



Bibliometric Analyses of Digitalization Studies in Health after the Pandemic

Pandemi Sonrası Sağlıkta Dijitalleşme Çalışmalarının Bibliyometrik Analizi

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Abstract

Introduction: This study aims to analyse the bibliometric analysis of digitalization trends in health after the pandemic. Bibliometric analyses can help us understand global digitalization trends and guide future work. These analyses can provide guidance for researchers and healthcare professionals and can be used to drive faster and more effective change in the digitalization of the healthcare industry.

Materials and Method: In this bibliometric study, research on digitalization in health carried out globally between the years 2020-2023 was examined. As a result of the searches using the keyword "digitalization in health" and "Covid-19", 1670 studies were found and 400 articles were used by eliminating the unsuitable and non-article studies. Web of Science and Scopus databases were used for systematic data collection and all text data of the publications included in the study were evaluated with "VOSviewer software". These analyses were performed using text mining and data visualization methods to ensure the accuracy and reliability of the study.

Results: In this article, information is given about 400 articles taken from the databases and 1847 citations to these articles. As of 2021, both the number of articles and the number of citations have increased. Most of the articles (55%) are devoted to health and economics. Germany is the country that publishes the highest number of articles (17.3%) on this subject. Most of the articles (58%) were published by publishers such as MDPI, Springer Nature, Elsevier, Sage and Wiley. Most of the articles (47%) are in the SCI-Expanded category.

Conclusion: This bibliometric analysis reveals global trends and key studies in healthcare digitalization and provides important insights into the future directions of research in this area. Since this analysis only aims to identify trends and trends in the literature, it is not intended to evaluate the applicability of this topic.

Keywords: digitalization in health; bibliometric review; bioinformatics.

Özet

Giriş: Bu çalışma pandemi sonrası sağlıkta dijitalleşme eğilimlerinin bibliyometrik analizini amaçlamaktadır. Bibliyometrik analizler, dünya genelindeki dijitalleşme trendlerini anlamamıza ve gelecekte yapılacak çalışmalara yön vermemize yardımcı olabilir. Bu analizler, araştırmacılar ve sağlık profesyonelleri için yol gösterici olabilir ve sağlık sektörünün dijitalleşmesinde daha hızlı ve daha etkili bir değişim sağlamak için kullanılabilir.

Gereç ve Yöntem: Bu bibliyometrik çalışmada, küresel olarak 2020-2023 yılları arasında gerçekleştirilen sağlıkta dijitalleşme araştırmaları incelenmiştir. "sağlıkta dijitalleşme" ve "Covid-19" anahtar kelimesi kullanılarak yapılan aramalar sonucunda 1670 çalışma bulunmuş ve uygun olmayanlar ve makale dışındaki çalışmalar elemeleri yapılarak 400 makale kullanılmıştır. Sistematik veri toplama işlemi için Web of Science ve Scopus veritabanları kullanılmış ve çalışmaya dahil edilen yayınların tüm metin verileri "VOSviewer yazılımıyla" değerlendirilmiştir. Bu analizler, çalışmanın doğruluğunu ve güvenilirliğini sağlamak için metin madenciliği ve veri görselleştirme yöntemleri kullanılarak gerçekleştirilmiştir.

Bulgular: Bu yazıda, veri tabanlarında alınan 400 makale ve bu makalelere yapılan 1847 atıf hakkında bilgi verilmiştir. 2021'den itibaren hem makale sayısı hem de atıf sayısı artmıştır. Makalelerin çoğu (%55) sağlık ve ekonomi konularına ayrılmıştır. Almanya bu konuda en fazla (%17.3) makale yayınlayan ülkedir. Makalelerin çoğu (%58) MDPI, Springer Nature, Elsevier, Sage, Wiley gibi yayınevlerinde yayınlanmıştır. Makalelerin çoğu (%47) SCI-Expanded kategorisinde yer almaktadır.

