International Journal of Psychology , Social and Educational Sciences
Vol.2, NO.4 , P: 53 - 65
Received : 15 October 2020
Accepted : 26 December 2020

Scientometrics of Coronavirus over the last fifty years in global science publication

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Abstract

The global spread of coronavirus has led to significant knowledge in this regard in a reputable international citation database. The present study aimed to monitor, observe, and quantitatively evaluate the above outputs for 50 years in the field of coronavirus. All coronavirus publications (5,128 documents) indexed on the WOS database between 1970 and 2019 are included in this article's statistical population. Excel 2016 software was used to identify keywords from medical subject headings (MeSH) .Publications in global coronavirus science fluctuated in different periods. The highest amount of scientific publications in 2005 (349 documents) and the highest number of citations (11385) are related to 2019. Enjuanes L, USA, and the University of Hong Kong are the world's most prolific coronavirus scientists, countries, and organizations in the last half-century .Results showed a direct relationship between coronavirus family outbreaks and the number of global publications in this area. The quality of researchers' products in this field has been influenced by researchers' scientometric, thought-provoking, and self-citation methods . Knowledge of coronavirus scientometric studies results is essential for researchers and policymakers to identify more appropriate treatment goals, make better decisions, and provide more effective solutions in the shortest possible time.

Keywords: Coronavirus, COVID-19, 2019-nCoV, Coronavirus infection, Scientometrics

Introduction

Coronavirus is considered a common disease between humans and animals (Zoonosis) [1, 2]. Coronaviridae is envelope non-segmented and has positive-sense RNA [3]. Genotypically and serologically, they are grouped into four types: alpha, beta, gamma, and delta, and approximately thirty types of coronavirus are common in humans, mammals, and birds. Human coronaviruses (MCOV-EMC) are alpha and beta-type [4]. This large family causes a wide range of viral illnesses, from the common cold to more severe illnesses such as coronavirus Middle East Respiratory Syndrome (MERS-CoV) and Acute Respiratory Syndrome (SARS-CoV). Coronaviruses have so far received a great deal of attention from pathogenesis and

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international pathology [5-7]. These viruses pose a threat to public health [8, 9]. As a causative agent of severe lower respiratory tract infection in humans, MERS-CoV has recorded a higher mortality rate than SARS-CoV [10-12]. The new coronavirus (nCoV-2019) or Covid-19 (COVID-19) was identified by the World Health Organization (WHO) in Wuhan, China, in early 2020 [2,5,6]. Covid-19 is considered the most dangerous virus of the Coronaviridae family these days and is a serious warning to all countries of the world (13). The virus has caused severe respiratory and intestinal infections in animals and humans [14]. IFR (Infection Fatality Risk) infection is also caused by this virus and leads to death [15].

According to the atlas published by Johns Hopkins University, as of Mar 7, 2017, 97,965 people from 87 countries have been infected with the disease, of which 3,354 have died. Meanwhile, 54,124 people have recovered and returned to normal life. Regular identification and evaluation of scientific outputs to be aware of the current situation have a high priority [16]. One of the methods of evaluating scientific research activities is scientometrics [17]. Scientometrics has many applications in describing, explaining, and predicting researchers and research centers' scientific status in various national and international arenas and always provides effective monitoring and ranking organizations, researchers, journals, and countries [18,19]. With the increase in global science production, observing such studies evaluating the scientific output of the subject domains of medical sciences has become more important. It has become an integral part of monitoring the performance of organizations [20]. Examining the existing capacities helps policymakers and research managers in the principled ranking, performance quality evaluation, correct and principled budget allocation, and leads to a better understanding of collections and trends [21].

Scientometrics of scientific articles of valid citation databases is one of the important tools for monitoring medical research processes and developments [22]. At present (November 2020), in line with the challenging and global spread of coronavirus, medical researchers are conducting extensive studies on ways to prevent and treat the virus, and the results of their studies will be presented at conferences and in scientific journals. Valid is published. In this regard, scientometric researchers have observed, monitored, and evaluated research outputs and, using various indicators, analyzed the documents related to coronavirus and presented their findings to scientists and science policymakers.

