

Global Research Status and Development of COVID-19 in 2020: A Bibliometric Analysis

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Abstract

Background: The coronavirus disease 2019 (COVID-19) is caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). It is currently widespread in the world. This study aimed to access the characteristics of the publications involving COVID-19 by using a bibliometric analysis.

Methods: COVID-19 publications published between 1 January 2020 and 31 July 2020 was searched from the Web of Science database on 1 August 2020. The database retrieval was done on the same day. Analysis parameters mainly include publication month, research institutions, authors, journals, countries and cooperation networks among them.

Results: A total of 14186 COVID-19 associated articles were retrieved from the Web of Science database, and the quantity of articles increased rapidly month by month. The authors of the top ten manuscripts per number of citations and the most productive institution were both from China. The total publication number of China was as high as 3,029—second only to the United States. Moreover, China ranks first in the number of total citations of articles and the average article citations. The United States has the highest number of total publications and ranks second only to China in terms of the influence of individual articles. Authors, institutions and Countries established a network of close cooperation for research on COVID-19.

Conclusion: There was a growing number of articles on COVID-19 around the world, China and the United States are the two most influential countries.

1. Background

COVID-19 was first reported in Wuhan, China, [1] in December 2019, after that it has spread throughout China and is now a global epidemic. By 2020-08-01, a total of 17396,943 patients had been diagnosed in more than 200 countries, including 675,060 deaths, the United States, Brazil and India are the top three countries with the highest number of infections.[2] The COVID-19 epidemic poses not only a health threat but also a negative impact on the global economy and other aspects.[3] The World Health Organization declared a pandemic in March 2020. [4] Therefore, from the beginning of the epidemic outbreak, a large number of researchers from various countries and institutions Shared a large number of cases, explored solutions, timely formulated guidelines and specifications, and produced a large number of articles, which played a vital role in the COVID-19 epidemic research and prevention.[5]

Bibliometric analysis takes the literature system and its characteristics as the object of study and applies quantitative and qualitative analysis to the publication and citation times of journals and articles.[6][7] Bibliometric analysis measures the scientific output of individuals, institutions or countries to represent the current state of the research field and plays an important role in better understanding the scientific field,[8] and it has been widely used to assess scientific research activities in various fields, including infectious diseases such as Zika virus,[9] Ebola virus disease, [10][11] Mayaro fever,[12] Leishmaniasis, [13][14] influenza,[15] Middle East Respiratory syndrome coronavirus.[16] This paper makes a statistical

analysis of COVID-19 related articles published in the Journal of Web Of Science before 2020-08-01 by bibliometric analysis, aim to learn about the critical article in the field of COVID-19, as well as about the authors, institutions, countries with important contributions and their networks of collaboration with each other.

2. Methods

2.1 Data source

The database Web of Science (WoS) was used for retrieval and the retrieval strategy was formulated. Then checked and discussed, when the results of two authors were inconsistent, the third author ruled, and then formulated the final search strategy. The retrieval terms were (2019-NCOV OR 2019nCoV OR COVID-19 OR SARS-COV-2) AND (2020[PDat] : 2021[PDat]). The time of publication was from January 1, 2020 to July 31, 2020. All the literatures was included in the core collection of Web of Science, including the literatures published online with priority, and the literature types were "ARTICLE" and "REVIEW". Exclude articles such as conference papers, letters and comments; The selection of literature was carried out by two groups on the web page respectively, and inconsistency was checked and dealt with by discussion or by the third group. To avoid errors caused by database updates, all data retrieval, filtering and downloading were completed by August 1, 2020.

2.2 Statistical analysis

Statistically analyzed monthly, country, institution, author, and source journals by using the online analysis function of WOS database. R language (Version 1.2.5033) and Bibliometric analysis were used for Bibliometric analysis.[17] Statistical analysis the COVID – 19 related publications growth rule, the number of publications and citations by countries, institutions, journals, and authors, to measure their impact, and analysis collaboration between them (journal articles published by at least two authors from different countries or institutions are defined as collaboration). Visual analysis with VOSviewer.

