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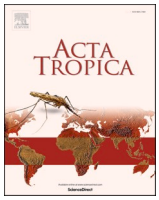

A retrospective analysis of schistosomiasis related literature from 2011-2020: Focusing on the next decade

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ABSTRACT

Background: Schistosomiasis, an ancient and neglected tropical disease, which poses a huge threat to over 200 million people globally. It is necessary to have a general summary of schistosomiasis research after the new roadmap 2021–2030 issued by WHO. This study analyzes the current status of schistosomiasis research from the perspective of the One Health concept by analyzing important research literature published from 2011 to 2020, while further highlighting research priorities, difficulties, and research directions in order to propose suggestions for tropical disease studies research.

Methods: Published literature related to schistosomiasis was searched from the Web of Science Core Collection (WoSCC) database. Focusing on a visual analysis of the main research literature in the field of schistosomiasis, CiteSpace software was used to conduct co-occurrence analysis with keywords, countries, institutions, and authors. Moreover, clustering and burst analyses of keywords and co-citation analysis of authors, publications, and journals were performed.

Results: A total of 6638 schistosomiasis-related articles were published from 2011 to 2020, all of which can be sourced from the WoSCC database. The publication of schistosomiasis research has remained stable over the past 10 years, and contains studies in the area of human epidemiology, animal surveillance and the environment. The top five high-frequency keywords included Schistosoma mansoni, schistosomiasis, infection, praziquantel, and Schistosoma japonicum. The keywords formed nine clusters, including praziquantel, epidemiology, Schistosoma japonicum, helminths, protein, diagnosis, schistosomiasis, response, and haematobium. In recent years, most research studies focused on the mechanism of liver fibrosis, eliminating schistosomiasis, controlling risk factors, and the relationship between schistosomiasis infection and host immunity. The most productive countries include the United States, China, and Brazil, and the most productive institutions are the University of Basel, the Swiss Tropical and Public Health Institute, and the University of São Paulo. Highly productive authors include Jürg Utzinger and Donald P. McManus. At the time of writing, the author with the highest co-citation frequency (993 times) was Peter Hotez, and the journal with the highest co-citation frequency (3,720 times) was PLoS Neglected Tropical Diseases. Human schistosomiasis, published by Colley et al. (2014), was the most frequently co-cited publication (494 times).

Conclusions: This study provides a preliminary description of the current status of schistosomiasis research and an initial exploration of future research directions. The One Health concept was applied in the field of schistosomiasis control, as confirmed by this bibliometric analysis. Our study provides guidance for the development of research on schistosomiasis and other neglected tropical diseases.

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1. Introduction

Schistosomiasis, an ancient and neglected tropical disease, is a widespread zoonotic parasitic disease caused by infection with trematodes of the genus *schistosoma*, which seriously endangers human health and socioeconomic development (Angora et al., 2020; Huang et al., 2016, 2020; LoVerde, 2019). The World Health Organization (WHO) has estimated that approximately 779 million people are at risk of schistosomiasis infection worldwide, and more than 250 million people were infected in 2016 (McManus et al., 2018; Ross et al., 2017). Schistosomiasis is endemic in more than 78 countries and poses a serious disease burden to society, representing a major public health problem (Huang et al., 2019; Zhu et al., 2021). As a vector-borne disease, schistosomiasis is closely related to a variety of environmental changes and activities from human and animals, such as the biological, natural, and socioeconomic risk factors (Guo et al., 2021; Kokaliaris et al., 2022). The One Health concept is a practical approach to disease control that focuses on the interaction of human beings, animals and the environment (Ryu et al., 2017). To eliminate schistosomiasis earlier and completely, a One Health approach should be adopted to address complex health issues from the macro perspective of human, animal, and environment interactions, emphasizing multi-institutional, interdisciplinary and cross-regional cooperation and communication (Hong et al., 2022). Over the past decade, achievements have been made in reducing the prevalence of schistosomiasis through the implementation of One Health measures such as mass drug administration, animal management and snail control (Léger et al., 2020; Stensgaard et al., 2019). However, there are still multiple limiting factors that hinder the control and elimination of schistosomiasis (Tantengco and Rojo, 2022). Therefore, it is important to understand current research on schistosomiasis and to identify future research directions aimed at controlling and eliminating this disease.

Bibliometrics is an interdisciplinary science that uses mathematical and statistical methods to conduct quantitative analyses on all knowledge carriers. It is also a tool for statistical analysis and quantitative research on publications or literature (Belter, 2015; Ellegaard and Wallin, 2015; Zhang et al., 2020). CiteSpace is a bibliometric visualization analysis software program developed by Professor Chaomei Chen (Chen, 2013; Zheng and Wang, 2019), which allows researchers to perform bibliometric analysis on literature related to a certain discipline. It identifies important paths or key nodes of the evolution and development of this field, and provides guidance for further development in this domain (Chen, 2017).

In January 2021, a roadmap for neglected tropical diseases 2021–2030 was published by the World Health Organization (WHO). It provided the general objective, targets of different steps to achieve the Sustainable Development Goals (SDGs). Hence, for schistosomiasis, it was necessary to summarize the research in the past 10 years and lead a direction for the follow-up study. In this study, schistosomiasis- related research publications were analyzed, having been obtained from the WoSCC Database. Citespace was applied to focus on schistosomiasis related research outputs in order to: (i) review research on schistosomiasis in the past 10 years; (ii) predict future research directions; and (iii) provide some reference for the prevention and control of schistosomiasis and other neglected tropical diseases.

