

Analysis of Publications on *Acinetobacter*: A Scopus Database Search Study

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Abstract

Aim: We aimed to review the global literature on *Acinetobacter*, which is a global health problem, and identify and characterize the publications to direct scientific studies.

Material and methods: We conducted a bibliometric analysis by searching the Elsevier' Scopus database. This database is one of the biggest international bibliometric database. We searched original research articles from this database using the keywords "*Acinetobacter*" or "*Acinetobacter spp.*" and "Article" since July 05, 2021. We carried out detailed analysis to identify the characteristics of articles by using the bibliometric data analysis technique. The articles were analyzed due to the following characteristics: the country of origin, authors' names and affiliations, year of publication, content, number of citations and impact factor.

Results: The total number of publication on *Acinetobacter* were 35587 and the first publication was published in the year 1974. 30074 of these studies were research articles. Only research articles were evaluated in our study. There was a rapid increase in the number of articles after the year 2000 and the number of articles did not decrease until 2020 over the years. There was a decrease in the number of published articles in the year 2020. The majority of the articles (n=26862, 89.31%) were written in the English language. Chinese was the second most preferred language. The most scientifically productive countries on *Acinetobacter* literature were the United States, China and India. Ronald N Jones (n=174) from the USA and Harald Seifert (n=114) from Germany were the most productive authors on *Acinetobacter* research.

Conclusion: As a result, both the number of articles on *Acinetobacter* and the number of citations were quite high. Since the *Acinetobacter* genus is one of the most important pathogens in hospital infections, it seems that researchers will continue to work on this topic.

Key words: *Acinetobacter*, bibliometric analysis, Scopus

Introduction

Acinetobacter genus is Gram-negative, double or chained cocci or coccobacilli, non-spore-forming, sometimes encapsulated, aerobic, oxidase-negative, catalase-positive bacteria [1,2]. There are difficulties in treatment, especially because they have multiple antibiotic resistance and cause hospital infections, especially in intensive care units, globally. It has been shown that there are 12 different genomic types in its taxonomic classification. There are 49 species in the genus *Acinetobacter*. The clinically important species are *A. calcoaceticus*- *A. baumannii* (genomic

strain 2), *Acinetobacter* nosocomial (genomic strain 13TU), *Acinetobacter pittii* (genomic strain 3), and *A. calcoaceticus* (genomic strain 1), which are clinically important species [2,3]. *A.baumannii* complex (ABC) cannot be distinguished biochemically. *Acinetobacter* spp. is the most common cause especially in hospital-acquired pneumonia and bloodstream infections and their antibiotic resistances rates increase over the years (41%, 36%) [1-5].

Although *Acinetobacter* species are generally considered as pathogens with low virulence, that group bacteria have multiple virulence factors. It emerges as

an opportunistic pathogen that causes nosocomial infections with severe clinical manifestations, especially in patients with underlying disease and various risk factors [6]. Factors such as prolonged use of antibiotics, prolonged hospitalization in the hospital and especially in the intensive care unit, long-term use of medical equipment such as catheters and implants, being connected to a ventilator, cardio-pulmonary disease, extensive burns, change in consciousness and immune system deficiencies are related attributable risk factors for *Acinetobacter* infections development. Among *Acinetobacter* species, *A. baumannii* are known as the most virulent species. Multivariate analyzes revealed that the mortality of *A. baumannii* infections is nine times higher than infections caused by other species [6,7]. *A. baumannii* is at the top of the list of 'resistant bacteria that urgently require new antibiotic discovery' due to the increasing resistance rates published by the World Health Organization in the year 2018 [8]. Due to the antimicrobial resistance problem, studies to elucidate the virulence factors and antibiotic resistance mechanisms of *A. baumannii* should continue without slowing down in order to treat *Acinetobacter* infections. It should not be forgotten that researches on the inhibition of virulence factors with different methods, especially molecular methods, new applications that can be an alternative to antibiotic treatment, researches to be carried out for the development of efflux pump inhibitors and antibiofilm agents are very valuable in terms of the control of infections and public health worldwide [9].

We aimed to review the world literature on *Acinetobacter*, which is a global health problem, and identify and characterize the publications to direct scientific studies. To our knowledge, our study is the first bibliometric research in the field of *Acinetobacter* by using the Scopus database.

Material and methods
Research model

In this study, bibliometric analysis method was used as a research model, which is one of the qualitative research method [10]. With this method, studies on a subject can be analyzed mathematically on the axis of various research parameters, including publication years, general characteristics, authors and institutions, keywords, funding institutions, citations, methods and samples [10].

