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Bibliometric Analysis of Studies on the Relationship between COVID-19 Vaccines and Myocarditis

COVID-19 Aşıları ile Miyokardit Arasındaki İlişkiye Dair Çalışmaların Bibliyometrik Analizi

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Abstract: In this study, a bibliometric analysis of the worldwide trends of studies on the relationship between COVID-19 vaccines and myocarditis was performed. This bibliometric study investigates the studies on the relationship between COVID-19 vaccines and myocarditis conducted worldwide between the years 2020-2023. For this purpose, 746 studies were examined as a result of searches made in Web of Science and Scopus databases. For data collection, information such as title, author names, publication year, journal name and number of citations were used. All text data are analyzed with "VOSviewer software" to ensure accuracy and reliability. In this study, analyses using text mining and data visualization methods (eg bubble maps) helped to make the results more understandable. In this article, information is given about 733 articles from Web of Science and Scopus databases and 11797 citations to these articles. The average number of citations per article is 16 and the H index is 45. As of 2021, both the number of articles and the number of citations have increased. Almost all of the articles have been published in the cardiovascular system and other health sciences. The USA, Italy, England and Japan are the countries that published the most articles (54%) on this subject. Most of the articles (79%) are in the SCI-Expanded category. The findings we obtained in our study show that many researchers are active in studies on the relationship between COVID-19 vaccines and myocarditis and that the research in this field is increasing.
Keywords: Analysis, Bibliometric, COVID-19, myocarditis, vaccine.

Özet: Bu çalışmada, COVID-19 aşıları ile miyokardit arasındaki ilişkiye dair dünya çapındaki çalışmaların eğilimlerinin bibliyometrik analizi yapılmıştır. Bu bibliyometrik çalışma, 2020-2023 yılları arasında dünya çapında COVID-19 aşıları ile miyokardit arasındaki ilişkiye dair yapılan çalışmaları incelemektedir. Bu amaçla, Web of Science ve Scopus veri tabanlarında yapılan taramalar sonucunda 746 çalışma incelenmiştir. Veri toplamada, başlık, yazar adları, yayın yılı, dergi adı ve atıf sayısı gibi bilgiler kullanılmıştır. Tüm metin verileri, doğruluk ve güvenilirliği sağlamak için "VOSviewer yazılımı" ile analiz edilmiştir. Bu çalışmada, metin madenciliği ve veri görselleştirme yöntemleri (örneğin kabarcık haritaları) kullanılarak yapılan analizler, sonuçların daha anlaşılır olmasına yardımcı olmuştur. Bu makalede, Web of Science ve Scopus veri tabanlarından alınan 733 makale ve bu makalelere yapılan 11797 atıf hakkında bilgi verilmektedir. Makale başına düşen atıf sayısı ortalaması 16 olup H indeksi 45'tir. 2021 yılı itibariyle hem makale sayısı hem de atıf sayısı artmıştır. Makalelerin neredeyse tamamı kardiyovasküler sistem ve diğer sağlık bilimleri alanında yayınlanmıştır. Bu konuda en fazla makale yayınlayan ülkeler ABD, İtalya, İngiltere ve Japonya'dır (%54). Makalelerin çoğu (%79) SCI-Expanded kategorisindedir. Çalışmamızda elde ettiğimiz bulgular, birçok araştırmacının COVID-19 aşıları ile miyokardit arasındaki ilişki üzerine çalışmalarda aktif olduğunu ve bu alandaki araştırmaların arttığını göstermektedir.
Anahtar Kelimeler: Analiz, Bibliyometrik, COVID-19, miyokardit, aşı.

Ethics Committee Approval: This study is a bibliometric analysis that does not include human or animal experiments. Therefore, ethics committee approval is not required.

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1. Introduction

This research examines the worldwide trends in studies on the relationship between Covid-19 vaccines and myocarditis. The bibliometric study carried out in this area reveals the reflection of studies on the relationship between COVID-19 vaccines and myocarditis to scientific research.

Myocarditis is an important cardiovascular disease resulting from inflammation of the heart muscle. This condition has been associated with a number of factors that have adverse effects on the cardiovascular system. In recent years, the COVID-19 pandemic has led to a major health crisis worldwide. There is growing evidence that myocarditis cases are increasing among the clinical manifestations caused by COVID-19. However, the relationship of COVID-19 vaccines to the development of myocarditis is not yet fully understood (1-3).

COVID-19 vaccines have been rapidly developed and implemented to reduce the effects of the pandemic and control the spread of the disease. Widespread use of these vaccines has been a major step forward in limiting the spread of the disease and preventing serious health problems. However, the issue of whether there is a relationship between COVID-19 vaccines and myocarditis has been an important research area for both health authorities and scientists (4-6).