2. Methods

2.1. Data collection

The published literature related to schistosomiasis was searched and analyzed in the WoSCC database (www.webofknowledge.com). The advanced search option was adopted, and the retrieval strategy was TS = (schistosomiasis or schistosome or *schistosoma)*. The publication time range was set from January 1, 2011 to December 30, 2020. Only original research articles were included; letters, reviews, editorials, and other article types of documents were excluded. Literature was de-duplicated using CiteSpace 5.8.R1 software.

2.2. Data analysis

The retrieved literature was exported to a file in sequence in a format recognized by the software (recorded content: full record and cited references; file format: plain text); the file was named download_x.txt, a format recognized by the software. The literature was de-duplicated by CiteSpace 5.8.R1 software, and then the data were imported into CiteSpace software for analysis. The time slicing was set as 2011–2020, the number of years per slice was set as 1, and Top N was set as 50. Pruning was set to Pathfinder. By setting Node Types, co-occurrence analysis was performed based on author, institution, country, and keyword. Keyword clustering analysis and keyword burst analysis were also conducted on the basis of keyword co-occurrence analysis, where the log likelihood ratio algorithm was used for clustering keyword extraction in the clustering analysis; then the co-citation analysis was performed on references, co-cited authors, and co-cited journals to generate the visualization map. Based on the network structure and cluster clarity, CiteSpace provides a Modularity Q value and the Silhouette S value. These two metrics are the basis for judging the effectiveness of cluster mapping. The Modularity Q value evaluates the modularity of the network, and a Q value greater than 0.3 indicates that the network association structure or clustering structure is significant. The Silhouette S value of clustering evaluates network homogeneity, and an S value greater than 0.5 indicates that the clustering is reasonable, while an S value greater than 0.7 means that the clustering is convincing (Xie, 2015). In addition, centrality was used to reflect the key nodes in the visualization map, where higher centrality indicates that the content of the node has higher importance, and centrality greater than 0.1 is generally deemed to indicate a meaningful key node (Guo et al., 2019).

3. Results

3.1. Analysis of publication outputs

A total of 6638 schistosomiasis-related articles were published in the WoSCC database from 2011 to 2020. The annual number of literature publications was stable, with an average of 663.8 and a standard deviation of 38.27. The number of articles was the highest in 2014 (712) and the lowest in 2019 (600) (Fig. 1).

3.2. Keyword Co-occurrence analysis

CiteSpace was used to visualize and analyze the occurrence of literature keywords in the field of schistosomiasis in the WoSCC database from 2011 to 2020, and a keyword co-occurrence map was

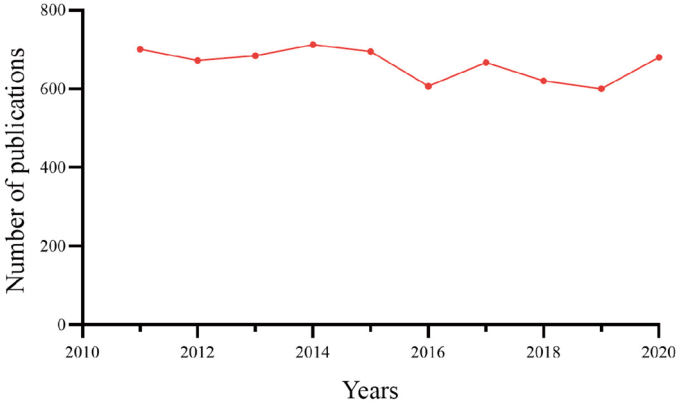


Fig. 1. The number of annual publications on schistosomiasis.