The data of the study were obtained using the Elsevier Scopus bibliometric database, which is one of the main the international databases. This database, providing access to articles and references contained in these articles, allows it to search both forward and backward in time [10]. We searched original research articles from this database using the keywords "*Acinetobacter*" or "*Acinetobacter spp.*" and "Article" since July 05, 2021. Duplications were included in the study only once. The obtained data were analyzed in the Excel file created by the researcher.

Çanakkale Onsekiz Mart University's online library and digital resources were used to access information.

Data analysis

We carried out detailed analysis to identify the characteristics of articles by using the bibliometric data analysis technique. The articles were analyzed due to the following characteristics: the country of origin, authors' names and affiliations, year of publication, content, number of citations and impact factor. Also statistical analyzes (frequency and percentage) were performed to analyse the publications by using Statistical Package for the Social Sciences (SPSS) for Windows Version 23.0 software

(SPSS Inc., Chicago, IL, USA). Data were reported as mean ± standard deviation values, number and percentage. Descriptive statistics were used in the statistical evaluation.

Ethics committee

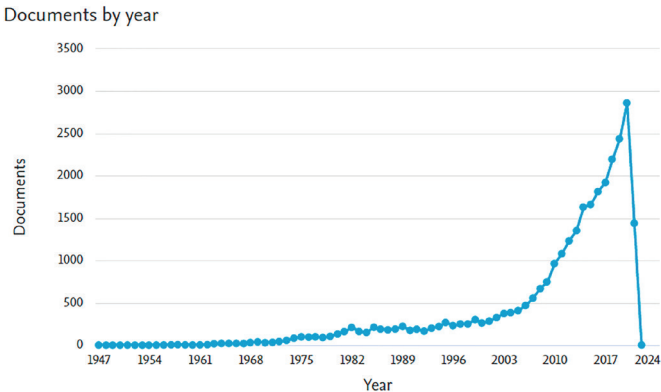
The study complied with the Helsinki Declaration, which was revised in 2013. Ethics committee approval is not required as there is no human or animal research.

Results

It was determined that there were 35587 publications on *Acinetobacter* topic and the first publication was published in the year 1974. 30074 of these studies were research articles. Only research articles were included to our study.

The greatest number of articles published in the last 20 years period from 2000 to 2020 and the number of articles did not decrease since 2020. In 2020, there was a decrease in the number of published articles (Figure 1).

Figure 1 - Number of published articles by years.



The most scientifically productive countries on *Acinetobacter* literature were the United States (USA), China and India. Turkey was in 9th place. The countrywide contribution of the articles is shown in Table 1.

Table 1 The countrywide contribution of the articles (n=30074).

| Country | Number of publications | Percentage by total number of publications |
|----------------|------------------------|--|
| USA | 5049 | 16.78 |
| China | 4559 | 15.15 |
| India | 2218 | 7.37 |
| United Kingdom | 1529 | 5.08 |
| Germany | 1410 | 4.68 |
| France | 1306 | 4.34 |
| Japan | 1236 | 4.10 |
| Spain | 1060 | 3.52 |
| Turkey | 1034 | 3.43 |
| South Korea | 985 | 3.27 |

The majority of the articles (n=26862, 89.31%) were written in English language. Chinese was the second most preferred language. 12503 (41.57%) of the articles were published in open access (AE) (Open Access) journals. Ranking of institutions according to the number of contributions to research given in Table 2. The institution with the highest number of contributors is Ministry of Education China (n=363). China-based institutions were in the first two places among the institutions with the highest number of publications.

Table 2 The list of top 15 institutions contributing the Acinetobacter literature (n=30074).

| Institution | n | % |
|---|-----|------|
| Ministry of Education China | 363 | 1.20 |
| Chinese Academy of Sciences | 283 | 0.94 |
| Inserm | 179 | 0.59 |
| Zhejiang University | 178 | 0.59 |
| Tel Aviv University | 177 | 0.58 |
| Mahidol University | 175 | 0.58 |
| Hospital Clinic Barcelona | 175 | 0.58 |
| Universidade de Sao Paulo - USP | 168 | 0.55 |
| National Taiwan University Hospital | 168 | 0.55 |
| CNRS Centre National de la Recherche Scientifique | 165 | 0.54 |
| Monash University | 159 | 0.52 |
| Tehran University of Medical Sciences | 151 | 0.50 |
| Russian Academy of Sciences | 150 | 0.49 |
| National Yang-Ming University Taiwan | 145 | 0.48 |
| The University of Queensland | 141 | 0.46 |

Figure 2 - Number publications according to journals contributing the most to the related literature on Acinetobacter.

