authors, organizations, keywords, abstracts of each record, H-index, and citations within the WOS publications were saved as TXT files and imported into Microsoft Office Excel 2019 (Los Angeles, CA, USA). Data for this investigation were obtained on April 15, 2022. We selected articles and reviewed articles. In publications that do not contain information about the identity of the author, the first and responsible author is the same person. Similarly, publications published by a single institution were categorized as the first author's and corresponding author's institutions. Furthermore, we only considered the corresponding author in articles with numerous corresponding authors. Addresses were used to determine the type of collaboration.

As a timeline, only documents published between the years 1970 and 2021 were analyzed. Since 2022 has not been completed yet, publications from this time period were omitted from the study.

The VOSviewer 1.6.18 for Microsoft Windows systems tool was used to visualize country collaboration networks and keywords. We generated co-occurrence networks using the bibliographic material from the publications we collected (e.g., nations, citations, and keywords).

Results

Based on the search method utilized in this study, the findings revealed that 701 documents on this topic were indexed in the Wos database between the years 1970 and 2021. 576 of the documents were articles and 66 review articles. We only analyzed these 642 documents.

83.178% of them were published in Science Citation Index Expanded (Sci-Expanded) and 15.576% in Emerging Sources Citation Index (ESCI) indexed journals. English (88.785%), Turkish (5.296%), French (1.713%), Portuguese (1.246%), and Spanish (1.246%) were the mostly preferred languages. Since 2000, the number of articles had not fallen below 10 articles/year. The most significant number of publications was published in 2019 (n = 50) (Figure 1).

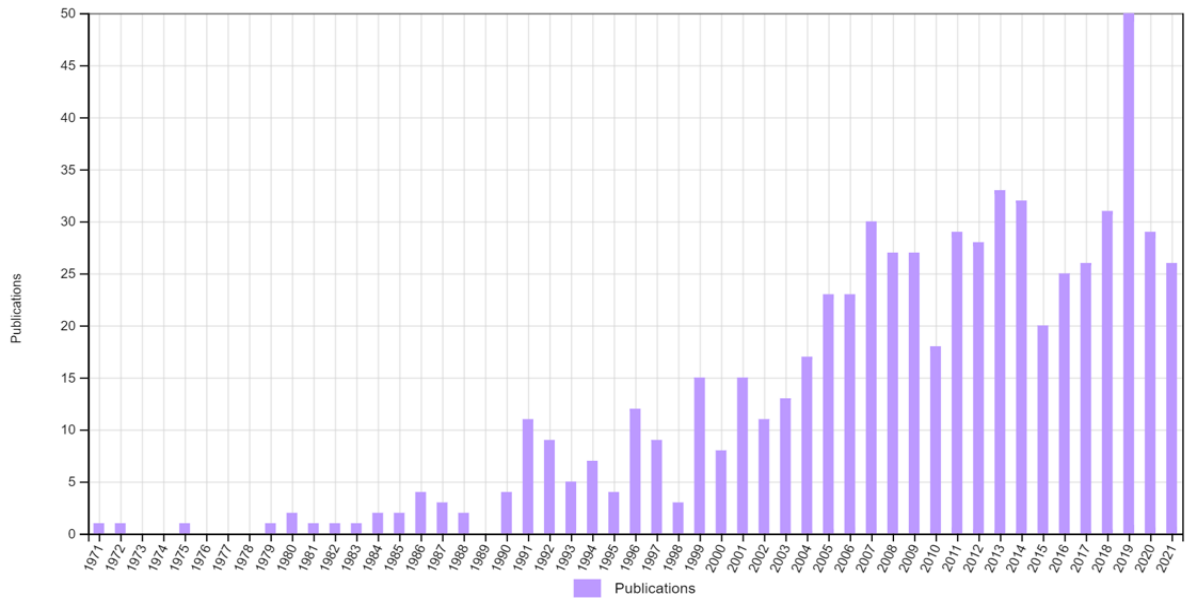

Fig. 1. The number of publications in 1970-2021.

Researchers from 70 countries contributed to the growth of scientific studies. Turkey was ranked the first with total of 177 publications. The United States of America (USA) (11.059%), the Peoples' Republic of China (8.411%), Iran (6.698%), and Spain (6.698%) were the top five countries according to the number of publications (Table 1). Institutions originating from Argentina, USA, Turkey, and Iran were the institutions that produced the most of the publications. The University of Buenos Aires produced the highest number of publications (Table 2). The main research areas were Infectious Diseases, General Internal Medicine, Microbiology, and Rheumatology (Table 3). Most of the funding agencies were from Argentina and the USA (Table 4).