Bibliographic analysis of coronaviruses: SARS-CoV, MERS-CoV, 2019-novel CoV was studied in three bibliographic databases WoS, Scopus, and PubMed 1951 to 2020. The results show that 18,158 articles from Scopus (the US, China, and the UK, respectively), 14,455 articles from PubMed (the US, China, and Germany, respectively), and 11,775 articles from SCI (the US, China, and Germany, respectively) was retrieved. Most of the articles published in the databases were from 2002 and related to SARS-CoV and then MERS-CoV. This study showed that the United States and China play a major role in CoV research, and the United States produces one-third of the scientific outputs of this field [14]. In the bibliographic analysis of the Middle East Respiratory Syndrome Coronavirus (MERS-CoV) from 2012 to 2015, the Scopus database "studied" 883 documents indexed in this database from 92 countries. The results showed rapid growth of publications in this period. The United States, with 319 and Saudi Arabia, with 113 articles, had the highest science production among the countries. Among them, the Netherlands, the United Kingdom, and Germany have had the most scientific cooperation in this field with other countries [24]. It should be noted that scientometric tools and methods have always

been used in various fields of medical sciences. Studies such as Nipah Virus [3], Human Papilloma Virus [25], parasitology [26], diabetes [27], surgery [28], and neonatal health [29] are evidence of this.

A review of the literature shows that medical researchers have considered various scientometric tools. The analysis of this method has been useful in representing the knowledge of the structure of medical sciences to the extent that scientometric studies as a basis for familiarity. With the knowledge structure of various disciplines and as a roadmap for policymakers and decision-makers in academic disciplines, especially medical sciences, the world has become. Given the great and strategic importance of coronavirus's subject area, especially the new coronavirus (2019-nCoV) and the increase in this subject area's global science production, attention to scientometrics in this regard is of particular importance. A look at the current trend, the flow of science production, effective and core centers and organizations, active and productive countries, and finally, the introduction of nuclear journals in the realm of coronavirus seems more and more necessary in the current situation. According to this article's findings, scientists can easily spend many hours and maybe days searching, retrieving, and most importantly, analyzing coronavirus-related scientometric data. And in an organized and analyzed manner in this article.

This study's main issue is to determine the status of coronavirus's international research outcomes in the last 50 years. Representing the subject area of coronavirus from different angles will guide coronavirus researchers and pave the way for planners and policymakers in the scientific associations of the medical sciences. This article's main purpose is to measure 50 years of coronavirus science production globally based on the theoretical framework. To achieve the article's main goal, examining the process of global science production, type of resources, citing articles and self-citations, publications, researchers, countries, and top organizations in coronavirus in 1970 to 2019 is more important and necessary.

Elements of a Paper

This article is of the applied type, done by the scientometric method and with an analytical approach. The statistical population is all scientific publications of coronavirus's subject area from 1970 to 2019, in English and the form of articles. After consulting with respiratory and infectious disease specialists, a search strategy was developed. The Medical Subject Header (MeSH) browser was used to specify keywords. In the next step, WOS, the most authoritative, most widely used, and the oldest citation database in the world was used to search and retrieve coronavirus documents [30, 31]. In the advanced WOS search section, 5,128 documents were retrieved and transferred to Excel 2016 software for scientometric analysis and output analysis.

Results and discussion

Figure 1 shows the global coronavirus production trend from 1970 to 2019 in the WOS database.