Possible causes of myocarditis include viral infections and autoimmune reactions caused by immune responses. COVID-19 is a disease caused by the SARS-CoV-2 virus, which causes respiratory infections. In this context, the use of COVID-19 vaccines to stimulate the immune system requires us to understand the effects of immune responses and possible inflammatory effects on the development of myocarditis (7-9).

The potential relationship between COVID-19 vaccines and myocarditis has attracted attention, especially with the increasing incidence of myocarditis occurring in young adults. In the literature, it is stated that myocarditis cases have been observed especially after mRNA-based COVID-19 vaccines. However, the number of these cases is still quite low in the general population, and considering the benefits of vaccines, it should be stated that these cases are rare (10, 11).

This article aims to examine in more detail the possible relationship between COVID-19 vaccines and myocarditis. It will thoroughly evaluate the available evidence in the literature and help us better understand the effects of COVID-19 vaccines on the development of myocarditis. In addition, while emphasizing the positive effects of vaccines on general health, this article aims to provide important perspectives on how to address possible side effects such as myocarditis (12, 13).

This study, it is aimed to bibliometrically analyze the worldwide trends regarding the studies on the relationship between COVID-19 vaccines and myocarditis. This review aims to reveal the global publications on the relationship between COVID-19 vaccines and myocarditis, made by researchers in different disciplines, using the bibliometric analysis method. The main objective is to explore the importance of publications on this topic and to review relevant trends and clusters.

2. Materials and Metod

A systematic data collection method, search strategy and network analysis software were used to ensure the reliability of our study and the accuracy of the results. The use of these methods enabled the collection and analysis of the most up-to-date and comprehensive data in the literature. In addition, the analysis of this data provides information on current trends and trends in the scientific community regarding the relationship between COVID-19 vaccines and myocarditis. Global publication trends on studies on the relationship between COVID-19 vaccines and myocarditis were determined by examining different factors such as the most influential researchers, countries and the most frequently used keywords.

2.1. Data collection method and search strategy

In this bibliometric study, using the databases "Web of Science Core Collection (WOS, Clarivate Analytics, Philadelphia, PA, USA)" and "Scopus (Elsevier B.V.)" between 2020-2023 (last access date: 07.08.2023) His studies on the analysis of global trends in the relationship between 19 vaccines and myocarditis were reviewed. As a result of searches made using the keywords "vaccine, myocarditis, COVID-19" in the database, 746 studies were found. The remaining 733 articles were used when ineligible studies from these studies, those in 2020 and before, and studies other than the article were eliminated. The articles in the database were analyzed using information such as article title,

authors' names, publication year, journal name and number of citations. The materials were accessed using the online library and digital resources of Van Yüzüncü Yıl University. The search language is English.

In the study, publications related to the global trends in the relationship between COVID-19 vaccines and myocarditis using WOS and Scopus databases were examined using bibliometric methods. WOS and Scopus are comprehensive databases of academic articles published in many disciplines and topics. These databases are important resources for conducting interdisciplinary research. In this study, publications in WOS and Scopus databases were collected using specific search terms and subjected to bibliometric analysis. Data were collected using the online interfaces of WOS and Scopus and analyzed using various parameters. Data on post-growth, most active countries and institutions, and keyword matching were analyzed. All articles have been meticulously reviewed.

2.2. Network analysis

In this bibliometric study, "Network of collaboration, highlights and future trends" using VOSviewer (version 1.6.19, University of Leiden, The Netherlands) to identify global trends in the relationship between COVID-19 vaccines and myocarditis, and key topics of research in this area. analyzed. Web of Science and Scopus databases were used for systematic data collection, and all text data of the publications included in the study were collected and evaluated with VOSviewer software. These analyzes were performed using text mining and data visualization (bubble maps and other graphical) methods to ensure the accuracy and reliability of the study.