Sonuç: Bu bibliyometrik analiz, sağlıkta dijitalleşme alanındaki küresel eğilimleri ve önemli çalışmaları ortaya koymakta ve bu alandaki araştırmaların gelecekteki yönleri hakkında önemli bilgiler sağlamaktadır. Bu analiz sadece literatürdeki eğilimleri ve trendleri belirlemeyi amaçladığı için, bu konunun uygulanabilirliklerini değerlendirme amacı taşımamaktadır.

Keywords: sağlıkta dijitalleşme; bibliyometrik inceleme; biyoinformatik.

Introduction

Digitalization in health after the pandemic has led to a transformation in the healthcare industry worldwide. The Covid-19 pandemic has once again demonstrated the importance and impact of digital technologies in the delivery of healthcare services. Digitalization in healthcare provides faster, more accessible and more effective service

to patients. Digital transformation affects the way health workers work, the delivery of health services and the access of patients to health services. It is used in many areas such as digitalization in health, telemedicine, diagnosis, treatment, hospital management, data analysis and reporting. Digitalization in health after the

pandemic has led to a transformation in the healthcare industry worldwide. The Covid-19 pandemic has once again demonstrated the importance and impact of digital technologies in the delivery of healthcare services. Digitalization in healthcare provides faster, more accessible and more effective service to patients. Digital transformation affects the way health workers work, the delivery of health services and the access of patients to health services. It is used in many areas such as digitalization in health, telemedicine, diagnosis, treatment, hospital management, data analysis and reporting. Digitalization in healthcare is used not only in the field of patient care but also in many areas such as hospital management, data analysis and reporting. Therefore, digitalization in healthcare is changing the way healthcare professionals work and patients' access to healthcare services. This transformation creates many opportunities in the health sector but also brings with it some challenges. Some difficulties with digitalization in the health sector; the need for technological infrastructure, insufficient legal regulations, the need for training and simultaneous change, the need for a separate budget, etc. In order to overcome these difficulties, it is necessary to establish adequate investment and management structures for digitalization in the health sector. In addition, issues such as the development of technological and legal regulations, personnel training and awareness raising in society should be given priority (1,2,3,4). With the increase in digitalization studies in health after the pandemic, bibliometric analyses have also gained importance. These analyses show the number of studies conducted worldwide on digitalization in health, the characteristics of published articles and the priorities of countries working in this field (5,6). Bibliometric analyses provide a general picture of the studies on digitalization in health. These analyses can help us understand global digitalization trends and guide future work (7). The bibliometric analysis of digitalization studies in health after the pandemic provides important information about the future of the health sector. These analyses can be a guide for researchers and healthcare professionals and can be used to drive faster and more effective change in the digitalization of the healthcare industry. The bibliometric analysis provides important information for understanding the development and trends of research in the literature. These analyses make it possible to follow developments in the publication process of scientific discoveries, identify new topics in scientific literature, and

observe citation trends in scientific literature. These analyses allow us to examine the trends of publications on digitization and their relevance to other research. These analyses can be used to guide future work on digitalization. This study, it is aimed to bibliometrically examine the worldwide trends in digitalization in health after the pandemic. This review aims to reveal the publications on digitalization studies in health made by researchers in different disciplines by using the bibliometric analysis method. This study is the first example of bibliometric research on digitalization in health post-pandemic on a global scale. The main objective is to explore the importance of publications on this topic and to review relevant trends and clusters.

Material and Method

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 these data provides information on the current trends and trends of the scientific community in the field of digitalization in health. Global publication trends in the field of digitalization in healthcare were identified by examining different factors such as the most influential researchers, countries and the most frequently used keywords. 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 these data provides information on the current trends and trends of the scientific community in the field of digitalization in health. Global publication trends in the field of digitalization in healthcare were identified 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, digitalization research in global post-pandemic health between 2020-2023 (last access date: April 3, 2023) using the "Web of Science Core Collection (WOS, Clarivate Analytics, Philadelphia, PA, USA)" and "Scopus (Elsevier B.V.)" databases were examined. As a result of searches made using the keywords "digitalization in health" and "Covid-19" in the database, 1670 studies were found. When

