

## Global Analysis of Research on Opisthorchiasis Infection Caused by *Opisthorchis* spp.

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### ABSTRACT

This study investigated the existence of infections caused by opisthorchiasis and conducted a bibliometric analysis of its global trends. The main objective of this study is to analyse trends and cluster in this field among researchers in developed and developing countries by reviewing publications on opisthorchiasis around the world in order to develop effective control strategies. We searched the Web of Science (WOS) databases for studies published between 1980 and 2024 using the keywords '*Opisthorchis* spp and *Opisthorchis viverrini* and *Opisthorchis felinus* and opisthorchiasis.' Information like title, author names, year of publication, journal names and number of citations to journals were used for data collection. In the study, the software VOSviewer (ver.1.6.20) was used to visualize literature data on a global level. This study aimed to make the results more understandable through analysis using text mining and data visualisation methods (bubble maps and graphs). In this study, information was provided on 1957 articles from the WOS databases and the references to these articles. The H-index is 90. It was then observed that the number of studies conducted after 2005 increased. It was reported that most of the published articles (40%) were in the field of parasitology. Thailand (50%), USA (13%) and Japan (10%) are the countries that publish the most articles on this topic. Most published articles are in the international SCI-Expanded category (93%). The results of this bibliometric study reveal global trends in opisthorchiasis and provide important information for future research directions in this field. This study is the first bibliometric analysis of opisthorchiasis.

**Keywords:** Bibliometrics, *opisthorchis felinus*, *opisthorchis viverrini*

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## *Opisthorchis* spp'nin Neden Olduğu Opisthorchiasis Enfeksiyonuna İlişkin Araştırmaların Küresel Analizi

### ÖZ

Bu çalışma, opisthorchiasis'in neden olduğu enfeksiyonların varlığını araştırmış ve küresel eğilimlerinin bibliyometrik bir analizini yapmıştır. Bu çalışmanın temel amacı, etkili kontrol stratejileri geliştirmek, dünya çapında opisthorchiasis ile ilgili yayınları gözden geçirerek gelişmiş ve gelişmekte olan ülkelerdeki araştırmacılar arasında bu alandaki eğilimleri ve grupları analiz etmektir. Bu amaçla 1980-2024 yılları arasında yayınlanmış çalışmalarını Web of Science (WOS) veri tabanlarında '*Opisthorchis* spp., *Opisthorchis viverrini*, *Opisthorchis felinus* ve opisthorchiasis' anahtar sözcüklerini kullanarak arama yapılmıştır. Verilerin toplanmasında başlık, yazar isimleri, yayın yılı, dergi adı ve atıf sayısı gibi bilgiler kullanılmıştır. Çalışmada, literatür verilerini küresel düzeyde görselleştirmek için VOSviewer (ver:1.6.20) yazılımı kullanılmıştır. Bu çalışma, metin madenciliği ve veri görselleştirme yöntemlerini (kabarık haritaları ve grafikler) kullanarak analiz yoluyla sonuçları daha anlaşılır hale getirmeyi amaçlamıştır. Bu çalışmada, WOS veri tabanlarından 1957 makale ve bu makalelere yapılan atıflar hakkında bilgi verilmiştir. H-index'i 90'dır. 2005 yılından sonra yapılan çalışmaların sayısının arttığı gözlemlenmiştir. Yayımlanan makalelerin çoğunun (%40) parazitoloji alanında olduğu bildirilmiştir. Tayland (%50), ABD (%13) ve Japonya (%10) bu konuda en çok makale yayınlayan ülkelerdir. Yayımlanan makalelerin çoğu uluslararası SCI-Expanded kategorisindedir (%93). Bu bibliyometrik çalışmanın sonuçları opisthorchiasis konusundaki küresel eğilimleri ortaya koymakta ve bu alanda gelecekte yapılacak araştırmalar için önemli bilgiler sağlamaktadır. Bu çalışma opisthorchiasis'in ilk bibliyometrik analizidir.

**Anahtar kelime:** Bibliyometrik, *opisthorchis felinus*, *opisthorchis viverrini*

To cite this article: Afşar M, Yıldız R, Elasan S. Global Analysis of Research on Opisthorchiasis Infection Caused by *Opisthorchis* spp. Kocatepe Vet J. (2024):17(3):214-220

Submission: 21.06.2024 Accepted: 27.08.2024 Published Online: 04.09.2024

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## INTRODUCTION

Opisthorchiasis caused by *Opisthorchis viverrini* (*Distomum sibiricum*) and *Opisthorchis felineus* (*Distoma felineum*), which have an important place in the list of food-borne trematodes, is a common zoonotic infection among dogs in endemic areas and many other fish-eating mammals, including humans. Infections caused by *O. felineus* are particularly prevalent in Siberia, East and South-East Asian countries and some European countries, and maintain their place among the trematodes that affect public health on a daily basis (Petney et al., 2013; FAO/WHO, 2014; Pakharukova and Mordvinov, 2022).