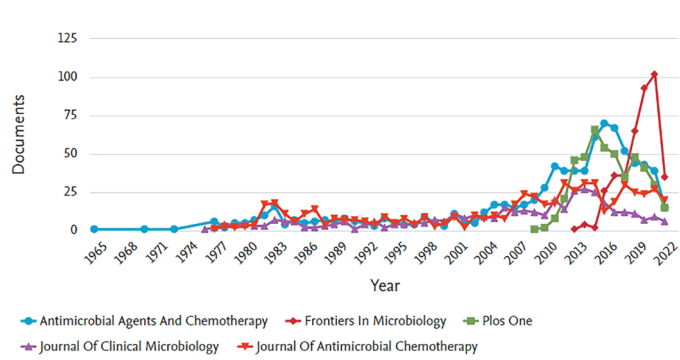


Table 3 The List of Top 10 Journals Contributing the Acinetobacter Literature (n=30074).

| Journals | n | % | CiteScore 2020 | SCImago Journal Rank |
|--|-----|------|----------------|----------------------|
| Antimicrobial Agents And Chemotherapy | 874 | 2.90 | 9.1 | 2.070 |
| Journal of Antimicrobial Chemotherapy | 541 | 1.79 | 9.1 | 2.124 |
| Plos One | 465 | 1.54 | 5.3 | 0.990 |
| Frontiers In Microbiology | 400 | 1.33 | 7.3 | 1.701 |
| Journal of Clinical Microbiology | 396 | 1.31 | 9.4 | 2.349 |
| International Journal of Antimicrobial Agents | 323 | 1.07 | 12 | 1.454 |
| Diagnostic Microbiology And Infectious Disease | 306 | 1.01 | 4.6 | 1.027 |
| Chemotherapy | 282 | 0.93 | 3.7 | 0.539 |
| American Journal Of Infection Control | 279 | 0.92 | 4.2 | 1.004 |
| Chinese Journal Of Infection And Chemotherapy | 278 | 0.92 | 0.4 | 0.112 |

* SCImago Journal Rank: SCImago Journal Rank measures weighted citations received by the serial. Citation weighting depends on subject field and prestige (SJR) of the citing serial.

Figure 3 - Documents by authors.

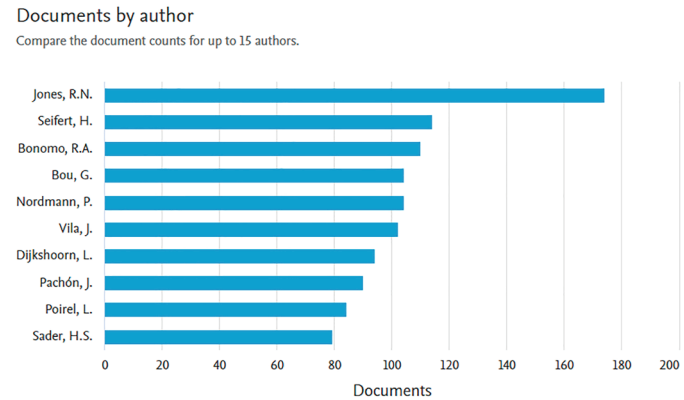


Table 4 The List of Most Cited Publications on Acinetobacter.

| Author, Year | Document title | Source | Cited by |
|-------------------|--|--|----------|
| Magiorakos,2012 | Multidrug-resistant, extensively drug-resistant and pandrug-resistant bacteria: An international expert proposal for interim standard definitions for acquired resistance | Clinical Microbiology and Infection | 4988 |
| Boucher,2009 | Bad bugs, no drugs: No ESKAPE! An update from the Infectious Diseases Society of America | Clinical Infectious Diseases | 3277 |
| Wisplinghoff,2004 | Nosocomial bloodstream infections in US hospitals: Analysis of 24,179 cases from a prospective nationwide surveillance study | Clinical Infectious Diseases | 3111 |
| Ventola,2015 | The antibiotic resistance crisis: Part 1: causes and threats | P and T | 1990 |
| Vincent,2009 | International study of the prevalence and outcomes of infection in intensive care units | JAMA - Journal of the American Medical Association | 1968 |
| Gao,2013 | Human infection with a novel avian-origin | New England Journal of Medicine | 1776 |
| Zhang,2015 | Comprehensive evaluation of antibiotics emission and fate in the river basins of China: Source analysis, multimedia modeling, and linkage to bacterial resistance | Environmental Science and Technology | 1649 |
| Hammer,1999 | Antimicrobial activity of essential oils and other plant extracts | Journal of Applied Microbiology | 1636 |
| Hidron,2008 | Antimicrobial-resistant pathogens associated with healthcare-associated infections: Annual summary of data reported to the National Healthcare Safety Network at the Centers for Disease Control and Prevention, 2006-2007 | Infection Control and Hospital Epidemiology | 1525 |
| Tacconelli,2018 | Discovery, research, and development of new antibiotics: the WHO priority list of antibiotic-resistant bacteria and tuberculosis | The Lancet Infectious Diseases | 1177 |

The list of the top 10 journals according to the number of publications on *Acinetobacter* given in Table 3 and Figure 2. The journal with the highest number of articles on *Acinetobacter* is Antimicrobial Agents and Chemotherapy (n=874).