ineligible from these studies, those before 2019 and studies other than the article were eliminated, the remaining 400 articles were used. The articles in the database were analyzed using information such as article title, authors' names, publication year, journal name and number of citations. The Hirsch (H) index was used as an indicator of publication effect. The materials were accessed using the online library and digital resources of Van Yuzuncu Yil University. The search language is English. In the study, publications on digitalization in health after the pandemic was examined using the WOS and Scopus database, using bibliometric methods. WOS and Scopus are comprehensive databases of academic articles published in many disciplines and subjects. This database is an important resource for interdisciplinary research. In this study, publications in this databases were collected using certain search terms and subjected to bibliometric analysis. Data were collected using the online interface of databases 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, a "network of collaboration, highlights and future trends" was analyzed using VOSviewer (version 1.6.19, University of Leiden, The Netherlands) to identify global trends in post-pandemic health digitalization and key topics for research in this area. Web of Science and Scopus databases was used for systematic data collection and all text data of the publications included in the study were collected and evaluated with VOSviewer software. These analyses were performed using text mining and data visualization (bubble maps and other graphical) methods to ensure the accuracy and reliability of the study.

2.3. Bubble Maps: In the bibliometric analyses 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 indicate how often these keywords are used together and with which other keywords.

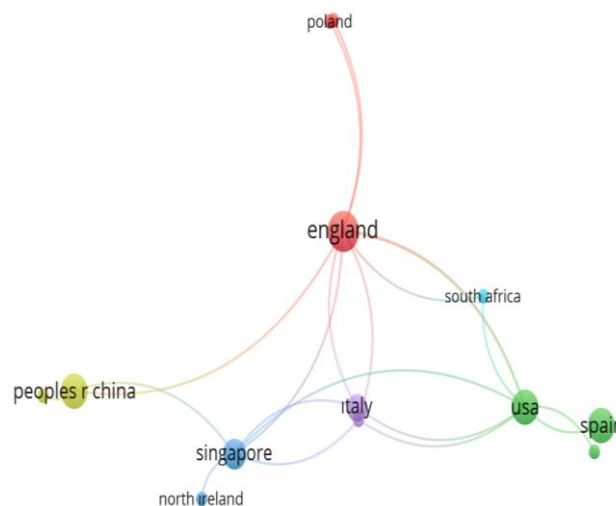


Figure 1. International collaboration network map. Country collaboration is depicted by lines (strength) and circle/text size (level of international collaboration).

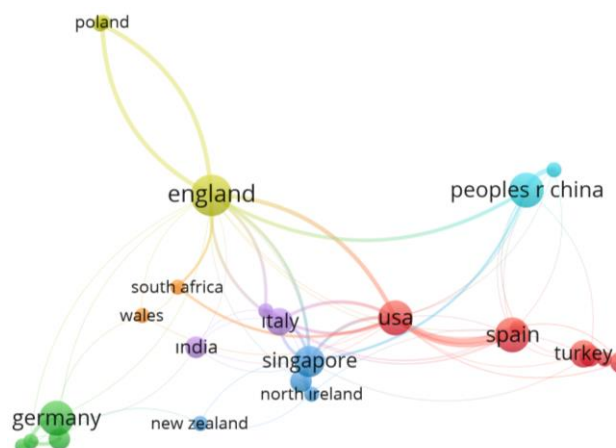


Figure 2. Bibliographic coupling analysis for country. (The relatedness of items was determined based on the number of references the share)

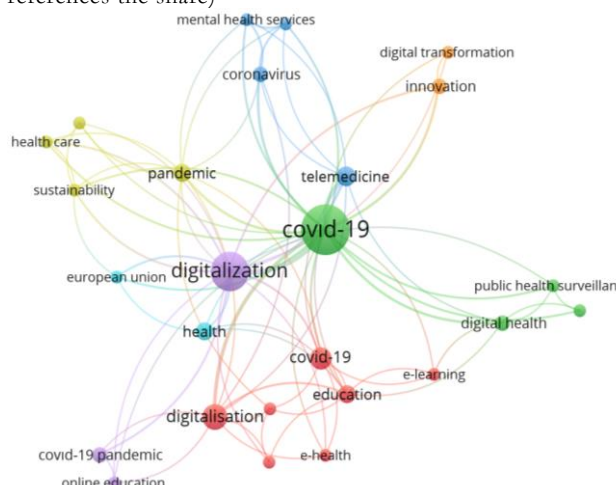


Figure 3. Keyword analysis. (Shows which keywords the topic is associated with and how often those keywords are used)