It has been reported that infections caused by opisthorchiasis are common in people of low socioeconomic status. More than 700 million people are currently at risk from these fish-borne trematodes, while up to 40 million people are at direct risk of infection. Opisthorchiasis infections have been reported in people in Eastern European countries and in countries in Asia (particularly East and South-East Asia) where it is common. While the adult worms of *Opisthorchis* spp. cause serious complications in the bile ducts and hepatobiliary system, these trematodes (*Opisthorchis* spp.) are known to be a major cause of liver and bile duct cancer (Hotez et al., 2007; IARC, 2012; Petney et al., 2013; FAO/WHO, 2023).

Two intermediate hosts are required in the parasite's life cycle. The first is the water snail *Bithynia leachi*, and the second is the intermediate host of various species of freshwater fish in the family *Cyprinidae*. Eggs excreted with the faeces of the final host develop in the body of the intermediate host and become cercariae. The cercariae leave the first intermediate host, then the cercariae penetrate the skin of the second intermediate host, the freshwater fish, settle in the muscles and become metacercariae, the infective form of their final host. Infection begins when fish with these metacercariae are consumed raw or undercooked (Crellen et al., 2021; Grundy et al. 2012).

The aim of this analysis is to review the policies aimed at controlling the incidence of the disease in humans in countries where opisthorchiasis infection, which is of zoonotic importance, is widespread. When selecting bibliographic sources, we first evaluated studies aimed at finding differences in opisthorchiasis, especially climate, geographical location, life cycle, intermediate host range, disease morbidity, carcinogenicity, genome and transcriptome (Pakharukova and Mordvinov, 2022).

The WOS database was searched using the terms *Opisthorchis viverrini*, *Opisthorchis felineus*, *Opisthorchis* spp. and Opisthorchiasis. A total of 1957 studies were listed from 1980 to 2024.

## Data Collection

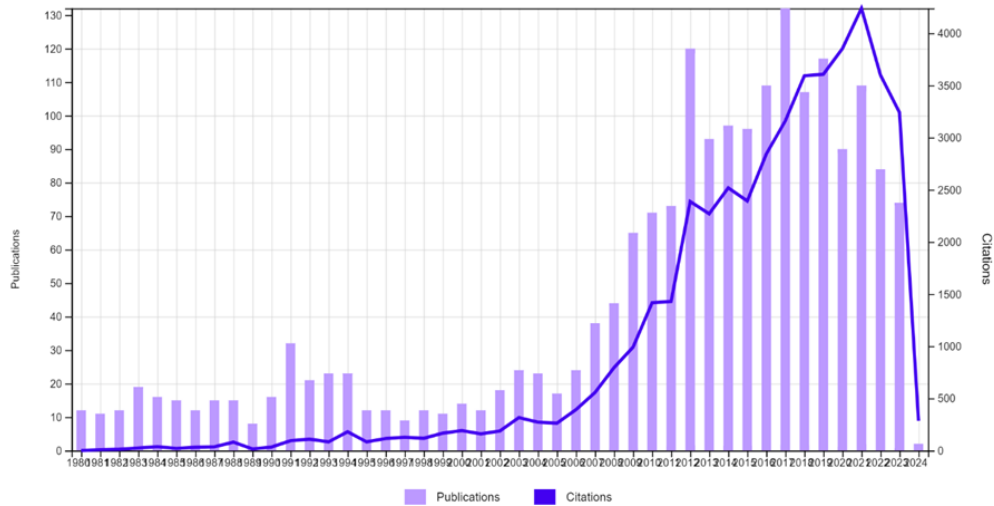
In this bibliometric study, the Web of Science Core Collection (WOS) databases were used to search for studies on the analysis of global trends in opisthorchiasis published between 1980 and 2024. Searches of the database using the keywords "*Opisthorchis* spp., *Opisthorchis viverrini*, *Opisthorchis felineus* and opisthorchiasis" yielded 1957 studies. The necessary analyses were carried out using information such as the articles in the database, the title of the article, the names of the authors, the year of publication, the name of the journal in which it was published and the number of citations. Entries and references were exported as plain text files and saved in download txt format. The data were obtained by using the online library and digital resources of Van Yüzüncü Yıl University. The search language is English.