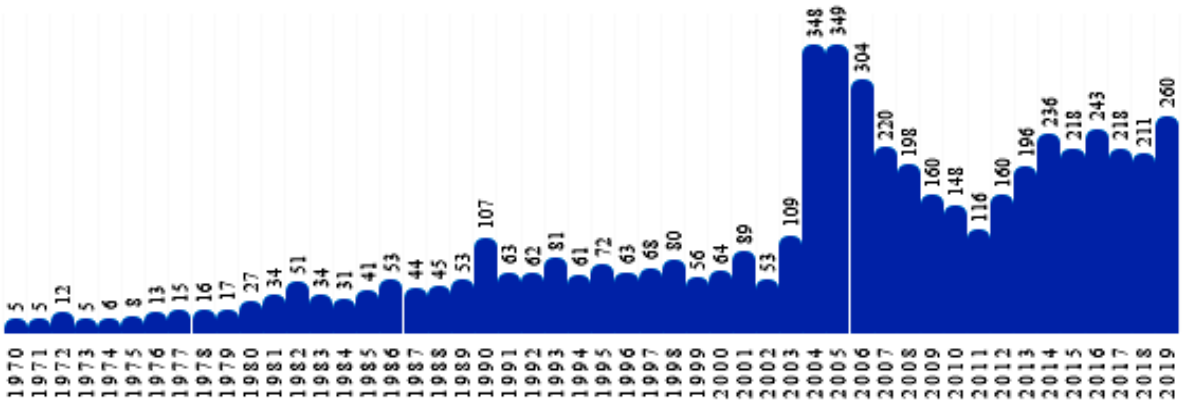

Figure (1) trend of coronavirus in WOS (1970 to 2019)

Figure 2 shows the abundance of various scientific coronavirus **products** in the WoS database from 1970 to 2019. The four main types of paper sources are seminar abstracts, conference summaries, and review papers viewed in frequency.

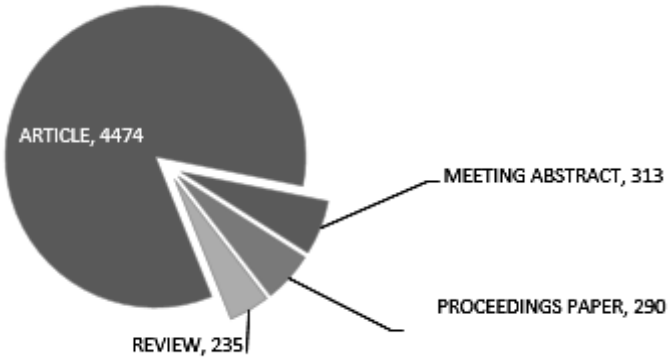

Figure (2) Types of sources for publishing WOS Coronavirus scientific products (1970 to 2019)

The data in Table 1 show the coronavirus thematic domain citation analysis for the period 1970 to 2019 in the WoS database.

Table (1) Citation received from articles on the subject area of coronavirus

year	Cited (Sum)	self-citation excluded	Citation	self-citation	self-citation per year	year	Cited (Sum)	self-citation excluded	Citation	self-citation	self-citation per year
1970	252	251	1	1	0.0003	1995	2003	1994	1505	9	0.0028
1971	143	143	8	0	0	1996	8	0	1340	9	0.0024
1972	704	701	38	3	0.0009	1997	413	389	1778	24	0.0073
1973	384	383	55	1	0.0003	1998	41	389	1639	9	0.0028
1974	255	0	58	255	0.0779	1999	98	87	1666	11	0.0034
1975	197	0	67	197	0.0602	2000	415	397	1631	18	0.0055
1976	431	429	70	2	0.0006	2001	85	64	2083	21	0.0064
1977	500	497	98	3	0.0009	2002	57	44	1373	13	0.0041
1978	393	391	200	2	0.0006	2003	753	527	2733	226	0.0691
1979	1	0	215	1	0.0003	2004	675	365	5968	310	0.0948
1980	3	0	250	3	0.0009	2005	16050	15758	8876	292	0.0893
1981	4	0	387	4	0.0012	2006	751	634	8811	117	0.0358
1982	1001	994	527	7	0.0021	2007	180	81	8059	99	0.0303
1983	1329	1315	385	14	0.0043	2008	253	184	8986	69	0.0211
1984	1204	1201	404	3	0.0009	2009	444	388	6905	56	0.0171
1985	4	0	504	4	0.0012	2010	661	616	7404	45	0.0138
1986	7	0	518	7	0.0021	2011	898	865	6381	33	0.0101
1987	263	248	672	15	0.0046	2012	566	510	6075	56	0.0171
1988	94	88	819	6	0.0018	2013	9202	8866	7654	336	0.1027
1989	141	136	802	5	0.0015	2014	630	273	10586	357	0.1091
1990	165	146	1107	19	0.0058	2015	157	14	10151	143	0.0437
1991	612	592	1189	20	0.0061	2016	370	256	11068	114	0.0349
1992	173	161	1284	12	0.0037	2017	910	810	9260	100	0.0306
1993	818	808	1842	10	0.0031	2018	1059	989	9243	70	0.0214
1994	958	936	1391	22	0.0067	2019	345	226	11385	119	0.0364

