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## Original article

# Bibliometric analysis on infective endocarditis

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## ABSTRACT

**Introduction:** Although infective endocarditis (IE) is rare disease, this disease has importance due to its high morbidity and mortality rates. The exact incidence is not known as it is not a reportable disease. Unlike developed countries, the disease affects the young more than the elderly in developing countries. Most of the time, the diagnosis cannot be made at the first examination and the disease is often overlooked. In order to reduce the mortality and morbidity of this disease, it is important to quickly recognize the disease by following current diagnosis and treatment methods, to identify the causative agent and to treat accordingly. Both the epidemiology and the management of IE are changing due to medical advances. This situation may also be reflected in scientific publications. We aimed to analyze the global researches on IE. **Material and methods:** The Scopus database was searched for bibliometric analysis without selecting document type. Data were retrieved for the time period January 1, 1940 and September 26, 2021, containing the keywords "Infective" and "endocarditis" in their title.

**Results:** 7911 publications were included in the study. The first publication was made in the year 1891. Most of the publications were research articles [n=5784 (73.11%)] and were from the United States of America (USA) [n=1622 (20.50%)]. Japan, France, United Kingdom and Spain were also in the top 5 publishing countries on IE.

**Conclusions:** Infective endocarditis is still an important reason of mortality, and there are many unanswered questions about the management and prevention of this disease. This situation reflected the scientific publications. Since this is a global problem, not just some developed countries involved in the IE research, also more countries should be encouraged to participate the studies on IE.

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## Análisis bibliométrico sobre endocarditis infecciosa

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### RESUMEN

**Introducción:** Si bien la endocarditis infecciosa (EI) es una enfermedad rara, esta enfermedad tiene importancia por sus altas tasas de morbilidad y mortalidad. No se conoce la incidencia exacta ya que no es una enfermedad de notificación obligatoria. A diferencia de los países desarrollados, la enfermedad afecta más a los jóvenes que a los ancianos en los países en desarrollo. La mayoría de las veces, el diagnóstico no se puede hacer en el primer examen y la enfermedad a menudo se pasa por alto. Para reducir la mortalidad y morbilidad de esta enfermedad, es importante reconocer rápidamente la enfermedad siguiendo los métodos de diagnóstico y tratamiento actuales, para identificar el agente causal y tratar en consecuencia. Tanto la epidemiología como el manejo de la EI están cambiando debido a los avances médicos. Esta situación también puede verse reflejada en publicaciones científicas. Nuestro objetivo era analizar las investigaciones globales sobre la EI.

**Material y métodos:** Se buscó en la base de datos Scopus para el análisis bibliométrico sin seleccionar el tipo de documento. Se recuperaron datos para el período de tiempo del 1 de enero de 1940 y el 26 de septiembre de 2021, que contenían las palabras clave "Infeccioso" y "Endocarditis" en su título.

**Resultados:** Se incluyeron 7911 publicaciones en el estudio. La primera publicación se realizó en el año 1891. La mayoría de las publicaciones fueron artículos de investigación [n = 5784 (73,11%)] y fueron de los Estados Unidos de América (EE.UU.) [n = 1622 (20,50%)]. Japón, Francia, Reino Unido y España también se encontraban entre los 5 principales países editores en la EI.

**Conclusiones:** La endocarditis infecciosa sigue siendo una causa importante de mortalidad y hay muchas preguntas sin respuesta sobre el manejo y prevención de esta enfermedad. Esta situación reflejó las publicaciones científicas. Dado que este es un problema global, no solo algunos países desarrollados involucrados en la investigación de EI, también se debe alentar a más países a participar en los estudios sobre EI.

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## 1. INTRODUCTION

Infective endocarditis (IE) is defined as infection of heart valves (natural or prosthetic), mural endocardium and intracardiac (CI) devices (permanent pacemakers and/or defibrillators). Although it is rare (3-10/100,000 cases), mortality rates are high. Commonly causative microorganisms are streptococcus, staphylococci and enterococci [1, 2]. Despite advances in diagnosis and treatment, in-hospital mortality rate is about 20%. According to the clinical situation and the causative microorganism, more than 1/3 of the patients die within a year. Today, IE patients are older and have more comorbidities compared to patients in previous years. Again, an increase in IE cases associated with health-care and CI device associated. The causative microorganisms are more pathogenic and have multiple antibiotic resistance [2]. In order to reduce the mortality and morbidity of this disease, cardiological examinations of the disease

(transthoracic echocardiography / transesophageal echocardiography) should be performed quickly. It is critical to identify the causative microorganism and to administer antibiotic therapy for the causative agent. However, most of the patients cannot be diagnosed at their first application, the diagnosis can be made after 3 months in about half of them, and the disease is often overlooked. Patients with IE can be followed by specialist physicians from many different branches [3].