3. Results

3.1 Overall publication trends

The search in the Web of Science database resulted in a total of 14186 articles by July 31, 2020. Figure 1 shows monthly trends in publications related to COVID-19 globally, the study just started in January and February, and the total number of published papers was only 329. Moreover, this part of articles was mostly written by Chinese researchers. Since March, it has entered a period of rapid growth and continued to develop rapidly, this may have something to do with the fact that COVID-19 began to be brought under control in China in March, producing a large amount of research results, and the subsequent global outbreak. At present, COVID-19 research has become a global research hotspot.

3.2 Analysis of the most cited articles on the COVID-19 field

As can be seen from Table 1, the top 20 cited publications published in the field of COVID-19 are mainly published in five journals including LANCET, JAMA, NEW ENGL J MED, NATURE and CELL. Among them, the top 10 articles with the most cited times were all descriptions of epidemiology and clinical characteristics of COVID-19 from Chinese researchers in the early stage of virus outbreak, and studies on the characteristics and transmission of SARS-Cov-2. Especially, the "CLINICAL FEATURES OF PATIENTS INFECTED WITH 2019 novel Coronavirus IN WUHAN, CHINA"[18] written by HUANG CL et al, and published in the Lancet, was ranking first. This paper is the first to describe the clinical characteristics of COVID-19, which has been cited a total of 3287 times, shows its high research level and important influence in COVID-19 research. "FIRST CASE OF 2019 NOVEL CORONAVIRUS IN THE UNITED STATES" [19] published in NEW ENGL J MED journal, ranked the 12th, first time reported for a case of COVID-19 in the United States. The reason may be that the United States is one of the countries most affected by COVID-19. Other top-cited articles mainly focused on the clinical manifestations, pathology, course, clinical outcome, drug therapy of COVID-19, and novel coronavirus characteristics, transmission ability, etc.[1, 20–26]

Table 1
The top 20 most cited publications

SCR	Authors	Month of publication	Cited by	Journal
1st	HUANG CL et al	February	3287	LANCET
2st	WANG DW et al	March	1985	JAM MED ASSOC
3st	GUAN W et al	April	1954	NEW ENGL J MED
4st	CHEN NS et al	February	1748	LANCET
5st	ZHU N et al	February	1726	NEW ENGL J MED
6st	ZHOU F et al	March	1417	LANCET
7st	ZHOU P et al	March	1271	NATURE
8st	LI Q et al	March	1195	NEW ENGL J MED
9st	WU ZY et al	April	1025	JAM MED ASSOC
10st	CHAN JFW et al	February	985	LANCET
11st	LU RJ et al	March	890	LANCET
12st	HOLSHUE ML et al	March	671	NEW ENGL J MED
13st	WANG ML et al	March	653	CELL RES
14st	HOFFMANN M	May	639	CELL
15st	XU Z et al	April	623	LANCET RESP MED
16st	YANG XB et al	May	576	LANCET RESP MED
17st	MEHTA P et al	May	576	LANCET
18st	VAN DOREMALEN N et al	April	573	NEW ENGL J MED
19st	WU F et al	March	519	NATURE
20st	ZOU LR et al	March	514	NEW ENGL J MED

SCR, Standard competition ranking.

3.3 The top 30 influential authors in research on the COVID-19 field and collaborations among them

As of July 31, 2020, a total of 72815 first authors and co-authors worldwide have participated in COVID-19 related studies and published articles. Zhang Li from Wuhan Jinyintan Hospital, China, was cited the most, nearly 7306 times, and he participated in as many as 301 articles. His involvement in research has included the earliest description of COVID-19 epidemiology, clinical features, treatment of COVID-19, and the Novel coronavirus vaccine study. We can see from Fig. 2(a) that Top 30 most influent authors in term

of citations in the COVID-19 field were all from China. From the collaboration network among the authors (Fig. 2(b)), it can be seen that there were close collaborations between these researchers, this is related to the fact that China was the earliest outbreak of COVID-19, and China concentrated its national strength to fight against COVID-19 at that time and achieved periodic victories. Moreover, Chinese influence in the global fight against COVID-19 is relatively high.