## Data Analysis

In this bibliometric study, "Collaboration Network, Highlights and Future Trends" was analysed using VOSviewer to determine the global trends in the presence of opisthorchiasis and the major research topics in the field. VOSviewer places great importance on the graphical presentation of bibliometrics in general. It is especially useful for presenting large bibliometrics in an comprehensible way (Van E. 2010). Web of Science databases were used for systematic data collection, and all textual data of the publications included in the study were picking and analysed using VOSviewer software. We used VOSviewer software to prove country/region and institutional collaborations, author supports, and keyword analysis. We also used Microsoft Office Excel 2019 to assess trends. These analyses were performed using text mining and data visualisation (bubble maps and other graphical methods) to demonstrate the correctness and credibility of the study.

## RESULTS

A total 1957 published articles were inclusive in the search of the WOS database. The articles had a total of 27166 citations (23670 citations excluding self-citations). The H-index is 90. In particular, since 2005 there has been an upward trend in both the number of citations to articles and the number of articles. The distribution of publications and citations is shown in Figure 1. When examined based on the bibliometric network across research fields, it is evident that publications in the field of parasitology are among the largest and most interconnected research areas (Figure 2).



**Figure 1:** Frequency of publications and quotes by year

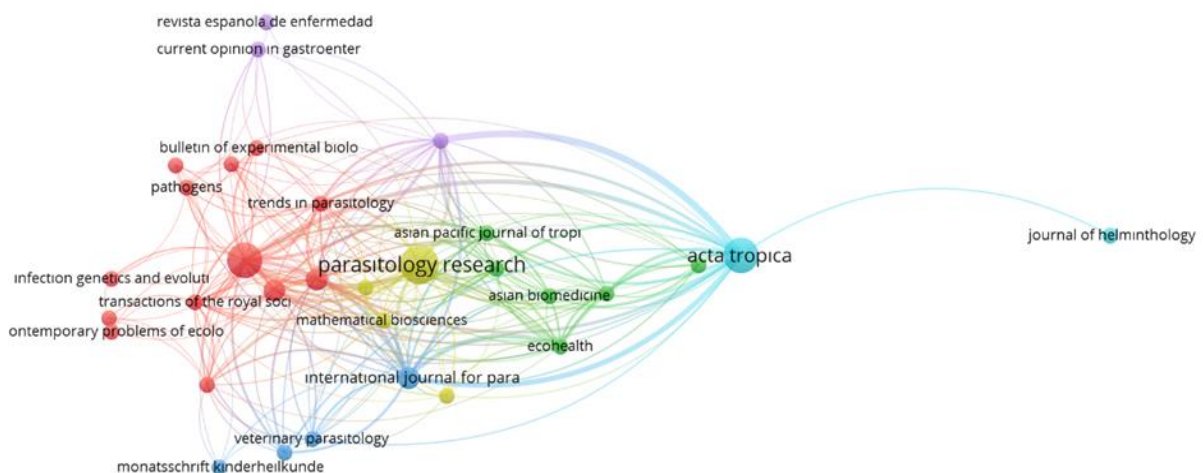
The highest number of articles were published in the fields of Parasitology (40.6%), Tropical Medicine (20.3%), Infectious Diseases (10.5%) and Oncology

(10.3%), respectively. The distribution of the top ten publications according to the research field is shown in Table 1.

**Table 1.** Categories of publication areas that are related to *Opisthorchis* spp.

Research Areas	Record Count	% of 1.957
Parasitology	796	40.6
Tropical Medicine	398	20.3
Infectious Diseases	206	10.5
Oncology	202	10.3
Public Environmental Occupational Health	200	10.2
Biochemistry Molecular Biology	95	4.8
General Internal Medicine	91	4.6
Gastroenterology Hepatology	90	4.6
Veterinary Sciences	79	4.0
Immunology	76	3.9

Showing 10 out of 75 entries



**Figure2:** Bibliometric network by research fields.

Thailand ranked first in terms of number of articles published (n=1028; 52.5%), followed by the USA (n=260; 13.3%), Japan (n=204; 10.4%) and Russia

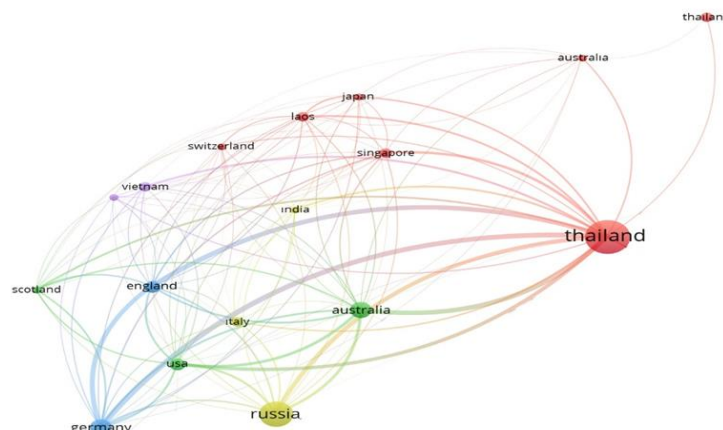
(n=204; 10.4%). The top 25 countries in this ranking are listed in Table 2.