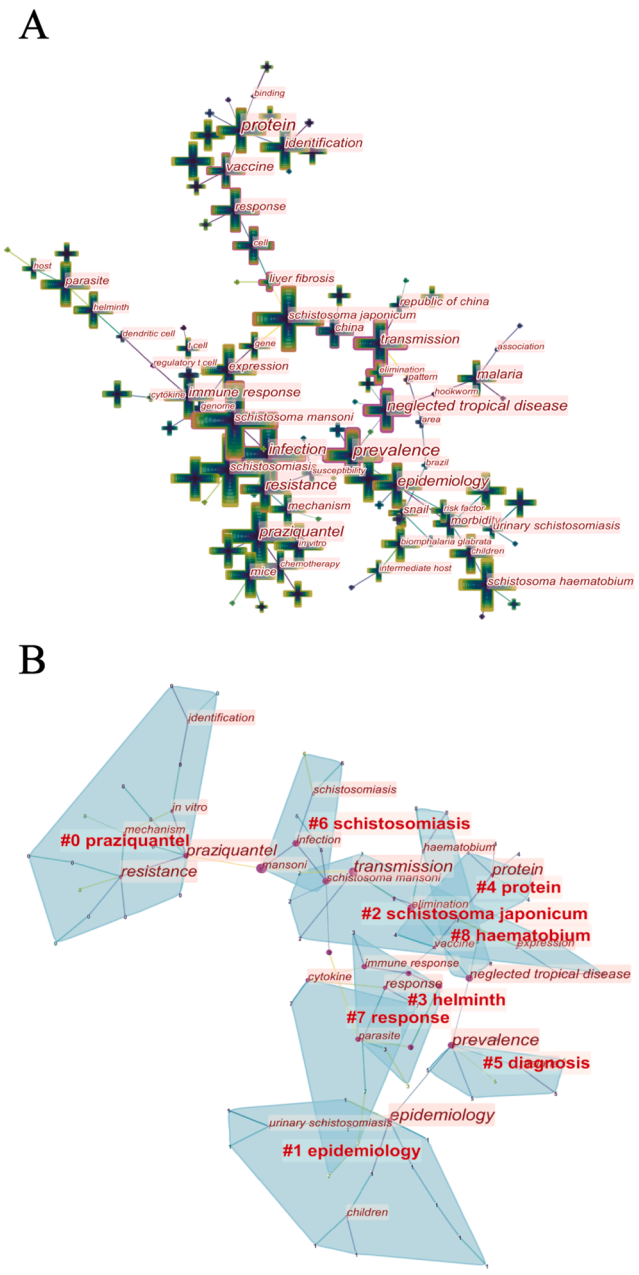
generated (Fig. 2A). Keywords with the same meaning were combined. The keyword *Schistosoma mansoni* appeared the most frequently (2480 times), followed by schistosomiasis (1421 times) and infection (1210 times). According to the frequency and centrality of the keywords, the top ten ranked keywords are shown in Table 1.

3.3. Keyword clustering analysis

Based on the keyword co-occurrence analysis, the LLR algorithm was used to cluster the keywords, and nine clusters were obtained. The clustering map is shown in Fig. 2B. The clustering analysis results showed that Modularity Q = 0.8034 > 0.3 and Silhouette S = 0.9696 > 0.7, indicating that the structure of the cluster map was convincing. The nine clusters obtained as a result were #0 praziquantel, #1 epidemiology, #2 *Schistosoma japonicum*, #3 helminth, #4 protein, #5 diagnosis, #6 schistosomiasis, #7 response, and #8 haematobium; the main keywords included in each cluster are shown in Table 2.

3.4. Keyword burst analysis

Keyword burst analysis was performed using CiteSpace, and 21 keywords were obtained. The results are shown in Fig. 2C. The results showed that schistosomiasis-related studies covered a wide range of fields before 2015, and no burst keywords appeared for a long time. Keywords including “liver fibrosis”, “risk factor”, “host”, and “elimination”, which have been hot topics in recent years, will likely continue to be maintained since 2016. The keywords “immunity” and “inflammation” began to burst in 2018, which may be a new hot research topic in the field of schistosomiasis.



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Top 21 Keywords with the Strongest Citation Bursts

Keywords	Year	Strength	Begin	End	2011 - 2020
dendritic cell	2011	13.82	2011	2012	
gene expression	2011	13.15	2011	2013	
fasciola hepatica	2011	10.94	2011	2013	
in vivo	2011	8.63	2011	2012	
antibody	2011	15	2012	2013	
susceptibility	2011	11.84	2013	2016	
risk	2011	6.97	2014	2015	
genome	2011	5.44	2014	2015	
mansoni infection	2011	4.88	2014	2015	
schistosoma	2011	4.79	2014	2015	
urinary schistosomiasis	2011	15.84	2015	2018	
intermediate host	2011	12.48	2015	2017	
cercariae	2011	11.27	2015	2016	
t cell	2011	6.6	2015	2016	
liver fibrosis	2011	16.53	2016	2020	
risk factor	2011	11.36	2016	2020	
elimination	2011	10.95	2016	2020	
host	2011	8.01	2016	2020	
africa	2011	13.37	2017	2018	
immunity	2011	10.32	2018	2020	
inflammation	2011	2.77	2018	2020	

Fig. 2. (A) Co-occurrence map of keywords in publications on schistosomiasis. The size of the cross in the map indicates the frequency of the keyword. The size of the purple area around the cross indicates the centrality of the keywords, where higher centrality means that the keywords are more closely related to other keywords. **(B) Clustering map of high-frequency keywords on schistosomiasis. (C) The keyword burst analysis of schistosomiasis.** Begin and end indicate the burst time of the keyword. Strength indicates the burst intensity of the keyword and its size indicates the influence of the keyword in this period.

Table 1
Top ten keywords in terms of frequency and centrality for publications on schistosomiasis.

Rank	Keywords	Frequency	Keywords	Centrality
1	*Schistosoma mansoni*	2480	prevalence	1.27
2	schistosomiasis	1421	neglected tropical disease	1.15
3	infection	1210	transmission	1.09
4	praziquantel	806	elimination	0.96
5	*Schistosoma japonicum*	732	infection	0.94
6	expression	491	*Schistosoma mansoni*	0.85
7	*Schistosoma haematobium*	483	china	0.79
8	prevalence	474	*Schistosoma japonicum*	0.78
9	transmission	418	liver fibrosis	0.61
10	diagnosis	395	cell	0.55

Table 2
Clustering analysis of keywords on schistosomiasis.