3.4 The top 10 highly productive and influential institutions in research on COVID-19 field and collaborations among highly productive institutions

As can be seen from Table 2, as of July 31, 2020, there were 5,282 papers published by the top 15 highly productive institutions in research on COVID-19, accounting for 37.23% of the total. Huazhong University of Science and Technology in Wuhan, China, was the most productive institution, with 841 publications, accounting for 5.93% of the total. The top three institutions in terms of the average number of citations per article in the field of COVID-19 were The University of Hong Kong (26.65), Wuhan University (17.58) and Sun Yat-sen University (17.25). The top 15 productive institutions were from China, the United States, Britain, Iran and Italy, Among them, there were 7 research institutions from China and 3 from the US. These institutions and countries have obvious overall advantages in the COVID-19 research field, and are in the leading position in the world with high influence. Figure 3 showed that different institutions from the same country or among different countries both have different levels of cooperation, which reflects the global solidarity and cooperation in the fight against the epidemic.

Table 2
The top 15 highly productive and influential institutions in research on COVID-19 field

SCR	Institution	country	No. of publications	LCSA
1st	HUAZHONG UNIV SCI AND TECHNOL	China	841	13.69
2st	WUHAN UNIV	China	524	17.58
3st	HARVARD MED SCH	USA	453	3.74
4st	UNIV TORONTO	UK	359	3.75
5st	UNIV TEHRAN MED SCI	Iran	344	0.63
6st	UNIV MILAN	Italy	330	3.92
7st	FUDAN UNIV	China	323	7.18
8st	ZHEJIANG UNIV	China	289	12.98
9st	UNIV OXFORD	UK	281	6.66
10st	UNIV WASHINGTON	USA	279	7.48
11st	SHANGHAI JIAO TONG UNIV	China	267	11.91
12st	UNIV HONG KONG	China	252	26.65
13st	COLUMBIA UNIV	USA	251	5.02
14st	SUN YAT SEN UNIV	China	247	17.25
15st	SHAHID BEHESHTI UNIV MED SCI	Iran	242	0.80

SCR, Standard competition ranking. LCSA, the average number of citations per article in the field of COVID-19.

3.5 Productivity and Collaboration Networks of Countries

Figure 4(b) shows the global distribution of published articles related to COVID-19, in which the lighter blue represents the more published articles in that country. As can be seen from the figure, North America, East Asia and Europe have a lighter blue color, indicating a higher volume of publications. Figure 4 show the top 20 countries in terms of publications and citations related to COVID-19. The publications number of the United States was the highest, reaching 4,357, and the number of articles published by the United States in cooperation with other countries was also the highest, followed by China (3,029), Italy, and the United Kingdom. However, in terms of the total number of citations of published articles and the average number of citations per article, China ranks first, followed by the United States, Italy, and the United Kingdom. (see Table 3) This indicates that these countries are far ahead of other countries in the field of COVID-19 research. On the one hand, these countries are affected by COVID-19 earlier and more seriously. On the other hand, they are closely related to the high investment and advanced research of these countries in the field of COVID-19.

Figure 4. Productivity and Collaboration Networks of Countries. LCS, the number of citations in the COVID-19 field (Local Citations). GCS, the total number of citations.

Table 3
The top 15 highly productive and influential institutions

SCR	country	No. of publications	LCS	GCS	LCSA
1st	USA	4357	23233	27856	5.33
2st	China	3029	49187	57623	16.24
3st	ITALY	2084	8064	10034	3.87
4st	UK	1570	10082	12386	6.42
5st	INDIA	884	1443	2028	1.63
6st	GERMANY	607	4652	6221	7.66
7st	CANADA	601	3767	4653	6.27
8st	FRANCE	601	3980	4479	6.62
9st	IRAN	481	773	1072	1.61
10st	SPAIN	475	2126	2512	4.48
11st	AUSTRALIA	455	3507	4708	7.71
12st	BRAZIL	452	1055	1256	2.33
13st	TURKEY	364	204	411	0.56
14st	SINGAPORE	263	2668	3003	10.14
15st	KOREA	229	1251	1737	5.46
16st	SWITZERLAND	220	2205	2573	10.02
17st	JAPAN	196	1891	2003	9.65
18st	BELGIUM	182	1160	1283	6.37
19st	NETHERLANDS	181	2164	2883	11.96
20st	PAKISTAN	129	303	425	2.35
21st	POLAND	122	271	419	2.22
22st	GREECE	120	823	905	6.86
23st	SOUTH AFRICA	120	284	331	2.37
24st	SAUDI ARABIA	117	1088	1548	9.30
25st	IRELAND	105	996	1079	9.49

SCR, Standard competition ranking. LCS, the number of citations in the COVID-19 field (Local Citations). GCS, the total number of citations. LCSA, the average number of citations per article in the field of COVID-19.