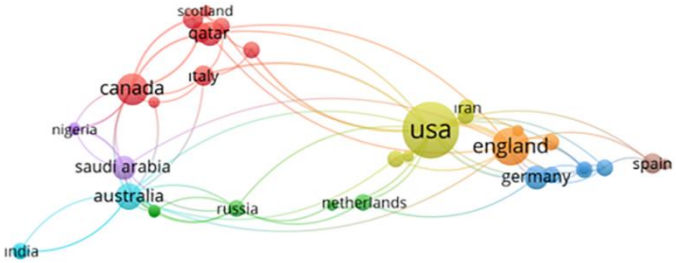

Figure 1. International collaboration network map. (Collaboration between countries is shown by lines, with thickness indicating strength, and circle/text size indicating the level of international collaboration)

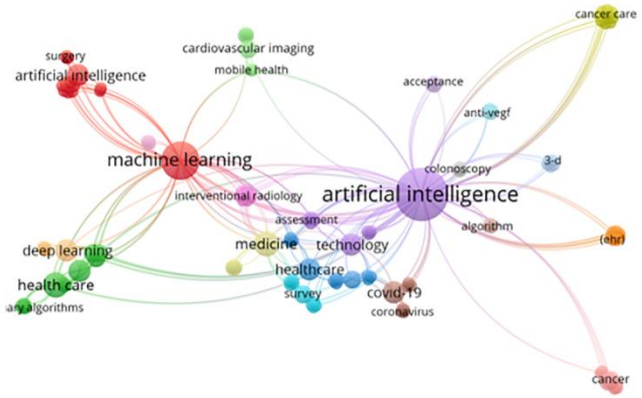

Figure 2. Keyword analysis. (Shows which keywords the topic is associated with and how often those keywords are used)

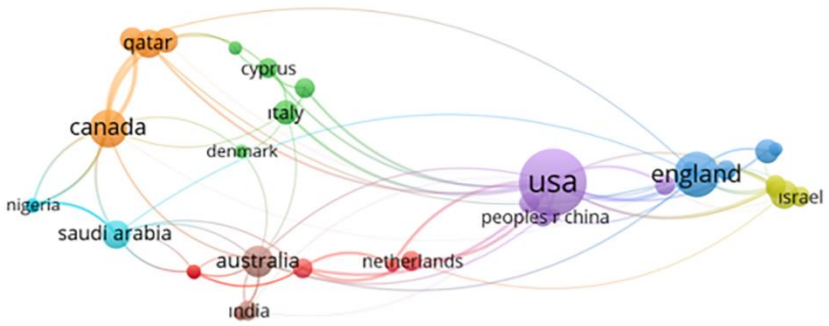

Figure 3. Bibliographic coupling analysis for country. (The relatedness of items was determined based on the number of references the share)

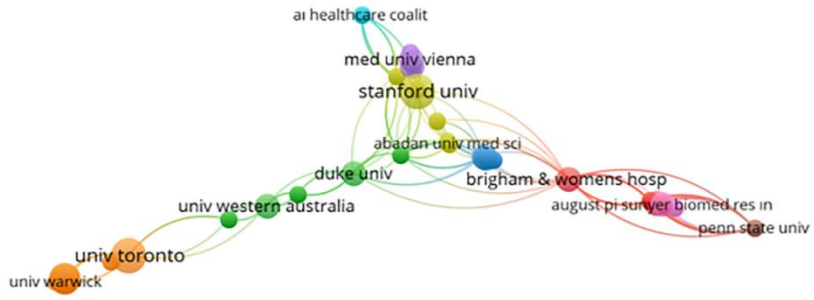

Figure 4. Bibliographic coupling analysis for organization. (The relatedness of items was determined based on the number of references the share)

2.3. Bubble Maps

In the bibliometric analyzes made with VOSviewer, the graphs called "Bubble maps" show the grouping of the articles published in a research area according to the frequency of the keywords. Each keyword or group is represented as a "balloon" and the size of the balloon depends on the frequency of that keyword or group. The balloons are colour-coded, ensuring that keywords related to the same group or topic are close together.

The thickness and length of the lines between the balloons show how often these keywords are used together, and with which other keywords they are used. Thus, by using "Bubble maps" in a bibliometric analysis, it is possible to identify the most important keywords or groups in the research area and visualize the relationships between these keywords.

Bubble maps, which are frequently used in bibliometric analysis, consist of small circles (bubbles), each representing a publication. The size of the bubbles is proportional to the number of citations the publication receives. Colours indicate sets or topics of publications. The thickness of the lines between two broadcasts reflects the co-citation

frequency between those broadcasts. Bubble maps allow researchers to quickly and easily understand keywords, citations, authors, institutions, countries and topics among publications on a particular topic.

3. Results

733 published articles were retrieved from the WOS and Scopus databases. A total of 11,797 citations were made to articles (7056 citations without self-citations). The average number of citations per article is 16. The H index is 45. Especially since 2021, both the number of citations and the number of articles showed an increasing trend. The distribution of publications and citations is shown in Figure 5. As shown in Figure 5, there was a steady increase in both the number of publications and citations over the years, with a sharp peak in 2022. The publication count rose significantly from 2021 onwards, corresponding with widespread vaccination campaigns and increased awareness of possible adverse effects, including myocarditis. While the number of publications slightly decreased in 2023, the cumulative citations remained high, indicating the sustained impact of earlier studies in the field.