Table (2) Ranking of journals based on the coronavirus domain impact factor

Title	Citation	self-citation excluded	self-citation	country	Influence score	Eigen factor	IF	Quartile
Proceedings of the National Academy of Sciences of the United States of America	6403	6324	79	USA	4.493	1.02189	9.58	Q1
Emerging infectious diseases	4182	4094	88	USA	2.725	0.05941	7.185	Q1
Journal of Infectious Disease	2939	2889	50	USA	2.164	0.07596	5.045	Q1
Journal of Clinical Microbiology	2384	2329	55	USA	1.381	0.05332	4.959	Q1

Journal of Virology	37309	31575	5734	USA	1.381	0.09997	4.324	Q1
Antiviral Research	882	865	17	Netherlands	1.137	0.01597	4.131	Q1
The Journal of Biological Chemistry	2971	2916	55	USA	1.503	0.25223	4.106	Q2
Viruses Basel	888	863	25	Switzerland	1.221	0.02409	3.811	Q2
Journal of Clinical Virology	997	980	17	Netherlands	0.97	0.01531	3.021	Q2
Journal of General Virology	6498	6185	313	England	0.883	0.01877	2.809	Q2

Table 2 details the top 10 journals (which have published more than 40 credits) in coronavirus's subject area. Table 2 is ranked based on the impact factor of journals [32, 33]. In the above table, you can see the Eigen index and the article's effectiveness along with the total citations, net citation, self-citation rate, country of publication of the journal, and Q journals. The Eigen index is the degree of importance, influence, and overall credibility of a scientific journal (which higher values indicate the greater scientific importance of a journal) [34-36], and the effectiveness of the article is the average importance of articles in a journal during the five years after publication. The average of this variable is 1. Values greater than 1 indicate that the articles in a journal were more effective than the overall average [32]. Table 3 shows the top 10 authors' details out of 14,553 authors who have published at least 50 documents in this research field. Figure 3 shows the ranking of top organizations and scientific centers in coronavirus's subject area from 1970 to 2019 in the WoS database.

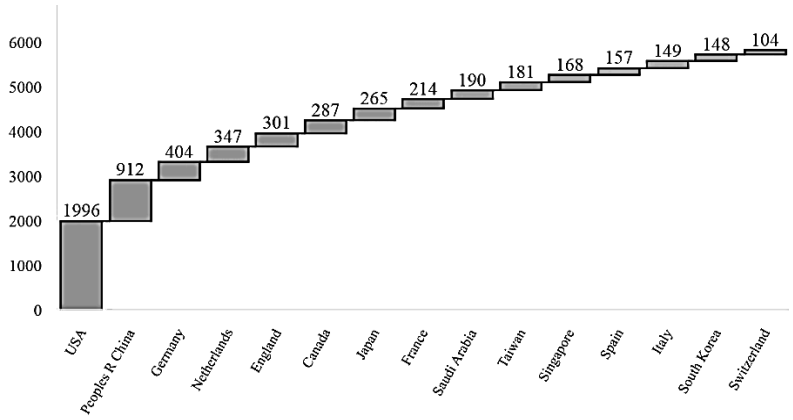

Figure (3) Countries influencing the thematic realm of coronavirus (1970-2019)

Figure 4 shows the list of centers and organizations of publications in the coronavirus field, among the 2573 active organizations in this field.