SCR	country	No. of publications	LCS	GCS	LCSA
26st	AUSTRIA	98	714	1490	7.29
27st	ISRAEL	97	486	593	5.01
28st	MEXICO	92	247	276	2.68
29st	PORTUGAL	90	232	274	2.58
30st	THAILAND	87	593	647	6.82

SCR, Standard competition ranking. LCS, the number of citations in the COVID-19 field (Local Citations). GCS, the total number of citations. LCSA, the average number of citations per article in the field of COVID-19.

4. Discussion

In 2020, the global outbreak of COVID-19 not only seriously endangers human health, but also has a great negative impact on the economy and society of various countries. Each country has carried out a lot of research on COVID-19 based on its own capacity and infrastructure, thus generating a large amount of articles.

In this study, as of July 31, 2020, from the Web of Science database retrieved 14186 articles, the number of articles published in January and February was less, because at this time of COVID-19 outbreak early, and mainly outbreak in China, the research on epidemiology, disease course, virus research and epidemic prevention and control were also in the initial stage. Since March, the number of publications has entered a period of rapid growth, and the research results of many countries have also been highlighted.

China was the country most initially affected by the COVID-19 outbreak, has respond quickly to the outbreak at the time, not only positive for disease control and prevention, treatment, and actively in research of COVID-19, More over, has united and organized scientists from all walks of life to race against time to conquer the disease together. China was the first to isolate and identify the virus strains and shared the full genetic sequence of the virus with the World Health Organization,[27][28] the first to describe the clinical characteristics of COVID-19,[19][22] actively promoted the research on vaccines,[29] [30] and putted forward important measures of mobile cabin hospitals, [31] etc., and published a large number of relevant papers in New England, the Lancet and other top academic journals for global communication. In this paper, it can be seen that the top 10 articles with the highest number of citations were all from Chinese researchers, and the top 30 most influent authors in terms of citations were also Chinese researchers. The total number of publications of China reached 3,029, second only to the United States, with Huazhong University of Science and Technology in Wuhan ranking first among institutions in the world. In addition, China ranks first in terms of the total number of citations of published articles and the average number of citations per article. The University of Hong Kong, Wuhan University and Huazhong University of Science and Technology, three Institutions from China, rank top 3 in the world in the term of the average number of citations per article in the field of COVID-19. It follows that China ranks

first in the breadth and depth of COVID-19 research, and plays an extremely important role in COVID-19 research.

In addition, according to the WHO's real-time data on the epidemic situation, the United States, Brazil, India and other countries are the most affected countries. [2] As the country with the largest number of people infected by the epidemic, the United States has also invested a lot in the study of COVID-19, with the highest publication volume, followed by China, Italy and the United Kingdom, and the ranking of the number of citations of articles and the average number of citations of individual articles was second only to China. The top 20 countries contributing to COVID-19 research come from the most affected countries, including China, the United States, the United Kingdom, Iran, Italy, Brazil and so on.

It can be seen from the cooperation networks among important authors, institutions and countries with most numbers of publications and citations that close cooperation networks have been established among authors, institutions and countries, both at home and abroad, and a large number of research results have been produced through cooperation, this was closely related to the WHO call, the strategic direction of countries, and scientific collaboration in the face of the COVID-19 epidemic. In addition, the COVID-19 epidemic has not been completely defeated, researches on vaccine development, clinical features and therapeutic drugs were still hot spots, and countries still need to maintain close communication and information sharing to speed up the breakthrough in all aspects of COVID-19 research.