**Table 2.** Countries with at least 30 publications

Countries/Regions	Record Count	% of 1.957
Thailand	1028	52.5
Usa	260	13.3
Japan	204	10.4
Russia	204	10.4
Australia	201	10.3
Germany	127	6.5
England	123	6.3
Peoples R China	120	6.1
South Korea	113	5.8
Switzerland	105	5.4
Laos	103	5.3
Ussr	64	3.3
Vietnam	59	3.0
Canada	44	2.3
Singapore	39	2.0
France	37	2.0
Spain	36	1.8
Italy	33	1.7
Denmark	32	1.6
India	28	1.4
Cambodia	22	1.1
Netherlands	22	1.1
Scotland	17	0.9
Belgium	16	0.8
Czech Republic	14	0.7

When Bibliographic coupling is evaluated by country, it is seen that Thailand, the USA, Japan and Russia

have a greater representation among the prominent countries in this field (Figure 3).



**Figure 3:** Citation network visualisation map among countries with publications on *Opisthorchis* spp. (The relatedness of items was determined based on the number of references the share)

During the evaluation of the priority status of the universities and research institutions in terms of the number of publications, the leading institutions were Khon Kaen University (37.6%), Mahidol University

(11.6%) and the Russian Academy of Sciences (7.0%). Accordingly, the top 10 leading institutions are shown in Table 3 according to their affiliations (Table 3).

**Table 3.** List of the top affiliations

Affiliations	Record Count	% of 1.957
Khon Kaen University	737	37.6
Mahidol University	227	11.6
Russian Academy Of Sciences	138	7.0
George Washington University	104	5.3
University Of Basel	95	4.8
Swiss Tropical Public Health Institute	94	4.8
Maharakham University	83	4.2
Institute of Cytology and Genetics of SB RAS	82	4.2
Siberian State Medical University	76	3.9
James Cook University	69	3.5

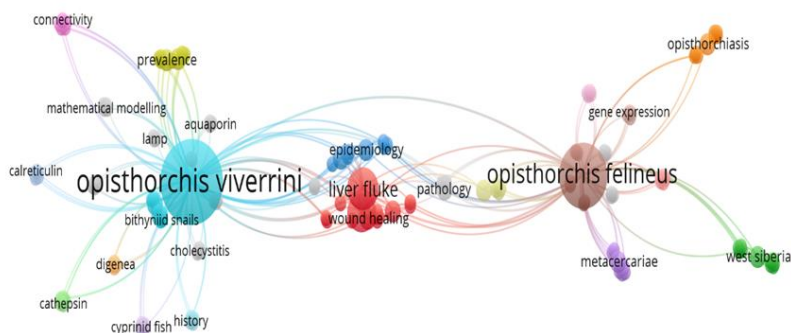
When we look at the Web of Science indexes, it is seen that the majority of the articles are in the Science Citation Index Expanded (SCI-Expanded) category

(93%), followed by Emerging Sources Citation Index (ESCI) (4.9%) and Conference Proceedings Citation Index. (CPCI-S) (3.0%) (Table 4).

**Table 4.** Web of Science Categories Index

Web of Science Index	Record Count	% of 1.957
SCI-EXPANDED	1822	93.0
ESCI	95	4.9
CPCI-S	59	3.0
BKCI-S	57	2.9
SSCI	28	1.4
A&HCI	4	0.2
Index Chemicus (IC)	3	0.15
CPCI-SSH	1	0.05

When analysing the selected keywords, keywords such as *Opisthoris viverrini* and *Opisthoris felinus* are among the largest and most linked topic areas (Figure 4).



**Figure 4:** Keyword analysis (Shows which keywords the topic is associated with and how often those keywords are used).

## DISCUSSION

These food-borne zoonotic trematode infections are a major public health problem in Asian countries, including Vietnam, Thailand, China and Korea. Fish-borne trematodes, in particular, cause significant morbidity in local populations and serious damage to the aquaculture industry. Almost all fish-borne trematode infections in humans are due to the habit of eating raw fish that comprise infective larvae (Andrews *et al.*, 2008; Chai *et al.*, 2014; Sakamoto *et al.*, 2023).