Cluster ID	Clustering Keyword	Silhouette	Main Keywords
0	praziquantel	1	praziquantel, identification, resistance, mice, *in vitro*
1	epidemiology	1	epidemiology, *Schistosoma haematobium*, children, impact, morbidity
2	*Schistosoma japonicum*	0.974	*Schistosoma japonicum*, expression, transmission, china, genome
3	helminth	0.897	parasite, immune response, helminth, fasciola hepatica, host
4	protein	0.943	protein, antigen, activation, vaccine, *schistosoma*
5	diagnosis	1	prevalence, diagnosis, malaria, helminth infection, plasmodium falciparum
6	schistosomiasis	1	*Schistosoma mansoni*, schistosomiasis, infection, mansoni, disease, biomphalaria glabrata
7	response	0.94	response, cell, inflammation, liver fibrosis, immunity
8	haematobium	0.899	haematobium, neglected tropical diseases, elimination, mansoni infection, africa

3.5. Analysis of countries and institutions in schistosomiasis research

The countries in which the publications originated were visualized using CiteSpace, and a map of country's published documents was generated (Fig. 3A). According to the statistical analysis of the number of publications and centrality, the top ten countries are shown in Table 3. Twenty-seven countries or regions were found to have published more than 100 articles, among which, the top three countries were the United States (1640), China (1280), and Brazil (969). In terms of centrality, the top three countries were Niger (1.33), Cameroon (1.33), and the Republic of Mali (1.09), and six of the top ten countries were African countries. Furthermore, the institutions that produced the publications were analyzed and a visualization map was generated (Fig. 3B). According to the number of publications and centrality, the top ten institutions are shown in Table 4. It can be seen that the University of Basel (315), the Swiss Tropical and Public Health Institute (311), and the University of São Paulo (213) are ranked among the top three. The top three Chinese institutions, in terms of number of publications, included the Chinese Center for Disease Control and Prevention (137), the Chinese Academy of Agricultural Sciences (132), and Fudan University (118). As for centrality, the London Imperial College of Science, Technology and Medicine (0.79), Makerere University (0.63), and the Chinese Center for Disease Control and Prevention (0.59) are ranked among the top three.

3.6. Analysis of authors and author co-citations

CiteSpace was used to generate a visualization map of authors (Fig. 4A). The top three authors included Jürg Utzinger of the Swiss Tropical and Public Health Institute (172), Donald McManus of the QIMR Berghofer Medical Research Institute in Australia (104), and Jennifer Keiser of the University of Basel (102). Xiaonong Zhou of the Chinese Center for Disease Control and Prevention ranked fifth with 76 articles, and Jiaojiao Lin of the Shanghai Institute of Veterinary Medicine of the Chinese Academy of Agricultural Sciences ranked seventh with 70 articles. The top three in order of centrality were David Rollinson of Wolfson Wellcome Biomedical Laboratories, Xiaonong Zhou of the Chinese Center for Disease Control and Prevention, and Louis-Albert Tchuem Tchuenté of the Ministry of Public Health in Cameroon. The top ten authors in terms of the number of publications and centrality are shown in Table 5. Then, visual analysis was conducted to capture author co-citations; the visualization map is shown in Fig. 4B. The top ten authors with respect to co-citations were counted (Table 6). Excluding the WHO, the top-ranked author was Peter Hotez (993) in terms of co-citations.

3.7. Co-citation analysis of journals and literature

CiteSpace was used to visualize and analyze journal co-citations in the field of schistosomiasis in the WoSCC database from 2011 to 2020, and these were visualized (Fig. 5A). There were 29 journals with more than 1000 co-citations and 61 journals with more than 100 co-citations. The journal with the highest number of co-citations was *PLoS Neglected Tropical Diseases* (3720), second was *Parasitology* (3185), and third was the *American Journal of Tropical Medicine and Hygiene* (3116). The top ten journals, in terms of co-citations, are shown in Table 7. Then, a visual map of literature co-citations was generated to conduct the visual analysis (Fig. 5B). Among them, Colley et al. (2014) published Human Schistosomiasis in the *Lancet* in 2014, which has been co-cited the most in recent years (494).

3.8. Discipline distribution of articles

CiteSpace was used to statistically analyze publication disciplines in the field of schistosomiasis in the WoSCC database from 2011 to 2020. The top five disciplines and the total number of papers in each discipline are shown in Table 8: these disciplines included parasitology; tropical medicine; infectious diseases; public, environmental and occupational health; and immunology.

4. Discussion

Human parasitic infections, including schistosomiasis, and many neglected tropical diseases caused a major global public health problem in a long history (Dejon-Agobé et al., 2022; Ung et al., 2021). In 2021, the World Health Organization issued a new roadmap for neglected tropical diseases, which also put forward new requirements and challenges for the research and prevention, and control of neglected tropical diseases in the next 10 years. In this paper, Citespace software was used to analyze the keywords, countries, institutions and authors corresponding to schistosomiasis-related literature from 2011 to 2020. This showed the current status of schistosomiasis research around the world, and can serve as a reference for the prevention and control of schistosomiasis and research.