Limitations of this paper: The main limitation of this bibliometric analysis was that the literature search relied on a single database, in this paper, Web of Science database is adopted because it is the most complete SCI literature database. More over, there was still the possibility that the author had the same name, although the results had been carefully checked.

5. Conclusions

During the past eight months of the COVID-19 epidemic, research activity related to COVID-19 increased rapidly. This study shows that in eight months, publications related to COVID-2019 has become more extensive and global. A large amount of publications in the field of COVID-19 research has come from China, the United States and other countries that have been severely affected by the COVID-19 epidemic. China and the United States are the two most influential countries.

Abbreviations

COVID-19

Coronavirus disease 2019; SARS-CoV-2:Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2).

Declarations

Ethics approval and consent to participate

Not applicable. No ethical approval was required, as this was a bibliometric review for the existing literature.

Consent for publication

Not applicable.

Data availability

The datasets generated during and/or analyzed during the current study are available from the corresponding author at songchangshi81@163.com on reasonable request.

Competing interests

The authors declare that they have no competing interests.

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Author Contributions:

XP and SS had full access to all of the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis. Study concept and design: SS, XP, and CG. Acquisition, analysis, or interpretation of data: SS and WL. Drafting of the manuscript: XP, WL, JX. Critical revision of the manuscript for important intellectual content: LZ, MY and CW. Statistical analysis: XP and SS.