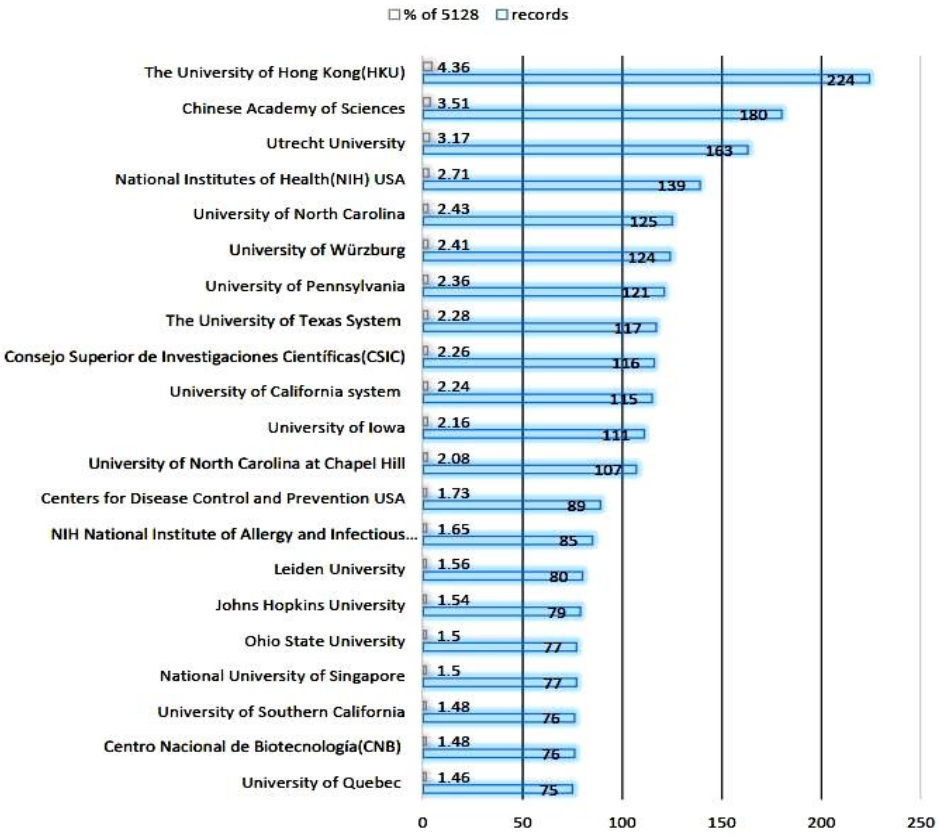

Figure (4) Organizations and scientific centers of the subject area of coronavirus

Table (3) Ranking of the authors of the core of the coronavirus thematic field

Author	Affiliation	Record	share	h-index	citation	self-citation	self-citation excluded
Enjuanes L	Department of Molecular and Cell Biology, National Center of Biotechnology (CNB-CSIC), Madrid, Spain	114	2.223	42	4105	603	3502
Perlman S	Department of Microbiology and Immunology, University of Iowa, Iowa City, Iowa, USA	107	2.087	36	2914	266	2648
Yuen KY	Department of Microbiology, Li Ka Shing Faculty of Medicine, The University of Hong Kong, Pokfulam, Hong Kong Special	107	2.087	49	10105	862	9243

	Administrative Region, China						
Weiss SR	Department of Microbiology, Perelman School of Medicine, University of Pennsylvania, Philadelphia, PA, USA	97	1.892	36	3424	459	2965
Baric RS	Department of Epidemiology, University of North Carolina, Chapel Hill, NC, USA	85	1.658	36	3676	283	3393
Rottier PJM	Virology Division, Department of Infectious Diseases and Immunology, Utrecht University, Faculty of Veterinary Medicine, Utrecht, the Netherlands	84	1.638	41	5146	346	4800
Drosten C	Institute of Virology, Charité Universitätsmedizin, Berlin, Germany.	82	1.599	38	8500	299	8201
Liu DX	Guangdong Province Key Laboratory of Microbial Signals & Disease Control, and Integrative Microbiology Research Centre, South China Agricultural University, Guangzhou, China	73	1.424	30	1867	455	1412
Makino S	Department of Microbiology and Immunology, The University of Texas Medical Branch, Galveston, Texas, USA	72	1.404	33	2904	358	2546
Woo PCY	State Key Laboratory of Emerging Infectious Diseases, The University of Hong Kong, Pokfulam, Hong Kong	67	1.307	34	4831	558	4273

The results show that in the last 50 years (1970-2019), the largest publication of global coronavirus science has been published in 2005 (349 documents), 2004 (348 documents), and 2006 (304 documents). From Nov 1, 2002, to Jun 11, 2003, atypical pneumonia, SARS-CoV, first broke out in 30 countries in China, killing about 8,098 people and killing about 916. Its pandemic period lasted until 2004 [37]. The next outbreak of

the newer strain of the virus, MERS-CoV, occurred in September 2012 in Saudi Arabia, infecting more than 2,428 people in 27 countries and causing 838 deaths, followed by a re-outbreak 2015 in the Republic of Korea (3837). Studies have shown that the increase in global science production in the area has been influenced by events and researchers' and scientists' efforts to understand the epidemic and pandemic conditions of the virus fully. nCoV-2019, named Covid-19, is a new form of the virus, first reported on Dec 31, 2019, and January 2020. According to the WHO, the number of victims has exceeded 1.4 million so far [13]. What is clear from the studies is that there is always a direct relationship between coronary outbreaks, of course, the number of coronavirus disease and mortality, and the number of articles published. In terms of the exponential growth of science production in the years between 2002 to 2006 and 2012 to 2015, the above results are the same as the results of the research of Bonilla-Aldana et al. [14].