In terms of the number of publications, there has been a significant increase in the number of publications in China in recent years. Comparing our results with those of Yang et al. (2010) with respect to the number of publications in this field from 1998 to 2008, China's rank climbed from fifth to second place. The increase in the number of published papers indirectly reflects China's achievements in schistosomiasis research over the past decade. According to the latest report, the

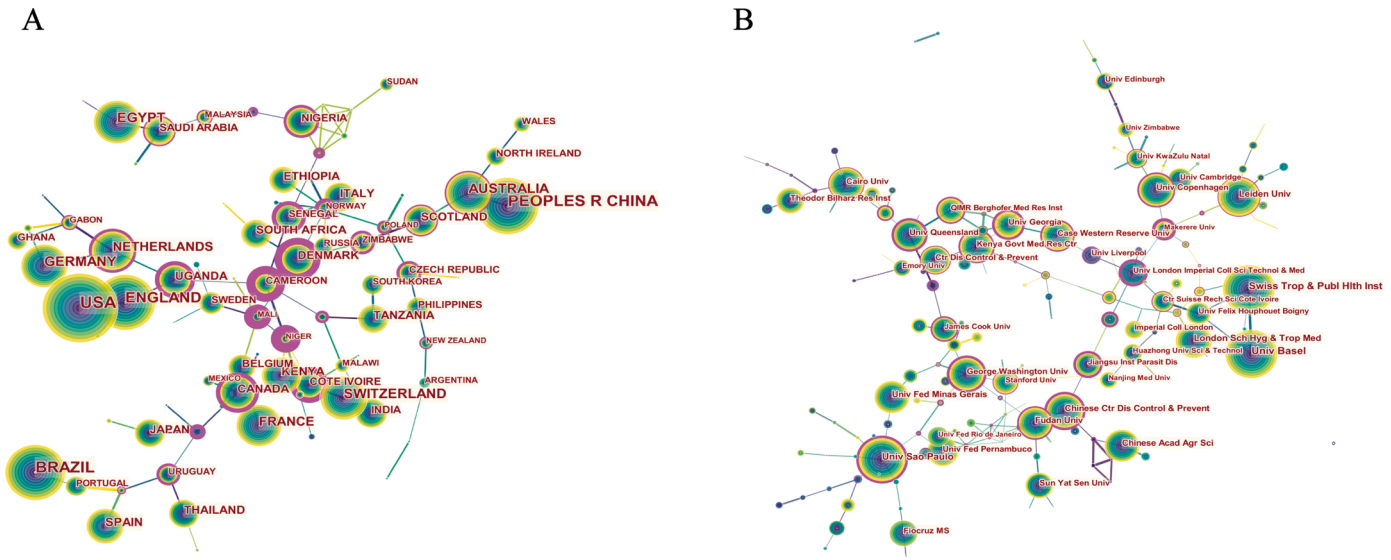

Fig. 3. (A) Visualization map of the main countries that published on schistosomiasis. The size of the annual circle in the map indicates the number of publications, and the size of the purple area outside the annual circle indicates the centrality; the larger the purple area, the closer the country cooperates with other countries. The line represents cooperation between countries, and the line color represents the time of publication; lighter coloring indicates a longer period of time since the first publication. (The interpretation of the co-occurrence map in the following figure is basically the same as here). **(B) Visualization map of the main institutions that published literature on schistosomiasis.**

Table 3
Top ten countries in terms of number of publications and centrality on schistosomiasis.

Rank	Counts	Country	Centrality	Country
1	1640	USA	1.33	Niger
2	1280	China	1.09	Cameroon
3	969	Brazil	1.01	Mali
4	888	England	0.83	Denmark
5	446	Switzerland	0.64	Côte d'Ivoire
6	428	Egypt	0.55	Canada
7	421	Germany	0.54	Senegal
8	349	Australia	0.52	Norway
9	313	France	0.46	Sierra Leone
10	282	Netherlands	0.44	Ireland

Table 4
Top ten institutions in terms of number of publications and centrality on schistosomiasis.

Rank	Counts	Institution	Centrality	Institution
1	315	University of Basel	0.79	London Imperial College of Science, Technology and Medicine
2	311	Swiss Tropical and Public Health Institute	0.63	Makerere University
3	213	University of São Paulo	0.59	Chinese Center for Disease Control and Prevention
4	173	Leiden University	0.52	George Washington University
5	152	London School of Hygiene & Tropical Medicine	0.50	The University of Georgia
6	143	Federal University of Minas Gerais	0.49	Jiangsu Institute of Parasitic Diseases
7	137	Chinese Center for Disease Control and Prevention	0.49	Soochow University
8	132	Chinese Academy of Agricultural Sciences	0.47	The University of Queensland
9	118	Fudan University	0.42	University of São Paulo
10	114	University of Copenhagen	0.37	Kenya Medical Research Institute

estimated number of schistosomiasis cases in China decreased from 326, 000 in 2010 to 30,000 in 2020 (Lei et al., 2011; Zhang et al., 2021). In addition, the keyword "elimination" started to burst from 2015 onwards, which to a certain extent reflects research frontiers and hot topics on schistosomiasis in recent years. Since 2015, China has satisfied the criteria in relation to schistosomiasis transmission control (Sun et al., 2017; Wang et al., 2021), and Chinese scholars have thus paid greater attention to schistosomiasis transmission interruption and elimination-related studies. China has made great achievements in the control of schistosomiasis over the past 70 years, and this has been the result of a multi-sectoral collaboration, with mass drug administration to both humans and livestock, as well as snail control and government campaigns (Fei et al., 2022; Zhou et al., 2021). The number of institutional publications shows that the Chinese Center for Disease Control and Prevention and the Chinese Academy of Agricultural Sciences dominate schistosomiasis and the latter more on animal schistosomiasis, although both institutions conduct research on environmental vector control. This also reflects the successful practice of the One Health concept with regards to schistosomiasis control.