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Figures

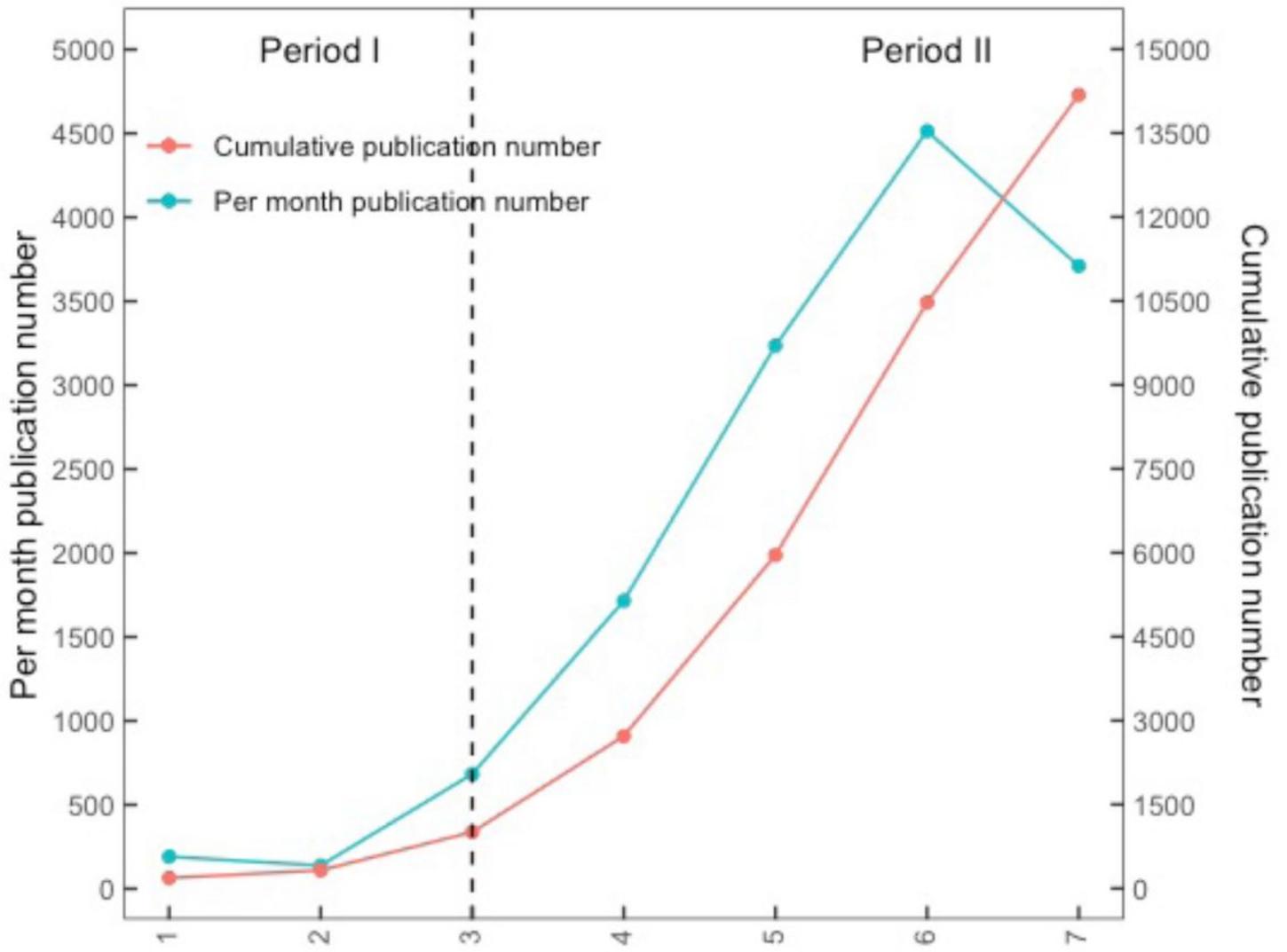


Figure 1

monthly trends in publications related to COVID-19 globally.

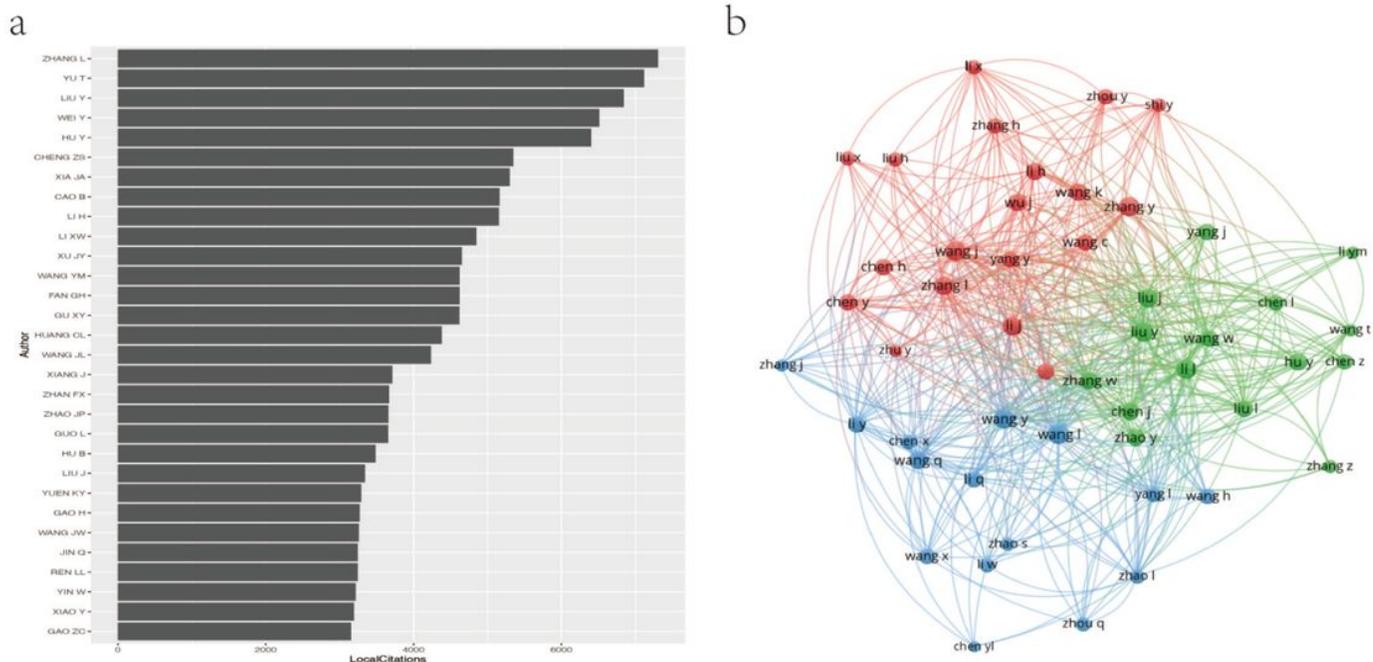


Figure 2

The top 30 influential authors in research on the COVID-19 field and collaborations among them. (a) Top 30 most influent authors in term of citations in the COVID-19 field. (b) Collaboration network among the most cited authors. In this figure, each dot represents the author, the size of the dot represents the number of collaborations between the author and researchers, the connection lines between the dots represent the collaboration between authors, and the color of the connection lines represents the author clustering.