These infections are particularly common in riverine areas and in communities where raw fish is consumed. Riparian areas in Southeast Asia, particularly the Mekong River basin in Vietnam, China and Thailand, are known to have a very high incidence of fish-borne trematode infections (Suwannatrai *et al.*, 2018; Sripa *et al.*, 2021; Sakamoto *et al.*, 2023). This trematode is most prevalent in Thailand, which therefore has one of the highest incidences of cholangiocarcinoma (CCA), a cancer associated with opisthorchiasis, in the world (Rachprakhon *et al.*, 2021; Sripa *et al.*, 2021).

The purpose of bibliometric studies is both to guide scientific research and to show the current state of a scientific subject. There are many valuable studies on *Opisthorchis* in the scientific world. It will guide scientists who want to do more research on these topics (Maciver *et al.*, 2020).

The target of this bibliometric study is to investigate the role of *Opisthorchis viverrini* and *Opisthorchis felineus* in opisthorchiasis infection and to show the global increase in the prevalence of scientific publications on the studies performed. The aim of the studies is to identify global trends and clusters in the investigation of the presence of *Opisthorchis* spp in patients diagnosed with opisthorchiasis, and to publish them in the form of a report on the areas in which research in this field is focused and in which countries it is most prevalent. In addition, important journals, authors and studies in this field were identified, and it was pointed out that they can take into account the existing deficiencies in this field and lead to future studies.

The search using the terms "*Opisthorchis viverrini* and *Opisthorchis felineus* and opisthorchiasis" in the WOS database yielded a total of 1957 studies. The articles had a total of 27166 citations (23670 citations excluding self-citations). The H-index is 90. Specially since 2005, both the number of citations and the number of articles show an increasing trend (Figure 1).

Search the WOS database search engine for '*Opisthorchis viverrini*, *opisthorchis felineus*, *opisthorchis* spp.' By typing the terms 'and opisthorchiasis', studies conducted from 1975 to 2023 were scanned, and as a result of the scanning, 1957 articles were reached. It was determined that very few studies were conducted on opisthorchiasis from 1975

to 2000, and more publications were made after 2005, and the most studies were conducted after 2017. It has been reported that almost half (40%) of the articles published on Opisthorchiasis are in the field of Parasitology. The countries with the most publications were determined to be Thailand (50%), USA (13%) and Japan (10%), respectively (Table 1, Figure 2, Table 2).

The analysis of the most searched keywords in the subject areas showed that *Opisthorchis viverrini* and *Opisthorchis felineus* were the most common. Among the universities and research institutions that researched the prevalence of this trematode, the most researched were Khon Kaen University (37.62%) and Mahidol University (11.58%), and the most researched institution was the Russian Academy of Sciences (47.04%) (Figure 3, Table 3).

When analysing the keywords selected for detailed scanning in the WOS database, keywords such as *Opisthorchis viverrini* and *Opisthorchis felineus* are among the largest and most linked subject areas (Figure 3).

## CONCLUSION

The most commonly used keywords for opisthorchiasis are *Opisthorchis viverrini* and *Opisthorchis felineus*, the most studied field is parasitology and the most studied country is Thailand. It has been reported that one of the reasons for its prevalence in this country is the consumption of raw freshwater fish. In order to improve effectual control strategies in the fight against opisthorchiasis, it would be useful for researchers and scientists in developed countries to establish research collaborations that will ensure the success of control and eradication programmes against this infection in Siberia, East and South-East Asia and some European countries where the disease is found.

Conflict of interest: The authors have no conflicts of interest to report.

Authors' Contributions: MA and SA contributed to the project idea, design and execution of the study. RY and MA contributed to the acquisition of data. RY and SA analysed the data. MA and RY drafted and wrote the manuscript. SA and MA reviewed the manuscript critically. All authors have read and approved the finalized manuscript.

**Ethical approval:** Since it was a bibliometric study, no ethical report was received. This study is not subject to the approval of HADYEK in according to the Regulation on Working Procedures and Principles of Animal Experiments Ethics Committees 8 (k). The data, information and documents presented in this

article were obtained within the framework of academic and ethical rules.

**Limitations:** Our study is the first bibliometric analysis of published studies of people with opisthorchiasis infection. As WOS is one of the most commonly used databases for bibliometric analysis, the data for our study were only obtained from WOS. Therefore, it is possible that publications found in other search engines but not in the Scopus database may have been overlooked. Our results must be interpreted with this limitation in mind.

**Acknowledgments:** This research has not received any specific grant from any funding body in the public, commercial or not-for-profit sectors.

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