In terms of the number of global publications, developed countries such as the United States, the United Kingdom, and Switzerland are ranked as leaders, having contributed more significant results to the field of schistosomiasis prevention and control. The African region, which is relatively economically backward, has a lack of scientific research funding and was found to produce less schistosomiasis research. However, Africa is a major endemic region for schistosomiasis, and this is especially true in sub-Saharan African countries, where more than 90% of global cases occur (Amoah et al., 2020). Evidently, African countries need greater access to funding in order to carry out more research on schistosomiasis, and fortunately, the high centrality ranking of some African countries indicates that good international cooperation has been established in African countries. However, funding for schistosomiasis research and international collaboration in the African region needs to be further strengthened in the post-epidemic era due to the impact of COVID-19. In addition to countries, the current study also analyzed the status with respect to relevant institutions. The results revealed that the Swiss Tropical and Public Health Institute and the

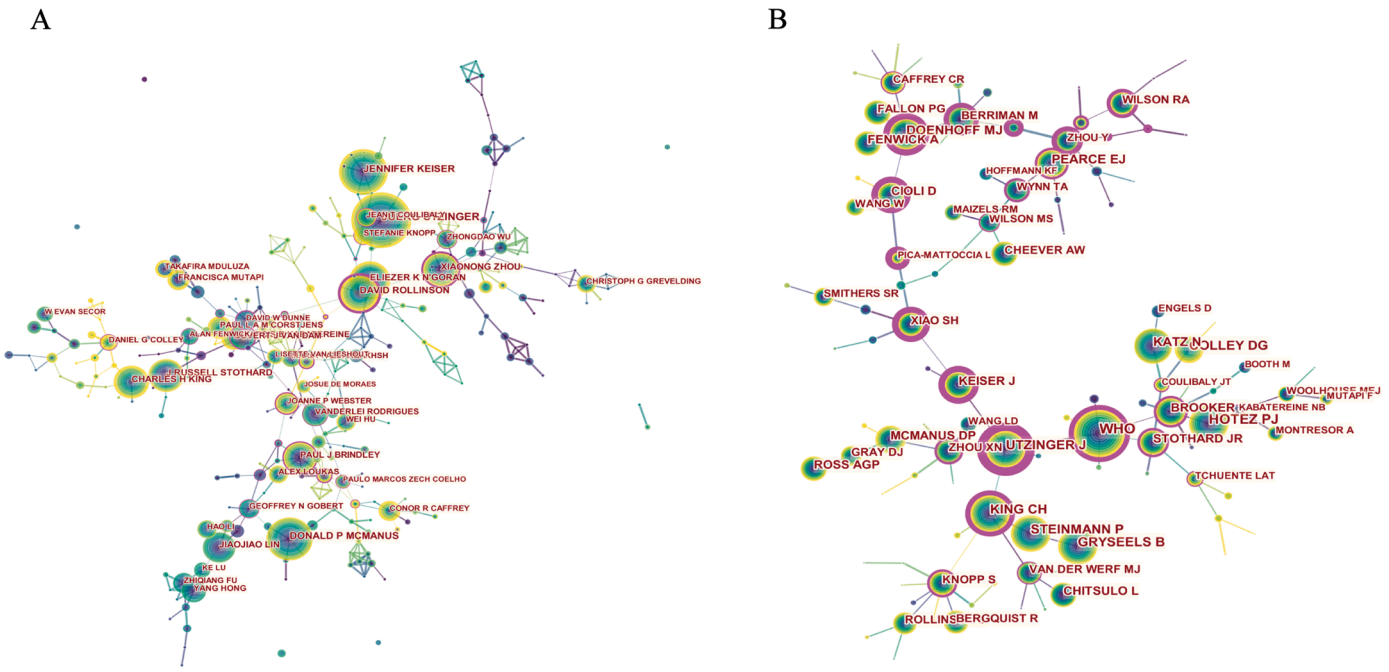

Fig. 4. (A) Author co-occurrence map associated with publications on schistosomiasis. (B) Author co-citation map associated with publications on schistosomiasis. The size of the annual circle in the map indicates the co-citation frequency. The size of the purple area outside the circle ring indicates the centrality. Larger purple areas indicate that the journal has a higher number of co-citations with other journals. (The interpretation of the co-citation map in the following figure is basically the same as here).

Table 5
Top ten authors published in schistosomiasis and centrality rankings.