IE occurs much more frequently, in men (60-70%), in the elderly, in patients with underlying heart valve disease, underlying chronic renal failure, hemodialysis patients, solid organ or hematopoietic stem cell transplantation patients [2, 3].

The management of patients with IE always adheres to current recommendations. In order for it to be carried out appropriately, it is necessary to ensure that every diagnosis and treatment process of IE is carried out needs to be standardized [3].

In summary, both the epidemiology and the management of

IE are constantly changing due to medical advances. Continuously updated diagnostic and treatment guidelines provide tailored advice on disease management [3, 4]. This situation may also be reflected in scientific researches. With this study we aimed to analyze the global researches on IE.

## 2. MATERIALS AND METHODS

Bibliometric data analysis method was used in this study to analyze publications on IE. Studies on IE were analyzed according to publication years, authors and institutions, themes, citations, keywords, funding institutions, methods and samples.

The Scopus database was searched for bibliometric analysis without selecting document type. Data were retrieved for the time period January 1, 1940 and September 26, 2021, containing the keywords "infective" and "endocarditis" in their title. The searches were performed on a single day September 26, 2021 to avoid bias as the database has daily updates. Duplications were included in the review only once. The obtained data were analyzed in the Excel forms created by the researchers. The data analyzed with both quantitative and qualitative methods.

As it is intended to add a general perspective on IE, only top rated countries, affiliations and authors were analyzed in details.

Canakkale On Sekiz March University's online library and digital resources were used to access information.

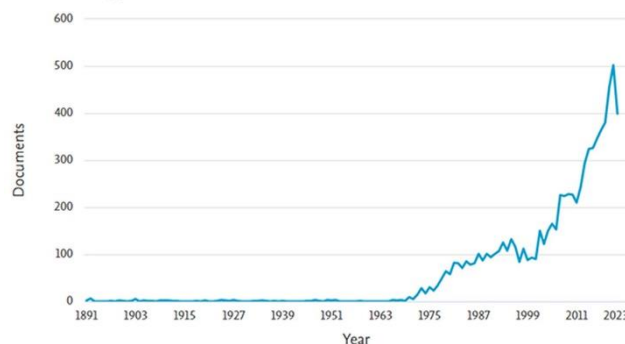
### 2.1. ETHICAL APPROVAL

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.

## 3. RESULTS

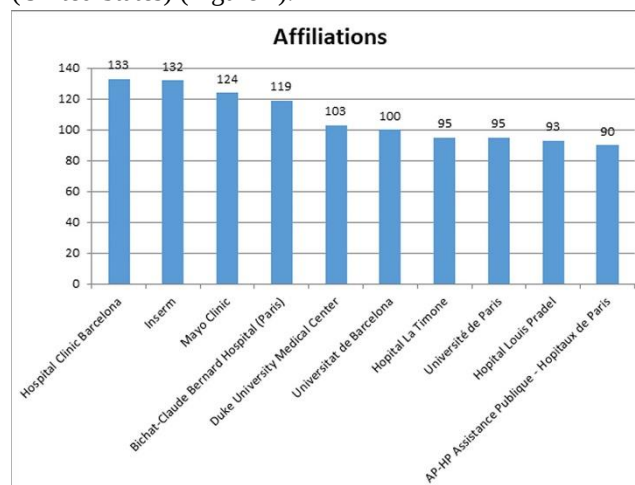
We reached totally 7911 publications on IE in the Scopus database, and the first publication was made in the year 1891 (Figure 1). Most of the publications were research articles [n=5784 (73.11%)] and reviews [n=745 (9.41%)]. Most of the publications were in the field of medicine [n=7455(%)]. Most of the publications [n= 6474(81.83%)] were written in English language. Most of the documents were from the United States of America (USA) [n=1622 (20.50%)]. Japan, France, United Kingdom and Spain were also in the top 5 publishing countries on IE (Table 1). Turkey was ranked 8<sup>th</sup>. Publications were from more than 100 countries globally. The number of documents has increased in last twenty years

and almost half of the articles were published after the 2000s (Figure 1).



**Figure 1:** Number of documents per year.

Most of the publications were from Hospital Clinic Barcelona (Spain), Inserm (France) and Mayo Clinic (United States) (Figure 2).



**Figure 2:** Number of documents according to productivity of top 10 affiliations on infective endocarditis research.

2648 (33.47%) of the articles were published in open access (AE) (Open Access) journals. The highest number of articles on IE were published in the journals of European Heart Journal.

[n=133 (1.68%)], International Journal of Cardiology [n=132 (1.66%)], Kyobu Geka The Japanese Journal of Thoracic Surgery [n=123 (1.55%)], American Journal Of Cardiology [n=113 (1.42%)] and Clinical Infectious Diseases [n =106 (1.33%)].