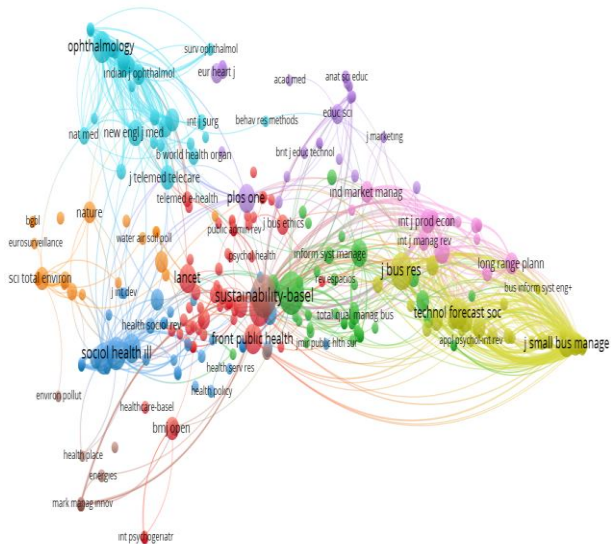


Figure 4. Citation Network of Articles. Citation network map for orgs with ≥5 publications. Collaboration shown by line thickness and circle/text size indicating international cooperation level.

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 the 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.

Results

400 published articles were retrieved from the WOS and Scopus databases. A total of 1847 citations were made to articles (1811 citations without self-citations). The average citations per article is 5. H index is 22. Especially since 2021, both the number of citations and the number of articles showed an increasing trend. The numbers of articles were mostly in “Public Environmental Occupational Health (20.3%), Business Economics (12.5%), Environmental Sciences Ecology (12.3%) and Health Care Sciences Services (9.0%) and other fields, respectively. The distribution of publications by research area is shown in Table 1.

Table 1: Publication Categories.

Research Areas	Record N	% of 400
Public Environmental Occupational Health	81	20.250
Business Economics	50	12.500
Environmental Sciences Ecology	49	12.250
Health Care Sciences Services	36	9.000
Education Educational Research	30	7.500
Computer Science	27	6.750
Science Technology Other Topics	21	5.250
Medical Informatics	20	5.000
Social Sciences Other Topics	19	4.750
Psychology	18	4.500
Engineering	15	3.750
General Internal Medicine	11	2.750
Public Administration	10	2.500
Sociology	10	2.500
Pharmacology Pharmacy	9	2.250
Government Law	8	2.000
Immunology	8	2.000
Research Experimental Medicine	7	1.750
Infectious Diseases	6	1.500
International Relations	6	1.500

Showing 20 out of 87 entries

Germany ranks first in the number of articles published (n=69; 17.3%), followed by England

(n=44; 11.0%); Spain (n=31; 7.8%); USA (n=30; 7.5%) and Italy-Romania (n=28; 7.0%) followed. There were broadcasts from a total of 84 countries

around the world, including these first 6 countries, and Turkey ranked 15th. Countries with ten or more publications are listed in Table 2.

Table 2: Countries with at least 10 publications.

Countries/Regions	Record Count	% of 400
Germany	69	17.250
England	44	11.000
Spain	31	7.750
USA	30	7.500
Italy	28	7.000
Romania	28	7.000
China	24	6.000
Switzerland	19	4.750
France	17	4.250
Netherlands	17	4.250
Russia	17	4.250
India	16	4.000
Canada	14	3.500
Australia	13	3.250
Turkey	12	3.000
Belgium	10	2.500
Japan	10	2.500
Malaysia	10	2.500
Norway	10	2.500
Saudi Arabia	10	2.500

Showing 20 out of 84 entries

In this respect; Leading institutions were the University of London (3%), the Free University of Berlin (2.8%) and Charite Universitätsmedizin

Table 3: Web of Science Categories Index.