Rank	Counts	Author	Centrality	Author
1	172	Jürg Utzinger	0.70	David Rollinson
2	104	Donald P. Mcmanus	0.46	Xiaonong Zhou
3	102	Jennifer Keiser	0.37	Louis-Albert Tchuem Tchuenté
4	79	David Rollinson	0.36	Tom Pennance
5	76	Xiaonong Zhou	0.33	Narcis B. Kabatereine
6	71	Eliézer K. N'goran	0.33	Thewarach Laha
7	70	Jiaojiao Lin	0.31	Joanne P. Webster
8	69	Charles H. King	0.31	David W. Dunne
9	69	J. Russell Stothard	0.31	Bonnie L. Webster
10	63	Paul J. Brindley	0.27	Paul J. Brindley

Table 6
Top ten in terms of frequency and centrality for authors co-citation on schistosomiasis.

Rank	Co-citation counts	Author	Centrality	Author
1	1782	WHO	1.28	Jürg Utzinger
2	993	Peter J. Hotez	0.96	Shuhua Xiao
3	895	Bruno Gryseels	0.92	Jennifer Keiser
4	879	Peter Steinmann	0.86	M. J. Doenhoff
5	878	Charles H. King	0.86	D. Cioli
6	826	Daniel G. Colley	0.84	Livia Pica-Mattoccia
7	793	Jürg Utzinger	0.77	WHO
8	647	Neal Katz	0.71	Matthew Berriman
9	603	M. J. Doenhoff	0.61	Charles H. King
10	477	Edward J. Pearce	0.61	Yan Zhou

University of São Paulo are leaders in schistosomiasis research. According to the number of publications per author and comparison with the statistical results of Yang et al. (2010) in 2010, it was found that Jürg Utzinger of the Swiss Tropical and Public Health Institute has published the highest number of papers in the past decade and is still committed to schistosomiasis research. A further review of the literature published in recent years showed that Jürg Utzinger paid more attention to the epidemiology of schistosomiasis (Assaré et al., 2020; Kouadio et al., 2020).

Keywords are generally used to extract the core content of a publication and can reflect the topics studied in the literature. The increase in the frequency of keywords within a certain period of time is also an indicator of emerging trends in the field (Pei et al., 2019). The keyword co-occurrence analysis results showed the highest frequency of *schistosoma mansoni*, indicating that the study of *Schistosoma mansoni* has been a hot topic in recent years. *Schistosoma mansoni* is endemic in most African countries and causes a higher disease burden than other schistosome species in terms of prevalence and countries (Colley et al., 2014; Gryseels et al., 2006). Moreover, the effective control of *schistosomiasis mansoni* in Africa is important for the global elimination of schistosomiasis. As early as 2012, the WHO set a global strategy for control of schistosomiasis by 2020 and global elimination by 2025 (WHO, 2013). However, various conditions have prevented these goals from being achieved. For example, there are problems with the availability of praziquantel, which is currently the only effective drug for schistosomiasis, and prophylactic chemotherapy with praziquantel is of great significance for the control and elimination of schistosomiasis (Wang and Liang, 2015). However, difficulties in accessing praziquantel and reported low coverage in Africa have delayed efforts to eliminate schistosomiasis (Tchuem Tchuenté et al., 2017; Wells et al., 2020). Unfortunately, the COVID-19 pandemic has aggravated the situation (mondiale de la Santé and Organization, 2021). Furthermore, Chinese national programs for schistosomiasis control have suggested that a single praziquantel strategy is not enough to interrupt transmission, and multi-sectoral cooperation should be strengthened by different actors (Wang et al., 2021), such as veterinarians, livestock producers, health workers, political decision-makers, and different levels of government measures (Hong et al., 2022), so as to develop a One Health governance model. In our study, the research on schistosomiasis in the past 10 years