Table 1. The top published countries.

Countries/Regions	Record Count	% of 642	Times Cited	H index
Turkey	177	27.570	2690	26
USA	71	11.059	1489	21
Peoples Republic of China	54	8.411	318	10
Iran	43	6.698	426	11
Spain	43	6.698	1757	19
Saudi Arabia	27	4.206	634	13
Argentina	24	3.738	476	13
England	19	2.960	414	11
India	19	2.960	227	5
Italy	19	2.960	351	8
Israel	18	2.804	413	12
France	16	2.492	192	8
Greece	16	2.492	419	10
Brazil	14	2.181	333	8
Germany	11	1.713	152	4

*Total 70 countries.

Table 2. The top ranked institutions.

Institutions, Country	Record Count	% of 642
University of Buenos Aires, Argentina	19	2.960
Texas A M University, USA	18	2.804
Baskent University, Turkey	13	2.025
Consejo Nacional De Investigaciones Cientificas Y Tecnicas Conicet, Argentina	12	1.869
Babol University of Medical Sciences, Iran	10	1.558
Tehran University of Medical Sciences, Iran	10	1.558
Cukurova University, Turkey	9	1.402
Dicle University, Turkey	9	1.402
Erciyes University, Turkey	9	1.402

*Total 835 organizations

Table 3. Research areas.

Research Areas	Record Count	% of 642
Infectious Diseases	128	19.938
General Internal Medicine	122	19.003
Microbiology	79	12.305
Rheumatology	73	11.371
Immunology	63	9.813
Veterinary Sciences	45	7.009
Surgery	43	6.698
Neurosciences Neurology	42	6.542
Orthopedics	41	6.386
Pediatrics	37	5.763

Showing 10 out of 59 entries

Table 4. Funding agencies.

Funding Agencies, Country	Record Count	% of 642
Agencia Nacional de Promoción Científica y Tecnológica (Anpcyt), Argentina	17	2.648
National Institutes of Health, USA	17	2.648
United States Department of Health Human Services, USA	17	2.648
Consejo Nacional De Investigaciones Cientificas Y Tecnicas Conicet (National Council for Scientific and Technical Research), Argentina	14	2.181
National Natural Science Foundation of China, China	13	2.025
National Institute of Allergy Infectious Diseases, USA	9	1.402
University of Buenos Aires, Argentina	8	1.246
Conselho Nacional De Desenvolvimento Cientifico E Tecnologico Cnpq (CNPq - National Council for Scientific and Technological Development), Brazil	6	0.935
Fundacao De Amparo A Pesquisa Do Estado De Minas Gerais Fapemig (Minas Gerais State Agency for Research and Development - FAPEMIG), Brazil	4	0.623
University of Missouri College of Veterinary Medicine and Research Board, India	4	0.623

Showing 10 out of 157 entries; 531 record(s) (82.710%) do not contain data in the field being analyzed.

Citing analysis

The publications were cited 11118 times (17.32 per item) and the mean of the H-index was 51. The number of citations has increased over the years (Figure 2). The publications published between 2000- 2009 received the highest number of citations and had the highest H indexes. The highest number of publications were published between 2010- 2019. H indexes and citation numbers of publications have decreased since 2010 (Table 5).

Mapping analysis

The mapping analysis of the documents were given in Figures 3-5.