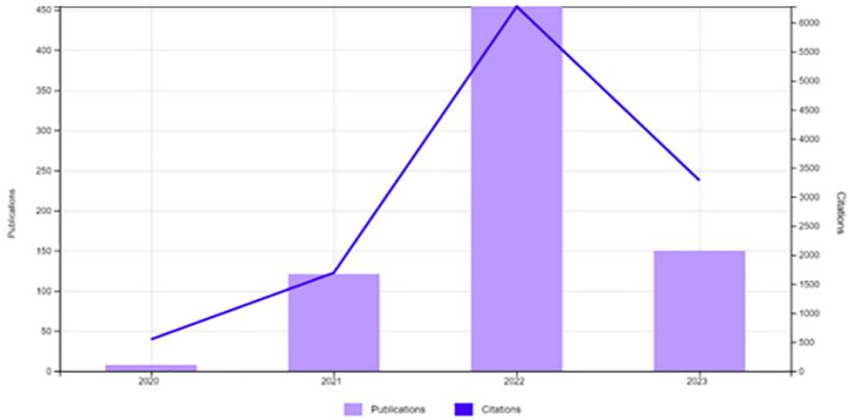

Figure 5. Frequency of publications and citations by year (last accessed 07.08.2023)

Most articles were published in the fields of Cardiac Cardiovascular Systems (28.38%), General Internal Medicine (24%), Immunology (14.3%), Experimental Medical Research (11.9%) followed by Pediatrics (8.2%), Infectious Diseases (5.7%), and Pharmacology (5%). As shown in Figure 2, keyword co-occurrence analysis revealed major thematic clusters in the literature. “Artificial intelligence,” “machine learning,” “healthcare,” and “deep learning” were among the most frequently used terms. This pattern strongly suggests that computational tools and technology-driven approaches are increasingly being used in the study of myocarditis in the context of COVID-19 vaccination, suggesting a shift toward data-driven clinical research. The distribution of publications by research area is shown in Table 1.

The USA ranks first in the number of articles published (n=262; 35.7%), followed by Italy (n=70; 9.6%); England (n=64; 8.7%) and Japan (n=57; 7.8%) followed. Publications originated from a total of 77 countries around the world, including these first 4 countries, and Turkey ranked 17th. As illustrated in Figure 1, the United States is shown as the central hub with strong collaborative links to countries such as the United Kingdom, Canada, Germany, and Italy. These connections highlight the high level of international cooperation in this area, highlighting the importance of cross-border data sharing and collective scientific effort during the pandemic. The first 23 countries with 10 or more publications are listed in Table 2. The bibliographic coupling analysis presented in Figure 3 highlights the interconnectivity of countries based on shared references in their publications. The United States, England, Canada, and Germany exhibited the highest degree of bibliographic coupling, suggesting that researchers from these countries often rely on similar sources and foundational literature. Such a shared reference base reflects coordinated and thematically aligned research across leading nations.

In this respect; the University of London (3.4%), University of California System (3.1%), and Harvard University (2.7%) were the leading institutions. Accordingly, most of the strongest institutional collaborations were based in the United States. A sample of 20 out of 1,585 institutional records is shown in the table (Table 3). Figure 4 presents the bibliographic coupling analysis of institutional collaborations. Stanford University, Harvard University, Brigham and Women's Hospital, and Duke University were among the most interconnected institutions. These institutions emerged as central nodes within the network, suggesting their key role in advancing research and fostering collaboration in studies related to COVID-19 vaccine-induced myocarditis.

Table 1. Publication Categories.

Research Areas	Record Count	% of 733
Cardiac Cardiovascular Systems	208	28.377
Medicine General Internal	176	24.011
Immunology	105	14.325
Medicine Research Experimental	87	11.869
Pediatrics	60	8.186
Infectious Diseases	42	5.730
Pharmacology Pharmacy	37	5.048
Public Environmental Occupational Health	31	4.229
Peripheral Vascular Disease	23	3.138
Microbiology	22	3.001
Radiology Nuclear Medicine Medical Imaging	22	3.001
Biochemistry Molecular Biology	14	1.910
Virology	14	1.910
Health Care Sciences Services	11	1.501
Emergency Medicine	10	1.364
Multidisciplinary Sciences	10	1.364

Showing 16 out of 63 entries

Table 2. Countries with at least 10 publications.