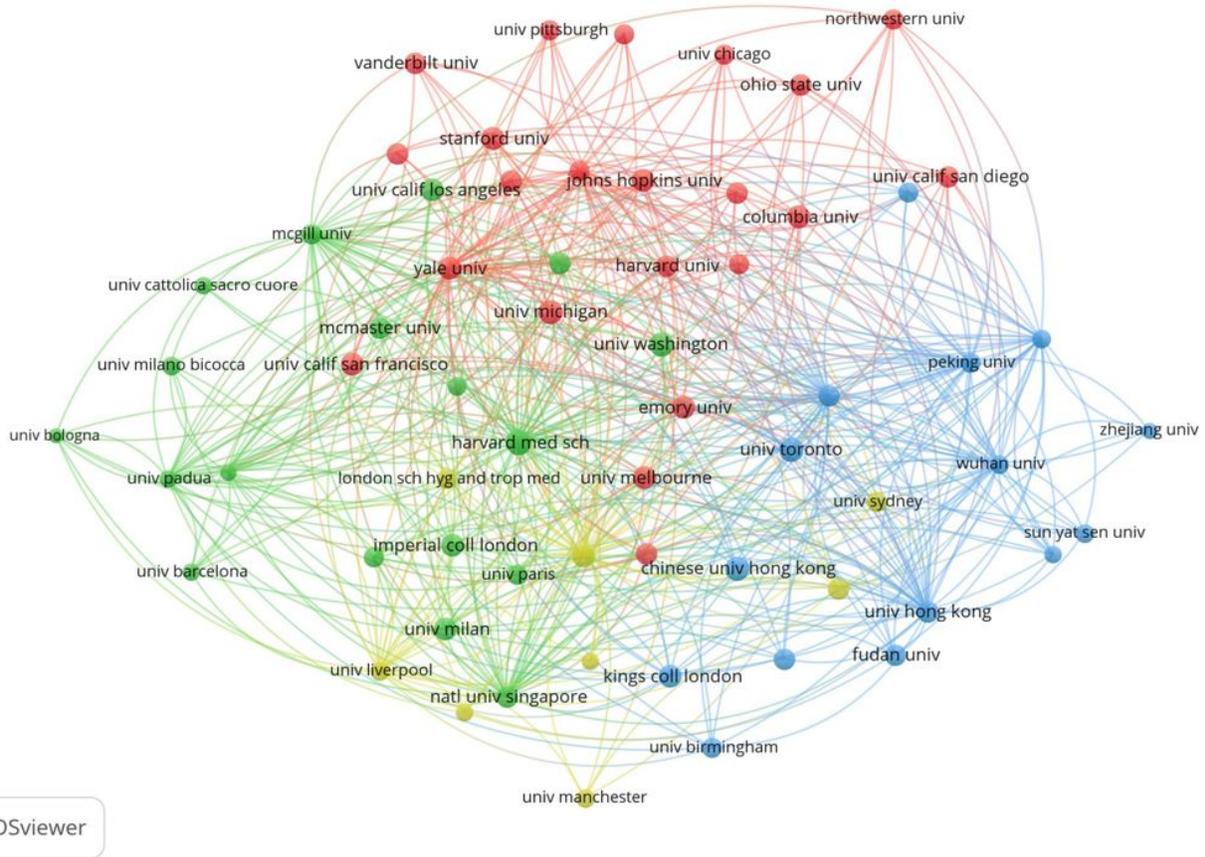


Figure 3

Collaboration network among highly productive institutions. In this figure, each dot represents a research institution, and the size of the dot represents the volume of the institution's publications. The lines between the dots represent cooperation between the institutions, and the colors of the lines represent clustering between the institutions.