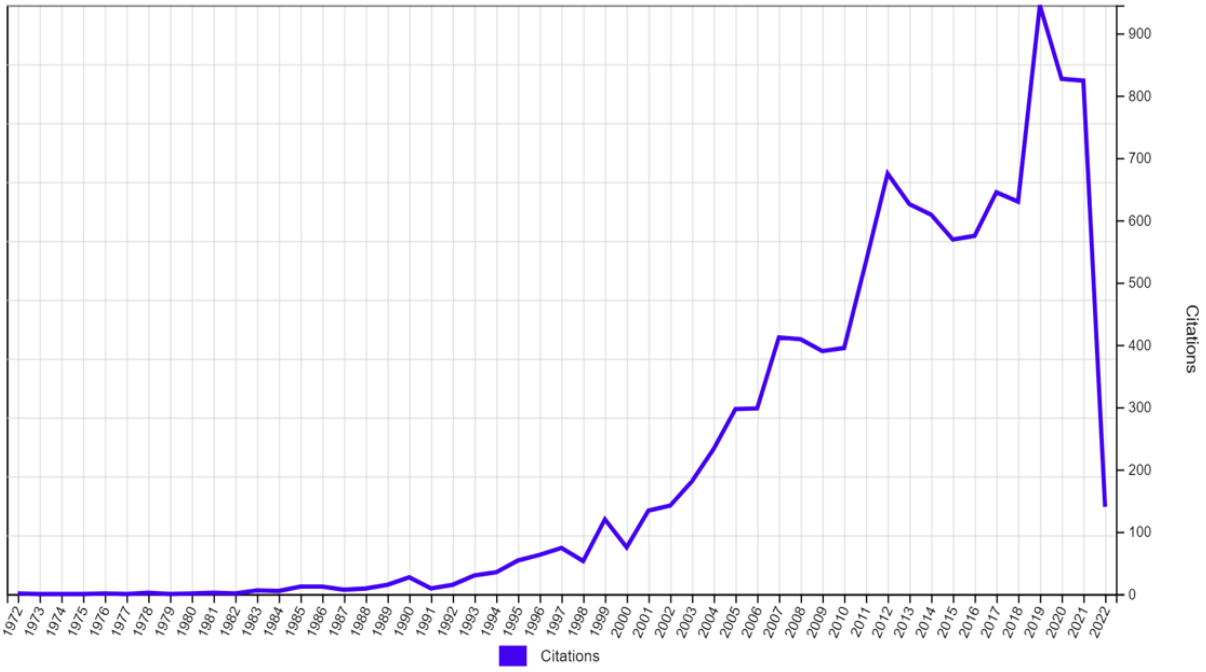

Fig. 2. The number of citations over the years.

Table 5. The summary of citations, H indexes, and the number of publications.

Time span	No. of publications	Total citations	Citations without self-citations	Citations average per item	H-Index
1970-1979	4	45	45	11.25	3
1980-1989	19	396	390	20.84	10
1990-1999	79	2799	2691	35.43*	28
2000-2009	194	4473*	4162	23.06	40*
2010-2019	292*	3358	2826	11.5	27
2020,2021	105	262	215	2.5	9

*the highest numbers according to categories.

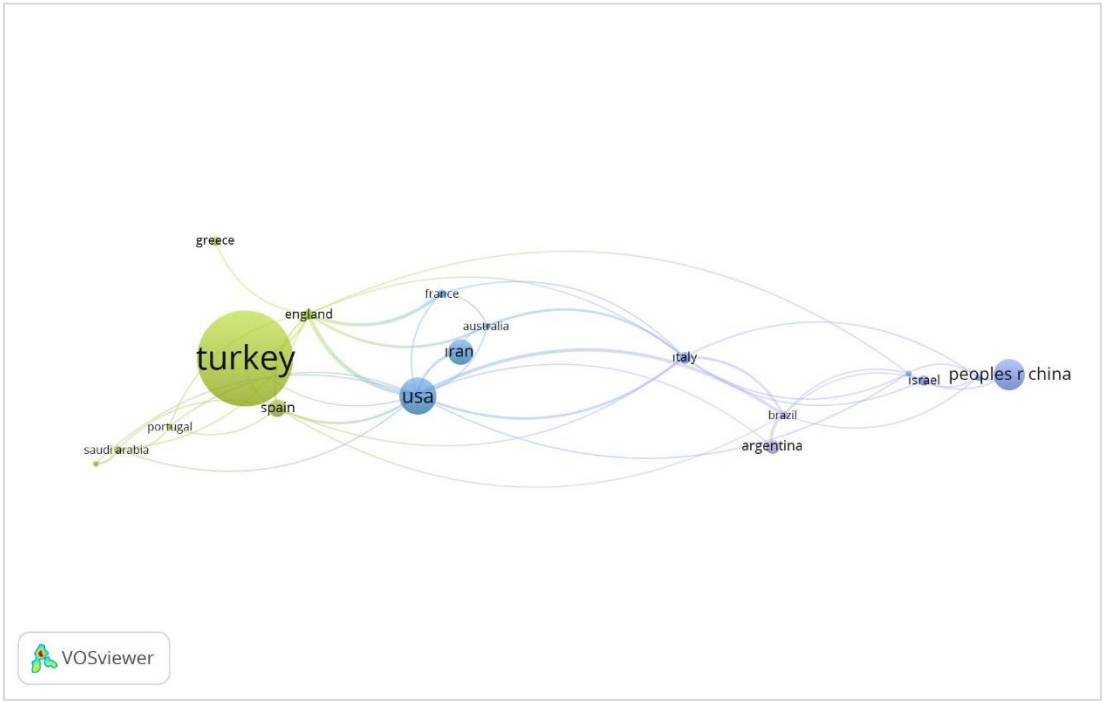

Fig. 3. Co-authorship (Countries)