Web of Science Index	Record Count	% of 400
Science Citation Index Expanded (SCI-Expanded)	187	46.750
Social Sciences Citation Index (SSCI)	161	40.250
Emerging Sources Citation Index (ESCI)	120	30.000
Conference Proceedings Citation Index - Science (CPCI-S)	17	4.250
Conf. Proc. Citation Index-Social Sci.& Human (CPCI-SSH)	16	4.000
Arts & Humanities Citation Index (A&HCI)	1	0.250

Digitalization in health has gained more importance after the pandemic and the number of research in this field has increased. Bibliometric analysis results show that the number of research in the field of digitalization in health has increased rapidly in recent years. The reason for this increase is that digital technologies provide many advantages for health services. Especially during the pandemic period, the use of digital technologies such as e-health, telemedicine, remote health services and digital health applications has increased. The use of these technologies facilitates safe healthcare delivery for both patients and healthcare professionals, while helping healthcare systems work more effectively

Berlin (2.3%). In this context, out of 916 records, 15 of them represent the prominent connections based in Europe. Most of the articles; Published in MDPI (16.3%), Springer Nature (11.5%), Elsevier (9.5%), Frontiers Media Sa (7.3%), and SAGE and Taylor & Francis (4.8%). Looking at the Web of Science Indexes; Most of the articles are in the category of “Science Citation Index Expanded (SCI-Expanded) (46.8%)” followed by “Social Sciences Citation Index (SSCI) (40.3%)” and “Emerging Sources Citation Index (ESCI) (30.0% (Table 3).

Conclusion

Digitalization in health has gained more importance after the pandemic and the number of research in this field has increased. Bibliometric analysis results show that the number of research in the field of digitalization in health has increased rapidly in recent years. The reason for this increase is that digital technologies provide many advantages for health services. Especially during the pandemic period, the use of digital technologies such as e-health, telemedicine, remote health services and digital health applications has increased. The use of these technologies facilitates safe healthcare delivery for both patients and healthcare professionals, while helping healthcare systems work more effectively and efficiently (8,9,10).

and efficiently (8,9,10). It is seen that research in the field of digitalization in health has increased rapidly after the pandemic. It provides information on trends in work in this field, leading researchers and institutions, and helps formulate strategies for the wider use of digital technologies for healthcare. In addition, the results of this analysis show that digitalization in health will maintain its importance in the future and research will continue in this area. This study presents a bibliometric analysis that examines worldwide trends and publication trends in post-pandemic healthcare digitalisation. The article is based on the analysis of 400 articles obtained as a result of a large literature review. In this analysis, the most

influential countries, institutions, authors, journals and keywords in post-pandemic health digitalization were determined. Its results can be used to guide research in this area and provide a roadmap for research in the field of post-pandemic health digitization. In conclusion, this bibliometric analysis reveals global trends and key studies in the field of post-pandemic health digitization and provides important insights into the future directions of research in this area. The highlights of these results can be summarized as follows: This bibliometric analysis reveals global trends and key studies in post-pandemic health digitization and provides important insights into the future directions of research in this area. Especially between 2020-2023 digitalization studies in health and the number of citations have increased significantly. It is foreseen that research in the field of digitalization in health will continue to increase. Germany, England, Spain and the USA are the countries that do the most work on digitalization in health. Türkiye ranked 15th. Studies were mostly published in SCI-E Indexed journals. The use of digital technologies such as telemedicine, remote health services and digital health applications has increased with the Covid-19 pandemic. The results of these analyses can be used to create strategies for the more widespread use of digitalization in health. Research in this area can focus on increasing interdisciplinary collaboration.

Study limitations: The limitations of these results can be summarized as follows: It should be noted that this study does not make an assessment of the accuracy or quality of the original data, presenting only a bibliometric analysis. Therefore, more comprehensive studies should be carried out in related fields and a similar analysis should be performed using different databases. Moreover, since this bibliometric analysis only aims to identify trends and trends in the literature, it is not intended to evaluate the applicability of this topic.

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