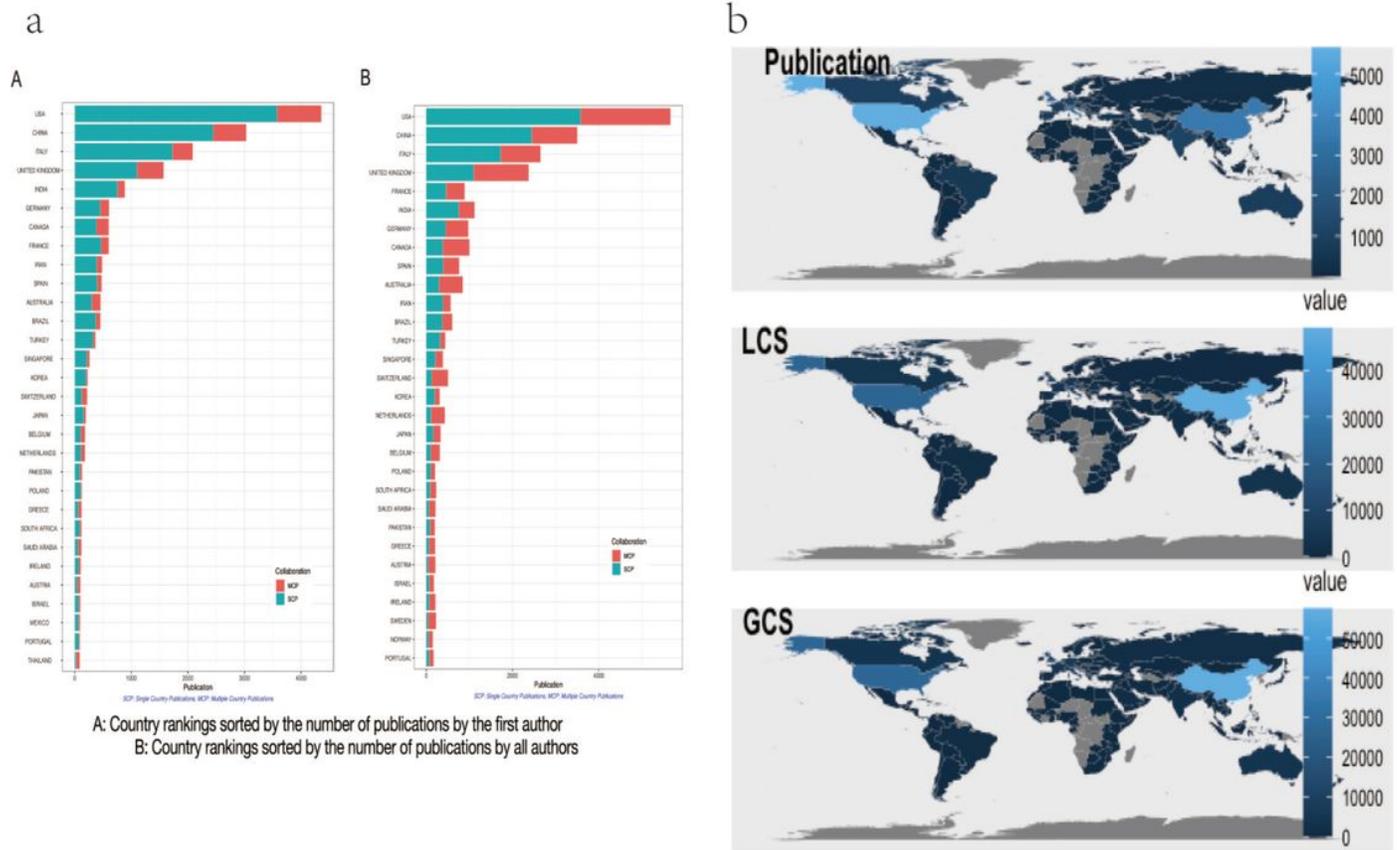


Figure 4

Productivity and Collaboration Networks of Countries. LCS, the number of citations in the COVID-19 field (Local Citations). GCS, the total number of citations. Note: The designations employed and the presentation of the material on this map do not imply the expression of any opinion whatsoever on the part of Research Square concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. This map has been provided by the authors.