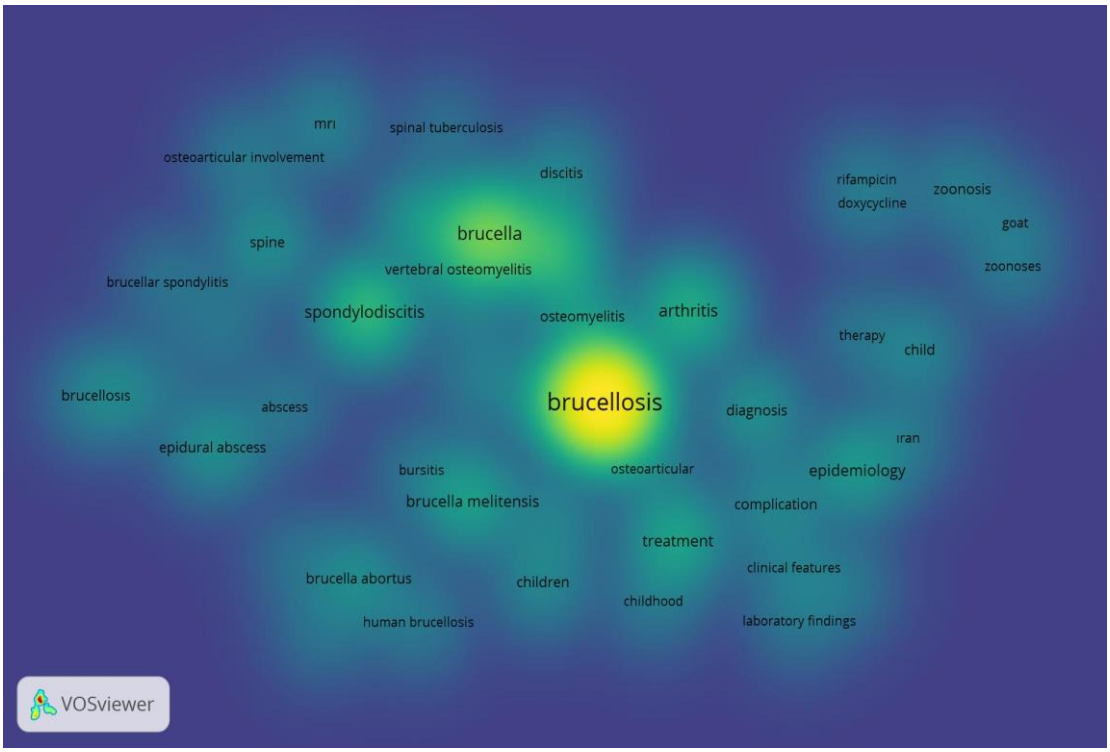

Fig. 4. Keyword co-occurrence

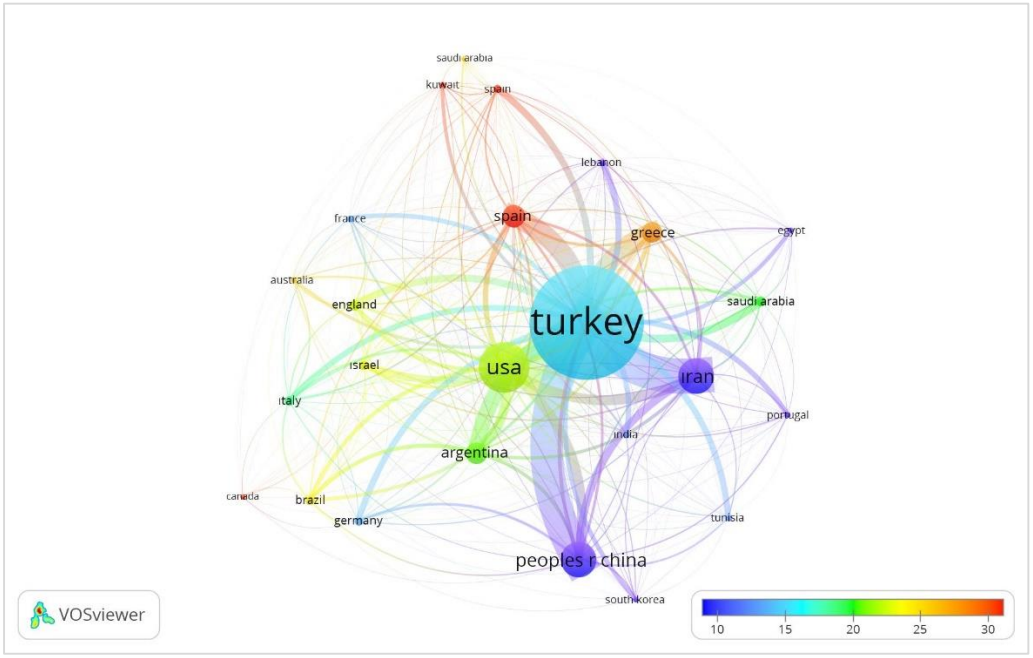

Fig. 5. Bibliographic coupling of countries according to citations

Discussion

Bibliometric analysis studies give an insight into the advances in a discipline, and they also offered the details of the most influential publications, institutes, countries, and authors. Although many bibliometric analysis studies have been carried out in the field of medicine recently, similar studies on brucellosis are quite limited (Bakri et al., 2018; Mızrakçı et al., 2021). In addition, no similar study published on osteoarticular involvement of brucellosis, which is the most common involvement of brucellosis, was found in the available literature.

In bibliometric investigations, the WOS database is the most widely used database (Bakri et al., 2018; Şahin, 2022). We also used the WOS database.

Although it was determined that most of the articles in the field of medicine were published in the USA in previous bibliometric analysis studies (Beshyah and Beshyah, 2019; Köylüoğlu et al, 2021; Küçük et al, 2021; Özlü A, 2021; Öztürk G, 2022), Based on our analysis of the WoS database, Turkey had published the majority of documents since 1970, followed by the USA.

Our findings paint a clear picture of the documents in the history of osteoarticular involvement in brucellosis research. In a study conducted in the Scopus database, the publications on brucellosis were examined. It was determined that most of the publications were from the USA (Mızrakçı et al., 2021). In a similar study (Bakri et al., 2018) the researchers evaluated the most cited articles on brucellosis and they used two databases (both Scopus and WOS databases). We used the WOS database for our research and we found that many countries, including American, European, Asian, and Mediterranean countries, contributed to this research, with the highest contribution from Turkey. This situation can be attributed to the fact that the disease is endemic in Turkey and in these countries (Papathanassiou et al., 1972).

A bibliometric analysis is an efficient method of calculating the overall trend of research activity and elucidating the relationships between relevant