Documents by authors are given in Figure 3. Ronald N Jones (n=174) from USA and Harald Seifert (n=114) from Germany were most productive authors on *Acinetobacter* related publications (Figure 3).

Twelve of the articles were cited more than 1000 times, 38 of them more than 500 times, 155 of them more than 250 times, 1034 of them more than 100 times, among all the articles on *Acinetobacter*. The article written by Magiorakos was the most cited article (n=4988) on *Acinetobacter*

Discussion

Bibliometric analysis which is social science study area, has been started to use in medical area in recent years. As different researchers made this analysis on different medical topics, it became easier to give way to perspective for future studies [11-16]. Pubmed, The Web of Science (WOS) and Scopus databases are mostly common databases mainly preferred in bibliometric analyses [11-16]. As *Acinetobacter* infections are common nosocomial pathogens all over the world and WHO reported it as an emerging pathogen we choose *Acinetobacter* keyword to highlight the importance of this topic and sought to give a bibliometric overview of the literature on *Acinetobacter*, by using Scopus database, which was used in previously published bibliometric studies. As a result of our study we detected the greatest number of articles published in the last 20 years period from 2000 to 2020. But there was a rapid decrease in the number of articles by the year 2020. This status may be relevant to the pandemic.

In only similar study from Turkey on *Acinetobacter* topic. In this study, scientific publications on *Acinetobacter bacteremia* were analyzed by using the Web of Science (WOS) database. This study was limited to *Acinetobacter bacteremia* [11]. Our study had wider range on *Acinetobacter*. And similarly to our study, number of publications on *Acinetobacter* topic have been increasing and growing rapidly in the past decade. In this study the first article was written in the year 1985 [11]. In our study first article was written in the year 1965. The reason for this can be interpreted as the concept of *Acinetobacter* may have been understood after about 20 years to cause bacteremia.

In a study from Iran, a bibliometric analysis was conducted with using WOS database and co-citation analysis was made with the "TI" tag using Ravar PreMap, UCINET 6.528.0.0, and Netdraw 1.0.0.0 programs [12]. "Seifert, Harald" from Germany was found as the most productive author on *Acinetobacter* topic. In our study Ronald N Jones (n=174) from USA and Harald Seifert (n=114) from Germany were the authors with most

publications on *Acinetobacter*. The reason for the difference may be the narrower distribution of the WOS database. Magiorakos et al was the most cited author in our study. But in Danesh et al.'s [12] study "Seifert, Harald * Higgins, Paul G" were the top cited authors. This was attributed to the fact that we did not use a similar database with our study.

When the studies on *Acinetobacter* are examined in terms of the publication language, it is seen that the English is the mostly preferred language [11,12]. Our study findings were similar. The majority of the articles (n=26862, 89.31%) were written in English language. Chinese was the second mostly preferred language. This situation shows that English is dominant in the literature. This finding shows that *Acinetobacter* topic has globally importance.

As mostly previously studies [11-17], our study showed that the majority of articles from USA. This may due to research findings and large number of researchers in USA. But the top cited article was published by authors from European Centre for Disease Prevention and Control team [18]. This may be due to the fact that there is a reputable scientific community in the area of Infectious Diseases. In addition, the most cited 3 articles were published in the Clinical Microbiology and Infection journal, and this may due to the fact that this journal with a high impact factor and it is one of the most respected journals in the area of Infectious Diseases.

As a result, both the number of articles on *Acinetobacter* and the number of citations are quite high. Since *Acinetobacter* genus is one of the most important pathogens in hospital infections, it seems that researchers will continue to work on this subject.

Limitations of the study

In this study single database used for research. So, we cannot say that the findings obtained in the research we conducted in a single database represent the total literature on *Acinetobacter*. As bibliometric databases only indexes the academic publications that it covers. International citation indexes include only academic publications indexed in the used database. So regional literature which don't listed in international citation indexes don't have international visibility. This is the second limitation of our study.

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