Citation analysis is one of the citation works that study the relationship between the citation document and the cited document and examines the rules governing this relationship. As one of the concepts of scientometrics, self-citation is an important challenge in evaluating researchers' scientific products, closely related to the quality of research [39]. One of the applications of citation analysis is the use of scientific and valid methods to evaluate researchers' articles using the number of citations; With these studies, it is possible to understand the level of scientific and research activity of individuals and the effectiveness and effectiveness of their studies, and on the other hand, the citation analysis of scientists provides a means of judging and evaluating the scientific achievements of researchers [40, 41]. According to the presented results, the highest scientific production of the coronavirus realm, equal to 2.223%, has been published by Enjuanes L with 114 documents. Enjuanes L recorded the highest production of world science, but Yuen KY, who is in the third row of production, obtained 107 documents, the highest citation index, the citations (10105), and self-citations (862). From a scientometric point of view, more citations, followed by an increase in the index of the index, do not necessarily mean higher value and quality of the author's work. The H-index is only an indicator introduced in 2005; due to its weaknesses and inability to diagnose it correctly, it has been criticized a lot to this date. Always newer indicators such as alpha (hα), hA-index proposed in 2020, G-Index, etc., evaluate the authors' status.

In the present study, the top and most prolific scientists in the coronavirus field do not have the highest HTML index or citation. This indicator indicates that the HTML index can increase with self-citation. Therefore, the H-index is a common indicator for evaluation but does not determine the author's level because it can easily change and increase on a large scale with the amount of self-citation [40, 42]. The total citations received in the 50 years of global coronavirus production in Table 1 were 165,451, of which 3,271 were citations. Citation counting is also considered one of the most important indicators for evaluating the journals' quality [42]. Table 2 is arranged based on the impact factor of journals. However, two important indicators, namely the factor and the article's effectiveness, which has been very important in recent years, are also presented, examining, and evaluating journals. In addition to the IF indicators provided, it is possible to check the top journals' Q levels in the field. Magazines that have IF are also at a high level in terms of factor and effectiveness and seem to be directly related. According to Table 2, the Journal of Virology has the highest total citation. Still, the most effective publication in this area by impact factor was Proceedings of the National Academy of Sciences of the

United States of America, one of the Q1 publications. The University of Hong Kong was recognized as the top and most active university in the field of coronavirus in this study, which is in line with the results of Zyoud [24]. Among the most productive countries, the USA ranks first to produce 38.924% of the total scientific documents in this field. China and Germany are in second and third place, respectively. The University of Hong Kong, the Chinese Academy of Sciences, Utrecht University, the National Institutes of Health (NIH), and the University of North Carolina are the top five top-ranked organizations in the field coronavirus ranking first to fifth.

In terms of quantitative increase in activities and production of science in various fields of research, the results of this article are in line with the results of Shirshahi et al. [26], Morovati Sotudeh [27], and Emami et al. [25]. Major scientific outputs have been published in the form of research articles, and from this dimension, the results of the present article are in line with the results of Morvati and Sotoudeh [27].

Conclusions

Due to the new and widespread wave of COVID-19 infection in China and worldwide since mid-January 2020, significant studies are underway to find treatments or discover new vaccines or drugs to fight the virus. The present study's findings can help scientists and specialists who are currently researching COVID-19 in research centers, especially Iranian specialists. Awareness of the results of scientometric studies of strategic issues such as coronavirus for researchers, policymakers, and health planners to identify more appropriate treatment goals, better decisions, and provide more effective solutions in the short term. The most time possible is essential. It is suggested that a brochure from the summary of 1200 words of this research be prepared by the Associations of Microbiology and the WHO as a scientific guide for researchers and published widely in cyberspace. The author also recommends that a wide scientometric study is implemented in the publications done in the year 2020.

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