research institutions, countries, or authors. Bibliometrics may also assess the number and evolution of scientific outputs across countries and years in important scientific disciplines, which is especially useful for novel disciplines whose implications on the larger field of medical research have yet to be thoroughly assessed (Beshyah & Beshyah, 2019; Köylüoğlu et al., 2021; Küçük et al., 2021; Özlü, 2021; Öztürk, 2022; Şahin, 2022). In our study, the current status of countries was given in Figure3 and Figure 5.

The H index has been identified as a reliable means of predicting future research, and it incorporates the number of times a specific country's publications are time-cited relative to the number of times those publications are at least co-cited (Zhao et al., 2018). In this current study VOSviewer was used to determine the consequence, the number of co-cited contributors, and frequency of co-cited connections. And also the H index of each top productive country was given in Table 1. In the examination of the organizations that provide funding for the publications, it was seen that the organizations of Argentine origin took place at the top of the list. However, the number of publications originating from Argentina was still in 8th place in the ranking and was also in 4th place in terms of the H index.

Conclusion

To detect the subject progression and trends in this domain's intellectual landscape, we created a series of scientific maps of countries, institutions, authors, co-cited references, and citation burst keywords. Turkey seemed to have a significant effect on this subject. Argentina has been discovered to be specifically interested in this topic. Publications published between 2000 and 2009 received the most citation and had the highest H indexes. Most publications were published between 2010- 2019. Since 2010, H indexes and publication citation numbers have decreased. Also, the number of publications has decreased in the last 2 years. This may be because the COVID 19 pandemic, which has affected the whole world, has attracted scientific attention.

Limitations

Only documents in the WOS database were included in the study. The last point is important here because brucellosis was discovered in 1887 and it is possible that some important studies are not indexed in the current database. Because in the current database, the period before 1970 cannot be evaluated. Furthermore, we believe that searching more than one database will uncover additional publications.

Acknowledgments

Not applicable.

Conflicts of Interest

The authors declare no conflicts of interest statement.

Ethical approval

Not applicable.

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