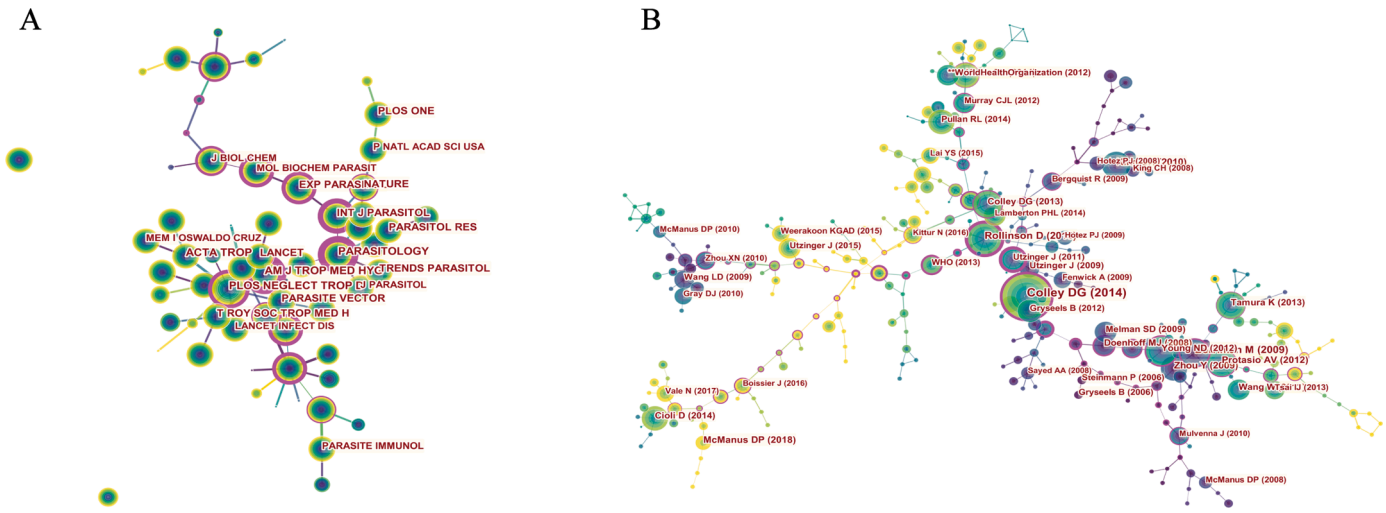

Fig. 5. (A) Journal co-citation map associated with publications on schistosomiasis. (B) Literature co-citation map associated with publications on schistosomiasis.

Table 7
Top ten journals in the field of schistosomiasis co-citation frequency.

Rank	Co-citation counts	Journal	IF (2020)
1	3720	PLoS Neglected Tropical Diseases	4.411
2	3185	Parasitology	3.234
3	3116	American Journal of Tropical Medicine and Hygiene	2.345
4	3113	Acta Tropica	3.112
5	2665	International Journal for Parasitology	3.981
6	2431	Lancet	79.321
7	2312	PLoS One	3.240
8	2225	Parasitology Research	2.289
9	2073	Trends in Parasitology	9.014
10	2010	Experimental Parasitology	2.011

Table 8
The top five disciplines that published on schistosomiasis.

Disciplines	Total Number of Papers
Parasitology	2842
Tropical Medicine	1868
Infectious Diseases	1201
Public, Environmental and Occupational Health	618
Immunology	565

mainly focused on treatment with praziquantel, epidemiology, and diagnosis, which also provides clues for future surveillance and evaluations of schistosomiasis. The 73rd World Health Assembly held in 2020 reintroduced a new global goal for elimination of schistosomiasis by 2030 (Group, 2019; WHO, 2020). Therefore, the achievement of the new global target requires countries to reassess progress in the area of schistosomiasis control, planning, and treatment strategies, as well as to evaluate treatment efficacy and appropriate resource allocation in the context of local epidemiological surveillance data. In addition to strengthening research on schistosomiasis elimination strategies, the keyword burst analysis also suggested that the study of schistosomiasis infection, host immunity, and the mechanism of schistosomiasis liver fibrosis are also hot topics for future research.

One Health is a global strategy that integrates the health of people, animals, and the environment, emphasizing multi-agency, interdisciplinary and cross-regional cooperation, and communication. Many factors hinder the elimination of schistosomiasis, including a variety of animal hosts, widespread snail habitats, frequent occurrences of floods, increased population mobilization, and transportation of goods (Hong et al., 2022). Applying the One Health concept to schistosomiasis control planning and research addresses complex health issues from a holistic perspective of human-animal-environment interactions.

According to the current study, the global COVID-19 pandemic has placed tremendous pressure on public health and healthcare systems, including all basic healthcare services (Abdela et al., 2020). Neglected tropical disease activities have been found to be among the most frequently and severely affected by the COVID-19 pandemic (Toor et al., 2021), proving even more serious in the year 2021 (Ahmed et al., 2022). The pandemic of 2019 novel coronavirus disease (COVID-19) resulted in the suspension of large-scale drug management programs and interrupted global vector control, which may have the potential to trigger a resurgence in certain parasitic diseases (Ehrenberg et al., 2020; Hollingsworth et al., 2021; Molyneux et al., 2020). It also raises concerns about the success of the roadmap to Neglected Tropical Diseases 2030. These issues are thus bound to attract extensive attention among scholars from various countries. China's success in the area of schistosomiasis control shows that the One Health concept is an important tool for schistosomiasis control. The bibliometric results also showed that human, animal, and environmental studies are crucial for controlling this disease, and our study also provides data which support schistosomiasis research in the post-pandemic era.

5. Conclusions

Our study provides a preliminary description of the current status of schistosomiasis research and an initial exploration of future research directions by constructing a knowledge map of schistosomiasis research networks using Citespace software. More importantly, this bibliometric analysis also provides strong theoretical and data support for identifying future research directions aimed at investigating the current status of tropical diseases research, which is often neglected. This study also highlights the importance of carrying out studies on the development and implementation of the One Health model for schistosomiasis prevention and control strategies.

Ethics approval and consent to participate

Not applicable.

Consent for publication

Not applicable.

Availability of data and materials

All data are included in the manuscript.

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CRediT authorship contribution statement

Qingkai Xue: Writing – review & editing, Project administration, Visualization, Data curation, Formal analysis. **Yao Deng:** Writing – review & editing, Data curation, Formal analysis. **Yiyun Liu:** Writing – review & editing, Data curation, Formal analysis. **Yuyan Wang:** Writing – review & editing, Data curation. **Wenjun Hu:** Writing – review & editing, Data curation. **Yuzheng Huang:** Writing – review & editing, Project administration, Visualization. **Kun Yang:** Writing – review & editing.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

All data in this article can be downloaded from the web of science database.

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