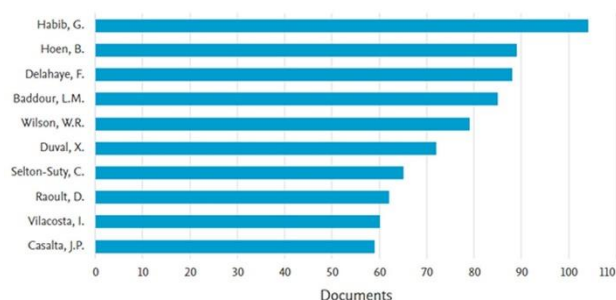
Top three funding sponsors were National Institutes of Health [n=142 (1.79%)], U.S. Department of Health and Human Services [n=108 (1.36%)] and National Institute of Allergy and Infectious Diseases [n=53(0.66%)].

Gilbert Habib from France, was the most productive author on IE with 104 articles. Also Bruno Hoën from France was at the 2<sup>nd</sup> and François Delahaye from France was at the third place in the ranking. In summary, the top 3 ranked authors were from France (Figure 3).

**Table 1. The document counts for up to top 10 ranked countries (n=7911)**

| Country        | Number of publications | Frequency |
|----------------|------------------------|-----------|
| United States  | 1622                   | 20.50     |
| Japan          | 771                    | 9.74      |
| France         | 636                    | 8.03      |
| United Kingdom | 588                    | 7.43      |
| Spain          | 535                    | 6.76      |
| Italy          | 373                    | 4.71      |
| Germany        | 329                    | 4.15      |
| Turkey         | 215                    | 2.71      |
| China          | 212                    | 2.67      |
| India          | 189                    | 2.38      |

The study of Li JS, from USA was the top cited document with 2529 cites (Table 2).



**Figure 3: Documents by top 10 authors.**

## 4. DISCUSSION

Infective endocarditis is defined as the infection of the inner surface of the heart valves and is a disease whose results are feared especially in the field of cardiology and infectious diseases. Mortality rates are still quite high, despite advances in medicine. To prevent the development of this disease, prophylactic antibiotic treatments may be required for patients who will undergo some invasive procedures and those with underlying valve disease. It is heterogeneous in terms of etiology, clinical manifestations and course of the disease. In fact, in some patients, medical treatments may be insufficient so patients may require surgery. Longstanding debates such as the timing of this surgery or the role of antibiotic prophylaxis remain unresolved [5, 6].

Infective endocarditis is a disease that can be fatal if not diagnosed and treated appropriately and it has been known since the end of the 1800s [4]. Many disciplines work together in the management of this disease. The first

guidelines on the management of this complex disease have been available in the medical literature since the 1980s. The first endocarditis guideline was published from Germany [7]. With this study we aimed the analyse of the publications on IE. Although many bibliometric analyzes have been made in the field of cardiology, no similar study has been found in the available literature regarding our study [8-10]. The Web of Science Core Collection (WoSCC) and Scopus databases are frequently used databases in bibliometric analysis. With this analysis method, publications can be analyzed using many methods such as visualization, citation analysis, mapping techniques [10-12]. Ready-to-use databases can be used, as well as database mining can be preferable. With this quantitative method, parameters such as the the leading country in a topic, authors, publication years, and contents of the publications [8-14]. We conducted a bibliometric study with the Scopus database, as it is the widest range on publications.

According to the Pubmed Medline search results, it was determined that the first publication on IE was published in the year 1848. While the publications on IE remained stagnant until the 1950s, a rapid increase was observed afterwards. Especially after the 1980s, the number of publications on IE did not fall below 500/year/publication [15]. In our study, it was determined that there was an increase in the number of publications after the year 1975 and the first publication was made in the year 1891. This may be due to the different journals take place in both databases.

In a bibliometric study, in which the 100 most cited articles in the field of cardiology were evaluated, it was found that most of the publications were published in the USA [8]. Our findings were similar. But, an interesting finding of our study was that, although the most of the publications were published from the USA, when evaluated on the basis of authors the first 3 ranked authors were from France.

The most cited journal with 100 articles was Circulation with 36, followed by the European Heart Journal with 28 in Shuaib's study [8]. But in our study, the most cited publications were Clinical Infectious Diseases, The American Journal of Medicine, and the European Heart Journal. This may be related to the fact that IE is a subject that also concerns the field of infectious diseases.

The difference in publications and reports for IE may have been caused by the use and availability of additional modalities used in the diagnosis of the disease. There are many modalities that can be used in the diagnosis of IE. Echocardiography is very useful in diagnosing IE and detecting complications. Echocardiography has 75% sensitivity and 90% specificity in detecting vegetations [16].