Countries/Regions	Record Count	% of 733
USA	262	35.744
ITALY	70	9.550
ENGLAND	64	8.731
JAPAN	57	7.776
CHINA	46	6.276
CANADA	40	5.457
GERMANY	38	5.184
ISRAEL	28	3.820
SOUTH KOREA	28	3.820
INDIA	27	3.683
AUSTRALIA	25	3.411
SPAIN	20	2.729
FRANCE	19	2.592
GREECE	16	2.183
IRAN	16	2.183
SAUDI ARABIA	13	1.774
TURKEY	**13**	**1.774**
PAKISTAN	12	1.637
BRAZIL	11	1.501
NETHERLANDS	11	1.501
QATAR	11	1.501
SINGAPORE	11	1.501
TAIWAN	11	1.501

Showing 23 out of 77 entries

Table 3. List of the top affiliations.

Affiliations	Record Count	% of 733
UNIVERSITY OF LONDON	25	3.411
UNIVERSITY OF CALIFORNIA SYSTEM	23	3.138
HARVARD UNIVERSITY	20	2.729
CENTERS FOR DISEASE CONTROL PREV USA	17	2.319

TEL AVIV UNIVERSITY	17	2.319
MAYO CLINIC	16	2.183
HARVARD MEDICAL SCHOOL	15	2.046
UDICE FRENCH RESEARCH UNIVERSITIES	15	2.046
KAISER PERMANENTE	14	1.910
UNIVERSITY OF TEXAS SYSTEM	14	1.910
EMORY UNIVERSITY	12	1.637
UNIVERSITY COLLEGE LONDON	12	1.637
UNIVERSITY OF HONG KONG	12	1.637
UNIVERSITY OF TORONTO	12	1.637
US DEPARTMENT OF VETERANS AFFAIRS	12	1.637
SACKLER FACULTY OF MEDICINE	11	1.501
UNIVERSITY OF OXFORD	11	1.501
VETERANS HEALTH ADMINISTRATION VHA	11	1.501
YALE UNIVERSITY	11	1.501

Showing 20 out of 1585 entries (least 11 publications)

Table 4. Web of Science Index.

Web of Science Index	Record Count	% of 733
Science Citation Index Expanded (SCI-EXPANDED)	578	78.854
Emerging Sources Citation Index (ESCI)	155	21.146
Conference Proceedings Citation Index – SCI (CPCI-S)	17	2.319
Social Sciences Citation Index (SSCI)	15	2.046

4. Conclusion

This research shows that scientific publications on the relationship between COVID-19 vaccines and myocarditis have increased globally. This study aimed to determine the global trends and clusters related to the relationship between COVID-19 vaccines and myocarditis, and to reveal which areas the research in this field focuses on and in which countries it is done the most. In addition, important journals, authors and studies in this field were identified, and it was pointed out in which areas the relationship between COVID-19 vaccines and myocarditis will be studied in the future and which researchers could be pioneers in this field.

This study presents a bibliometric analysis examining worldwide trends and publication trends in the relationship between COVID-19 vaccines and myocarditis. The article is based on the analysis of 733 articles obtained as a result of a large literature review. In this analysis, the most influential countries, institutions, authors, journals and keywords on the relationship between COVID-19 vaccines and myocarditis were determined. Its results can be used to guide research in this area and provide a roadmap for research on the relationship between COVID-19 vaccines and myocarditis.

The results of this study aim to reveal the importance and prevalence of research in this field by presenting a global perspective on the relationship between COVID-19 vaccines and myocarditis. This study can be a useful resource for health researchers, policymakers and industry representatives.

In conclusion, this bibliometric analysis reveals global trends and important studies in the field of COVID-19 vaccines and myocarditis relationship and provides important insights into the future directions of research in this area.

Limitations

Bibliometric analysis is a method used only to identify trends and trends in the literature and does not make an assessment of the accuracy or quality of the actual data. Therefore, more comprehensive studies on the research topic should be conducted and a similar analysis should be performed using different databases. Moreover, bibliometric analysis is not intended to assess the applicability, as this method only aims to analyze data from the available literature and provide an overview of specific issues.

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Highlights

1) This study analyzes the global trends and implications of research on the relationship between COVID-19 vaccines and myocarditis.
2) The relationship between COVID-19 vaccines and myocarditis, research is becoming widespread and it is expected to become more widespread in the future.
3) The relationship between COVID-19 vaccines and myocarditis is used as a useful tool for its results in the medical field.
4) The number of studies on the relationship between COVID-19 vaccines and myocarditis is increasing every year around the world.
5) Among the countries examined in the study, the USA, Italy, England and Japan are the prominent countries. Türkiye is in 17th place.