Multislice computed tomography is useful in imaging prosthetic valve abscess, pseudoaneurysm and fistula where echocardiographic imaging is insufficient [17]. In recent years, single-photon emission computed tomography (SPECT/CT) and positron emission tomography (PET/CT) have been used in the diagnosis of endocarditis [18, 19]. The sensitivity of Duke criteria in prosthetic valve and intracardiac device-related infections is low, and these new imagings are very useful [20].

Death is observed in one fifth of the patients hospitalized with the diagnosis of endocarditis [21, 22]. Early diagnosis

and treatment are important in line with current recommendations due to prosthetic valve, advanced age and additional diseases that adversely affect the prognosis [23].

## 5. CONCLUSIONS

In fatal endocarditis, preventive measures should be followed and new imaging methods should be used adequately in the diagnosis. Early diagnosis and treatment with a multidisciplinary approach by forming an

**Table 2: Citing analysis of the top cited 10 documents**

| Document title                                                                                                                                                                                                                                                                                                                                                                                                                                       | Authors; Year; country                 | Source                                      | Cited by |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------|---------------------------------------------|----------|
| <b>Proposed modifications to the Duke criteria for the diagnosis of infective endocarditis</b>                                                                                                                                                                                                                                                                                                                                                       | Li JS et al; 2000; USA                 | Clinical Infectious Diseases                | 2529     |
| <b>New criteria for diagnosis of infective endocarditis: utilization of specific echocardiographic findings</b>                                                                                                                                                                                                                                                                                                                                      | Durack DT et al; 1994; USA             | The American Journal of Medicine            | 2075     |
| <b>2015 ESC Guidelines for the management of infective endocarditis: The Task Force for the Management of Infective Endocarditis of the European Society of Cardiology (ESC). Endorsed by: European Association for Cardio-Thoracic Surgery (EACTS), the European Association of Nuclear Medicine (EANM).</b>                                                                                                                                        | Habib G, et al.; 2015; France.         | European Heart Journal                      | 2018     |
| <b>Prevention of infective endocarditis: guidelines from the American Heart Association: a guideline from the American Heart Association Rheumatic Fever, Endocarditis, and Kawasaki Disease Committee, Council on Cardiovascular Disease in the Young, and the Council on Clinical Cardiology, Council on Cardiovascular Surgery and Anesthesia, and the Quality of Care and Outcomes Research Interdisciplinary Working Group</b>                  | Wilson W et al.; 2007; USA             | Circulation                                 | 1695     |
| <b>Practice Guidelines. Guidelines on the prevention, diagnosis, and treatment of infective endocarditis (new version 2009): the Task Force on the Prevention, Diagnosis, and Treatment of Infective Endocarditis of the European Society of Cardiology (ESC). Endorsed by the European Society of Clinical Microbiology and Infectious Diseases (ESCMID) and the International Society of Chemotherapy (ISC) for Infection and Cancer.</b>          | Habib G et al.; 2009; France.          | European Heart Journal                      | 1529     |
| <b>Infective endocarditis: diagnosis, antimicrobial therapy, and management of complications: a statement for healthcare professionals from the Committee on Rheumatic Fever, Endocarditis, and Kawasaki Disease, Council on Cardiovascular Disease in the Young, and the Councils on Clinical Cardiology, Stroke, and Cardiovascular Surgery and Anesthesia, American Heart Association: endorsed by the Infectious Diseases Society of America</b> | Baddour LM, et al. 2005, USA           | Circulation                                 | 1274     |
| <b>Clinical presentation, etiology, and outcome of infective endocarditis in the 21st century: the International Collaboration on Endocarditis-Prospective Cohort Study</b>                                                                                                                                                                                                                                                                          | Murdoch DR, et al.; 2009, New Zealand  | Archives of Internal Medicine               | 1257     |
| <b>Infective Endocarditis in Adults: Diagnosis, Antimicrobial Therapy, and Management of Complications: A Scientific Statement for Healthcare Professionals From the American Heart Association</b>                                                                                                                                                                                                                                                  | Baddour LM, et al.; 2015; USA          | Circulation                                 | 1158     |
| <b>Infective endocarditis in adults</b>                                                                                                                                                                                                                                                                                                                                                                                                              | Mylonakis E, Calderwood, SB; 2001; USA | New England Journal of Medicine             | 1004     |
| <b>Changing profile of infective endocarditis: results of a 1-year survey in France</b>                                                                                                                                                                                                                                                                                                                                                              | Hoën B, et al.; 2002; France           | Journal of the American Medical Association | 768      |

endocarditis team will positively affect the prognosis. Infective endocarditis is still an important reason of mortality, and there are many unanswered questions about the management and prevention of this disease. This situation reflected the scientific publications. Since this is a global problem, not just some developed countries involved in the IE research, also more countries should be encouraged to participate the studies on IE.

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